ABSTRACTS

OF LECTURES AND SCIENTIFIC POSTERS

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Orals

001 IMMUNOHISTOCHEMICAL EVALUATION OF THE EFFECTS OF UNDIFFERENTIATED MESENCHYMAL STEM CELLS DERIVED FROM DIFFERENT TISSUES ON TOOTH MOVEMENT

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AIM: To compare the effects of mesenchymal stem cells (MSCs), derived from four different tissues [rabbit dental pulp (rDP), periodontal ligament (rPDL), bone marrow (rBM) and adipose tissue (rAT)] on tooth movement in a rabbit model.
MATERIALS AND METHOD: Tooth movement animal models were established in 25 New Zealand rabbits and randomly divided into four experimental groups (n = 5) and a control group (n = 5). 1 × 106 cells/1 ml which were PKH26 positive; rDP-MSCs (group 1), rPDL-MSCs (group 2), rBM-MSCs (group 3) and rAT-MSCs (group 4) were locally injected into alveolar bone and periodontal space for each tooth in the experimental animals and physiological saline solution at the same volume into control group before loading orthodontic force and on the 7th and 14th days of tooth movement. A helical spring fabricated from 0.014 in stainless steel wire was used for applying force and orthodontic tooth movement was planned for 21 days. The distance between the incisors was measured on days 1, 4, 7, 10, 14, 17 and 21 using a digital calliper. All rabbits were sacrificed on the 21st day of tooth movement. Histological analyses were performed in all animals, as well as analysis of RANKL, OPN, cathepsin-k, collagen-1 and tumour growth factor-1 markers by immunohistochemistry. Kruskal Wallis tests were used for intergroup comparisons.
RESULTS: Statistical analysis showed that there were no significant differences in the amount of tooth movement among the five groups ($P > 0.05$). PKH26 positive stem cells were observed under fluorescence microscopy in all experimental groups. Histological analyses showed that PKH26 positive stem cells produced new bone on the tension side.
CONCLUSION: Application of MSCs derived from different tissues has no effect on the rate of tooth movement in rabbits when compared with a control group.

002 DO ACRYLIC AND WIRE RETAINERS PERFORM SIMILARLY TO OTHER REMOVABLE RETENTION APPLIANCES? A SYSTEMATIC REVIEW OF RANDOMIZED CONTROLLED TRIALS

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AIM: Acrylic and wire retention removable appliances (Hawley, wrap-around, Begg, etc.) have traditionally been popular among orthodontists. The aim of this study was to compare their performance to the other removable appliances used for retention after the completion of orthodontic treatment.
MATERIALS AND METHOD: A search without restrictions for published and unpublished literature took place utilizing Medline via PubMed, the Cochrane Central Register of Controlled Trials, the Cochrane Database of Systematic Reviews, Scopus, Web of Science, Lilacs, IndMed, Scielo, Arab World Research Source, Deutsche Zentralbibliotek für Medizin, Google Scholar, ClinicalTrials.gov, International Standard Randomised Controlled Trial Number registry, OpenGrey and Pro-Quest Dissertation and Theses Global database. In addition, hand searching was performed. Randomized controlled trials (RCTs) that compared various acrylic and wire retention appliances (Hawley, wrap-around, Begg) to other removable retention appliances (clear thermoplastic appliances, tooth positioners and modifications, etc.) were reviewed. The risk of bias was assessed using the Cochrane

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Collaboration's Risk of Bias assessment tool for RCTs and the quality of evidence (confidence in the observed estimates) according the Grades of Recommendation, Assessment, Development and Evaluation approach.
RESULTS: The initially retrieved records were finally reduced to eight RCTs comparing Hawley to Essix appliances and one RCT that compared the Hawley appliance to a positioner. In general, Hawley and Essix appliances performed in a similar manner in terms of tooth alignment, arch form, occlusion, speech alterations and appliance survival. However, patients seemed to prefer more the transparent appliances that could also be considered more cost-effective in the context of a public health-care system. Hawley appliances were reported to be more beneficial to periodontal health compared to positioners. The overall quality of evidence limited the confidence in the observed estimates.
CONCLUSIONS: Acrylic and wire removable appliances and thermoplastic retainers seem to perform similarly in the medium term but patients have a greater preference for transparent appliances. Standardization, better reporting in longer follow-ups and data on patient compliance could be useful in forming robust recommendations for the clinical setting.

003 THREE-DIMENSIONAL EVALUATION OF TOOTH MOVEMENT IN CLASS II MALOCCLUSIONS TREATED WITHOUT EXTRACTIONS BY ORTHODONTIC MINI-IMPLANT ANCHORAGE
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AIM: To analyze tooth movement and arch width changes in the maxillary dentition following non-extraction treatment with orthodontic mini-implant (OMI) anchorage in Class II division 1 malocclusions.
SUBJECTS AND METHOD: Seventeen Korean adults with a Class II division 1 malocclusion. OMI were inserted at the buccal attached gingiva between the maxillary second premolar and first molar on both sides. Distalizing forces of approximately 200 g were applied from the OMIs to the posted hooks between the maxillary canines and lateral incisors. Three-dimensional (3D) virtual maxillary models were acquired pre- (T0) and post- (T1) treatment. The T0 and T1 3D virtual models were superimposed using the palatal rugae and the midline raphe as reference. Linear variables (anteroposterior and vertical displacement of maxillary dentition), angular variables (rotation of maxillary molars), and arch width variables were measured. Means and standard deviations were calculated, and variables of T0 and T1 were compared by *t*-test.
RESULTS: All maxillary teeth moved posteriorly; anterior teeth, U1, U2, and U3, were distalized (1.78, 0.98 and 1.39 mm, respectively; $P < 0.01$) and the posterior teeth, U4, U5, U6, and U7, were moved backwards (1.15, 1.40, 2.04 and 2.44 mm, respectively; $P < 0.001$). Comparing T0 and T1, there were no statistically significant differences in the vertical changes of the maxillary teeth except that the maxillary second molars (U7) were extruded (–0.86 mm, $P < 0.01$). The maxillary first molar (U6) and maxillary second molar (U7) were rotated distal-in (–4.59°, $P < 0.01$ and –3.08°, $P < 0.05$, respectively).
CONCLUSIONS: Using OMI anchorage for treatment of Class II division 1 malocclusions without extractions, the whole maxillary dentition could be retracted to achieve a Class I canine and molar relationship without a significant change in the vertical position of the teeth, but the second molars were significantly extruded. Simultaneously, in the occlusal view, the maxillary arch was shown to be expanded with distal-in rotation of the molars.

004 A CONE BEAM COMPUTED TOMOGRAPHIC EVALUATION OF ALVEOLAR HOUSING IN NORMAL, HYPO- AND HYPER-DIVERGENT SUBJECTS
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AIM: The buccal bone plate thickness, interradicular distance (IRD) and alveolar height will assist the orthodontist with insertion of miniscrews and to decide if expansion or extraction should be performed. The aim of this study was to evaluate the quantity of available alveolar bone in subjects with different vertical facial growth patterns.

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MATERIALS AND METHOD: Sixty cone beam computed tomographic (CBCT) scans of subjects aged between 17 and 46 years were retrospectively selected. Lateral cephalograms were synthesized from the CBCT and, based on gonial and FMA angles, divided into three groups: normal, hypo- and hyper-divergent. In both jaws, between the teeth posterior to the canines, the thickness of the buccal plates and IRD were measured 1, 3 and 5 mm from the crest of the alveolar bone together with the height of the alveolar bone. The obtained data were analyzed.
RESULTS: The mean values of IRD were 5.00 ± 0.95 mm, 4.99 ± 1.70 mm and 5.03 ± 1.02 mm in the normal, hypo- and hyper-divergent groups, respectively. Considering alveolar thickness, there was a significant difference between the three groups ($P < 0.001$). The mean values for the thickness of alveolar cortical plates were 1.19 ± 0.41 mm, 1.40 ± 0.5 mm and 0.97 ± 0.37 mm in the normal, hypo- and hyper-divergent groups, respectively. For alveolar bone height in both jaws only that of the hyperdivergent was more than in the hypodivergent subjects ($P < 0.041$). All IRD measured either at 1, 3, or 5 mm apical to the crest were significantly greater than the minimum space of 2.5 mm required for insertion of a miniscrew ($P < 0.001$). When the measurements were performed at points more apically distant from the crest, both the variables, cortical thickness and IRD, increased.
CONCLUSIONS: Facial growth pattern might influence cortical bone thickness and bone height, but not IRD. Compared to the maxilla, the IRD, cortical widths, and jaw heights were greater in the mandible. Older subjects would have thicker cortices. Under similar conditions in borderline cases with a hyperdivergent growth pattern, extraction is preferred to expansion.

005 MODERATION EFFECTS OF PERSONALITY TRAITS ON THE RELATIONSHIP BETWEEN ORTHODONTIC TREATMENT NEED AND ORAL HEALTH-RELATED QUALITY OF LIFE

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AIM: To explore the moderation effects of personality traits on the relationships between orthodontic treatment need and oral health-related quality of life (OHRQoL).
SUBJECTS AND METHOD: Two hundred and thirty subjects (125 girls, 105 boys) aged 11-14 years. Orthodontic treatment need was measured using the Index of Complexity, Outcome and Need (ICON). The Child Perceptions Questionnaire (CPQ) was used to assess the OHRQoL and the Basic Personality Traits Inventory (BPTI) for personality traits. Potential moderating effects were evaluated with Pearson correlations and hierarchical regression analyses, respectively.
RESULTS: There were weak correlations between treatment need and quality of life with social and emotional well-being dimensions ($r = 0.233$, $r = 0.268$ and $r = 0.195$). The moderating effect of extraversion was observed in the relationship between orthodontic treatment need and OHRQoL and social well-being (SWB; $\Delta R2 = 0.027$, $P = 0.017$, and $\Delta R2 = 0.038$, $P = 0.004$). Openness to experience affected the relationship between orthodontic treatment need and OHRQoL and emotional well-being (EWB; $\Delta R2 = 0.035$, $P = 0.014$, and $\Delta R2 = 0.038$, $P = 0.002$). In children with higher extraversion, the increase in ICON scores resulted in a lower increase in CPQ total and SWB scores. In children with higher openness to experience, the increase influenced CPQ total and EWB scores similarly.
CONCLUSIONS: The relationship between orthodontic treatment need and quality of life is moderated by personality traits. Younger adolescents with higher extraversion and openness to experience seem to be less affected by an increased orthodontic treatment need.

006 SECOND PREMOLAR AGENESIS IS ASSOCIATED WITH MANDIBULAR FORM: A GEOMETRIC MORPHOMETRIC ANALYSIS OF MANDIBULAR CROSS-SECTIONS

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AIM: To compare mandibular form (i.e., size and shape) between patients with agenesis of the lower second premolar (P2) and a control group without agenesis. Three hypotheses were tested:

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(H1) agenesis causes a change in mandibular morphology because of inadequate alveolar ridge development in the area of the missing tooth (mandibular plasticity); (H2) agenesis is caused by spatial limitations within the mandible (dental plasticity); and (H3) common genetic/epigenetic factors cause agenesis and affect mandibular form (pleiotropy).
MATERIALS AND METHOD: A geometric morphometric analysis was applied to cross-sectional images of computed tomography (CT) scans of three matched groups (n = 50 each): (1) regularly erupted P2; (2) agenesis of P2 and the primary second molar *in situ*; and (3) agenesis of P2 and the primary second molar missing for >3 months. Cross-sections of the three areas of interest (first premolar, P2, first molar) were digitized with 23 landmarks and superimposed by a generalized Procrustes analysis.
RESULTS: On average, the mandibular cross-sections were narrower and shorter in patients with P2 agenesis compared with that in the control group. Both agenesis groups featured a pronounced submandibular fossa. These differences extended at least one tooth beyond the agenesis-affected region. Taken together with the large interindividual variation that resulted in massively overlapping group distributions, these findings support genetic and/or epigenetic pleiotropy (H3) as the most likely origin of the observed covariation between mandibular form and odontogenesis.
CONCLUSIONS: Clinically, reduced dimensions and greater variability of mandibular form, as well as a pronounced submandibular fossa, should be expected during treatment planning of patients with P2 agenesis.

007 THE EFFECTS OF MICRO-OSTEOPERFORATIONS USING THE PROPEL APPLIANCE ON ORTHODONTIC ROOT RESORPTION – A MICROCOMPUTED TOMOGRAPHIC STUDY

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AIM: Micro-osteoperforation (MOP) is a novel technique involving controlled micro-trauma of the alveolar bone. Studies have demonstrated its potential efficacy in accelerating tooth movement by amplifying the expression of inflammatory markers. The aim of this investigation was to examine the effects of MOPs using the Propel appliance on orthodontic root resorption under microcomputed tomography (μCT).
SUBJECTS AND METHOD: This prospective split-mouth controlled clinical trial involved 20 subjects requiring extractions of the maxillary first premolars as part of their orthodontic treatment. A buccal tipping force of 150 g was applied to both first upper premolars. Using the Propel appliance, MOPs were applied at a depth of 5 mm on the mesial and distal aspects in the mid-root region of the experimental side first premolar root while the contralateral side served as the control. After 28 days, both premolars were extracted. The teeth were scanned in a μCT system and the volume of root resorption craters associated with MOP treated premolars were compared with that of control premolars, and paired *t*-tests were conducted to determine statistical significance using the IBM SPSS statistics program, version 21 (IBM Corporation, USA)
RESULTS: MOP treated premolars exhibited significantly greater average total root resorption than control teeth 0.576 mm^3 versus 0.406 mm^3, respectively with the total average volumetric root loss of MOP treated premolars being 42 per cent greater than that of control teeth.
CONCLUSIONS: This 28 day trial shows that the application of MOPs around orthodontically moved premolars resulted in more orthodontic root resorption. However the results should be tested on a patient sample that is undergoing full-length orthodontic treatment.

008 EFFICACY OF INFILTRATION TREATMENT ON POST-ORTHODONTIC WHITE SPOT LESIONS WITH VARYING SEVERITIES: A QUANTITATIVE LIGHT-INDUCED FLUORESCENCE STUDY

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AIM: To evaluate the efficacy of low-viscosity resin infiltration in the treatment of post-orthodontic white spot lesions (WSL) with varying lesion severities assessed by quantitative light-induced fluorescence (QLF).
MATERIALS AND METHOD: Clinically diagnosed post-orthodontic WSL (n = 57) comprised the study material. Images of all lesions were obtained in a light-proof room under saliva isolation by a single operator using a QLF device (Inspektor-Pro, version 2.0.0.48, Netherlands) prior to any treatment. Images were processed with the corresponding software producing the fluorescence loss (ΔF1) and lesion area (Δarea1) values. Lesions were treated with low-viscosity resin infiltrant (Icon, DMG, Hamburg, Germany) according to the manufacturers' instructions. QLF imaging was repeated (ΔF2 and Δarea2) from the same perspective using the software of the device. Kolmogorov-Smirnov and independent samples tests were used for data evaluation.
RESULTS: Lesions were grouped as follows: (1) incipient (5<ΔF<10, n = 14); (2) advanced (10<ΔF<25, n = 43). ΔF1 and ΔF2 values of incipient lesions were 8.48 ± 0.73 and 6.86 ± 0.88, respectively. Δarea1 and Δarea2 values of incipient lesions were 5.59 ± 5.19 and 0.28 ± 0.33, respectively. In incipient lesions, both ΔF1-ΔF2 and Δarea1-Δarea2 reduced significantly ($P < 0.001$, $P = 0.002$). ΔF1 and ΔF2 values of advanced lesions were 15.48 ± 5.32 and 8.65 ± 2.7, respectively. Δarea1 and Δarea2 values of advanced lesions were 5.81 ± 5.56 and 1.31 ± 1.86, respectively. In advanced lesions, both ΔF1-ΔF2 and Δarea1-Δarea2 presented significant decreases ($P < 0.001$). When ΔF1-ΔF2 and Δarea1-Δarea2 decreases of incipient and advanced lesions were compared, the decrease in ΔF was higher for advanced lesions ($P < 0.001$) whereas the decrease in lesion area was similar ($P = 0.588$).
CONCLUSIONS: Treatment of post-orthodontic WSL using low-viscosity resin infiltration significantly reduces the loss of fluorescence and lesion area regardless of lesion severity. However, in advanced lesions, the loss of fluorescence was improved more effectively.

009 THE EFFECTS OF FUNCTIONAL THERAPY ON SAGITTAL PHARYNGEAL DIMENSIONS IN SUBJECTS WITH SLEEP-DISORDERED BREATHING AND A CLASS II MALOCCLUSION
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AIM: To cephalometrically evaluate the craniofacial changes induced by functional treatment of mandibular advancement with special regard to the pharyngeal sagittal airway dimensions, tongue dimension and hyoid bone position in subjects with sleep-disordered breathing (SDB) and dentoskeletal Class II malocclusions when compared with an untreated Class II control group.
SUBJECTS AND METHOD: Fifty one subjects (24 females, 27 males; mean age 9.9 ± 1.3 years) with a Class II malocclusion and SDB consecutively treated with a functional appliance [modified monobloc, (MM)] were compared with a control group of 31 subjects (15 males, 16 females; mean age 10.1 ± 1.1) with an untreated Class II malocclusion. For the study group, mode of breathing was defined by an otorhinolaryngologist according to complete physical examination. The parents of all participants completed a modified version of the paediatric sleep questionnaire (PSQ-SRBD) scale (Chervin; the Italian version in 22 items form) before and after the trial. Lateral cephalograms were available at the start and end of treatment with MM. Descriptive statistics were calculated for all cephalometric measurements in the two groups for the active treatment changes.
RESULTS: Significant favourable skeletal changes in the mandible were observed in the treated group after treatment T2. Significant short term changes in the sagittal airway dimensions, hyoid position and tongue dimensions were induced by functional therapy of mandibular advancement in subjects with a Class II malocclusion and SDB when compared with untreated controls. After orthodontic treatment, a significant reduction in diurnal symptoms was observed in 45 of the 51 participants who had received an oral appliance.
CONCLUSIONS: Orthodontic treatment is considered to be a potential therapeutic approach for SDB in children. Orthodontists are playing an increasingly important role in managing snoring and respiratory problems by means of oral mandibular advancement devices and rapid maxillary expansion.

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010 INDIRECT VERSUS DIRECT BONDING OF MANDIBULAR RETAINERS. A RANDOMIZED CONTROLLED TRIAL COMPARING FAILURE AND POST-TREATMENT STABILITY: TWO-YEAR FOLLOW-UP

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AIM: To compare the number of failures of mandibular fixed retainers bonded using the indirect and direct bonding methods, and to investigate the post-treatment changes 2 years after placement.
SUBJECTS AND METHOD: Sixty-four consecutive patients were randomly allocated to either an indirect or a traditional direct bonding procedure of a canine-to-canine mandibular lingual retainer after the end of treatment (T0). The patients were recalled 12 (T1) and 24 (T2) months later: failures of retainers (i.e. at least one composite pad debonded) and unexpected post-treatment changes of the lower incisors and canines were recorded. Impressions and lateral cephalograms were taken at T0 and T2: changes in lower intercanine and interpremolar widths, as well as lower incisor inclination were assessed. The chi-squared test was used to compare the survival rate of the retainers bonded with the direct and indirect methods. Paired *t*-tests were used to assess differences in intercanine and interpremolar widths as well as lower incisor inclination at T0 and T2. Significance was set as $P < 0.05$.
RESULTS: One patient dropped out at baseline and three did not attend the T2 recall. In 24 out of 60 (40%) patients, the fixed retainer failed within two years: 13 out of 30 (43%) in the indirect bonding group and 11 out of 30 (37%) in the direct bonding group ($P = 0.64$). Bond failures occurred mainly during the first year. No clinically significant differences in lower intercanine and interpremolar widths or incisor inclination were found between T0 and T2. In five patients, all in the direct bonding group, unexpected post-treatment changes systematically consisting of a lingual inclination of the lower left canine were observed. In one case (3%) the change was considered clinically severe.
CONCLUSIONS: There is no difference in risk of failure between mandibular retainers bonded with the direct and indirect methods. Bond failures occur mainly during the first year. Bonded retainers are effective in maintaining intercanine and interpremolar widths. There seem to be less unexpected post-treatment changes with retainers bonded with the indirect compared to the direct method.

011 A MULTICENTRE, RANDOMIZED STUDY ON THE PLAQUE REMOVAL EFFICACY OF TWO INTERDENTAL BRUSHES IN THE AREA AROUND THE BRACKET BASE

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AIM: In patients treated with fixed appliances oral hygiene measures are impeded by the components of the appliances. The aim of this clinical multicentre study was to analyze the efficacy of the cleaning procedure of two interdental brushes in the area around the brackets.
SUBJECTS AND METHOD: In this multicentre, randomized, double-blind cross-over study, 20 patients (12 females, 8 males) between 12 and 18 years with fixed orthodontic appliances were examined at the Mainz School of Dentistry, Germany, and at the Children's Dental Clinic, St. Gallen, Switzerland. A conventional cylindrically-shaped interdental brush [IDBG-S® (IB), Top Caredent GmbH] was examined in comparison with an innovative waist-shaped interdental brush [CDB-8® (CB), Top Caredent GmbH]. Each patient was required to refrain from oral hygiene practice for three days and attended two examination appointments (T1/T2). Plaque Index (PI) scores were assessed following Silness and Löe before and after the cleaning procedure on eight tooth surfaces in the bracket area, on the archwire and on the bracket.
RESULTS: Both brushes showed a plaque removal effect. With application of the CB, the total PI of all surfaces was reduced by a median value of 0.68 [interquartile range (IQR): 0.63-0.77]. The application of the IB resulted in a median reduction of the total PI of 0.43 (IQR: 0.33-0.55). The difference between the two brushes was statistically significant at the 5 per cent level ($P = 0.0015$).

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In particular, the CB yielded a higher plaque removal efficacy (CB effect: 0.68/IB effect: 0.21) on the main areas 1 and 8, which are difficult to reach. There was no indication of a carry-over effect (T1/T2) (P = 0.5920).
CONCLUSIONS: The waist-shaped brush head of the CB significantly enhanced plaque reduction in total and particularly in problematic areas.

012 A NOVEL METHOD FOR SUPERIMPOSITION AND MEASUREMENTS ON MAXILLARY DIGITAL THREE-DIMENSIONAL MODELS – STUDIES ON VALIDITY AND RELIABILITY †††

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AIMS: Treatment effects or changes during retention can be analysed using serial three-dimensional (3D) study models. But, 3D study models need to be superimposed correctly before measurements can be assessed and earlier studies have shown that literally every anatomical structure in the palate could change due to growth or treatment. A new method for superimposition and measurement of maxillary 3D models that compensates for morphological changes has been developed. Changes are detected by deformation analysis. This analysis is based on an algorithm that identifies areas of deformation and therefore, in a second step, only unchanged areas are used for superimposition. The purpose of this study was to investigate the validity and reliability of a novel method for superimposition and measurement of serial 3D models.
MATERIALS AND METHOD: After sample size calculation 3D models from 16 patients were derived from an on-going study on anchorage. These 16 3D models were modified to simulate space closure and growth by an independent 3D engineer. Thus, true values for tooth movements on each model could be used as a reference. Four senior consultant orthodontists performed the measurements. Repeated measurements were carried out after at least two weeks. Statistical analysis was performed with linear mixed models using R.
RESULTS: Translational measurements had a mean error of 0.000851 mm (SD 0.03 mm). The range of the measurement error was 0.15 mm. The intraclass correlation coefficient (ICC) was 0.9996. Rotation measurements had a mean error of 0.024 degrees (SD 0043°), a range of 0.46 degrees and an ICC of 0.9999.
CONCLUSION: The tested method is a valid and reliable tool for measuring tooth movements in the maxilla. The method produces results with excellent accuracy and precision even when changes through growth or orthodontic treatment occur.

††† Winner of the W J B Houston Oral Research Award

013 CRANIOFACIAL MORPHOLOGY AND DENTAL OCCLUSION IN ADULTS WITH OSTEOGENESIS IMPERFECTA – A COMPARISON ACCORDING TO SEVERITY OF DISEASE

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AIM: To compare craniofacial characteristics and variation in dental occlusion according to severity of osteogenesis imperfecta (OI). OI is a rare inherited disease with fragility of bone and teeth because of abnormalities in the formation of collagen.
SUBJECTS AND METHOD: A total of 73 patients with a genetically confirmed diagnosis of OI were recruited. Standardized profile cephalograms were obtained in 68 patients. Cephalometric analyses were performed and cephalometric variables were compared according to OI severity [54 OI type 1 (mild) versus 14 OI type 3 or 4 (severe)]. The comparison was performed by multiple linear regression analyses with the cephalometric variables as outcome variable adjusted for the effect of

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age, gender, and family clustering. Patients had clinical photographs taken: overjet, overbite, crossbite and posterior open bite were assessed. Statistical analyses were by Fisher's exact test.
RESULTS: In comparison with mildly affected patients, the severely affected patients had significantly (P < 0.05) reduced mean (sd) lengths sella-basion [mild: 49 (3.6); severe: 45 (3.1)], basion-bregma [mild: 156 (7.7); severe: 149 (10.3)], basion-lambda [mild: 132 (7.0); severe: 124 (8.6)], and sella-lambda [mild: 136 (6.3); severe: 130 (8.5)], reduced mean (sd) thickness of the parietal theca [mild: 8 (1.8); severe: 6 (1.0)], a reduced maxillary mean (sd) length [mild: 95 mm (6.2); severe: 89 (8.3)] and maxillary posterior mean (sd) height [mild: 50 (3.7); severe: 46 (4.1)], a reduced maxillary prognathism [mild: 83 (3.4); severe: 80 (3.4)], increased mean (sd) maxillary inclination [mild: 6 (4.1); severe: 12 (4.1)], a reduced mandibular mean (sd) length [mild: 129 (7.2); severe: 120 (9.5)] and a reduced mean distance nasion-gnathion [mild: 129 (7.6); severe: 121 (10)]. More severely than mildly affected patients had mandibular overjet (≤ 0 mm) (mild OI: 4%, severe OI 64%) and posterior crossbite (mild OI: 15%, severe OI: 88%).
CONCLUSIONS: The degree of deviation in neurocranial morphology is associated with the severity of OI. The morphology and position of the maxilla is more affected in severe OI than in mild OI, the maxilla being more retrusive and with reduced posterior height. Mandibular overjet is a dominant symptom in severe OI.

014 TREATMENT OF MISSING MAXILLARY LATERAL INCISORS. SPACE CLOSURE OR IMPLANT THERAPY?

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AIM: To evaluate the aesthetic results in patients with missing maxillary lateral incisors treated with implant therapy or orthodontic space closure.
SUBJECTS AND METHOD: Evaluation was performed by three groups: laymen between 20 and 30 years of age (n = 26), laymen between 50 and 70 years of age (n = 26) and professionals; specialist in orthodontics (n = 25). These three groups were asked to view photographs of 44 different cases where patients with one or two missing maxillary lateral incisors had been treated with either implant-borne crowns or orthodontic space closure. The participants were asked to evaluate the aesthetics of the dentition, the aesthetics related to the shape and colour of the tooth replacing the missing maxillary lateral incisor and the gingiva adjacent to the same tooth.
RESULTS: The survey received 77 responses with evaluations of the 44 cases. When comparing cases with implant-borne crowns and those with orthodontic space closure, of all the variables rated, there was only a difference concerning the gingival colour adjacent to the tooth replacing the missing maxillary lateral incisor, which was rated as better aesthetics in the space closing cases (P < 0.000). The professionals preferred the aesthetics of the dentition as a whole in the space closure cases (P < 0.042). The three groups did not differ concerning the evaluation of the cases with implant-borne crowns. Comparing the three groups when evaluating the cases with orthodontic space closure, the young laymen were more dissatisfied with the colour of the tooth replacing the missing lateral incisor (P < 0.043). The professionals were more satisfied with the colour of the gingiva adjacent to the replacing tooth compared to the laymen (P < 0.000).
CONCLUSIONS: When all rates were included there was no difference in the overall aesthetic result in patients treated with implant therapy or orthodontic space closure. The colour of the gingiva adjacent to implant-borne crowns had poorer aesthetic ratings. The professionals preferred the aesthetics of the dentition as a whole in the space closure cases.

015 BIOLOGICAL EFFECTS OF ANODIC OXIDATION ON ORTHODONTIC MINISCREWS

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AIMS: In orthodontics, some miniscrews available commercially are characterized by a specific colour-coding of the screw for visual distinction of length, provided by anodic oxidation.

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Nevertheless, to date no studies have investigated the influence of anodic oxidation on the cellular viability and growth to the surface of the orthodontic temporary anchorage devices (TADs). Therefore the aim of present study was to investigate on the effects of anodic oxidation of orthodontic TADs on human osteogenic cells viability and growth.
MATERIALS AND METHOD: One hundred-twenty 5 mm and thirty two 10 mm titanium grade V disks were used for the experiments. Human osteoblast-like osteosarcoma Saos-2 cell growth was evaluated for 24 hours in two different sections and the number of cells was calculated in eight equal fields of view. Distribution and intensity of procollagen I signal was determined using Zeiss ZEN 2008 and SP1D8 as the antibody. Cell viability was analyzed by the live/dead viability/cytotoxicity assay kit (Thermofiscer). For cell migration assay a culture-Insert-2-Well (IBIDI) was used and monitored for 12, 24, 40 and 48 hours. Data collected were first analyzed by means of conventional descriptive statistics. Pearson product-moment correlation, supplemented by one way analysis of variance for unpaired samples, was used for statistical analysis.
RESULTS: The impact of TiO_2 coating resulted to be negatively associated to cell growth. No significant difference in cell death was found among different disks. Greater distribution and amount of procollagen I was found between the control group and TiO_2 covered disks. Finally, cell migration revealed significant differences in ability of cells to repopulate disk surfaces at an early time point. Nevertheless, after 48 hours all discs showed complete repopulation of the gap area.
CONCLUSION: Anodic oxidized miniscrews are not toxic for human osteoblast-like cells. Nevertheless, the anodization process of the TAD surface negatively influenced cell adhesion and migration monitored at 12 hours. However, at 48 hours no difference was found between TADs with or without anodic oxidation process.

016 THE EFFICACY OF FUNCTIONAL THERAPY ON THE QUALITY OF LIFE IN THE MANAGEMENT OF TEMPOROMANDIBULAR DISORDERS IN PATIENTS AFFECTED BY JUVENILE IDIOPATHIC ARTHRITIS

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AIM: Juvenile idiopathic arthritis (JIA) is a chronic inflammatory joint disease which can cause cartilage and bone damage as well as disability. The temporomandibular (TMJ) is frequently involved during JIA and, given the important role of TMJ disorders (TMD), there is an increasing interest in therapies that could improve the quality of life (QoL) in JIA patients. The objectives of the present study were to evaluate the clinical effectiveness of functional therapy used to reduce TMD in patients with JIA and to determine any change in the oral-health-related quality of life (OHRQoL).
SUBJECTS AND METHOD: A cohort of 58 patients with JIA (mean age, 13.4 ± 3.3 years; range, 5-18.2 years) and with TMJ involvement. Each patient, following the collection of clinical parameters, was treated for 24 months with a functional appliance individually customized by acrylic resin and resilient stainless steel with posterior and anterior metallic bite planes. During clinical assessment, TMJ signs and symptoms were recorded and OHRQoL was measured using the Oral Health Impact Profile (OHIP-14) questionnaire designed to measure the frequency of problems associated with the stomatognathic apparatus. The differences before (T0) and after therapy (T1, 24 months) of the clinical TMJ signs and symptoms parameters were evaluated by the chi-squared test and the Friedman two-way analysis of variance (ANOVA) was used to compare the relative changes in the OHRQoL scores at T0 and T1.
RESULTS: All patients successfully completed the study. The use of a functional appliance resulted in a statistically significant difference in pain during jaw movement, maximal mouth opening, TMJ sounds and crepitations ($P < 0.001$) and TMJ clicking significantly reduced at T1 ($P < 0.05$). Significant changes were observed in the different OHIP-14 scores parameters ($P < 0.001$) and there were significant reductions in the domain of the OHIP-14 scores as treatment progressed compared with T0 ($P < 0.001$).
CONCLUSIONS: Functional therapy significantly improves OHRQoL and most probably reduces the level of TMJ inflammation and TMJ arthritis-related orofacial symptoms, and was safe and well tolerated by the patients.

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017 DO CONTEMPORARY TREATMENT TECHNIQUES CHANGE THE NEED FOR EXTRACTION IN THE 21ST CENTURY? DATA FROM THE UNIVERSITY OF NORTH CAROLINA

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AIM: The extraction of permanent teeth has long been a key strategy to manage the boundaries of the alveolar envelope of tooth movement. Have contemporary treatment techniques (e.g. self-ligating brackets, skeletal anchorage devices) changed the need for extraction? The aims of this study were to use an epidemiologic approach to 1) report contemporary orthodontic extraction frequencies at a university centre and 2) investigate what technique-related factors might influence the likelihood of extraction.

MATERIALS AND METHOD: The records of 2,995 consecutive patients treated at the University of North Carolina from 2000-2013 were analyzed. Year by year rates for overall orthodontic extractions and for extraction rate by pattern of teeth extracted were calculated. Logistic regression, adjusting for all recorded patient risk factors for extraction (e.g. Angle Class, crowding), as well as all technique-related factors (e.g. growth modification), was used to examine both the changes in extraction frequencies over time and the influence of technique-related factors on the odds of extraction.

RESULTS: Over the time period investigated, the overall extraction rate remained nearly level, just below 25 per cent. When controlling for changes in patient characteristics from year to year, this rate did not vary in a statistically significantly way (OR 0.97; 95% CI 0.94, 1.00). When controlling for patient-related diagnostic characteristics that might influence the decision to extract teeth, there was a statistically significant increase in the odds of extraction when temporary anchorage devices (TADs) were used (OR = 2.45; 95%CI 1.07, 5.60), but not with other treatment techniques such as surgical-orthodontics or maxillary expansion. Consistent with previous findings, diagnostic factors such as crowding (OR = 1.20), overjet (OR = 1.07), overbite (OR = 0.87), Angle classification (OR = 1.51), incisor position (OR = 1.53), and lip incompetence (OR = 1.41) had statistically significant effects on the odds of extraction.

CONCLUSIONS: In a university centre, overall extraction rates remained level from 2000-2013, near 25 per cent. When controlling for variations in patient-related factors, the odds of extraction increased with the use of TADs, but not with the use of other treatment techniques. In contemporary orthodontic practice, patient-related diagnostic factors, rather than treatment techniques, are more likely to affect the need for extraction.

018 PERIODONTAL BONE CHANGES IN CONE-BEAM COMPUTED TOMOGRAPHY AFTER ORTHODONTIC TOOTH MOVEMENT WITH FIXED APPLIANCES

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AIM: To quantify the treatment-related change in periodontal bone volume in orthodontic patients.

MATERIALS AND METHOD: Cone-beam computed tomographs (CBCT) of 43 patients (24 females, 19 males; mean age: 25 years 5 months ± 13 years 5 months; 10 years 2 months to 56 years 9 months), who had been receiving orthodontic treatment with multibracket appliances for at least 1 year, were chosen for retrospective evaluation. Patients with periodontal diseases or requiring combined orthodontic-surgical treatment were excluded; the key inclusion criterion was an image resolution of 0.25 mm^3 voxel size. Despite dehiscence depth and bone width, the change in inclination was determined for 954 teeth. Statistical analyses were conducted with the help of SPSS Statistics®.

RESULTS: There was a significant decrease in mean periodontal bone height (vestibular: –0.82 ± 1.47 mm, +1.27 to –9.5 mm; lingual: –0.57 ± 0.79 mm, +1.84 to –6.07 mm) and width (–0.56 ± 0.71 respectively –0.69 ± 0.9 mm) during the period of treatment ($P < 0.001$). In terms of gender, there was no difference regarding bone height and vertical bone loss. A significantly greater dehiscence depth with an increased vertical bone loss occurred in patients older than 30 years. In patients <30 years old, approximately 20 per cent of the teeth showed defect depths >2 mm before treatment. In 90 per cent of these patients at least one tooth was affected. The upper canines and all lower teeth

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showed a higher risk for vestibular bone loss. The initial vertical defect depth and the amount of bone loss during orthodontic treatment were not mutually dependent. The therapeutic change in inclination correlated with horizontal bone loss.
CONCLUSIONS: Based on the present results it is reasonable to evaluate the periodontal bone volume in orthodontic patients older than 30 years on a routine basis due to increased vertical bone loss. Ninety per cent of patients younger than 30 years showed a reduced bone volume on at least one periodontium. Three-dimensional imaging, especially in young patients should be performed with milliampere-reduced CBCT.

019 SELF-PERCEIVED ATTRACTIVENESS AND FACIAL SHAPE – A GEOMETRIC MORPHOMETRIC INVESTIGATION

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AIM: To investigate the effect of facial shape on self-perception of facial attractiveness.
SUBJECTS AND METHOD: The study population consisted of 321 young adults who were all dental students at Tufts University. Three-dimensional (3D) resting facial photographs of all participants were obtained using a 3D stereophotogrammetry system (3dMD, Atlanta, USA). Digitization of 3D images and geometric morphometric analysis of landmark configurations were performed using ViewBox 4 software (dHAL software, Kifissia, Greece). Assessment of participants' perception regarding their facial appearance was performed with a short questionnaire, and answers were recorded with visual analogue scales. Procrustes superimposition was applied to all 3D images, including all 1021 landmarks and semi-landmarks, and the subsequent landmark coordinates were used for analysis as dependent variables. The overall variation of the facial form (shape and size) was explored through principal component analysis. Multivariate regression analysis was performed on principal component scores to study the effect of facial form (dependent variables) on facial attractiveness (independent variable). All statistical analyses were performed at the 0.05 level of significance.
RESULTS: In the overall sample, more than 60 per cent of variability in form was explained by the first three principal components. Facial form was significantly different between genders ($P < 0.001$). In females, self-perception of facial attractiveness was affected to a larger extent by facial form than in males ($P < 0.05$). Certain facial configurations were considered more attractive than others both in males and females.
CONCLUSIONS: There are significant differences between male and female facial forms. Facial form appears to have a stronger impact on female's self-perception of facial appearance, while in males other factors, such as psychosocial status, may play a more significant role.

020 MEAN GINGIVAL THICKNESS OF THE MAXILLARY AND MANDIBULAR ANTERIOR REGION IN INDIVIDUALS WITH DIFFERENT CRANIOFACIAL MORPHOLOGY

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AIM: To evaluate the mean gingival thickness of the maxillary and mandibular anterior region in individuals with different craniofacial morphology.
SUBJECTS AND METHOD: For each dental arch 128 periodontally healthy orthodontic patients with normal values of upper incisor position (1/NA angle and mm, IMPA angle) and lower incisor position (1/NB angle and mm, 1/SN angle) were enrolled in the study. The craniofacial morphology of the participants was evaluated in the sagittal (ANB angle) and vertical directions (SN/GoGn angle) on lateral cephalograms taken at the beginning of treatment. In the sagittal direction the individuals were divided into three groups as Class I, II and III. Each group was classified as low, normal and high

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angle in the vertical direction. The mean gingival thickness of maxillary and mandibular anterior region was determined by the ratio of the sum of the gingival thickness of the relevant teeth, measured by the transgingival probing technique, to the number of the teeth. Factorial variance analysis was employed in order to identify the extent to which a difference was apparent according to these parameters.
RESULTS: The ANB angle of the Class I, II and III groups was 2.591 ± 0.918, 6.05 ± 1.277 and –0.844 ± 1.441, respectively, and the SN/GoGn angle of low, normal and high angle groups was 25.258 ± 1.57, 32.702 ± 1.99 and 39.802 ± 3.187, respectively. The mean gingival thickness of the maxillary anterior region was 1.173 ± 0.61 mm, 1.103 ± 0.207 mm and 1.130 ± 0.244 mm in the Class I, II and III groups, respectively, and 1.084 ± 0.150 mm, 1.136 ± 0.247 mm and 1.159 ± 0.249 mm in the low, normal and high angle groups, respectively. The mean gingival thickness of the mandibular anterior region was 0.710 ± 0.156 mm, 0.741 ± 0.176 mm and 0.691 ± 0.157 mm in the Class I, II and III groups, respectively, and 0.705 ± 0.184 mm, 0.701 ± 0.132 mm and 0.735 ± 0.174 mm in the low, normal and high angle groups, respectively.
CONCLUSIONS: There was no significant difference between groups in terms of the mean gingival thickness of the maxillary and mandibular anterior region in individuals with different craniofacial morphologies.

021 EFFECTS OF THE PARTIALLY COX-2-SELECTIVE NON-STEROIDAL ANTI-INFLAMMATORY DRUG MELOXICAM DURING TOOTH MOVEMENT IN THE ABSENCE/PRESENCE OF PERIODONTITIS
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AIM: Orthodontists are increasingly confronted with patients with chronic periodontitis or who regularly take non-steroidal anti-inflammatory drugs (NSAID) to alleviate pain, including orthodontic pain. Whereas the effects of unselective NSAID and coxibes during orthodontic therapy have been studied, the consequences of a partially selective inhibition of cyclooxygenase 2 (COX-2) over COX-1 (11:1), as induced by the NSAID meloxicam, remain unclear. Thus the adverse side and beneficial effects of meloxicam in orthodontic therapy and whether meloxicam may be useful for preventing periodontal bone loss associated with recurring active inflammation during tooth movement in periodontally challenged individuals was investigated.
MATERIALS AND METHOD: One hundred and five male inbred Fischer344-rats were randomly assigned to five experimental groups: (1) control, (2) orthodontic tooth movement (OTM) of the upper left first/second molars (NiTi coil-spring; 0.25 N), (3) OTM with 3 mg/kg meloxicam p.o., (4) OTM with experimental periodontitis (cervical silk ligature), (5) OTM with periodontitis and meloxicam. After 14 (28) days of OTM, periodontal bone loss and OTM as well as C-reactive-protein serum concentration, gastric toxicity, orthodontically-induced inflammatory root resorption (OIIRR), osteoclast activity and dental-periodontal gene expression of known inflammatory/osteoclast markers was determined. *In vitro*, human periodontal ligament fibroblasts (hPDL) were stimulated with orthodontic pressure (2 g/cm^2) and combined with toxins of Aggregatibacter actinomycetemcomitans with/without meloxicam (10 µmol) and gene/protein expression of inflammatory/osteoclast markers as well as osteoclastogenesis in co-culture with RAW264.7 cells were determined.
RESULTS: Meloxicam significantly reduced tooth movement velocity and OIIRR by 40-50 per cent, osteoclast activity and relative expression of inflammatory/osteoclast marker genes within the dental-periodontal tissue, while presenting a good gastric tolerance profile. *In vitro*, a corresponding significant decrease of PG-E_2/IL-6/RANKL(-OPG) expression and hPDL-mediated osteoclastogenesis was observed. Meloxicam prevented the orthodontically triggered exponentiation of periodontal bone loss during acute periodontitis as well as *in vivo*/*vitro* the periodontitis-induced exponentiation of tooth movement velocity, OIIRR and the associated pseudo-inflammation/osteoclastogenesis.
CONCLUSIONS: Meloxicam seems to downregulate hPDL-mediated inflammation, RANKL-induced osteoclastogenesis and consequently tooth movement velocity, limiting its suitability for orthodontic analgesia. Since tooth movement is not completely inhibited, but only decelerated, its gastric

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tolerability and protective effects regarding OIIRR and periodontal bone loss (in acute phases of chronic periodontitis) suggest the possibility of a future prophylactic application.

022 SOFT TISSUE CHANGES IN EXTRACTION VERSUS NON-EXTRACTION TREATMENT WITH FIXED ORTHODONTIC APPLIANCES: A SYSTEMATIC REVIEW AND META-ANALYSIS

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AIM: To compare the soft tissue response of comprehensive orthodontic treatment with fixed appliances and the systematic extraction of permanent teeth from clinical trials on human patients in an evidence-based manner.

MATERIALS AND METHOD: Ten electronic databases were searched from inception to October 2016 without year, language, or publication type limitations for controlled clinical trials comparing extraction and non-extraction comprehensive orthodontic treatment with fixed appliances, followed by manual searches. After duplicate study selection and data extraction, risk of bias within and across studies was assessed in duplicate with the Cochrane risk of bias tool and the GRADE approach, respectively. Random-effects meta-analyses of mean differences (MDs) with the 95 per cent confidence intervals (CIs) were conducted, followed by mixed-effects subgroup and sensitivity analyses.

RESULTS: A total of 62 clinical studies were included in the systematic review. Extraction treatment was associated with a statistically significant increase of nasolabial angle (17 studies; 787 patients; MD = 2.60°; 95% CI = 1.56 to 3.64°; $P < 0.001$; I2 = 8%), a statistically significant increase in N'-Sn-Pg' angle (5 studies; 237 patients; MD = 1.21°; 95% CI = 0 to 2.45°; $P = 0.05$; I2=57%), and a statistically non-significant decrease in Gl'-Sn-Pg' angle (3 studies; 183 patients; MD = -1.56°; 95% CI = -3.30 to 0.18°; $P = 0.80$; I2=68%). No significant overall differences in the soft tissue response according to extraction pattern, but underlying tooth movements, anchorage management, and appliances used had a considerable effect. Finally, significant signs of bias were linked to the methodological quality of the included studies.

CONCLUSIONS: Different extraction patterns do not seem to have an impact on soft tissue changes while extractions in general led to an increase of the nasolabial angle and to contradictory results with regard to the angle of facial convexity. Future research investigations should focus on the elimination of a series of methodological biases to enable robust prediction of effects of extraction treatment on the facial soft tissues.

Registration: PROSPERO (CRD42016049390)

023 ASSESSMENT OF GINGIVAL THICKNESS AT THE MANDIBULAR INCISORS OF ORTHODONTIC PATIENTS WITH FOUR DIFFERENT METHODS. A CROSS-SECTIONAL STUDY

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AIM: To find the most accurate and reliable method for measuring gingival thickness at the mandibular incisors of orthodontic patients.

MATERIALS AND METHOD: Probing with a periodontal probe was set as the standard method for measuring gingival thickness bucco-lingually, as this may be considered the gold standard in everyday practice for gingival biotype evaluation. This method was compared to three alternative procedures, namely needle measurements, as those used in acupuncture procedures, ultrasonic measurements with a special ultrasonic device and probing with the Hu-Friedy Colorvue® Biotype Probe. Orthodontic patients were examined consecutively with all techniques 2 mm below the margin of the keratinised gingiva at the labial gingival side of the two central mandibular incisors.

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Pocket depth and bleeding on probing were also recorded. The new methods were plotted versus the standard one. Violation of data normality assumptions were tested both graphically and via Shapiro-Wilk tests. The independence of the differences found was tested via Pearson's correlation coefficient. In the case of magnitude-dependence, data were transformed and retested for normality.
RESULTS: Needle and ultrasonic measurements provided increased measurements when compared to the standard technique. The estimated magnitude of disagreement was +0.24 mm (95% CI = [0.21, 0.27]) for the needle measurement and +0.17 mm (95% CI = [0.14, 0.21]) for the ultrasonic measurement estimated at tooth #31. Similar results were obtained at tooth #41: +0.20 mm (95% CI = [0.17, 0.23]) and +0.13 mm (95% CI = [0.10, 0.16]), respectively. There seems to be an increasing trend for larger differences, when the average of the measurements between the compared methods increases, as indicated by the statistically significant positive Pearson's correlation coefficients. The biotype probe consistently confirmed gingival biotype when compared with the other procedures.
CONCLUSIONS: The findings suggest that the standard technique for assessing gingival biotype, i.e. probing with a periodontal probe, may underestimate gingival thickness at the mandibular incisors.

024 COMPARISON OF TWO- AND THREE-DIMENSIONAL MEASUREMENTS OF ALVEOLAR BONE OVER MAXILLARY INCISOR ROOTS USING POINT A AS A REFERENCE

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AIM: In cephalometry, the landmark point A is used to determine the most forward position of the maxilla and the maxillary incisors. However, overlying structures can confound structure identification on two-dimensional radiographs. The purpose of this retrospective study was to use point A as the reference to compare bone thickness over the most forward maxillary incisor (MFMI) in two- (2D) versus three-dimensions (3D) and, in 3D, to compare bone thickness, inclination, and position of the roots of each maxillary incisor to MFMI.
MATERIALS AND METHOD: Following power analysis, 34 pre-treatment cone beam computed tomographs (CBCTs) of Caucasian adults were coded, randomized and evaluated in Dolphin 3D. Two dimensional cephalograms were derived from each CBCT. Point A and the MFMI crown were located. Following reliability tests, alveolar bone buccal to three root points on the MFMI, bone to reference line [Frankfort Horizontal (FH-A)] at the three points, and incisor inclination (1–FH) were measured by one investigator. Measurements were repeated on three-dimensional CBCTs for all maxillary incisors. 2D and 3D measurements were compared using paired *t*-tests; 3D comparisons made with ANOVA. Associations were performed using Pearson's correlations. A 5 per cent significance level was used for all tests.
RESULTS: In 2D, the width of buccal bone at the MFMI root apices and distance between the buccal bone and FH-A line at the root apices and 3 mm from the cementoenamel junction (CEJ) were significantly greater than in 3D. In 3D, bone thickness at the MFMI root apex and the distance from the FH-A line at all root points was significantly greater than at the lateral incisors whereas bone thickness 3 mm from the CEJ was significantly smaller than at the lateral incisors. An increased incisor angle was associated with greater bone thickness at the root apices but less 3 mm from the CEJ.
CONCLUSIONS: The amount of bone covering MFMI root apices is overestimated in 2D as compared with 3D and could affect treatment outcome when labial root torque is applied. Upright incisors have less bone over the root apices than proclined incisors. Incisor proclination is related to more bone thickness at the root apices and less bone thickness at the CEJ compared with retroclination.

025 COULD COMMON PRESCRIPTION MEDICATION AFFECT ORTHODONTIC TOOTH MOVEMENT? A SYSTEMATIC REVIEW

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Miltiadis Makrygiannakis, Eleftherios G. Kaklamanos, Athanasios E. Athanasiou, Hamdan Bin Mohammed College of Dental Medicine, Mohammed Bin Rashid University of Medicine and Health Sciences, Dubai, United Arab Emirates

AIM: The recently documented increasing use of prescription medication across the age spectrum in developed countries could constitute a confounding factor in influencing orthodontic treatment. The aim of this study was to investigate whether frequently prescribed drugs may have an effect on orthodontic tooth movement (OTM) characteristics.
MATERIALS AND METHOD: A search without restrictions for published and unpublished literature and hand searching took place. Data from studies investigating the effect on various OTM characteristics of the most commonly prescribed medication according to the United States 2012 National Ambulatory Medical Care Survey (excluding analgesics) were reviewed.
RESULTS: The initially identified records were finally reduced to 18 studies conducted on animals. An increase in the rate of OTM was observed after administration of Vitamin D and thyroid hormones. Reduction in the rate was demonstrated in studies investigating proton pump inhibitors, angiotensin II receptor antagonists, antihistaminic drugs and anti-hyperlipidemic agents. Inconsistent results were observed regarding the effects attributable to anti-depressants, beta-adrenergic blocking agents and adrenal cortical steroids. The overall quality of evidence was affected by important confounding factors such as dosage and the chronic or acute nature of administration of the various substances.
CONCLUSIONS: Although not adequately investigated in humans, commonly prescribed drugs may have the potential to modify OTM. Prescription, as well as non-prescription, medication and dietary supplements should be an integral and important part of medical history monitoring not only when planning but also during the course of orthodontic treatment.

026 CYTOTOXIC DRUG TREATMENT IN CANCER-SURVIVORS SIGNIFICANTLY INFLUENCES THE STABILITY OF ORTHODONTIC TREATMENT – A CASE CONTROLLED STUDY

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AIM: To compare the stability of orthodontic treatment in cancer survivors compared with a control group of healthy subjects.
SUBJECTS AND METHOD: Fifty two cancer-survivors treated orthodontically between 2008 and 2013 (29 males, 23 females; median age 19.2 years). All had received cytotoxic drugs in the period of permanent tooth development. Fifty two healthy control subjects matched for age, gender, and malocclusion served as the control. Thirty three patients had skeletal a Class II, six a skeletal Class III and 13 a skeletal Class I. The Peer Assessment Rating (PAR) Index, the Index of Complexity, Outcome and Need (ICON) and Patients Satisfaction Score were assessed before treatment, after treatment and at the 3-year follow-up. A repeated ANOVA was used to test the statistical relationship of the scores.
RESULTS: An appropriate ideal occlusion was achieved in all patients with mean PAR scores of 4.2-6.0 in both study groups. The reduction in PAR score was on average 81.7 and 80.5 per cent in the control and cancer-survival patients, respectively. At follow-up, the average PAR score reduction was insignificantly lower (78.7; $P = 0.4$) for the control group (relapse in three patients classified as ‘improved’ and in one patient classified as ‘greatly improved’). At the same time, the average PAR reduction significantly decreased (72.3; $P < 0.05$) for the cancer-survivor group with relapse in five and two patients classified as ‘improved’ and ‘greatly improved’. Similarly, there was an insignificant increase (9.3 versus 10.2; $P = 0.2$) in the mean ICON score in the control group and a significant increase (10.2 versus 15.6; $P < 0.05$) in the cancer-survivor group comparing the time after treatment and at the 3-year follow-up. There was no significant change in patient satisfaction score.

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CONCLUSIONS: The results of properly conducted orthodontic treatment of cancer survivors do not differ significantly from those of healthy subjects. However, there is a significant worsening of treatment stability during the follow-up of the cancer survivors. This group of patients should have a more intense follow-up to maintain the results of orthodontic treatment and more detailed pre-treatment discussion about possible outcome.

027 MANDIBULAR INCISOR DENTOALVEOLAR COMPENSATION AMONG CLASS I, II AND III MALOCCLUSION PATIENTS WITH DIFFERENT VERTICAL FACIAL PATTERNS

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AIM: To compare mandibular incisor dentoalveolar compensation and associated mandibular symphysis morphology among Class I, Class II division 1 and Class III malocclusion patients with different facial vertical skeletal patterns.
MATERIALS AND METHOD: Mandibular incisor extrusion and inclination, as well as buccal and lingual symphyseal bony cortex depth, and mandibular symphyseal height were measured on 199 lateral cephalometric radiographs of adult patients without prior orthodontic treatment. Differences between overjet, sagittal and vertical patterns among malocclusion types were contrasted. Through a principal component analysis (PCA) an adaptation pattern for lower incisor behaviour inside its symphyseal environment was identified based on the underlying malocclusion features.
RESULTS: Differences were identified for mandibular incisor inclination and extrusion in Class II division 1 and Class III compared to Class I malocclusions. In all groups, the correlation between mandibular plane angulation increase and dentoalveolar compensations was weak. According to the PCA, in close to 70 per cent of the Class III malocclusion sample, the mandibular symphysis elongates and narrows, especially in subjects with a long face tendency.
CONCLUSION: Dentoalveolar compensation was linked to lower incisor inclination and extrusion in Class I and Class III malocclusions, while in Class II division 1 malocclusions dentoalveolar compensation was not primarily linked to the evaluated cephalometric factors. The vertical facial pattern is a significant influencing factor in mandibular symphysis morphology especially in the long face Class III malocclusion type.

028 MALOCCLUSION AND ORAL HEALTH RELATED QUALITY OF LIFE IN SOUTH AMERICAN INDIGENOUS ADOLESCENTS

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AIM: Malocclusion is considered a public health problem due to its impact on quality of life. The overall goal of this study was to assess the impact of malocclusion on Oral Health Related Quality of Life (OHRQoL) in indigenous Peruvian adolescents.
SUBJECTS AND METHOD: This cross-sectional study was conducted among 286 school children living on the islands of Amantani and Taquile in the Titicaca Lake in Peru. OHRQoL was assessed by the Child Oral Health-Related Quality of Life questionnaire (COHIP) short version (19 questions). The severity of malocclusion was assessed using the Index of Complexity, Outcome and Need. General information on demographic data was also recorded. All statistical analysis was performed using SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, New York, USA). ANOVA were employed for statistical analysis and Tukey's test for *post hoc* analysis.
RESULTS: The severity of malocclusion and orthodontic treatment need had no impact on the OHRQoL in this population. Total COHIP score (P = 0.34), oral health domain (0.38), functional (P = 0.25), social (P = 0.84), self-image (P = 0.12), school (P = 0.30). Tukey's *post hoc* test also did not yield statistically significantly results.
CONCLUSIONS: The isolation and lack of media access seems to explain, in part, the lack of impact of malocclusion in this indigenous population.

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029 *IN VITRO* EVALUATION OF THEOBROMINE, ENAMEL MATRIX PROTEIN DERIVATIVES, CASEIN PHOSPHOPEPTIDE AMORPHOUS CALCIUM PHOSPHATE AND SEA SALT ON ENAMEL REMINERALIZATION NEXT TO ORTHODONTIC BRACKETS

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AIM: To evaluate and compare the remineralization potential of theobromine, enamel matrix derivatives (Emdogain), casein phosphopeptide amorphous calcium phosphate (CPP-ACP), fluoride (NaF) and sea salt under similar *in vitro* conditions to prevent incipient caries lesions under and next to orthodontic brackets.

MATERIALS AND METHOD: Ninety extracted human premolars were randomly allocated to six groups [n = 15; control (C), theobromine (T), Emdogain (E), CPP-ACP (C), fluoride (F), and sea salt (D)]. All brackets were bonded with Transbond XT and the teeth were coated with nail varnish, only leaving a window on the occlusal and cervical enamel around the brackets. All groups were subjected to a pH cycle for 30 days and each day the tested materials were applied for 3 minutes to specific samples. The extent of remineralization in each group was assessed using energy dispersive X-ray spectroscopy (EDX) working with scanning electron microscopy and calcium (atomic %Ca), phosphor (atomic %P) contents and %Ca/P ratios were calculated.

RESULTS: In all regions, except the middle region under the brackets, %Ca values and %Ca/P ratios in T, E, C, F and D groups were found significantly higher compared to the C group ($P < 0.001$). The remineralization potential of all tested materials showed no statistically significant differences after pH cycles ($P > 0.05$).

CONCLUSIONS: The applied remineralization materials in all test groups showed a positive effect. New remineralization materials such as theobromine, enamel matrix derivatives and NaF could be used during fixed orthodontic treatment to prevent white spot formation as an alternative therapy to provide remineralization.

030 IMPACT OF A PIEZOSURGICAL CORTICOCISION ON THE SPEED OF ORTHODONTIC TOOTH MOVEMENT AND BONE ACTIVITY

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AIM: Corticocision has been described as an effective and safe method to accelerate orthodontic tooth movement. However, little is known about bone activity during the remodelling process. The aim of this study was to investigate the effect of a corticocision performed by means of a piezotome on bone activity and its relationship to orthodontic tooth movement.

MATERIALS AND METHOD: Male Wistar-rats (n = 12, age: 10 weeks) underwent a vertical corticocision of the maxillary alveolar process, 2 mm mesial of the first molar on one randomly determined side. Subsequently, the maxillary molars on both sides were ligated and moved together mesially by means of a closed coil spring which was fixed to both maxillary incisors. Immediately before placement of the orthodontic appliance and again after its removal, 4 weeks later, all animals underwent a single photon emission computed tomography (SPECT) in combination with a microcomputed tomography (µCT). As there were two drop-outs, only 10 animals successfully completed the trial. Subsequently, the speed of orthodontic tooth movement was measured on the µCT and the bone activity determined by SPECT.

RESULTS: A significantly higher bone activity was measured on the side treated with corticocision compared to the control side with conventional tooth movement only. The speed of orthodontic tooth movement also increased significantly as a consequence of the surgical procedure. In addition bone activity correlated well with the speed of orthodontic tooth movement.

CONCLUSIONS: A corticocision of the alveolar process in the upper jaw of the rat by means of a piezotome results in an acceleration of orthodontic tooth movement which could be explained by an increase of the remodelling speed.

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031 A RANDOMISED CONTROLLED TRIAL OF A PATIENT DECISION-MAKING AID FOR ORTHODONTIC TREATMENT

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AIMS: To assess the efficacy of a patient decision-making aid (PDA) for adolescent subjects considering fixed appliance orthodontic treatment.

SUBJECTS AND METHOD: The study was a prospective randomised controlled trial with participants randomly allocated to one of two groups. Patients aged 10-16 years old were recruited prior to consenting to fixed appliance treatment from both new patient clinics and subsequent record appointments. All patients received information regarding fixed appliances and information leaflets according to normal practice, as well as standardised verbal information from the researcher about the general benefits and risks of fixed appliances. The intervention group additionally received the PDA. All patients then completed a Decisional Conflict Scale (DCS) questionnaire to assess levels of decisional conflict in their decision-making.

RESULTS: Seventy-two patients were recruited and 71 DCS questionnaires were fully completed, satisfying the sample size calculation. The median total DCS score was lower in the intervention group (15.63, range 0 to 37.5) than in the control group (19.53, range 0 to 40.6), however, this did not reach statistical significance ($P = 0.32$). Considerable individual variation was noted. The median DCS subscores for the following sub-domains of decisional conflict were also calculated: uncertainty (intervention 16.67, control 25.00, $P = 0.36$); informed (intervention 16.68, control 20.83, $P = 0.38$); values clarity (intervention 16.67, control 20.83, $P = 0.47$); support (intervention 8.33, control 8.33, $P = 0.27$); effective decision (intervention 12.50, control 15.63, $P = 0.39$). All of the median DCS subscores were lower for the intervention group than the control group but none reached statistical significance. Univariable linear regression analyses showed that the group allocation, age, gender, ethnicity and the clinic from which patients were recruited did not have a statistically significant effect on levels of decisional conflict.

CONCLUSION: The null hypothesis that there was no difference in the level of decisional conflict in patients who received the PDA compared with those who did not was upheld. Although statistical significance was not reached, decisional conflict was reduced for some patients and there may be a benefit in providing a PDA to some individuals, however, it is not yet possible to say how these patients could be identified.

032 PREMOLAR AUTOTRANSPLANTATION IN ORTHODONTIC TREATMENT

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AIM: To present the long-term evaluation of survival and failures of autotransplanted premolars, followed more than 30 years.

SUBJECTS AND METHOD: One hundred consecutive patients treated with autotransplantation caused by tooth loss, hypodontia and ectopic tooth position. All patients (9.2-14.4 years, mean 12.8 years, 53 boys, 47 girls), had one-rooted premolar transplanted from one region to another or *in situ*. In total 118 premolars were transplanted in root stages with an open apex wider than 1 mm. Primary healing and follow-up were tested using a Siemens electrometric pulp tester to detect pulpal reinnervation and standardized radiographs to test transplant healing and root development generally. Assessments were carried out at 1, 4, 8, 12 and 24 weeks and thereafter yearly after transplantation. Tooth eruption and root development was evaluated using a colour coding technique (developed at the Karolinska Institute, Stockholm). Transplants were moved or rotated orthodontically 3-9 months after transplantation.

RESULTS: Complicated problems were moved to other regions or replaced, which made them easier to solve orthodontically. Most transplanted premolars showed normal tooth eruption, compared with contralaterals. Transplants induced tooth eruption and bone induction. Transplants erupted before visible root formation and before visible alveolar bone formation. Furthermore, marginal

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gingiva was transferred with both papillae. A survival rate of 91.5 per cent and a failure rate of 8.5 per cent was found for all transplants. Premolars transplanted as maxillary incisors had a higher incidence of failure (15%) than premolars transplanted to the mandibular premolar regions (7.6%).
CONCLUSIONS: The method is therefore essential in orthodontic treatment planning.

033 THE ALVEOLAR BONE AFTER AUTOTRANSPLANTATION OF PREMOLARS TO THE ANTERIOR MAXILLA. A PILOT STUDY USING CONE BEAM COMPUTED TOMOGRAPHY MEASUREMENTS

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AIM: To evaluate the status of the alveolar bone after autotransplantation of developing premolars to replace traumatically lost maxillary incisors.
SUBJECTS AND METHOD: Eleven patients aged 10 to 12 years (mean: 10 years 7 months) with unilateral loss of a maxillary central incisor had autotransplantation of a developing premolar to replace a missing or traumatized maxillary central incisor. Cone beam computed tomography was performed from 1 to 14 years (mean: 4 years) after surgery to evaluate alveolar bone prior to orthodontic treatment. The thickness of the buccal bone and the height and width (marginal and at half of the vertical dimension) of the alveolar process were evaluated at the transplant and control (non-affected contralateral central incisor) sites.
RESULTS: The mean thickness of the buccal bone at the transplant and control sites was 0.78 mm (range: 0.47-1.67) and 0.82 mm (range: 0.61-0.93), respectively. The mean alveolar bone height was 15.15 mm (range: 8.92-21.31) at the transplant and 15.12 mm (range: 9.12-21.41) at the control sites; mean marginal thickness of the alveolus was 7.75 mm (range: 5.87-9.92) at the transplant and 7.98 mm (range: 6.46-8.86) at control sites. The mean thickness of the alveolus at half of its vertical dimension at the transplant and the control sites was 7.54 mm (range: 4.72-10.98) and 8.03 mm (4.63-9.97), respectively.
CONCLUSIONS: Buccal bone thickness, the width and height of alveolar process at the sites of the transplanted premolars replacing traumatized incisors did not significantly differ from the control sites. Transplanted developing premolars can successfully preserve and regenerate the alveolar process in patients with traumatically lost upper incisors.

034 EVALUATION OF MASTICATORY MUSCLE ACTIVITY IN PATIENTS WITH UNILATERAL POSTERIOR CROSSBITE BEFORE AND AFTER ORTHODONTIC TREATMENT

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AIMS: To detect whether there is an asymmetrical function of the masticatory muscles in subjects with a unilateral posterior crossbite (UPCB) as compared to UPCB-free controls, and whether maxillary expansion could affect the activity of jaw muscles.
SUBJECTS AND METHOD: A cohort of 29 children (mean age 9.7 ± 1.6 years) with UPCB (UPCB group) and 40 children (mean age 10.3 ± 2.4 years) UPCB-free controls (control group). Electromyographic (EMG) activity of the left and right temporalis (AT) and masseter (MM) muscles was recorded during maximum voluntary clenching on cotton rolls and in intercuspal position, and during a set of masticatory tasks. Data were collected in the UPCB group before (T0), immediately after (T1) and 3 months after the UPCB correction (T2), and at one time point in the controls (T0). The analysis of the differential EMG signals provided standardised EMG indices (POC, Tc, Ic%Clench, SMI, ASIM) useful to characterize muscle activity during various tasks. Parametric and non-parametric tests for paired and unpaired data and chi square test were performed to test between and within group differences in EMG parameters.
RESULTS: At T0, no significant differences were found between the two groups for all the standardised EMG indices. UPCB was not associated with a more asymmetrical activity of the jaw muscles (ASIM, P = 0.749). At T1, the overall electrical activity of the muscles in the UPCB group decreased (Ic%clench, T0 = 118%; T1 = 97%; P= 0.043), and a greater asymmetric activity of paired

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muscles was found during mastication (SMI, T0 = 71.7; T1 = 59.4; *P* = 0.044). At T2, data showed a trend toward the values at T0 (Ic%clench T2 = 110.0; SMI T2 = 62.6).
CONCLUSION: Standardised EMG indices depicting jaw muscle asymmetry were not different between UPCB and UPCB-free patients. The treatment of UPCB did not affect the baseline EMG indices of asymmetry in static tasks.

035 PREVALENCE AND MAGNITUDE OF RECESSIONS DURING AND AFTER HERBST-MULTIBRACKET TREATMENT – AN ANALYSIS OF 492 CONSECUTIVE CLASS II DIVISION 1 CASES

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AIM: To assess the prevalence and magnitude of gingival recessions (GR) during and after Herbst-multibracket (Herbst-MB) treatment (Tx) in Class II division 1 patients.
SUBJECTS AND METHOD: All Class II division 1 patients who completed Herbst-MB Tx between 1986 and 2014. Study casts from before Tx, after Herbst-MB Tx and (if available) after at least 24 months of retention were evaluated regarding the prevalence of GR. The evaluated teeth were summarized in six groups: incisors (UI/LI), canines and premolars (UCP/LCP) and molars (UM/LM).
RESULTS: A total of 492 Class II division 1 patients with a mean pre-Tx age of 14.4 years (range: 9.8-44.4) were included. Tx consisted of a Herbst phase (mean 8.1 months) and a subsequent MB phase (mean 16.1 months). Data from ≥24 months of retention (mean 32.6 months) were available for 232 patients. The prevalence for GR >1 mm ranged between 0-0.5 per cent before Tx and between 0.2-1.2 per cent after Herbst-MB. GR >2 mm were not seen. After retention the prevalence of GR >1 mm ranged between 0.0-2.8 per cent and GR >2 mm between 0.0-0.4 per cent. The incidence of recession was neither related to Class II severity nor to skeletal maturity. At all observation times the prevalence was highest for the lower incisors (0.5/1.1/3.2%).
CONCLUSIONS: As a result of Herbst-MB Tx, the prevalence of teeth with GR >1 mm increased from 0.2 per cent before Tx to 1.4 per cent after retention. The highest prevalence of recessions was found for the lower incisors after retention (3.2%).

036 THE IMPACT OF OBESITY ON ORTHODONTIC TOOTH MOVEMENT: A PROSPECTIVE COHORT STUDY

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AIM: Obesity is a widespread chronic inflammatory disorder characterized by an increased overall disease burden and significant association with periodontitis. The aim of this prospective clinical study was to investigate the clinical and biochemical effects of obesity on orthodontic tooth movement with fixed-appliances.
SUBJECTS AND METHOD: Fifty-five patients (27 males, 28 females) mean age 15.1 (SD, 1.7) years and a mean body mass index of 30.2 (3.5) in obese and 19.4 (2.2) kg/m^2 in normal-weight groups were followed from the start of treatment to completion of tooth alignment with fixed-appliances. The primary-outcome was the time taken to complete tooth alignment, whilst secondary outcomes included the rate of tooth movement and change in clinical parameters (plaque/gingival indices, unstimulated whole mouth salivary flow rate and gingival crevicular fluid biomarkers). Data collection took place at the start of treatment; 1 hour and 1 week following appliance placement; and at completion of alignment on placement of a 0.019 × 0.025-inch stainless steel archwire. The results were analyzed with descriptive statistics and generalized estimating equation regression modelling.
RESULTS: Obese patients needed less time to complete tooth alignment compared to those of normal weight (–23.1 days; 95 CI: –65.4, 19.2) but this was non-significant (*P* = 0.284). However, after adjusting for confounders, obese patients had a significantly higher rate of tooth movement compared to those of normal weight (+0.016 mm/day; 95 CI: 0.007, 0.025; *P* < 0.001). Additionally, explorative analyses indicated that levels of the adipokines leptin and resistin, the inflammatory-

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marker myeloperoxidase and the cytokine receptor for nuclear factor kappa-B ligand (RANKL) were significantly different between obese and normal weight patients and associated with the observed rates of tooth movement.
CONCLUSIONS: This investigation provides the first prospective data demonstrating a different response in obese patients compared to subjects of normal weight during orthodontic tooth movement with fixed appliances. These differences in the response of periodontal tissues to orthodontic force in the presence of obesity have potential short and long-term clinical implications.

037 A POTENTIAL ROLE FOR SEMAPHORIN 3A IN THE REGULATION OF ORTHODONTIC TOOTH MOVEMENT

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AIM: Besides various cytokines and growth factors, neuronal guidance molecules (NGM) gained attention for their roles in bone homeostasis and thus potential roles during orthodontic tooth movement (OTM). Among the NGMs recently implicated in the regulation of bone remodelling Semaphorin 3A (SEMA3A) is the most interesting as it concurrently induces osteogenic differentiation in osteoblasts and disturbs osteoclast differentiation. To analyse potential functions of NGM in OTM and to elucidate the underlying mechanisms, the objectives of this study were (i) to investigate if different mechanical forces modulate the expression of SEMA3A and its receptor Neuropilin1 (NRP1) in periodontal fibroblasts and osteoblasts of the alveolar bone, (ii) to investigate the effects of SEMA3A stimulation on alveolar bone osteoblasts differentiation.
MATERIALS AND METHOD: Periodontal fibroblasts and alveolar bone osteoblasts were stimulated mechanically by applying compressive and tensile forces. The expression of SEMA3A and its receptor were analyzed by means of quantitative polymerase chain reaction (qPCR) and Western blot analysis. Moreover, alveolar osteoblasts were stimulated by recombinant human SEMA3A and its impact on osteogenic differentiation was analyzed by monitoring the expression of different osteoblast differentiation markers by qPCR.
RESULTS: While mechanical strain in osteoblasts of the alveolar crest did not significantly alter the expressions of SEMA3A and NRP1, compressive forces significantly reduced SEMA3A and NRP1 expressions. The combination of compression forces and proinflammatory stimuli resulted in a significant reduction of the mRNA expression of SEMA3A and NRP1.
CONCLUSIONS: These data on SEMA3A suggest that the role of NGMs in the regulation of OTM might have been underestimated. Thus, this study might have identified additional cellular and molecular events which might be useful as targets for pharmacological manipulations aiming for a side effect free and accelerated orthodontic tooth movement.

038 VERTICAL AND HORIZONTAL ALVEOLAR BONE CHANGES AROUND MANDIBULAR INCISORS AFTER ORTHODONTIC TOOTH MOVEMENT

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AIM: To evaluate vertical and horizontal alveolar bone changes after orthodontic tooth movement in order to assess if the alveolar envelope limits orthodontic tooth movement.
MATERIALS AND METHOD: Pre- and post-treatment cone beam computed tomography images of 41 adult patients were used to measure alveolar bone width and height changes on the lingual and labial surfaces of mandibular incisors. Width measurements were made at 2.5, 5, 7.5 and 10 mm apical to the cementoenamel junction (CEJ). Height measurements were made from the marginal bone crest to the CEJ. Linear regression was applied to correlate bone changes with a change in the incisor mandibular plane angle, labio-lingual and occluso-gingival movement of the incisal edge and root apex. Regression models to adjust for all parameters and with specific interactions between selected parameters were also applied.
RESULTS: Every 1 degree increase in the incisor mandibular plane angle reduced labial bone width by 0.07 mm (P = 0.009), and increased lingual width by 0.09 mm (P = 0.003) at 2.5 mm apical to the

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CEJ. For 1 mm of labial movement of the incisal tip, bone height decreased by 0.31 mm (P = 0.012) on the labial and by 0.28 mm (P = 0.040) on the lingual. For 1 mm of extrusion of the incisal tip, bone height decreased by 0.50 mm (P = 0.030) on the labial and by 0.24 mm (P = 0.001) on the lingual.
CONCLUSIONS: Alveolar bone width decreased on the labial and increased on the lingual surfaces with incisor proclination. Bone height decreased on the labial and lingual surfaces with incisor advancement and extrusion. Significant changes of the alveolar envelope occurred with orthodontic tooth movement.

039 PIEZO-CORTICISIONS USING A NEW SURGICAL GUIDE: EVALUATION OF PAIN AND REDUCTION OF ORTHODONTIC TREATMENT TIME?

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AIM: To assess the efficiency, the pain and the impact on daily life of orthodontic treatment combined with piezo-corticision surgery (OT-PC) using a novel surgical guide (SG).
MATERIALS AND METHOD: A radiological guide was developed with a vacuum-formed retainer and cones of gutta percha and then converted into a SG after analysis of cone beam computed tomographs. Thirteen adult patients [average of discrepancy index (DI) = 16) were submitted to OT-PC. A quarter of bone incisions were not carried out on the lower incisors due to root proximities. The control group consisted of 13 retrospective patients (average of DI = 9) matched with OT-PC group for age, compliance, non-extraction cases, active self-ligating metallic brackets. For the pain and daily life assessments, a questionnaire using a visual analogue scale (VAS) was used during the first week. A questionnaire of satisfaction was used at the end of the OT-PC. The Shapiro-Wilk test was used to evaluate the normality of distribution. Overall treatment time was analyzed by an independent samples test and the duration of alignment was compared by a Mann-Whitney test.
RESULTS: Treatment time was significantly reduced in the OT-PC group for alignment of upper (52%, P < 0.0001) and lower (33%, P = 0.017) teeth and overall treatment (46%, P < 0.0001) when compared to the control group. The median score pain was low (VAS = 1/10) and temporary (< 5 days) with a median overall consumption of acetaminophen of 3.5 g (1-8.5). Chewing was the function the most affected by OT-PC and resulted in the most disturbed the quality of life. After one week, 92.3 per cent of patients would repeat the surgery. At the end of treatment, all patients were satisfied by OT-PC and they would redo the surgery.
CONCLUSIONS: The OT-PC performed with a novel surgical guide was efficient in reducing the length of treatment while causing minimal post=operative pain. Patient satisfaction with this treatment was high.

040 THE IMPACT OF FORCE MAGNITUDE ON THE EFFECTIVENESS IN CERVICAL HEADGEAR THERAPY – A CEPHALOMETRIC ANALYSIS

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AIM: To study the impact of different force magnitudes on the effectiveness of cervical headgear (HG) therapy.
SUBJECTS AND METHOD: Subjects with a Class II or end-to-end molar relationship in the mixed dentition with moderate crowding to be treated with HG were recruited for the study. Patients were allocated to a light (L, 300 g) or heavy (H, 500 g) force in the HG. The force magnitude was set while the patient was sitting and looking straight forward. The inner bow of the HG was expanded (3-4 mm) and the long outer bow bent upwards 10-20 degrees in relation to the inner bow. Patients were asked to wear HG for 10 hours/day. HG use was controlled and adjusted every 6-8 weeks until the end of the study at 10 months. Adherence to instructions and force magnitude in HG use was

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monitored by a Smartgear (Swissorthodontics, Switzerland) module. Lateral cephalograms were obtained before (T1) and after (T2) treatment, and studied with the modified Pancherz analysis with Planmeca Romexis Ceph module (Planmeca, Finland). The present study is based on 40 children (L group n = 22, H group n = 18, mean age 9.73 ± 0.74 years and 9.88 ± 0.73 years, respectively; 15 male, 25 female). The total number of days monitored was 11344. The Mann-Whitney *U* test was used for statistical analysis

RESULTS: Children in the L group used the HG statistically significantly more than in the H group (10.0 ± 1.5 hours and 8.3 ± 2.1 hours, respectively, $P = 0.002$). The only statistically significant difference in cephalometric analysis was the inclination of upper incisors at T1 ($P = 0.010$) 111.3 ± 6.5 degrees and 105.6 ± 6.4 degrees and at T2 ($P = 0.011$) 114.4 ± 7.5 degrees and 108.3 ± 6.7 degrees in the L and H groups; respectively. In both groups reduction in the SNA was found (L group T1 82.7 ± 3.6°, T2 82.0° SD ±3.5° and H group T1 82.6 ± 4.7°, T2 81.5 ± 4.5°), but no statistically significant difference between the groups.

CONCLUSIONS: Children with a lower force in the HG seem to adhere better to the instructions for HG use. After 10 months use, however, no statistically significant differences were found in the dental or skeletal outcome, but in the H group the outcome was achieved with less daily use.

041 EXAMINATION OF LOW DOSE LASER THERAPY AND PIEZOCISION EFFECTS ON THE RATE OF ORTHODONTIC TOOTH MOVEMENT

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AIM: To examine the effects of piezocision and low dose laser therapy (LDLT) on the rate of orthodontic tooth movement during canine distalization and to compare these application effects with each other.

SUBJECTS AND METHOD: Miniscrew supported canine distalization was performed on a full arch in 20 patients (15 females, 5 males) with a mean age of 16.35 ± 1.14 years. In this split mouth design study, the piezocision was carried out on the mesial and distal attached gingiva of the right maxillary canines and micro-damage with a 3 mm depth was created at cortical bone. The biostimulation was applied to left maxillary canines with a diode laser with a wavelength of 940 nm and energy density of 5 J/cm^2 at 0, 3, 7, 14, 21 and 28th days. The data was evaluated at baseline (T0), and at the first (T1), second (T2) and third (T3) month. Due to the reason that the variables were homogeneous, a paired *t*-test was used to determine the treatment changes within the group and a Student's *t*-test was applied between the groups. One-way ANOVA with repeated measures was used for the comparison of changes in different periods of treatment in each group and the least significant difference test was performed to determine the time period that the differences arose from.

RESULTS: In cephalometric evaluation, statistically significant retrusion ($P < 0.01$) and retraction ($P < 0.001$) occurred in the maxillary incisors in the T0-T3 period. It was also established that the maxillary canines were significantly tipped distally in both groups ($P < 0.001$) but no differences were present between the two groups. Canine distalization in the T0-T1 period was significantly different compared to other periods ($P < 0.001$) and this difference was significantly increased in the LDLT group in comparison with the piezocision group ($P < 0.01$). In other periods, there was no statistically significant difference between the two groups. However, the amount of distalization between the T1-T2 and T2-T3 periods were statistically significant in the LDLT group ($P < 0.05$).

CONCLUSIONS: From the results of this study, both piezocision and LDLT applications could be used for accelerated tooth movement and LDLT could be the method of choice for this purpose.

042 EVALUATION OF THE EFFECTIVENESS OF TWO DIFFERENT TYPES OF SELECTIVE ALVEOLAR DECORTICATIONS ON ORTHODONTIC TOOTH MOVEMENT

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AIM: To evaluate differences between two types of selective alveolar decortications (SAD) during canine retraction after extraction of the upper first premolars.
SUBJECTS AND METHOD: Seventeen patients (mean age, 15 years) with an Angle Class I or II malocclusion with dentoalveolar protrusion or crowding requiring the therapeutic extraction of the upper first premolars, with subsequent retraction of the upper canines. One side of the maxillary arch was randomly chosen for treatment with perforations (PS) and the other side for treatment with vertical cuts (VCS). Canine retraction was initiated after levelling via closed nickel titanium coil springs applying a force of 150 g on a continuous 0.016 × 0.022 inch stainless steel archwire using miniscrews as anchorage. The rate of tooth movement, molar mesial movement, canine rotation and canine intrusion were evaluated on plaster models obtained before the start of canine retraction and at the first, second and third months (T0, T1, T2, T3 respectively) using the 3Shape orthoanalyzer programme. The patients were also observed for scar tissue. Data were evaluated statistically using a paired *t*-test and Wilcoxon's signed rank test.
RESULTS: The mean retraction rate was 1.03 and 1.12 mm/1 month with VCS and PS, respectively. The amount of canine retraction, intrusion, rotation, and molar mesial movement were not statistically significantly different between PS and VCS at any time period. With VCS the amount of canine retraction was significantly ($P = 0.006$) higher at T0-T1 than at T2-T3. No significant difference was found between T0-T1 and T2-T3 at PS for this measurement. Scar tissue was observed in 67 per cent of the patients on both sides.
CONCLUSIONS: The two methods of SAD revealed similar results regarding the rate of canine movement, canine rotation and molar anchorage loss. The rate of tooth movement was not different from the rates previously reported for conventional canine retraction.

043 EVALUATION OF CORTICOTOMY-ASSISTED POSTERIOR MAXILLARY INTRUSION WITH ZYGOMATIC ANCHORAGE: A FINITE ELEMENT STRESS ANALYSIS
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AIM: To evaluate the effects of different corticotomy techniques in posterior maxillary intrusion supported by zygomatic anchorage, by means of finite element stress analysis.
MATERIALS AND METHOD: Three different scenarios were established on the hypothesis that, subapical corticotomies could benefit tooth movement. The first scenario comprised no corticotomy, the second included buccal corticotomy, and the third involved both buccal and palatal corticotomies. An acrylic appliance covering all maxillary posterior teeth and two rigid transpalatal bars were built up, then an intrusive force of 200 g was applied from the appliance towards the miniplate located at the zygomatic buttress, and the stress levels were evaluated.
RESULTS: Posterior teeth and the inferior curvature of the zygomatic buttress had the highest stress values in all scenarios. Increased stress values were observed on the spongious bone mostly on the buccal surface, beneath the corticotomy regions. Dental structures showed increased stress values mainly at the apical region of the first molar mesiobuccal root, indicating no significant difference between scenarios.
CONCLUSIONS: Conclusively, corticotomies may enable clinicians to achieve accelerated bone-turnover, revealed by the increased stress values in the spongious bone. In this respect, performing a buccal corticotomy might be sufficient instead of buccal and palatal corticotomy due to less surgical procedures. Despite corticotomy assistance, appliance designs and force application should be taken into account during posterior maxillary intrusion.

044 CORTICOTOMY OF THE BUCCAL AND LINGUAL ALVEOLAR WALLS AND ITS INFLUENCE ON ORTHODONTIC TOOTH DISPLACEMENT USING A FINITE ELEMENT ANALYSIS
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AIM: Corticotomies are considered to accelerate orthodontic tooth movement. Whether the induced local trauma affects the load transfer from orthodontic appliance on the alveolar wall is not

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yet known. This study assessed the amount and type of tooth displacement of a human central and lower lateral incisor while simulating corticotomy of either the buccal or lingual alveolar wall.
MATERIALS AND METHOD: A finite element model based on a microcomputed tomographic scan of a human lower jaw segment, containing a central and lateral incisor, was developed. Corticotomy was simulated by decreasing the bone density values either on the buccal or lingual alveolar walls of either the central or lateral incisor. A control model with no corticotomy was generated. Different moment-to-force (M/F) ratios were analysed in the bucco-lingual direction in order to achieve various tooth movements: controlled and uncontrolled tipping, translation and root torque. The location of the centres of rotation and their associated types of tooth displacement in the aforementioned five simulations were analysed.
RESULTS: All analyses showed larger tooth displacements in the corticotomized models compared to the control model. The M/F ratio associated with translation increased in the corticotomized models. Finally, the presence of a corticotomy at either the buccal or lingual alveolar wall of a given tooth did not influence the load transfer and type of tooth displacement of its neighbouring teeth.
CONCLUSIONS: Following corticotomy the expected tooth movement changes were compared to the untreated situation and, in particular, not only the amount, but also the type of tooth movement changes. Therefore, the classical displacement of the centre of rotation described by Burstone and Pryputniewicz cannot be expected under circumstances where bone density is locally decreased, as after corticotomies. Clinicians applying corticotomies should thus be aware of these changes.

045 THE 0.018 OR 0.022 INCH SLOT BRACKET SYSTEM? PRELIMINARY RESULTS FROM AN ENROLLED CLINICAL TRIAL

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AIM: To compare, in a randomised clinical trial, the effectiveness of orthodontic treatment with the 0.018 and 0.022 inch slot bracket systems. The primary objective was to compare treatment duration and the secondary to compare (1) the quality of treatment as measured by the American Board of Orthodontics-Case Report-Evaluation ABO-CR-Eval), the Peer Assessment Rating (PAR) scores, incisor inclination, and patient perception; and (2) the adverse effect of treatment as evaluated by the amount of maxillary incisor root resorption after 9 months from the start of treatment.
SUBJECTS AND METHOD: A multicentre prospective randomised clinical trial was carried out in Scotland. One hundred and ninety-eight participants with different types of malocclusion aged 12 years or over were randomly allocated to treatment with the 0.018 or 0.022 inch slot MBT appliance (3M-Unitek, Monrovia, California, USA). The treatment and archwire sequence were standardised and data were collected at the start and end of treatment. Treatment outcome measures included: (1) duration of treatment (2) number of appointments and other treatment-related factors (3) ABO-CR-Eval (4) PAR scores and percentage PAR score reduction (5) incisor inclination (6) patient perception using the Aesthetic Component of the Index of Orthodontic Treatment Need and three questionnaires for patient perception before, during and after treatment and (7) root resorption. Parametric tests (independent samples *t*-test and two-way ANOVA) and non-parametric tests (Chi-square with Fisher's exact tests and Mann-Whitney *U*-test) assessed any differences between the groups ($P < 0.05$).
RESULTS: The total number of patients with complete data was 153 (mean age: 19.1 years). The baseline characteristics were similar between groups. The mean duration of treatment for the 0.018 and 0.022 inch slot groups was 29.3 and 31.2 months, respectively. Patient perception of aesthetics improved as well as incisor root resorption occurred in both groups ($P < 0.05$). However, there were no statistically significant differences between the two treatment groups in terms of treatment duration, number of appointments, quality of occlusal outcome, patient perception of treatment, and incisor root resorption ($P > 0.05$).
CONCLUSIONS: There were no statistically significant differences in treatment duration, occlusal outcome, patient perception or root resorption with either the 0.018 or 0.022 inch slot MBT appliance.

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046 OUTCOME OF ORTHODONTIC TREATMENT SIMULTANEOUS TO OR AFTER PERIODONTAL CAUSE RELATED TREATMENT IN PERIODONTALLY COMPROMISED PATIENTS

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AIM: Orthodontic treatment in periodontally compromised patients is controversial and lacking scientific evidence. The aim of the present study was to compare two treatment strategies regarding the effect of orthodontic tooth movement on periodontal status in patients with periodontally compromised dentitions.

SUBJECTS AND METHOD: A randomized, parallel, prospective clinical study was performed from 2010 to 2016 in the Lithuanian University of Health Sciences and two private clinics in Kaunas, Lithuania. Fifty periodontally compromised patients (15 men 35 women) were enrolled and randomly assigned to a test or control group according to periodontal treatment timing. Inclusion criteria were: >25 years, good general health, a minimum of six anterior teeth present, periodontitis experience and general marginal bone loss. All patients received oral hygiene instruction and supra- and sub-gingival debridement by ultrasonic instrumentation supplemented with hand instruments following baseline examination. Control group patients received cause-related periodontal treatment before the start of orthodontic treatment. Periodontal treatment for test group was performed simultaneously to treatment with fixed orthodontic appliances. Orthodontic treatment with conventional straightwire mechanics was performed for all patients in the study. Changes in periodontal status at baseline and before and after orthodontic treatment were compared between the test and control groups. The primary outcome variable was the change in percentage of sites with a clinical attachment level ≥4 mm. Statistical analyses to compare the two independent groups were conducted using the non-parametric Mann-Whitney *U* test.

RESULTS: No difference between the test [median 23.2%, interquartile (IQR) = 12.7% of sites] and control (median 25.0%, IQR = 12.6% of sites) groups was found in the median percentage of sites with clinical attachment level (CAL) gain. A significant difference was found in the median percentage of sites that changed to the lower disease group of pocket depth after the whole periodontal-orthodontic treatment between the test (25.0%, IQR = 19.8%) and control (36.4%, IQR = 26.3%) groups ($P < 0.05$). Total periodontal-orthodontic treatment duration was significantly longer for the control group, mean difference 4.05 ± 1.59 months ($P < 0.01$).

CONCLUSIONS: Both groups showed gain of CAL and reduction of sites with a pocket depth of more than 4 mm. Total periodontal-orthodontic treatment time was significantly longer for the control group.

Scientific Posters

047 WNT10A MUTATION RESULTS IN SEVERE TOOTH AGENESIS IN A FAMILY OF THREE SISTERS

Mushriq Abid, Paul Sharpe, Martyn Cobourne, King's College London, U.K.

AIM: To identify the causal gene mutation(s) for patients with severe tooth agenesis.

SUBJECTS AND METHOD: A family of three sisters diagnosed clinically and radiographically with severe hypodontia. DNA was extracted and sequenced using whole exome sequencing looking for candidate gene responsible for this anomaly.

RESULTS: A nonsense heterozygous mutation in WNT10A gene (RS121908119) (exon2, c.C321A: p.C107X) was found.

CONCLUSIONS: It is concluded that this mutation is responsible for the severe tooth agenesis in this family by creating a stop codon and truncating the amino acid sequence causing loss of function. Mutation in this gene has been strongly associated with different types of syndromic and non-syndromic. Especially those with ectodermal dysplasia, this family has no sign of ectodermal dysplasia.

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048 EVALUATION OF ORTHODONTIC MINI-IMPLANT STABILITY USING RESONANCE FREQUENCY ANALYSIS: A HUMAN CLINICAL TRIAL

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AIM: To evaluate the change in the stability of orthodontic mini-implants over time.
SUBJECTS AND METHOD: Fifteen orthodontic mini-implants were inserted in one side of the maxillary arches of 15 adults who required therapeutic extraction of the maxillary first premolar and maximum anchorage in canine retraction. The mini-implants were immediately loaded with force of 150 g. Mini-implant stability was measured with resonance frequency analysis 0, 1, 2, 3, 4, 6, 8 and 10 weeks after placement. Data was gathered and statistically analyzed using repeated measures ANOVA followed by Tukey's *post-hoc* test to study the changes over time.
RESULTS: Clinically the success rate was approximately 78.5 per cent. The stability of mini-implants showed a statistically significant decrease in weeks 2 and 3 ($P < 0.05$).
CONCLUSIONS: The second and third weeks of mini-implant loading could be considered as a critical period in the healing stage of orthodontic mini-implants.

049 PREVALENCE OF DENTAL ANOMALIES IN PATIENTS WITH IMPACTED MAXILLARY AND MANDIBULAR CANINES‡‡‡

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AIM: To assess the prevalence of dental anomalies in orthodontic patients with impacted maxillary and mandibular canines compared to orthodontic patients without canine impaction.
MATERIALS AND METHOD: Panoramic radiographs of 102 patients with canine impactions (70 maxillary, 32 mandibular) were assessed for the presence of peg-shaped lateral incisors, tooth agenesis, supernumerary teeth, tooth transposition and canine transmigration. A group of 117 orthodontic patients matched for age and gender served as the controls. Patients with impactions in both the maxilla and the mandible were not included.
RESULTS: The mean age in the maxillary canine impaction group (UCI) was 20.6 years (SD: 10.32) and in the mandibular canine impaction group (LCI) 15.2 years (SD: 9.3). No difference in gender between patient groups was present ($P = 0.17$). The prevalence of all types of tooth agenesis was significantly higher in the UCI group compared to the LCI group [OR = 3.03, 95% CI: 1.04, 10.18, $P = 0.04$]. The prevalence of supernumerary teeth [OR = 0.13, 95% CI: 0.012, 0.79, $P = 0.02$] and transmigration [OR = 0.05, 95% CI: 0, 0.34, $P = 0.001$] was significantly higher in the LCI group compared to the UCI group. The prevalence of second premolars agenesis [OR = 3.95, 95% CI: 0.49, 183.12, $P = 0.32$] and peg-shaped maxillary lateral incisors (OR = 5.11, 95% CI: 0.67, 231.33, $P = 0.17$] was higher in the UCI group compared to the LCI group. Patients with UCI had a significantly higher prevalence of tooth agenesis [OR = 2.13, 95% CI: 1.16, 3.94; $P = 0.015$] and transpositions [OR = 9.79, 95% CI: 1.27, 441.74, $P = 0.02$] compared to the control group.
CONCLUSIONS: Different patterns of dental anomalies were present in the UCI and LCI groups. Agenesis of all teeth and peg-shaped lateral maxillary incisors were associated with maxillary canine impaction and supernumerary teeth and canine transmigration with mandibular canine impaction. Presence of dental anomalies can be an additional diagnostic tool in the early detection of canine impaction.

050 PATIENT REPORTED EXPERIENCE WITH ORTHODONTIC-ORTHOGNATHIC TREATMENT IN NORTH YORKSHIRE

Kulraj Achal, Jay Kindelan, Department of Orthodontics, York Hospital, U.K.

AIM: To assess patient experience with elective orthognathic surgery and to determine if the reporting of better experiences by elective orthognathic surgical patients was associated with better outcomes.

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SUBJECTS AND METHOD: This prospective audit was carried out within the orthodontic department at York Hospital from February 2013 to November 2016. Patients who had completed their orthognathic treatment within the last two years were invited to participate. Standards for an audit were set as: 90 per cent or more of patients receiving orthognathic treatment had a good experience during their treatment (PREMs) and 90 per cent or more were satisfied with the outcome (PROMs). The questionnaire aimed to record demographic data, reasons for treatment, information provided by clinicians, benefits of treatment, satisfaction with surgical-orthodontic treatment and their experience during their journey. An electronic platform (Survey Monkey™) was chosen for distribution of the questionnaire.
RESULTS: A total of 88 patients (36 males, 52 females) completed the on-line survey. Thirty five per cent (n = 31) were aged between 18 and 29 years and 42 per cent were between 21-29 years. The majority of surgical procedures were bimaxillary osteotomies (79.6% n = 70). Eighty seven patients (98.9%) felt the specialist listened to them and gave them enough time to fully discuss their treatment. In addition a similar number felt the specialist explained the reasons for treatment in a way that they could understand. The operation date was rescheduled by the hospital for 20.7 per cent (n = 18). Eighty six subjects (97.73%) received information about their treatment although 2.30 per cent (n = 2) did not find it useful. This service would be recommended to family and friends for treatment by 93.2 per cent (n = 82).
CONCLUSIONS: The 'gold standard' target for patient satisfaction was met. Overall the PREMS demonstrated a high quality of orthognathic service provided in North Yorkshire. It was difficult to correlate PREMS with treatment outcomes PROMS as only one patient was dissatisfied with the overall outcome. It was not surprising that the same patient was dissatisfied with their experience. Most comments by patients showed that good communication with the specialist improved their overall understanding and hence experience.

051 REGIONAL PROSPECTIVE AUDIT OF ORTHODONTIC MOLAR BOND AND MOLAR BAND FAILURE RATES IN NORTH YORKSHIRE, UK

Kulraj Achal[1], Samuel Anthony[2], Zararna Nelson-Moon[1], Departments of [1]Orthodontics and [2]Oral and Maxillofacial Surgery, York Teaching Hospitals NHS Trust, U.K.

AIM: To assess molar bracket failure rate (debond) and molar band failure rate following placement of fixed orthodontic appliances in the North Yorkshire region of the United Kingdom.
MATERIALS AND METHOD: Standards for the audit were based on a previous study, Gillgrass *et al.,* 2013. Therefore, the 'gold standard' for failure of bonded molar attachments was set at 18 per cent and banded molar attachments at 26.3%. This prospective audit was carried out within the orthodontic departments in the North Yorkshire hospitals (York, Harrogate and Scarborough). All new patients provided with fixed appliances were included. Details of bonding method and individual debonds were noted along with demographic data and malocclusion. Data was collected using an electronic platform – a data collection proforma was developed on Survey Monkey™. Clinicians were asked to make a note of all debonds during treatment and to assess reasons for debond and method of rebonding or rebanding. The audit also assessed the variation in practice between different grades of clinician.
RESULTS: A total of 465 bonds and 137 bands were placed on the first molars with 91 bonds and 18 bands placed on the second molars. Total first molar bond failure rate was 4 per cent whereas the band failure rate was 2 per cent. For second molars, bands had a higher failure rate of 20 per cent whereas bond failure rate was 3 per cent. Consultants had the lowest failure rate (5%), whilst dentists with a special interest had the highest failure rate (32%). Higher failure numbers were seen in reduced and average facial proportions (26%). In patients with increased facial proportions the bond failure percentage was 12 per cent. Finally band failures were found only in patients with reduced facial proportions (12%).
CONCLUSIONS: The gold standard was achieved for both bands and bonds. There were a significantly low number of failures. The failure rates were low in comparison to previous published studies. The number of failures doubled in reduced and average facial proportions compared to

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those with increased facial proportions. Consideration should be taken to using molar bands when selecting molar attachments in patients with reduced facial proportions

052 PREDICTION OF MAXILLARY INCISORS ROOT RESORPTION ASSOCIATED WITH PALATALLY DISPLACED MAXILLARY CANINES USING DISCRIMINANT FUNCTION ANALYSIS

Asma Al Emam, Elham Abu Alhaija, Jordan University of Science and Technology, Irbid, Jordan

AIM: Incisor root resorption (IRR) associated with palatally displaced canines (PDC) is an important phenomenon that might alter the orthodontic treatment plan. The aim of this study was to identify predictors for IRR-PDCs.

MATERIALS AND METHOD: Cone-beam computed tomography (CBCT) images of 82 patients with 107 PDCs were analysed for the presence of IRR. The PDC sample was then divided into those showing IRR (80 canines) and those with no IRR (27 canines). IRR prediction in PDC subjects was performed using discriminant function analysis. The variables studied were canine follicle size, canine position horizontally and vertically, lateral incisor and canine angulation and inclination, overlap between canine and lateral incisors, associated dental anomalies, presence of peg-shaped lateral incisors, space available in the dental arch, dental arch width, and distance of the upper first molar and upper canine to the pterygoid vertical plane.

RESULTS: Stepwise analysis using CBCT records produced a discriminant function based on three variables. The function was statistically significant at $P < 0.001$. The constant and discriminant function coefficients were –1.886, 2.527, –0.903 and 0.325, respectively. The variables contributing to the prediction equation were canine contact with adjacent incisors, presence of a peg-shaped lateral and the size of canine dental follicle. The analysis correctly predicted the outcome in 83 per cent of subjects. The discriminant function equation derived from the original sample was applied to a fresh sample of 10 PDC. The data for each patient were entered into the equation. A positive discriminant score indicated predicted membership of PDC-IRR group. Correct prediction occurred in 100 per cent of the sample.

CONCLUSIONS: Excellent predictive discrimination between PDC subjects who will experience IRR emerges using discriminant function analysis.

053 CAREER SATISFACTION AND WORK-LIFE BALANCE IN ORTHODONTICS

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AIMS: To investigate factors affecting career satisfaction and work-life balance in specialist orthodontists in the United Kingdom/Republic of Ireland.

SUBJECTS AND METHOD: This was a prospective questionnaire-based study. The questionnaire was sent to all specialist orthodontists who were members of the British Orthodontic Society. Simple descriptive statistics were used to describe the demographics and work related information of the respondents. Multiple regression analyses were used to investigate the potential impact of the various factors explored in the questionnaire on career satisfaction and work-life balance.

RESULTS: Orthodontists reported high levels of career satisfaction (median score 90 out of 100). Career satisfaction was significantly higher in those who showed: i) satisfaction with current working hours ii) satisfaction with the level of control over their working day iii) ability to manage unexpected home events and iv) confidence in how readily they managed patient expectations. The work-life balance score was lower than the career satisfaction score but was still relatively high with a median score of 75 out of 100. Work-life balance scores were significantly affected by the same four factors but also by satisfaction with current working patterns and were higher in those who worked part-time compared with those who worked full-time.

CONCLUSION: Orthodontists in this study were highly satisfied with their career and the majority said they would choose their career again. Work-life balance scores were lower than the career satisfaction score but were still relatively high. It remains important that the profession considers certain measures in order to maintain or improve career satisfaction and work-life balance and in order to continue to recruit to the profession; this includes continuing to maintain flexibility of

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working hours and providing training in management of patient expectations through educational courses, continuing professional development or mentoring.

054 USE OF PERSONAL PROTECTIVE EQUIPMENT IN AN ORTHODONTIC DEPARTMENT: AN AUDIT

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AIM: The correct use of personal protective equipment (PPE) and appropriate clothing is essential for safe clinical practice. PPE consists of: tunic, bare below elbows, appropriate footwear, long hair tied back, no jewellery, masks, gloves and eye protection (clinician and patient). The aims of this prospective study were to identify if staff of the orthodontic department were compliant with the trust policy of the University College London Hospital on PPE during clinical sessions and what areas of PPE staff are least compliant with.
MATERIALS AND METHOD: A prospective audit carried out for a 2 week period in January 2015 and a second cycle in a 2 week period in October 2015 in the orthodontic department at the Eastman Dental Hospital (EDH). The gold standard was: all members of staff were 100 per cent compliant with trust policy on PPE.
RESULTS: First cycle: 100 per cent compliance was achieved in all areas except for the use of masks (50.2%), and clinician's eye protection (46.4%). The least compliant groups were the student nurses followed by the Fixed Term Training Appointment group. Intervention: 1. The importance of compliance with the infection control policy and PPE was reinforced through a lecture given to all orthodontic staff. 2. A separate lecture was given to student nurses on PPE. Second cycle: compliance improved in all groups with the least compliant group being student nurses. One hundred per cent compliance was again achieved in all areas except masks and clinician eye protection being slightly less than 100 per cent.
CONCLUSIONS: The use of PPE in the clinical environment is important for the safety of members of staff and patients. A laminated 'aide memoire' sheet of PPE requirements was produced and distributed in all kits at the orthodontic department at EDH and it was recommended to re-audit in a year after implementation of this advice.

055 MICROGNATHIA IN CILIOPATHIC MODELS

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AIM: Defects in development of the mandible can lead to micrognathia, or a small jaw, which manifests in ciliopathic conditions such as orofaciodigital, Meckel-Gruber and Bardet-Biedl syndrome. Although micrognathia occurs frequently in human and mouse ciliopathies, it has been difficult to pinpoint the underlying cellular causes. The aim of this presentation is to shed light on the tissue specific contributions to ciliary dysfunction in the development of the mandible.
MATERIALS AND METHOD: Two ciliopathic mouse models: fuzzy (Fuz) and oral-facial-digital type 1 (Ofd1) were used to investigate bone and cartilage development in the mandible and alcian blue and alizarin red staining to measure and follow the developing Meckel's cartilage and mandible. The Student's *t*-test was used to analyze the parameters. mRNA *in situ* hybridization for multiple markers, to analyze the underlying signalling and micromass and quantitative polymerase chain reaction essays to investigate chondrogenic and osteogenic mechanisms.
RESULTS: The data suggests that micrognathia in ciliopathic models arises early in embryogenesis, during the initiation of the chondrogenic condensations. Positioning of the condensations occurs as a result of multiple intersecting signalling pathways (such as the hedgehog gene, fibroblast growth factor). When this 'map' is perturbed, the condensations are incorrectly placed, leading to pathological conditions. Moreover, multiple cell population influences Meckel's cartilage size and pattern. Cranial neural crest cells (CNCC) are the major player in the development of micrognathia in OFD1.
CONCLUSIONS: CNCC are the major contributor for the development of OFDS1 oral and facial phenotypes including micrognathia. Expansion of mid-face markers results in the characteristic

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widening phenotype (hypertelorism and palatal malformations). The findings highlight the usefulness of the Ofd1 mouse model.

056 CORRELATION BETWEEN OCCLUSION AND BODY POSTURE IN YOUNG MEN

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AIM: Connections between body posture and the craniomandibular system (CMS) are controversially discussed in the current literature. Therefore, the aim of the present study was to investigate correlations between statics of the upper body and the CMS.
SUBJECTS AND METHOD: One hundred and two male subjects with an average age of 25.4 ± 3.6 years (18-35 years). Upper body statics were recorded using a three-dimensional back scanner (Backmapper, ABW GmbH, Frickenhausen, Germany). Based on plaster models, a model analysis was performed. Upper body statics were recorded in the physiologic rest position by symmetrical locking of the premolar region with cotton rolls. Statistical data analysis was performed with non-parametric tests due to non-normal distribution of the data. All *P*-values were then subjected to Bonferroni correction. The significance level was 5 per cent.
RESULTS: Inhibition of the occlusion resulted in a significant reduction in the scapula distance ($P \leq 0.001$), an increase in the thoracic bend angle ($P \leq 0.001$) and an increase in the kyphosis angle ($P \leq 0.001$) compared to the rest position. Comparison of the three Angle classes revealed no statistically detectable differences. Differences in the backscan parameters for subjects with/without a crossbite were not demonstrated. The centreline displacement comparison (left/none/right) showed a significance difference between left and right ($P \leq 0.04$) and no and right ($P \leq 0.001$) for maximum lateral deviation of the vertebral column.
CONCLUSIONS: The results show a measurable influence of occlusal parameters on the statics of the upper part of the body and on the upper region. Especially the induced non-occlusion had a demonstrable effect on upper body stance.

057 EFFECTS OF THE FLASH-FREE BONDING TECHNIQUE ON PLAQUE RETENTION AND DEVELOPMENT OF WHITE SPOT LESIONS: A RANDOMIZED CLINICAL TRIAL

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AIM: To compare the effects of flash-free (FF) and conventional bonding techniques of orthodontic brackets on plaque formation and retention, and white spot lesion (WSL) development *in vivo.*
SUBJECTS AND METHOD: The maxillary incisors of 20 randomly selected patients were used. Plaque samples were collected from around orthodontic appliances after bonding and analyzed using ATP-driven bioluminescence; the enamel surfaces of the maxillary incisors were scanned using the Canary System™ to evaluate WSL development, and the number of spontaneous debonding brackets were counted in the first 6 months of treatment.
RESULTS: No significant differences were found in plaque formation and retention between brackets bonded using the FF technique and those bonded using the conventional technique. No significant difference in WSL development was observed around the brackets using either technique during the same study period; however, demineralization of enamel surfaces was seen on the mesiofacial and distofacial surfaces of the maxillary incisors. Failure rates of 5.26 and 0 per cent were observed for brackets bonded using the FF and conventional techniques, respectively, during the first 6 months of orthodontic treatment.
CONCLUSIONS: Mesiofacial and distofacial surfaces of maxillary incisors are more susceptible to demineralization, but the presence or absence of excessive adhesive (flash) around orthodontic brackets may not play a significant role in plaque retention and WSL development in patients during the first 6 months of orthodontic treatment with fixed appliances. Furthermore, FF brackets may fail

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more often than conventional brackets during the first 6 months of orthodontic treatment with fixed appliances.

058 EVALUATION OF CRANIOFACIAL SYMMETRY AND GROWTH/TREATMENT CHANGES IN HEMIFACIAL MICROSOMIA PATIENTS BY CONE BEAM COMPUTED TOMOGRAPHY

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AIM: Hemifacial microsomia (HFM) is a congenital anomaly. The aim of this study was to assess and describe the initial asymmetry of hard tissues and changes on the affected and non-affected sides during treatment with functional distraction splints.
SUBJECTS AND METHOD: Sixteen HFM patients in the age range of 5 to 15 years were diagnosed and classified according to the Pruzansky/Kaban classification as types I, IIa and IIb. Treatment started with an individually constructed distraction splint that allowed the patient to stretch the affected side and have an occlusion throughout the course of treatment. Cone beam computed tomography (CBCT) scans were taken during the course of treatment and the existing material was analyzed. The images were converted from DICOM format into three-dimensional visualization software for analysis (Mimics). For each patient hard tissue measurements were performed on the initial and last available CBCT scan. Hard tissue landmarks were identified, reference planes were defined and constructed and the degree of asymmetry of affected versus non-affected side was assessed. Intra-observer reliability was assessed based on double measurements and systematic error was determined based on the Method of Moments.
RESULTS: Cranial base angle, width and depth as defined by the mastoid process and reference planes were in different positions on the affected and non-affected sides. Nasomaxillary length showed an improvement during treatment on the affected and non-affected sides. Gonial angle length and width showed changes that were not statistically significant. Temporomandibular position, width and depth grew slower on the affected side.
CONCLUSIONS: The cranial base measurements reflect natural growth-related changes. The maxillary measurements showed an increase of the middle third of the face, with a correction to the cant of the occlusal plane. The mandibular measurements showed variation between the affected and non-affected sides during the course of treatment. These results suggest that many factors are involved and have a significant role in affecting the treatment, outcome and growth rate of the mandible, maxilla and craniofacial region in patients with varying severities of HFM.

059 EVALUATION OF MATERIAL RELATED-STRESS DISTRIBUTION OF ORTHODONTIC MINI-IMPLANTS

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AIM: To test with finite element analyses (FEA) the stress release of three different orthodontic mini-implants (OMI). The null hypothesis of this study was that titanium-zirconium (Ti-Zr) based OMI causes less stress.
MATERIALS AND METHOD: Three different material-based OMI, were tested: Ti6Al4V, Ti-Zr and Zr based OMI. The dimensions of the OMI were: length: 8 mm, diameter: 1.6 mm.
RESULTS: The least stress was distributed by TiZr, followed by Zr and Ti6Al4V OMI. The null hypothesis was accepted
CONCLUSIONS: The null hypothesis is accepted. This appears to be the first study to biomechanically compare three different types of OMI materials. There is a need for clinical investigations.

060 LINEAR AND TORQUE CHANGES OF TRANSVERSE DIMENSION IN A SAMPLE OF PATIENTS TREATED WITH PASSIVE SELF-LIGATING FIXED APPLIANCE

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AIM: To measure, in a controlled study, the maxillary and mandibular dental arch widths and torque changes after treatment with a passive self-ligating appliance.
SUBJECTS AND METHOD: From a sample group of 10 patients (mean initial age 12.9 years), a total of 40 arches (maxillary and mandibular, before and after treatment, mean time 1.6 years), was examined with three-dimensional software to evaluate the differences in torque values, transverse arch dimensions and arch perimeters. Seventy-four landmarks were placed on every virtual model. Linear and angular measurements were then calculated. A paired t-test ($P < 0.05$) was used to determine the differences in the measurements before and after treatment.
RESULTS: The differences between the arches before and after treatment showed a general increment of arch width, especially for the upper second premolars (4.4 mm on average) and for the upper first premolars which had the greatest transverse expansion (4.7 mm on average). The increase of the transverse diameters was associated with a significant positive torque gain, that was recorded at the first premolars (7.3° lower and 6,7° upper), and moreover for the lower canines and for the lower second molars (10.5° and 9.8°, respectively). The stability of arch depth was associated with a slight increase in torque at the central incisors (2.2° upper and 2.9° lower). A significant increase of the arch perimeters (2.3 mm maxillary, 4.2 mm mandibular) was also detected.
CONCLUSIONS: Transverse arch dimensions, along with the torque values, increased significantly after treatment with the passive self-ligating appliance. The arch perimeters were also increased.

061 A NOVEL ORTHODONTIC BRACKET BONDING ADHESIVE FOR PREVENTION OF ENAMEL DEMINERALISATION DURING ORTHODONTIC TREATMENT

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AIM: To investigate a novel orthodontic adhesive for its potential to release therapeutic ions, increase the pH and prevent the demineralisation of enamel around orthodontic brackets.
MATERIALS AND METHOD: A light cured adhesive made from a melt derived, fluoride containing, bioactive glass (BAG) and a resin (BisEMA and TEGDMA) was characterised for its release of ions following immersion in demineralising artificial saliva pH = 4 (AS4) and remineralising artificial saliva pH = 7 (AS7). Cured adhesive disks (n = 30) with a diameter of 10 mm and a thickness of 1 mm were immersed in 10 ml of the solution at 10 time points (6 hours-6 months). The resulting solution was investigated using a pH meter, ion selective electrode for F-detection and inductively coupled plasma optical emission spectroscopy for Ca^{2+} and PO_4^{3-} detection. Orthodontic brackets were bonded on premolar teeth using either the BAG adhesive or Transbond™ XT (3M Unitek) as a control. The teeth with the brackets were immersed individually in AS4 for 24 hours. The teeth with the brackets were scanned using X-ray microtomography (XMT) before and after acid treatment and the resultant scans were reconstructed and subtracted images were obtained.
RESULTS: The adhesive disks released F- 4-10 ppm in AS4 and 1-15 ppm in AS7 along the immersion time points. The cumulative fluoride release in AS4 was higher than in AS7. The disks also released 150-450 ppm and 130-160 ppm Ca^{2+} in AS4 and AS7, respectively and 1-10 ppm PO_4^{3-} in both solutions during the immersion period. The adhesive disks raised the pH of the AS4 solution to 6.8 from the original value of 4. XMT images revealed that the BAG composite used in this study resulted in a significantly lower demineralisation of the enamel around the brackets compared to the control Transbond™ XT, which demonstrated a substantially wide radiolucency on the enamel surfaces surrounding the bracket with a significant difference in the values of the linear attenuation coefficient.
CONCLUSIONS: This novel BAG composite is potentially a successful candidate as an orthodontic bonding adhesive to prevent white spot lesion development during fixed appliance therapy.

062 EFFECT OF ORTHODONTIC FORCE ON SALIVARY LEVELS OF LACTATE DEHYDROGENASE ENZYME

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AIM: To evaluate the activity of the lactate dehydrogenase (LDH) in saliva during orthodontic tooth movement using different magnitudes of continuous orthodontic force.
SUBJECTS AND METHOD: Thirty orthodontic patients (12 males, 18 females) aged 17-23 years with a Class II division I malocclusion all requiring bilateral maxillary first premolar extractions. The patients were randomly divided into three groups according to the magnitude of the force application (40, 60 and 80 g). A sectional fixed appliance was bonded and designed to give labial force to the maxillary first premolar for 3 weeks. Unstimulated saliva was collected from the patients before force application, then 1 hour after force application, followed by 1, 7, 14 and 21 days. Salivary levels of LDH were measured using a spectrophotometer and compared with the baseline level.
RESULTS: LDH enzyme level increased with increasing magnitude of orthodontic force (from 40 to 80 g). This was statistically significant after 1 hour, 1, 7, 14 and 21 days of force application. The LDH significantly increased from baseline after 1 hour and peaked at 21 days for all three force levels.
CONCLUSIONS: The LDH level reflects the biological activity that takes place in the periodontium during orthodontic tooth movement, and therefore it can be used as a diagnostic tool for monitoring correct orthodontic tooth movement in clinical practice.

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063 ASSESSMENT OF THE DISCOLOURATION OF CLEAR ELASTOMERIC LIGATURES: AN *IN VITRO* COMPARATIVE STUDY

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AIM: To evaluate the discolouration of clear elastomeric ligatures from four manufacturers (Ortho Technology, Morelli, Ortho Organizer, and Ormco) exposed to the oral environment for 4 weeks.
MATERIALS AND METHOD: A total of 240 elastomeric modules were examined, 60 modules of each brand. Each of 60 patients enrolled in the study, received four elastomeric modules on the four lower incisors, one of each brand. The specimens were placed and collected after 1, 2 and 4 weeks. After removal each module was kept in a sealed plastic bag and prepared for imaging and colour measurement, which were made before and after use of the specimens. Images were taken using a cellular attachable microscope connected to mobile phone with a special Jcam program and the colour changes were calculated according to the CIE L*a*b* colour spaces system using the Adobe Photoshop program. The resulting data were statistically analyzed using ANOVA, least significance difference and Chi square tests.
RESULTS: All the elastomeric ligatures discoloured after use. The discolouration increased with the increased incubation period in the mouth reaching a peak at the 4-week interval. The yellowness index was the most affected colour component. Morelli elastomeric ligatures were the most prone to discolouration, while Ortho Organizers and Ormco ligatures were the least prone to discolouration, with the presence of large individual variation.
CONCLUSIONS: It is necessary to alert the patient about the colour changes of clear ligatures and the staining effect of certain foods. The orthodontist should select brands that are more resistant to colour change.

064 BIOMIMETIC GRADED INTERPENETRATING NETWORK CERAMIC-RESIN COMPOSITE ORTHODONTIC BRACKET MATERIALS

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AIM: Fixed orthodontic appliances that combine good aesthetic and clinical performance are most likely to result in a good treatment outcome. Enamel and dentine exhibit interconnected dual phase structures that enable them to meet the functional needs of the teeth. By mimicking such structures, it might be possible to create orthodontic brackets which inherit good mechanical, wear and bonding properties.
MATERIALS AND METHOD: Alumina powder was mixed with dispersant in distilled water. A gelatine solution was added to the slurry as a binder and ball milled for 6 hours in an oven. The slurries were frozen in a custom built system and then dried and finally sintered in a furnace. Sintered blocks were

silanated and filled with polymer mixture. Physical and mechanical properties such as density, porosity, flexural strength, fracture toughness and hardness were then measured.
RESULTS: The fabrication technique used allowed tuneable formation of the final scaffold microstructure. Regarding the effect of the gelatine concentration on the final structure of the scaffolds, the shape of the pores in the higher concentration looked more round and hexagonal while the distance between the layers decreased and smaller pores were formed. Infiltration of the porous alumina scaffold with polymer mixture (1:1 by weight Urethane dimethacrylate and Triethylene glycol dimethacrylate) resulted in two interconnected phase composite material. The measured mechanical properties of the biomimetic composites were influenced by the ceramic precursor. A higher ceramic fraction implied a higher density and increased compressive and flexural strengths. The polymer infiltrated ceramic materials had density, flexural strength, compressive strength, elastic modulus, hardness, and fracture toughness values of 2.8 MPa, 190 MPa, 250 MPa, 28.4 GPa, 1.4 and 1.6 GPa, and 3.9 to 4.9 MPa respectively. The relatively enhanced mechanical properties imply a reinforcement mechanism of the precursor ceramic scaffold by a flexible polymer phase.
CONCLUSIONS: The ratio between ceramic and polymer contents of the final composite material influenced the mechanical properties of the novel interpenetrating phase composite material. It is expected that this method will enable development of novel biomimetic composites with an anisotropic structure combining the advantages of both ceramic and polymer.

065 CORTICOTOMY-INDUCED TOOTH MOVEMENT, HOW FAST ARE WE MOVING? A REVIEW ARTICLE

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AIM: Constant demands for quicker treatment call for interventions, adjunct to conventional orthodontic treatment that could speed up tooth movement with the least tissue damage while maintaining a high standard of treatment outcome. One such option is corticotomy, a surgical technique that involves cutting, perforating or modifying only the outer cortical layer of bone and leaving intact the medullary bone, as opposed to osteotomy which involves penetration of both layers. Corticotomy-induced tooth movement (CITM) is an established and efficient orthodontic technique that has recently been studied in more depth. It has gradually gained popularity as an adjunct treatment option for conventional orthodontic treatment, mainly for adults. It involves selective alveolar decortication in the form of decortication lines and dots performed around the teeth that are to be moved.
MATERIALS AND METHOD: To present a comprehensive review of the literature, including historical background, indications, contraindications and complications. The objective was to review the rationale for CITM, the recent surgical techniques, clinical applications and evidence on its effectiveness and shortcomings to justify its use in the daily clinical setting.
RESULTS: A review of the literature was carried out using the following search methods: PubMed, Medline, Embase and the Cochrane Central Register of Controlled Trials. The search was focused on various keywords including: ‘corticotomy’, ‘corticotomy induced orthodontics’, ‘surgically assisted orthodontics’, as well as hand literature searches, which were conducted on studies published until December 2016.
CONCLUSIONS: CITM is a promising treatment modality that has many applications in the orthodontic treatment of adults given that it helps to overcome many of the current limitations of this treatment, including lengthy duration, lack of growth and the limited envelope of tooth movement. Further human histological studies are necessary to confirm the underlying mechanisms of CITM to standardise surgical techniques to take full advantage of the effects. Studies evaluating side effects are mostly too short-term for concrete conclusions to be drawn. More attention on movement rates are needed in future studies.

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066 WHAT IS THE IDEAL MATERIAL AND SEQUENCE OF INITIAL ALIGNING ARCHWIRES FOR ORTHODONTIC ALIGNMENT?

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AIM: The initial archwire is defined as the first archwire to be inserted into the fixed appliance at the start of treatment and is used mainly for correcting crowding and tooth rotations. The ideal property of the initial archwire is to apply optimal force which is dependent upon the stiffness of the wire, the range of wire, the strength, the ease of use, harmony with the bracket slot, while being cost effective and biocompatible. Therefore the material should be of low stiffness to deliver light forces on activation, have a good range to be able to maximise activation, strength and resistance to prevent permanent deformation, ease of use and facilitate engagement into the brackets, as well as being cost effective. The success of the archwire and therefore treatment also depends on the geometric factors such as cross-sectional shape (circular, rectangular, square). The aim of this presentation is to determine the difference between archwire sequences and material choice in initial archwire selection. There is a paucity of research that has examined both sequence and wire material simultaneously.

MATERIALS AND METHOD: A review of the literature was carried out using the following search methods: PubMed, Medline, Embase, Cochrane Central Register of Controlled Trials (CENTRAL) and Google Scholar. The search was focused on various keywords including: 'archwire sequence', 'archwire material', 'initial aligning archwire', as well as hand literature searches, which were conducted on studies published until December 2016. Eight randomised controlled trials were included in this review.

RESULTS AND CONCLUSIONS: There is no strong reliable evidence in this review that any specific initial archwire material is better or worse than another with regard to speed of alignment and/or pain. The current data is weak; therefore, no recommendations can be made for the use of any available archwire type regarding effectiveness, efficacy or potential side effects.

067 LINGUAL FRAENULUM TEST IN INFANTS AT A MATERNITY HOSPITAL

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AIM: To evaluate the lingual fraenulum test in infants at the maternity hospital and to identify lingual fraenulum change, its interference with breastfeeding, and to provide a differential diagnosis for fraenectomy indication.

SUBJECTS AND METHOD: A score evaluation protocol of the lingual fraenulum proposed by Martinelle, 2013, was applied to infants during the 48 hours infants remained in the mother-baby unit. One thousand five hundred and thirty five newborns were evaluated.

RESULTS: One hundred and forty one (9.18%) had scores indicative of lingual fraenulum abnormalities, whereas 112 (79.43%) had scores demonstrating a direct interference of the lingual fraenulum with breastfeeding, and underwent a lingual fraenectomy while in the maternity unit. Twenty-nine showed scores indicating the need for re-evaluation, with a new scheduling for retest after 30 days. After 30 days, 24 (82.76%) infants were re-evaluated while five 5 (7.24%) did not return for examination. Twenty-one (87.5%) of the 24 infants re-evaluated showed changes and underwent a fraenectomy, while three (12.5%) showed no changes and no need for surgical intervention.

CONCLUSIONS: The lingual fraenulum test allowed diagnoses of changes in the lingual fraenulum and its interference with breastfeeding, and a differential diagnosis for fraenectomy.

068 COMPARISON OF THE EFFICACY OF TOOTH ALIGNMENT AMONG LINGUAL AND LABIAL BRACKETS: AN *IN VITRO* STUDY

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AIM: To evaluate the efficacy of tooth alignment with different conventional and self-ligating lingual and labial brackets using the orthodontic measurement and simulation system.
MATERIALS AND METHOD: The tested orthodontic brackets were 0.022 inch slot size for labial and 0.018 inch for lingual brackets and were as follows: (1) labial brackets: a) conventional brackets [GAC-Twin (Dentsply), b) passive self-ligating brackets [Damon-Q® (Ormco); Ortho classic H4™ (Orthoclassic); FLI®SL (Rocky Mountain Orthodontics)] and c) active self-ligating brackets [GAC In-Ovation®C (Dentsply) and Speed™ (Strite)]. (2) lingual brackets: a) conventional brackets [Incognito (3M) and Joy™ (Adenta)]; b) passive self-ligating bracket [GAC In-Ovation®LM™ (Dentsply)] and c) active self-ligating bracket [Evolution SLT (Adenta)]. Thermalloy-nickel titanium 0.013 and 0.014 inch archwires (Rocky Mountain Orthodontics) were used with all brackets. The archwires were tied to the conventional brackets with stainless steel ligatures 0.010 inch (Rocky Mountain Orthodontics). The simulated malocclusion represented a maxillary central incisor displaced 2 mm gingivally (*x*-axis) and 2 mm labially (*z*-axis).
RESULTS: The lingual brackets showed lower efficiency of tooth alignment compared to labial brackets for both conventional and self-ligating brackets. The inciso-gingival correction obtained by labial brackets ranged from 72 to 95 per cent and from 70 to 87 per cent with 13 and 14 inch Thermalloy, while with lingual brackets ranged from 25 to 44 per cent and from 29 to 52 per cent with 13 and 14 inch Thermalloy, respectively. The labio-lingual correction obtained by labial brackets ranged from 83 to 138 per cent and from 82 to 129 per cent with 13 and 14 inch Thermalloy, respectively, while for lingual brackets it ranged from 12 to 40 per cent and from 30 to 45 per cent with 13 and 14 inch Thermalloy, respectively.
CONCLUSIONS: The lower inciso-gingival and labio-lingual correction achieved with lingual compared to labial brackets in the initial levelling and alignment phase of orthodontic treatment could be clinically reasonable for a long levelling time with a lingual appliance.

069 EFFECT OF RAPID MAXILLARY EXPANSION AND PROTRACTION ON THE PHARYNGEAL AIRWAY IN INDIVIDUALS WITH NON-SYNDROMIC CLEFT LIP AND PALATE

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AIMS: To evaluate and compare pharyngeal airway volume and minimal cross-sectional area in non-syndromic individuals with cleft lip and palate (CLP) using cone beam computed tomography (CBCT) before and after Phase I orthodontic maxillary expansion and protraction.
MATERIALS AND METHOD: This is a retrospective study of CBCT data of preadolescent individuals with a CLP (n=20). IRB approval was obtained. The volume and minimal cross-sectional area of the pharyngeal airway were evaluated before and after orthodontic treatment using 3dMDvultus software. Five measurements were repeated to verify reliability using Pearson's coefficient. Changes in volume and cross-sectional area were analyzed using a paired *t*-test (with $P < 0.05$ as statistical significance).
RESULTS: The method was found to be reliable. There was a statistically significant increase in pharyngeal airway volume after phase I orthodontic treatment, however, there was no statistically significant change in minimal cross-sectional area.
CONCLUSION: 3D imaging using CBCT and 3dMDvultus is reliable for assessing airway volume and minimal cross-sectional area. Phase I orthodontic treatment with maxillary expansion and protraction may have an influence on increasing pharyngeal airway volume in non-syndromic children with CLP.

070 A NOVEL APPROACH FOR THE ASSESSMENT OF FACIAL ASYMMETRY BEFORE AND AFTER PRIMARY LIP SURGERY OF UNILATERAL CLEFT LIP AND PALATE

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AIM: To evaluate the effect of primary surgical repair of a cleft lip on facial symmetry by the application of generic facial mesh.
MATERIALS AND METHOD: Three-dimensional (3D) facial images of 15 unilateral cleft lip and palate (UCLP) infants (mean age 3.9 months). The images were captured 1-2 days before primary lip surgery and about 4 months after surgery using a 3dMD device. Generic mesh, a mathematical facial mask that consists of thousands of points, was conformed on the pre- and post-operative images. This mesh is indexed to identify the right and the left sides of the face. The conformed mesh provided a prefect representation of the underlying 3D facial morphology. Total facial asymmetry and naso-labial asymmetry were measured by calculating the absolute mean of linear distances between the points of the right side of the face and the mathematically corresponding points of the left side. In a perfectly symmetrical face, these distances should be equal to zero.
RESULTS: The measured asymmetry of the facial and the naso-labial region decreased significantly following surgery. However, residual asymmetries were identified at the alar base and at the lip on the cleft side. The application of the generic mesh provided an accurate measure of facial asymmetry. Surgical correction of the cleft lip improved the symmetry of the cheek regions.
CONCLUSIONS: Primary surgery of UCLP improved facial symmetry. However, surgical revision might be required to deal with the detected residual asymmetries. Dense correspondence analysis is an accurate method for measuring facial asymmetry in UCLP before and after surgery.

071 THE EFFECT OF A UNILATERAL POSTERIOR CROSSBITE ON MAXILLOFACIAL AND DENTAL STRUCTURES: A CONE BEAM COMPUTED TOMOGRAPHIC EVALUATION

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AIM: To evaluate the effect of a unilateral posterior crossbite (UPC) on bone density of the condyles, maxilla and mandible compared to the contralateral side; and to investigate the influence of crossbite on the masseter muscle and supporting tissues of the affected teeth. Cone beam computed tomography (CBCT) was used for this purpose.
MATERIALS AND METHOD: Full head CBCT of 37 patients (13 males, 24 females, mean age 21.27 ± 2.36) with a UPC were obtained. Specialized software was used to measure the CBCT grey scale of bone density in three different regions of interest (ROIs) in the condyle, maxilla and mandible. The masseter muscle length and thickness were measured in addition to the width of the supporting alveolar apparatus. The crossbite side data was compared to the non-crossbite side using a Student's *t*-test. The results were evaluated at significance level of $P < 0.05$.
RESULTS: The condylar and mandibular body bone density in the ROIs was significantly lower on the crossbite side ($P < 0.05$). The masseter muscle width and the width of the mesial root of the lower first molar were significantly smaller on the crossbite side.
CONCLUSIONS: A UPC may cause mandibular asymmetry in terms of bone mineral density of the body of the mandible and condyle. A reduced masseter muscle thickness and root width of the mandibular molars may result on the crossbite side.

072 RELATIONSHIP BETWEEN CONDYLAR VOLUME AND FACIAL MORPHOLOGY

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AIM: Previous studies have shown that a retrognathic mandible and hyperdivergent patterns are significantly associated with degenerative disease of the temporomandibular joint (TMJ). The

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purpose of this study was to evaluate the relationships between condylar volume and facial morphology in orthodontic patients using panoramic radiographs (pano), posteroanterior cephalograms (PA), and computed tomography (CT).
SUBJECTS AND METHOD: A total of 58 adult orthodontic patients were examined. Condylar and mandibular variables were measured on their pano and PA. After condylar volume and its components (cortical and trabecular part) were calculated from CT images, relationships between condylar volumes and facial morphologies were analyzed by Pearson correlation coefficients.
RESULTS: There were significant relationships between condylar volumes and facial variables. In pano variables, condylar heights and condylar head heights were positively associated with total condylar volume. Among PA variables, ramal height was positively correlated and frontal gonial angle was negatively correlated with total condylar volume. Cortical bone volume and trabecular bone volume were significantly correlated with pano and PA variables. They showed a similar trend to total condylar volume, but trabecular bone volume had more effects on facial morphology than cortical bone volume.
CONCLUSIONS: In this study, facial morphologies, specifically condylar and mandibular shapes, were significantly correlated with condylar volume. The results suggest that specific facial morphology, such as a retrognathic mandible and hyperdivergent patterns associated with degenerative joint disease of TMJ may result from decreased condylar volume.

073 SLEEP, OCCLUSION, DENTAL ARCH AND PALATAL MORPHOLOGY IN CHILDREN WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER COMPARED TO CONTROLS

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AIM: To compare sleep, occlusion, dental arch dimensions and palatal morphology in a group of children with attention-deficit/hyperactivity disorder (ADHD) to a group of healthy children (control).
SUBJECTS AND METHOD: Fifteen children with ADHD (10 boys, 5 girls, mean age 10.98 years) and 36 healthy age matched children (21 boys, 15 girls, mean age 10.60 years) had an intraoral three-dimensional scan of the dentition and palate. All children with a history of upper airway obstruction or snoring were excluded from the control group. The analysis of the occlusion, dental arch dimensions and palatal morphology was performed on the intraoral scans. Sleep and tiredness was evaluated from questionnaires. The differences between the two groups were analyzed by Fisher's exact test and general multiple linear regression analysis.
RESULTS: The children with ADHD had a significantly narrower palate at the level of the canines compared to the control children ($P < 0.05$). There were no significant differences between the two groups in the occurrence of malocclusion, space anomalies, palatal height or dental arch dimensions measured at the level of the first upper molars. Analysis of the questionnaire showed that children in the ADHD group snored more ($P < 0.05$) and slept more restlessly ($P < 0.0001$) compared to the control children. The ADHD children had a tendency to sleep for fewer hours during the night ($P = 0.066$) and felt inadequately rested in the morning ($P = 0.051$) compared to the controls. There was no significant difference in how tired they felt during the day.
CONCLUSIONS: Children with ADHD have a narrower palate anteriorly, a more restless sleep pattern and a tendency to sleep less hours during the night compared to healthy children. The results may prove valuable in the diagnosis and treatment planning of children with ADHD.

074 DENTAL ARCH FORM MODIFICATION AS A METHOD FOR PROVIDING SPACE FOR TOOTH MOVEMENT

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AIM: To determine whether timely treatment could provide space for teeth in the dental arch by form modification of the latter.
SUBJECTS AND METHOD: Thirty six patients of various ages having the same diagnosis, a unilateral distal crossbite, treated with different orthodontic appliances types. The appliances used were: a

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myofunctional appliance; a fixed upper lingual plate with a screw to be activated on a daily basis within 6 weeks and a rapid maxillary expansion appliance. The patients were divided into two groups: group 1 where treatment took over 6 months and group 2 where treatment carried out within 3 months.
RESULTS: These were grouped into a completely corrected crossbite in group 1, where the number was 29, and incomplete correction in group 2. Seven of those children were in the primary dentition and the first upper permanent molar corrected a crossbite. The following additional treatment results were observed: a tongue position improvement, an improved closure of the labial slot, and a regular form of the upper dental arch.
CONCLUSIONS: Early orthodontic treatment of a unilateral distal crossbite provides for a proper dental arch form, improves nasal breathing and has an effect on tongue position. It is easily adaptable in patients and has a short stay-in-mouth period.

075 COMPARATIVE ANALYSIS OF THE MECHANICAL PROPERTIES OF FIBRE AND STAINLESS STEEL MULTISTRAND WIRES USED FOR LINGUAL FIXED RETENTION

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AIM: To evaluate the effect of different resins used for the co-polymerization of EverStick fibre-reinforced fixed orthodontic retainers on its mechanical properties and to compare the mechanical properties of these configurations to commonly used multistrand wires.
MATERIALS AND METHOD: Ten 0.0175 inch WildCat (WC175), ten 0.0215 inch WildCat (WC215) three-strand twisted wires and 30 EverStick fibres were tested. The EverStick fibres were equally shared in three groups (n = 10). The samples of first group (ESRE) were polymerized employing Stickresin (Light cure enamel adhesives), the second one (ESFT) employing Flow Tain (Light cured composite), whilst the specimens for the third group (ES) were not combined with resin. All samples were loaded in tensile up to fracture in a universal tensile testing machine and the Young modulus, tensile strength and strain after fracture were recorded. The same groups were also tested employing instrumented indentation testing (IIT) and Martens hardness (HM), indentation modulus (EIT) and elastic index (ηIT) were determined. The results of tensile testing and IIT were statistically analyzed employing one-way ANOVA and SNK at a = 0.05 level of significance.
RESULTS: WC175 and WC215 showed higher elastic modulus and tensile strength but lower strain after fracture compared to the Everstic groups. IIT illustrated significantly higher values for HM, EIT, and ηIT for WC groups compared to ESRE, ESFT and ES. ESFT showed higher HM and elastic index compared to ESRE and ES, a finding which is attributed to the fact the FlowTain is a filler-reinforced composite with higher hardness compared to unfilled resins.
CONCLUSIONS: WC groups demonstrated higher values in mechanical properties compared to EverStick ones. The co-polymerization with difference resins does not affect the tensile properties of Everstic, however the use of a light cured composite has a beneficial effect on hardness.

076 A PROSPECTIVE AUDIT EVALUATING PATIENT SATISFACTION THROUGH THE ORTHODONTIC AND ORTHOGNATHIC PATHWAY

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AIM: To evaluate patients' motivations, expectations and experience of their joint orthodontic/surgical experience and to determine patient satisfaction with their overall patient journey.
MATERIALS AND METHOD: A prospective audit was carried out over a 12 month period of orthognathic patients who attended the Department of Orthodontics, Queen's Hospital, using a patient satisfaction survey to review all aspects of the patient's journey and patient motivations. Based on previous United Kingdom, a gold standard of 90 per cent satisfaction rate was set. Data

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was collected from 60 patients who attended the bimonthly joint orthodontic/orthognathic clinic from December 2015 to November 2016.
RESULTS: Compliance with the gold standard was not met, with an overall satisfaction rate of 70 per cent achieved. The most common motivation was to 'improve the smile' followed by to 'improve the bite'. Dissatisfaction with certain aspects of communication was found. However a change in personnel during the course of the audit resulted in a 100 per cent level of patient satisfaction in communication and understanding from the new multidisciplinary team.
CONCLUSIONS: This audit highlighted the reasons for patients seeking orthognathic treatment, patient feedback about their overall journey and areas of deficiency within the service. Audit recommendations include ensuring sufficient information is provided at the initial stage of treatment and further development of the team with regard to patient preparation, communication and teamwork within the multidisciplinary team to facilitate efficiency and quality of care.

077 *IN VITRO* IMPACT OF INSERTION ANGLE ON PRIMARY STABILITY OF MINISCREWS

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AIM: The use of miniscrews as anchorage has become increasingly popular, but there is no consensus on the best insertion angle. The purpose of this study was to determine the impact of insertion angle on primary implant stability.
MATERIALS AND METHOD: Sixty-four miniscrews, 6 × 1.6 mm, were placed in 64 fresh bone segments from 32 sheep mandibles. The miniscrews were inserted into the bone surface at four angles: 30, 45, 60 and 90 degrees. The maximum resistance forces of miniscrews in pullout and shear tests were determined as primary stability using a universal testing machine.
RESULTS: In the pullout tests, the 90 degree insertion angle had the highest primary stability. Oblique angulations of the miniscrews resulted in lower resistance. In the shear tests, angulations of the miniscrews from 90 to 45 degrees led to increased primary stability. A more oblique insertion (30°) resulted in reduced primary stability.
CONCLUSIONS: The direction of the applied force had a significant impact on the primary stability of miniscrews at various insertion angles. The highest primary stability values were achieved at 45 degrees when the miniscrews were loaded by shear force and at 90 degrees when pullout force was applied.

078 PERIODONTAL PROBLEMS WITH ORTHODONTIC FIXED RETAINERS IN THE LOWER ARCH

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AIM: To assess the evidence of periodontal problems related to orthodontic fixed retainers in the lower arch through a literature review.
MATERIALS AND METHOD: A digital search was performed in PubMed, Google Scholar, Cochrane and ScienceDirect as well as a hand search in textbooks, journals and websites. Keywords were: fixed retainer, periodontal health, biofilm, bonded orthodontic retainers, lingual retainers and periodontal disease. Inclusion criteria were: articles published between 2007 and 2016, articles in English and randomized clinical trials, case control studies. The exclusion criteria were: animal studies, articles published before 2007 and articles in languages other than English.
RESULTS: Although some authors mentioned gingival recession, higher gingivitis or plaque index, most articles concluded that these problems were not clinically or statistically significant in relation to fixed orthodontic retainers in the lower arch.
CONCLUSIONS: Although few studies have been carried out so far in this field of research, the majority of the authors conclude that: there is no clinically or statistically significant damage on a patient's periodontal health related to wearing fixed retainers regardless of the type of material they

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are made of, and the number of teeth the retainer is attached to. This may be an interesting field of research for future studies to obtain more information.

079 THE ASSOCIATION BETWEEN PALATAL RUGAE MORPHOLOGY AND TOOTH NUMBER

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AIM: The palatine rugae are a series of irregular transverse ridges within the keratinized mucosa of the anterior hard palate. There is some evidence of commonality in developmental pathways underlying development of the rugae and dentition. This study aimed to compare rugae patterns in subjects with a normal number of teeth number and those with tooth agenesis.

MATERIALS AND METHOD: The maxillary dental casts of 60 Caucasian subjects with a normal complement of teeth and 60 affected by tooth agenesis (a maximum of six permanent teeth, excluding third molars) were collected. All subjects were under the age of 18 years. Analysis of rugae pattern was made by one operator using a classification of number, length (divided into primary, secondary and fragmentary), shape (divided into straight, curve, wavy and annular), unification and direction. Statistical tests compared rugae patterns on the left and right sides between the sample groups.

RESULTS: The total sample comprised 120 subjects with an overall mean age of 13.49 years (sd = 1.54). The sample contained an equal number of males and females and the genderwise mean (sd) of age were 13.47 (1.44) and 13.50 (1.65) for males and females, respectively. The mean age did not differ significantly (P = 0.92) between genders. The difference between the mean age of unaffected (13.40 ± 1.55) and affected (13.56 ± 1.54) groups was not statistically significant (P = 0.58). The mean (sd) of total number of primary rugae on the left and right were 4.35 (0.98) and 4.33 (0.92), respectively. There were no significant differences in the length or direction of rugae between groups (P > 0.05). Statistically significant differences were found between groups for the number of secondary rugae on the left (P = 0.006), number of fragmentary rugae on the right (P = 0.004), shape of primary rugae 3 on the right (P = 0.004), shape of primary rugae 2 on the right (P = 0.012) and unification of primary rugae 3 on the left (P = 0.02). Repeated measurements showed no statistical differences between observations and a high-level of agreement between measurements (correlation 0.997).

CONCLUSIONS: There are significant differences in rugae pattern between subjects affected by tooth agenesis and those with normal tooth number. These differences affected the number, shape and unification of specific rugae. This suggests that shared developmental pathways exist during rugae and tooth development.

080 THE EFFECTS OF FIXED ORTHODONTIC RETAINERS ON PERIODONTAL HEALTH. A SYSTEMATIC REVIEW

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AIM: To search the literature and assess the available evidence on the effects of fixed orthodontic retainers on periodontal health of the maxillary and mandibular anterior teeth.

MATERIALS AND METHOD: Electronic database searches of published and unpublished literature were performed in the following electronic databases without language or publication date restrictions: Medline (via Ovid and PubMed), Embase (via Ovid), the Cochrane Oral Health Group's Trials Register and Central, ClinicalTrials.gov, the National Research Register, and Pro-Quest Dissertation Abstracts and Thesis database. The reference lists of all eligible studies were checked for additional studies. Two review authors performed data extraction independently and in duplicate using data collection forms. Disagreements were resolved by discussion or the involvement of an arbiter. The risk of bias of randomised controlled trials (RCTs) was assessed using the Cochrane risk of bias tool. Prospective and retrospective studies were evaluated with ACROBAT-NRSI (A Cochrane Risk of Bias Assessment Tool for Non-Randomized Studies of Interventions).

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RESULTS: Twenty studies were considered eligible for inclusion in this systematic review. Two RCTs concerned different types of wires and another one assessed the effects of the presence or absence of liquid resin during the bonding procedure. Out of the 17 prospective studies, eight evaluated different designs of fixed retainers, three compared fixed with removable retainers, four assessed the long-term periodontal status of patients with fixed retainers and two investigated the effects of fixed retainers compared to an untreated control group. The level of provided evidence ranged from low to moderate. Overall, the main reported outcome was a slight but not clinically significant increase in gingival indices, plaque index and bleeding on probing. Apparent also was a calculus accumulation in patients with glass-reinforced composite retainers.
CONCLUSIONS: There is a considerable agreement among the included studies that bonded wire orthodontic retainers are a viable retention strategy both in the short- and long-term. As far as periodontal health is concerned, no severe detrimental effect on the periodontium was reported.

081 THE EFFECTIVENESS OF PIEZOCORTICOTOMY AND MINISCREW ANCHORAGE IN CASES OF THIRD AND SECOND MOLAR MESIALIZATION WHEN THE FIRST MOLAR IS MISSING

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AIM: To compare the mesialization rate of molars, in adult patients, with and without using piezo surgery with corticotomies. In addition a further aim was to evaluate alveolar bone thickness before and after manipulation and after complete tooth movement and to evaluate root resorption.
SUBJECTS AND METHOD: Forty patients (22 females, 18 males) aged 25-40 years with a fixed appliance (0.022 inch slot brackets with Damon prescription) and the absence of molars in the lower jaw. The patients were divided into two groups: group 1 included 23 patients (7 both-sided, 16 single-sided absence of the first molar) who had piezocorticotomy and miniscrew placement. Group 2 comprised 17 patients (2 both-sided, 15 single-sided absence of the first molar) who had miniscrew insertion without piezocorticotomy. Nickel-titanium coil springs with a force of 150 g were used for molar mesialization, as well as two parallel cable type elastic chains exerting a force of 150 g. The space reduction was evaluated every 2 weeks by measuring the distance between the interproximal surfaces of the second molar and the second premolar. Cone-beam computed tomography was performed before and after orthodontic treatment, as well as immediately after the piezocorticotomy in order to evaluate changes in alveolar bone thickness and root resorption.
RESULTS: The average rate of molar mesialization was significantly higher in the group 1. The rate of movement in group 1 was 1.1 mm / month and in group 2, 0.3 mm / month. However, accelerated tooth movement was only observed during the first 3 months after corticotomy, after that period the speed gradually decreased. Alveolar bone density after surgery decreased, but at the end of treatment returned to the original level. Roots resorption was higher in group 2.
CONCLUSIONS: Piezo surgery with corticotomies is an effective method to accelerate the mesialization of lower molars during the first 3 months after surgery.

082 AGREEMENT BETWEEN CHILDREN AND PARENTS/CAREGIVERS IN RATING ORAL HEALTH RELATED QUALITY OF LIFE USING CHILD PERCEPTIONS QUESTIONNAIRE ISF:16

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AIM: 1. To evaluate the agreement between children's self-ratings and parental ratings of the children's oral health related quality of life (OHRQoL) as measured by the child perceptions questionnaire (CPQ11-14-ISF:16). 2. To analyze if the level of agreement between children's self-assessments and parent´s perceived assessments of the children's OHRQoL differed between groups with or without malocclusion or with the different orthodontic treatment needs in children.
SUBJECTS AND METHOD: Two hundred and forty-seven children aged 11-14 years and their parent/guardian were asked to participate. They responded to CPQ11-14-ISF:16 in conjunction with a clinical follow-up examination during the period from September 2012 to September 2013. The

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subjects were a cohort of children followed from three years of age for the natural history of malocclusion or not. Orthodontic treatment need was assessed according to the Index of Orthodontic Treatment Need (IOTN-DHC).
RESULTS: Both self- and parental-ratings showed good OHRQoL. Children's self-ratings were higher (total score 9.27; range 0-33) than parental ratings (total score 5.15; range 0-26). The agreement between self- and parental-ratings was low (ICC = 0.20). The impact from orthodontic treatment need did not improve the agreement between children and parents.
CONCLUSIONS: The children's self-assessments and parental assessments show that the group OHRQoL was generally good, although, the agreement between the children's self-assessments and parental assessments of children's OHRQoL was low and did not improve when orthodontic treatment need was taken in to consideration.

083 FORCE MAGNITUDES BETWEEN TWO LEVELS OF HOOK HEIGHT FOR MAXILLARY POSTERIOR SEGMENT DISTALIZATION WITH MINISCREW ANCHORAGE***
Thannapat Aungkatawiwat, Virush Patanaporn, Orthodontic Department, Chiang Mai University, Thailand

AIM: To estimate the force magnitude for maxillary posterior segment distalization with miniscrew anchorage between two levels of hook height, 0 and 8 mm, using the finite element (FE) method.
MATERIALS AND METHOD: A FE model was constructed by three-dimensional laser scanning of a maxillary dentition. The thickness of the periodontal ligament (PDL) was assumed to be uniform (0.25 mm), with a non-linearly elastic equation. The alveolar bone was produced, consisting of cortical and cancellous bone. The bracket, archwire and retraction hook were created. The miniscrew position was set at 8 mm apical to the archwire, at the midpoint between the bracket of first molar and second molar. The retraction hook was located mesial to the first premolar 0 and 8 mm apical to the archwire. Distalizing force (50-250 g) was applied from a miniscrew to two levels of hook height. The ABAQUS program was used to generate the FE analysis.
RESULTS: The 91 g and 75.72 g of force was the greatest distalizing force magnitude for distalizing the maxillary posterior segment when applied force to hooks of 0 and 8 mm, respectively that did not create pressure in the PDL that exceeded the highest capillary hydrostatic pressure (0.0047 MPa)
CONCLUSIONS: From the FE analysis, the greatest force magnitude for maxillary posterior segment distalization with miniscrew anchorage at the 0 mm. and 8 mm. of retraction hook are 91 g. and 75.72 g. respectively. The amount of force magnitude decreased slightly as the length of the lever arm increased, due to the greater horizontal vector of the distalizing force

084 ADAPTATION OF THE CHILD PERCEPTIONS QUESTIONNAIRE 11-14 FOR THE TURKISH LANGUAGE: VALIDATION IN AN ORTHODONTIC PATIENT SAMPLE
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AIM: To prepare the Turkish version of the Child perceptions Questionnaire 11-14 (CPQ 11-14) and to test its psychometric properties in an adolescent orthodontic patient sample.
MATERIALS AND METHOD: The questionnaire was adapted to Turkish language utilizing a forward-backward translation method. It was found to be understandable in a pilot study (n = 15). The Turkish form of the CPQ 11-14 was administered to 200 orthodontic consultation patients (aged 11-14 years). Retests were conducted in 50 patients two weeks after the first tests. The Index of Complexity and Orthodontic Need (ICON) was used to measure orthodontic treatment need. Decayed, missing and filled teeth were also recorded with the DMFT index. Spearman correlations and *t*-tests were used to assess validity. Internal consistency was assessed with Cronbach's alpha coefficient and, intraclass correlation coefficients (ICC) were calculated to assess test-retest reliability.
RESULTS: Significant positive correlations were found between CPQ 11-14 scores and the global ratings of oral health (r = 0.381), global ratings of well-being (r = 0.350), ICON scores (r = 0.211) and, DMFT scores (r = 0.233) supporting construct validity. Children who needed orthodontic treatment had a worse quality of life than children who did not need orthodontic treatment (*P* = 0.016).

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Cronbach's alpha and ICC were calculated as 0.917 and 0.817 demonstrating good internal consistency and acceptable retest reliability.
CONCLUSIONS: The CPQ 11-14 Turkish version was found to be valid and reliable in 11-14 year old orthodontic patients.

085 LOWER FACIAL CHARACTERISTICS CONTRIBUTING TO PERCEPTION OF FACIAL ASYMMETRY IN DENTISTS AND LAYPERSONS

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AIM: To find differences in how dentists and laypersons evaluate facial asymmetry and to identify the lower facial characteristics contributing to the perception of asymmetry.
MATERIALS AND METHOD: Photographs of 50 young male and female faces were morphed according to lower face height, lower facial width, the direction of chin deviation, and the angle of chin deviation. Thirty dentists (mean age, 28 years; 16 males, 14 females) and 50 laypersons (mean age, 22.2 years; 24 males, 26 females) answered a questionnaire evaluating asymmetry of the 24 photographs (12 males, 12 females) using a visual analogue scale (VAS). The individual *t*-test, Welch's test, chi-square test and logistic regression analysis were used for statistical analysis.
RESULTS: Dentists (VAS, 70.76 ± 19.64) were more critical than laypersons (VAS, 66.47 ± 21.34) when evaluating photographs with a large chin deviation angle (10˚). Photographs of faces with long lower face heights, left deviation of the chin, and a large chin deviation angle were considered to be more asymmetric than those with a normal lower face height, right deviation of the chin, and small chin deviation angle, respectively, by both evaluator groups ($P < 0.05$). There was no consistent relationship between lower facial width and perception of facial asymmetry in either group.
CONCLUSIONS: Dentists evaluated facial asymmetry with a large chin deviation angle as more asymmetric than laypersons. Perception of facial asymmetry was affected by several factors including lower face height, lower facial width, the direction of chin deviation, and the amount of chin deviation angle.

086 THE IMPACT OF RECONDITIONED ORTHODONTIC BRACKETS ON BOND STRENGTH *IN VIVO*

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AIM: To evaluate the bond failure rate of new and reconditioned stainless steel orthodontic brackets during orthodontic treatment.
SUBJECTS AND METHOD: A total of 66 patients were selected from the orthodontic waiting list and randomly divided into three main groups of 22 patients each. Sixty six sets of 3M Unitek™ Gemini brackets were used consisting of 20 brackets of each set. The first was a control group, while in the other two groups the brackets were reconditioned using either a Er,Cr3+:YSGG laser or 50 µm aluminium oxide particle powder for sandblasting prior to bonding. After polymerization, nickel titanium 0.014 archwire was inserted within 30 minutes. Monthly follow-ups of all the patients were undertaken during a period of 12 months. Bond failure rate was recorded and calculated by percentage of failure. The debonded brackets were categorized according to each group. The results were subjected to statistical analysis; ANOVA and Tukey's *post hoc* test were used to identify the difference in bond failure rate with the level of significance was established at $P < 0.05$.
RESULTS: There was no significant difference between the percentage of bond failure rate of the new brackets and for reconditioned groups ($P > 0.05$).
CONCLUSIONS: Reconditioned orthodontic brackets using Er,Cr3+:YSGG laser or 50 µm aluminium oxide particle powder sandblasting methods can be used as an alternative to new brackets following bond failure.

087 LONG-TERM STABILITY OF TRANSVERSE CHANGES AND TOOTH ALIGNMENT IN THE LOWER DENTAL ARCH TREATED WITH SELF-LIGATING BRACKETS

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AIM: To evaluate the long-term stability of transverse changes and tooth alignment in the lower dental arch treated with self-ligating brackets, by analysis of digital dental casts.
SUBJECTS AND METHOD: Twenty five individuals, mean age 29.56 years (sd 10.08) treated with passive self-ligating appliance Damon mx Ormco®, all presenting a Class I or one-quarter Class II molar malocclusion with upper crowding of at least 4 mm and treated only with a fixed appliance without stripping, extraction or distalization. For evaluation of transverse changes and tooth alignment, the dental casts of individuals were digitized and the intercanine, interpremolar and intermolar distances and Little's index were assessed pre- (T0), post- (T1) treatment and post-treatment follow-up (T2). Statistical analysis was by *t*-test dependent on comparison of the initial and final measurements, in millimetres, of the transverse measurements of the lower dental arch. Statistical significance was set at $P < 0.05$.
RESULTS: In the lower dental arch intermolar and intersecond premolar distances exhibited a significant increase. Little's index was reduced. Between T2-T1 there was a slight reduction of transverse dimensions and a slight increase in Little's index, yet without statistical significance.
CONCLUSIONS: In the long-term, the increases in transverse dimension and tooth alignment obtained with self-ligating appliances remained stable.

088 EFFECTIVENESS OF TEMPORARY ANCHORAGE DEVICES DURING ANTERIOR MAXILLARY TOOTH RETRACTION: A RANDOMIZED CLINICAL TRIAL

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AIM: To evaluate the efficiency of temporary anchorage devices (TADs) as anchorage in maxillary premolar extraction cases during anterior tooth retraction with a labial orthodontic fixed appliance.
SUBJECTS AND METHOD: Patients aged from 12 to 50 years with a malocclusion indicating first or second maxillary bilateral premolar extractions were included and randomly selected as the 'TAD' or 'control' group. The retraction of anterior teeth was realized with the *en masse* technique using skeletal anchorage in the TAD group, and with conventional dental anchorage in the control group. A computed tomographic (CT) scan was obtained after tooth alignment and before the beginning of the retraction phase in both groups, and a second CT scan at the end of extraction space closure. A three-dimensional superimposition was realized to visualize and quantify TAD stability and maxillary first molar movement during the retraction phase as well as the quantity of incisor retraction.
RESULTS: Thirty-four patients could be included for the final analysis with two CT scans, 17 in the TAD group and 17 in the control group. The TADs on the labial side were quite stable with a slight mesial movement. On the palatal side the TADs moved more in a mesial direction during anterior maxillary tooth retraction. There was a statistical difference between the two groups in mesial movement of the first maxillary molar, with less significant anchorage loss for the maxillary first molars in the TAD group in comparison to the control group. The incisor retraction was more efficient in the TAD group in comparison to the control group with a significant difference.
CONCLUSIONS: TADs could be considered as efficient anchorage during *en masse* anterior maxillary tooth retraction in comparison to conventional dental anchorage. TADs remain stable when correctly placed in the bone during the anterior tooth retraction phase.

089 THE EFFECT OF SOFT TISSUE THICKNESS ON THE SOFT TISSUE RESPONSE TO MANDIBULAR SETBACK SURGERY

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AIM: To determine the effect of soft tissue thickness on the soft tissue response to mandibular set-back surgery at the lower lip, point B and Pogonion regions.
MATERIALS AND METHOD: Pre- (T0) and post- (T1) surgical lateral cephalometric radiographs of 35 patients who undergone mandibular set-back surgery were evaluated. Soft tissue thickness, soft tissue response and soft tissue change to hard tissue change ratios were calculated for lower lip, point B and Pogonion. The thickness of the soft tissues was measured from the lower incisors to the lower lip, from soft tissue point B to hard tissue point B and from soft tissue Pogonion to hard tissue Pogonion. Soft tissue change to hard tissue change ratios of these regions was calculated using hard and soft tissue changes as the result of surgery. The relationship between soft tissue thickness and soft tissue change to hard tissue change ratios were analyzed using Pearson's correlation test.
RESULTS: The soft tissue point B and Pogonion response to mandibular set-back demonstrated positive and significant correlation with the amount of the surgery ($P < 0.001$). Negative correlation was found between soft tissue thickness and soft tissue response of lower lip, point B and Pogonion. Soft tissue thickness of point B and Pogonion significantly affected the soft tissue response of these points ($P < 0.01$) while negative correlation between lower lip thickness and soft tissue response was not statistically significant.
CONCLUSIONS: The soft tissue response of point B and Pogonion to mandibular set-back surgery was predictable in these regions and the soft tissue thickness of point B and Pogonion affected the soft tissue response negatively.

090 THE EFFECT OF ENAMEL SANDBLASTING ON ENHANCING BOND STRENGTH OF ORTHODONTIC BRACKETS: A SYSTEMATIC REVIEW AND META-ANALYSIS

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AIM: Intraoral sandblasting introduced in 1945 has been known to increase surface area thus contributing to potentially improved bracket bonding properties. This systematic review aimed to critically appraise the evidence regarding the effect of enamel sandblasting on the bond strength of orthodontic brackets either on the labial or lingual tooth surface.
MATERIALS AND METHOD: Electronic database search of published and unpublished literature was performed (Medline via PubMed, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, Clinical Trials.gov, Open Grey and National Research Register). Search terms included sandblasting, enamel abrasion, tooth surface, bond strength, bond failure and adhesive remnant. The data was extracted in standardized piloted forms. Risk of bias assessment was made using the Cochrane risk of bias tool adapted for *in vitro* studies where necessary.
RESULTS: Of the 81 articles initially retrieved, 13 were eligible for inclusion in the systematic review, while all were *in vitro* studies of unclear risk of bias primarily due to unclear reporting of blinding of outcome assessors. Eight studies assessed the combined effect of enamel sandblasting and etching, while only five evaluated the isolated effect of sandblasting on the buccal enamel surface. In view of the apparent heterogeneous study settings, intervention protocols, specimen preparation and storage sequences, only two studies were deemed eligible for quantitative synthesis. Random effects meta-analysis revealed no evidence to support sandblasting prior to etching compared to etching alone with regard to shear bond strength of orthodontic brackets bonded *in vitro* to lingual enamel surfaces of extracted premolars (Standardized mean difference: 0.36; 95%CI: –0.21, 0.94; $P = 0.22$).
CONCLUSIONS: The findings of the present study cannot support lingual enamel sandblasting prior to etching for augmentation of bond strength of orthodontic brackets. However, further research is necessary and should be directed towards intraoral evaluation of this supplementary means to draw robust conclusions.

091 COMPARISON OF NASAL AIRFLOW BETWEEN TOOTH- AND TOOTH-BONE-BORNE MAXILLARY EXPANSION APPLIANCES

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AIM: To evaluate, in a randomised clinical trial, the effects of tooth- and tooth-bone-borne maxillary expanders on nasal airflow.
SUBJECTS AND METHOD: Thirty eight patients, mean age 10.0 (SD ± 1.45) years, with a constricted maxilla and crossbite requiring maxillary expansion were randomly allocated to using a tooth-borne Hyrax (11 boys, 8 girls) or a tooth-bone-borne hybrid Hyrax (10 boys, 9 girls). All subjects were referred to the Ear, Nose and Throat unit at the Örebro University Hospital for rhinomanometric measurements (RhinoMetrics, Rhinostream) at baseline (T0) and directly post-expansion (T1), 15 minutes after nasal decongestion. Nasal airflow was assessed from each nasal cavity, while a reference pressure (150 Pa) was measured from the contralateral nostril. All subjects performed registration at T0 but only 28 at T1, of which 16 had been randomized to tooth-borne and 12 to hybrid expanders. Nasal airflow at T1 was evaluated with linear regression analysis, adjusted for the baseline nasal airflow, for comparison between the study groups. The evaluation was done with complete cases and, due to missing values for T1 measurements regarding 10 cases, with multiple imputation (MI). Baseline nasal airflow, age, gender and study groups were used as predictors in the imputation model. The normality assumption was evaluated by the regressions residuals with Shapiro-Wilk test.
RESULTS: Complete case-analysis showed significantly higher post-expansion nasal airflow for the hybrid group, mean difference 49.7 Pa (95% CI; 4.4-95.0, *P* = 0.033), compared to the conventional tooth-borne expanders. The MI model showed similar mean difference, 52.2 Pa (95% CI; 3.6-100.8, *P* = 0.037), in favour of the hybrid group when taking into account the missing values from the T1 examination.
CONCLUSIONS: It seems that tooth-bone-borne hybrid expanders influence the nasal airflow values significantly more than conventional tooth-borne expanders. This effect is likely due to the capacity of the hybrid expanders to induce more skeletal expansion in the maxilla.

092 EXTRACTED TOOTH ROOTS USED FOR LATERAL RIDGE AUGMENTATION – A NEW BIOLOGICAL CONCEPT

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AIM: Experimental studies have found extracted tooth roots to be a structural and biological alternative to autologous bone grafts. The aim of this research was to elucidate the biological potential of this novel therapy from an orthodontic perspective.
MATERIALS AND METHOD: Within a preclinical study in dogs, the efficacy of tooth roots used as autografts for lateral ridge augmentation and staged early osseointegration of titanium (Ti) implants were evaluated. For this purpose, differently conditioned tooth roots from maxillary premolars (PM) were used for ridge augmentation at chronic-type defects in both lower quadrants, and tested against retromolar cortical autologous bone blocks (AB) serving as a control. After tooth extraction, the crowns were decapitized, the root cementum was removed, and the grafts were fixed using osteosynthesis screws. Ti implants were inserted after 12 weeks of healing, and the animals were killed after an additional 3 weeks of healing. Analyses were performed using histology, biomechanical testing and microcomputed tomography
RESULTS: Histological evaluation revealed a replacement resorption with comparable median early osseointegration values (PM: 36.96-50.79%, AB: 32.53-64.10%), a comparable osteocalcin antigen reactivity (PM: 6.71%, AB: 2.73%), comparable bone fractions values (PM: 34%, AB: 21%), and comparable removal torque moments (PM: 61.97 Ncm; AB 44.8 Ncm).
CONCLUSIONS: The preclinical results indicate that tooth root grafts might become an alternative to autologous cortical bone grafts for localized alveolar ridge augmentation and staged

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osseointegration of titanium implants. This potential should be considered once third molar teeth are planned to be extracted.

093 ACCURACY AND ELIGIBILITY OF CONE BEAM COMPUTED TOMOGRAPHY TO DIGITIZE DENTAL PLASTER CASTS

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AIM: Software based orthodontic planning requires digital casts and sometimes cone beam computed tomographic (CBCT) radiography. However, purchasing a dedicated model scanner can be expensive and might not be required. The present study aimed to assess whether digital models derived from CBCT scans and models digitized using a dedicated model scanner are of comparable accuracy.

MATERIALS AND METHOD: A total of 20 plaster casts were digitized with eight CBCT scanners and five three-dimensional (3D) model scanners. Corresponding models were superimposed using six control points and subsequent iterative closest point matching. Median distances were calculated among all registered models. Boxplots were generated and the paired *t*-test, a Friedman test and a *post-hoc* Nemenyi test were employed for statistical comparison. The results were found significant at $P < 0.05$.

RESULTS: All CBCT scanners allowed the digitization of plaster casts, but failed to reach the accuracy of the dedicated model scanners ($P < 0.0001$). Median distances between CBCT and 3D scanned casts were 0.064 ± 0.005 mm. Qualitative differences among the CBCT scanners were detected (Chi2 = 85.67, $P < 0.0001$), and one CBCT scanner providing a special plaster cast scan mode was found superior to the competitors ($P < 0.05$).

CONCLUSIONS: CBCT scanners failed to reach the accuracy of 3D scanners, but within the limits of the study, accuracy appeared to be sufficient for digital planning and forensic purposes.

094 FOUR DIMENSIONAL CONTROL OF ROOT MOVEMENT IN LINGUAL ORTHODONTICS BY PRE-TREATMENT CONE BEAM COMPUTED TOMOGRAPHY AND PROGRESSIVE INTRAORAL SCANS

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AIMS: To propose a method that integrates pre-treatment cone beam computed tomography (CBCT) and progressive intraoral scans to monitor lingual orthodontic treatment in three dimensions without any other irradiation in adults with a severe periodontal defect at the lower incisors.

SUBJECTS AND METHOD: Fifteen subjects were enrolled with the following inclusion criteria: adult patient, absence of systemic diseases, presence of at least one periodontal defect such as gingival recession associated with bone reduction due to an incorrect root position in the lower arch. CBCT of the dental arches was performed before treatment (T0) and progressive intraoral scans were obtained at T0, during treatment and post-treatment. The three-dimensional (3D) teeth were obtained by matching the segmented roots from the CBCT and the crowns obtained from intraoral scans at T0. The position of the roots at every observation was registered by superimposing the 3D teeth on the crowns obtained from intraoral scans.

RESULTS: After analysis of the root position during treatment some adjustments were made either for bracket repositioning or bending the wire to achieve the correct placement of roots, required for successful orthodontic treatment that is stable, healthy and functional. The technique was successfully used on examined patients and allowed accurate assessment of the position of the roots of the teeth inside the bone limits of the patients associated with well aligned, levelled lower arches and a spontaneous correction or improvement of gingival recessions, due to a more appropriate location of the roots in the periodontium.

CONCLUSION: The proposed system has been found to be reliable, effective and non-invasive in monitoring active orthodontic treatment, especially in periodontal cases, where it is necessary to consider the anatomical boundaries of the patient's tissues. The limits of the proposed approach

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could be related to any imprecision of segmentation due to differences in density of bone and teeth related to individual characteristics of the patients.

095 USING ARTIFICIAL INTELLIGENCE TO EVALUATE THE IMPACT OF ORTHOGNATHIC THERAPY ON APPARENT AGE AND FACIAL ATTRACTIVENESS †††

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AIM: Improvement of facial appearance is one of the primary reasons why patients seek orthognathic treatment. While it is extremely difficult to quantify beauty, artificial intelligence enables the estimation of attractiveness (i.e. characterizing the attractiveness of particular facial traits) and apparent age from a single facial image. The aim of this study was to apply an established and validated algorithm to orthognathic patients in order to assess the impact of orthognathic treatment on apparent age and facial attractiveness.

MATERIALS AND METHOD: Pre- and post-treatment photographs (n = 2175) of 148 consecutive orthognathic patients [females: 79 (53.4%); males: 69 (46.6%); mean age before treatment: 23.1 years] were collected for this longitudinal retrospective single-centre evaluation. For every photograph, apparent age and facial attractiveness were established with a computational algorithm comprising a face detector, convolutional neural networks for the extraction of deep features, and support vector regression for apparent age and facial attractiveness. The computational algorithm was trained on >13,000 facial images with over 17 million ratings for attractiveness, and on >0.5 million images for age estimation. The results for pre- and post-treatment photographs were averaged for every patient separately, and compared to real age. Differences between real age and apparent age, and changes in facial attractiveness due to orthognathic therapy were investigated using a Wilcoxon signed-rank test.

RESULTS: Before therapy, patients appeared older than their real age, with a mean difference between apparent age and real age of 1.53 years for females ($P = 0.008$) and 1.67 years for males ($P < 0.001$). After treatment, the discrepancy between apparent age and real age was reduced in both genders. With a mean difference of 0.44 years for females, real age and apparent age did not significantly differ ($P = 0.371$), whereas in males most of the dissimilarity remained with a mean difference of 1.55 years ($P = 0.002$). Facial attractiveness did not significantly improve for females (42.3 to 40.7%; $P = 0.318$) or males (46.9 to 48.4.0%; $P = 0.255$).

CONCLUSIONS: Orthognathic therapy changes facial features and produces, especially in females, a younger facial appearance. However, facial attractiveness, as assessed with artificial intelligence, seems to remain unaffected. Potential patients for orthognathic therapy should be made aware of this fact.

††† Winner of an EOS Scientific Poster Award

096 THE ROLE OF SONIC HEDGEHOG IN EARLY DEVELOPMENT OF LINGUAL EPITHELIA

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AIM: The mammalian tongue dorsum is characterized by multiple rows of fungiform papillae, which contain differentiated taste buds and contribute to taste sensation. Sonic hedgehog (Shh) is a secreted signalling molecule, which progressively localizes to the fungiform papillae during specification and subsequent morphogenesis of these repetitive structures. It has been demonstrated using inhibitor experiments in explant culture that Shh has multiple roles during the development of fungiform papillae such as regulating local induction and patterning of these structures, whilst constitutive activation in transgenic mice alters lingual epithelial cell fate.

MATERIALS AND METHOD: The role of Shh signalling during tongue development using tamoxifen-inducible Cre-mediated ablation immediately following the initiation of tongue development and prior to specification of the papillary placodes was investigated.

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RESULTS: Early loss of Shh results in the formation of ectopic epithelial thickenings in the anterior tongue that initially resemble disorganized placodes. These thickenings later develop into bulb-like structures with disrupted morphology, innervation and delayed growth. The results demonstrate a role for Shh in cell fate determination in undifferentiated tongue epithelium. Specifically, Shh has a dual role both before and after formation of the fungiform papilla.
CONCLUSIONS: Interestingly, the ectopic bulb-like structures that appear in the anterior tongue in the absence of Shh signalling resemble tongue nodules. These nodules are often found on the tongue dorsum of patients affected by ciliopathies, which suggests a potential mechanism underlying these defects associated with disrupted Shh signalling.

097 DOES SYSTEMIC MEDICATION IN JUVENILE IDIOPATHIC ARTHRITIS PATIENTS AFFECT CONDYLAR GROWTH DIFFERENTLY THAN ARTICULAR CORTICOSTEROID INJECTION?

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AIM: Arthritic joint affection in juvenile idiopathic arthritis (JIA) patients can be treated in different ways to reduce chronic inflammation of the synovia. Primarily, local corticosteroid injection (CSI) or systemic medications known as disease modifying anti-rheumatic drugs (DMARD) are used in treatment. The aim of this study was to evaluate how condylar growth in children diagnosed with JIA is affected when patients are treated with DMARD compared to those treated with CSI of the temporomandibular joint (TMJ).
SUBJECTS AND METHOD: Forty-nine consecutive JIA patients treated with DMARD (35 females, median age 6.4 years) were recruited for this longitudinal retrospective single-centre evaluation. Based on serial magnetic resonance imaging (MRI) of the TMJ (median observational period 3.4 years), changes in ramus length were assessed and compared to another previously investigated cohort of 33 JIA patients (23 females, median age 5.2 years) of the same centre who were subjected to repetitive intra- or extra-articular CSI of the TMJ over a median period of 5 years (2.4 ± 1.4 CSI per joint, range 0-7 CSI). Ramus length was defined as the line parallel to the posterior border of the ramus through the most cranial point of the condyle to the intersection with the inferior border. All measurements were performed on contrast-enhanced MRI (1.5 Tesla scanner), on minimum intensity projections.
RESULTS: Yearly mean growth rate, defined as yearly ramus length increase over the observed time, differed between patients receiving DMARD and the cohort subjected to CSI. Ramus length increased normally in patients treated with DMARD (1.35 mm/year). In comparison, long-term ramus length increase was reduced in JIA patients receiving CSI (0.7 mm/year), while short-term growth rate indicated even a decrease of ramus length in JIA patients receiving intra-articular CSI (–1.0 mm/year).
CONCLUSIONS: DMARD and CSI affect condylar growth differently. For JIA patients with chronic inflammation of the TMJ synovia, treatment with DMARD seems more beneficial for condylar growth than articular CSI.

098 STRONTIUM ENHANCES PERIODONTAL LIGAMENT CELL GROWTH AND OSTEOGENIC BEHAVIOUR *IN VITRO*

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AIM: Retention after orthodontic tooth movement is problematic, and may be improved pharmacologically by strontium (Sr) treatment. Reorganization of tooth supporting tissues, such as periodontal ligament (PDL) and alveolar bone after orthodontic tooth movement is important in order to avoid relapse. Thus, the aim of this study was to investigate the effect of non-radioactive Sr on PDL cells (PDLCs) growth and osteogenic behaviour.
MATERIALS AND METHOD: Primary human PDLCs were cultured with or without one of four increasing Sr concentrations, ranging from the physiological level of Sr to thousands of times this

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value. Changes to the morphology of PDLCs were assessed by measuring cell spreading area after 2, 4, 6 and 24 hours. The proliferation rate of PDLCs was analyzed by automated cell counting after 1, 3 and 7 days. Osteogenic behaviour of PDLCs was assessed by alkaline phosphatase (ALP) activity after 7 and 14 days. Expression of osteogenic genes, ALP, Runt-related transcription factor 2 (RUNX2), osteopontin (OPN), and osteocalcin (OCN), was analyzed using real-time polymerase chain reaction after 1, 3, 7, 14 and 21 days. Data was compared group- and period-wise by one-way ANOVA followed by Tukey multiple comparison tests.
RESULTS: PDLCs were responsive to treatment with the highest Sr concentration (Sr4) used in this study, when compared to non-treatment. PDLCs subjected to Sr4 had an increased spreading area after 4 hours and a higher proliferation rate from 3 days. In addition, PDLCs treated with Sr4 showed an increased expression of two important bone matrix proteins, OCN and OPN, from 7 days. Moreover, osteogenic behaviour was also found to be altered by lower ALP activity from 7 days, lower ALP gene expression from 3 days and transient lower RUNX2 gene expression at 7 and 14 days, when subjected to Sr4.
CONCLUSIONS: PDLCs responded to Sr treatment with enhanced cell proliferation and osteogenic behaviour *in vitro*. Therefore, Sr treatment may represent a feasible strategy to improve retention after orthodontic tooth movement by enhancing the potential for PDLCs guided remodelling of PDL and alveolar bone formation.

099 OUTCOME QUALITY OF HERBST-MULTIBRACKET TREATMENT – A COMPARISON OF 708 CONSECUTIVE CLASS II DIVISION 1 AND CLASS II DIVISION 2 PATIENTS

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AIM: Outcome quality evaluation of Herbst-Multibracket appliance (MBA) treatment comparing Class II:1 and Class II:2 malocclusions.
SUBJECTS AND METHOD: All Class II patients who had been treated with a Herbst appliance and subsequently with a MBA at the study centre since 1986. Study models from before treatment, after Herbst-MBA treatment and after ≥24 months of retention were assessed using the Peer Assessment Rating (PAR) index (Richmond *et al*., 1992), the Ahlgren scale (Ahlgren, 1993) and standard occlusal variables.
RESULTS: A total of 708 patients (526 Class II:1; 182 Class II:2) had been treated with a Herbst-MBA. The mean pre-treatment age was 14.4 (Class II:1) and 16.0 (Class II:2) years, respectively. The mean total treatment duration amounted to 24.2 (Class II:1) and 22.1 (Class II:2) months. During active treatment a PAR score reduction from 32.4 ± 8.8 to 8.0 ± 4.5 (minus 75.3%) occurred in Class II:1; the corresponding values in Class II:2 were 25.2 ± 7.7 and 7.1 ± 4.5 (minus 71.8%), respectively. During the post-treatment period (mean 31.8 months, n = 319) a PAR score increase (mean 1.0 ± 5.3) was only seen in Class II:1 (final score: 8.8 ± 5.1). According to the Ahlgren scale, 52-53 per cent of the results were excellent or good, while 44-45 per cent were rated acceptable, and only 3 per cent were considered unsuccessful.
CONCLUSIONS: Herbst-MBA therapy is an effective treatment concept for Class II:1 and Class II:2 malocclusions. During an active treatment period of approximately 2 years high-quality outcomes can be achieved in the majority of patients. The short-term stability of these results is good for Class II:1 and very good for Class II:2.

100 HERBST-MULTIBRACKET TREATMENT – HOW STABLE ARE THE RESULTS 15-25 YEARS LATER?

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AIM: To investigate the post-treatment (Tx) changes (≥15 years) after Herbst appliance and subsequent multibracket appliance (MBA) Tx in former Class II division 1 patients.
SUBJECTS AND METHOD: Fifty two out of 119 former patients could be located and participated. At a mean age of 13.7 ± 1.8 years, Herbst-MBA Tx had been performed. The mean post-Tx observation

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period was 18.3 ± 3.1 years. Study models from before and after Tx, after retention as well as after recall were evaluated using the Peer Assessment Rating (PAR) index as well as standard occlusal variables.
RESULTS: Pre-Tx, the mean values of the 52 participants were: PAR score = 27.2 ± 7.6, Class II molar relationship (MR) = 0.7 ± 0.2 cusp widths (CW), overjet = 8.2 ± 2.1 mm and, overbite = 4.1 ± 1.6 mm. After Tx, the mean PAR score was 3.3 ± 2.2. A Class I MR (0.0 ± 0.1 CW) was present while overjet and overbite had decreased to 2.3 ± 0.7 and 1.3 ± 0.7 mm, respectively. After retention (mean 31.4 months), the mean values were: PAR score = 5.6 ± 4.8, Class II MR (0.0 ± 0.1 CW), overjet = 3.1 ± 0.9 mm and overbite = 2.1 ± 1.3 mm. The data of the 67 non-participants did not differ significantly, although the PAR scores were slightly higher by 3.0-4.6 at all times. At recall (mean 18.3 ± 3.1 years post-Tx), a slight PAR score increase (+2.6) had occurred (final value: 8.2 ± 5.5); this was mainly due to mild increases in overjet and overbite (final values: 3.6 ± 1.1 mm and 2.8 ± 1.6 mm) while the sagittal MR (0.0 ± 0.2 CW) was stable.
CONCLUSIONS: Herbst-MBA Tx enables Class II division 1 correction with very good long-term stability.

101 A NOVEL STANDARDIZED THREE-DIMENSIONAL ANALYSIS TO ASSESS CLEFT SIZE BASED ON DIGITAL MODELS OF UNILATERAL CLEFT LIP AND PALATE PATIENTS

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AIM: To develop a three-dimensional (3D) analysis based on digital models in unilateral cleft lip and palate (UCLP) patients in order to quantify cleft dimensions and to evaluate the validity and intra-examiner reproducibility of this method.
MATERIALS AND METHOD: Thirty-one plaster casts of UCLP infants (mean age: 1.1 months) were digitized. The virtual models were analyzed with software for 3D analysis for the linear measurements and 3D-modelling software for the surface measurements (Mimics 18.0 and 3-matic 10.0, Materialise, Leuven, Belgium). Anatomic and geometric landmarks and a coordinate system were defined. Cleft size was measured using a linear and an area approach, and the ratio between cleft surface and total palatal surface was calculated (3D Infant Cleft Severity Ratio). The intra-examiner error of the method was quantified. For the validity assessment, the digitally measured major and minor segment areas of 10 models were compared with silicone membranes adapted to the corresponding plaster casts and analyzed by optic microscopy.
RESULTS: Bland Altman plots revealed a clinically insignificant bias for anterior cleft width (0.15 mm) and arch length (0.2 mm). The technical error of the method ranged from 0.26 to 0.46 mm for linear measurements and from 8.9 to 11 mm² for area measurements. Intra-rater reliability for ratio measurements was 0.99 (intraclass correlation). Differences for area measurements performed on digital and plaster models were less than 2 per cent.
CONCLUSIONS: The developed analysis, based on laser scanned digital infant models, offers a valid and reproducible 3D assessment of cleft size and morphology. The 3D Infant Cleft Severity Ratio can serve as a baseline, when the results of different treatment approaches are compared. It may also have an important diagnostic value when planning surgical closure, and a prognostic value when predicting maxillary growth.

102 MANDIBULAR INTERMOLAR WIDTH CHANGES DURING TREATMENT WITH AND WITHOUT EXTRACTIONS

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AIM: Stability of orthodontic results is related to preservation of pre-treatment arch form and size. The aim of the study was to evaluate mandibular intermolar width during treatment and compare changes between patients treated with and without extractions. Additional arch size measurements were investigated.

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MATERIALS AND METHOD: The study was retrospective in design, ethically approved. Each group (extraction, non-extraction) comprised 40 patients, treated at the postgraduate orthodontic clinic, University of Bergen. Variables such as age, gender, Angle classification, overjet, overbite, curve of Spee, crowding, headgear, lingual arch, agenesis and incisor inclination and position were recorded from the treatment journals. Pre- and post- treatment models were digitally scanned. Distances between the first molars, canines, first and second premolars, arch cord, arch canine and molar depth were measured in both jaws. Paired *t*-tests were performed to evaluate treatment changes for all variables. Differences, considering treatment changes of mandibular intermolar width, between the groups were assessed by Student's *t*-test. This was repeated for the rest of the measured variables. Regression analysis was applied to examine the effect of the recorded journal variables on changes of arch measurements during treatment.
RESULTS: Mandibular intermolar distance was significantly more reduced at extraction group [P = 0.02, confidence interval (CI = –2.69, –0.28). For all patients, there was a significant reduction of mandibular intermolar width (P = 0.01, CI = 0.12, 1.37). Mandibular intercanine distance remained stable. The distance between the maxillary molars was reduced significantly more in the extraction group, but no significant changes were observed for the total sample. For all patients, the maxillary intercanine distance was significantly increased, without any significant difference between groups. Maxillary and mandibular molar depths, mandibular canine depth and arch cord were reduced significantly more in the extraction group and for all patients. Overjet, crowding, age, interincisal angle, incisor position and inclination were significantly associated with some measured variables.
CONCLUSIONS: Extraction treatment seems to result in reduction of intermolar width in both jaws. Mandibular intercanine distance was stable. Apart from maxillary intercanine distance, no other expansion effect of treatment on arch dimensions was observed which could have a positive contribution on the stability of the result.

103 MAGNETIC CEPHALOMETRIC DIAGNOSTICS***

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AIM: New magnetic four-dimensional-measurements of the orthodontic patient lead to accurate and repeatable cephalometric data. The device offers accurate 1:1 coordinates from the patients direct after scanning.
MATERIALS AND METHOD: To evaluate the accuracy of the noXrayCeph-Device, a patient and an anatomic skull were measured 10 times by different trained and untrained observers. The device from the noXrayCeph AG, CH-Meilen is a magnetic scanner with a carbon headcap, including three magnetic coils. The stylus is measures the *x, y* and *z* coordinates with a technical error of 0.22 mm.
RESULTS: The three-dimensional data produces a picture of the skull, reduced to the 76 points of orthodontic importance. The accuracy of the measurements from four different observers were calculated using the Wilcoxon test. Intraobserver test was significant at 0.01 for the ANB, the position of MX 11 and 21 point to A and the incisor angulation. The interobserver test was significant at the 0.05 level.
CONCLUSIONS: The noXrayCeph device is reproducible with a quite low intra- and inter-observer error. Reproducibility can be measured on one patient, because cephalometric diagnostics is possible without radiographs. Due to fast measurements the device seems to be useful in clinics, where different observers examine the patients. The low weight of the carbon head cap allows movements of the patient's head, because the coordinates move 1:1 with the patient.

104 DIFFERENCE OF NON-INVASIVE NOXRAYCEPH *IN VIVO* AND *IN VITRO****

Thorsten Brandt[1], Stefan Kopp[2], Departments of Orthodontics, [1]OrthoClinic Meilen/University Frankfurt, Meilen, Switzerland and [2]University Frankfurt, Frankfurt/M., Germany

AIM: There is still a deviation between *in vivo* and *in vitro* examination in cephalometric examination. To diminish these differences, patients were measured with a fixed head device,

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noXrayCeph, which is moveable. The fixation to the moving patient should not make any difference in an unmoving *in vitro* examination.
MATERIALS AND METHOD: The magnetic device, noXrayCeph (noXrayCeph AG, Meilen, Switzerland) is the only device for orthodontic cephalometric examination without radiographs. It is used by the Universities of Leipzig and Greifswald, Germany for live studies of 100.000 inhabitants or student education. Accuracy varied from 0.22 to 0.34 (standard deviation). A skull and four patients were examined by five observers. The accuracy of different angulation of the incisors and the length of the upper and lower jaw were compared and analyzed by Student's *t*-test.
RESULTS: The angulation of the upper incisors was more accurate in the *in vitro* group ($P < 0.01$). The length of the lower jaw on the left and right sides was also measured *in vivo* and *in vitro*. Due to a small intra-observer mistake, the difference was significant. A quite small difference of a maximum of 0.75 mm was found. With pressure of 0.5 N on the tip of the stylus, differences were less than 0.55 mm.
CONCLUSIONS: The noXrayCeph device measures three-dimensional anatomical points, such as the incisors as good *in vivo* as *in vitro*. The differences in bone length could be explained by the soft tissue and the different pressure of each observer due to more or less contact to the bone. Even the measurement procedures seem to influence the result. However, *in vitro* was more accurate, than the measurements of a moving patient.

105 IS INTERCEPTIVE ORTHODONTIC TREATMENT EFFECTIVE AND DOES IT REDUCE THE NEED FOR FURTHER COMPREHENSIVE ORTHODONTIC TREATMENT?
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AIM: To investigate the effectiveness and economical aspects of interceptive orthodontic treatment (IOT). The null hypothesis is that IOT reduces the need of comprehensive orthodontic treatment (COT) and/or reduces the risk of developing a further malocclusion. Therefore, it would be more economical in the long run to treat patients in the early mixed dentition.
MATERIALS AND METHOD: A retrospective systematic review of medical journals at Karolinska Institute, Sweden with IOT registered among patients between the ages of 7-17 years at the beginning of treatment. The parameters of malocclusion examined were gender, age and treatment modalities.
RESULTS: The majority of malocclusions in both genders was anterior crossbite. Patients between the ages of 7-12 years had a higher number of removable bite plates as treatment compared to those aged between 12 and 17 years. A significant number of patients (41%) with an anterior crossbite received a removable bite plate as treatment. The appliances used in the treatment of crossbite were removable bite plate (44%) and quadhelix (56%). Seventy five per cent of scissor bites were corrected with the use of cross elastics. Patients with a Class II division 1 malocclusion who received COT had serial extraction treatment as IOT previously in 75 per cent of all studied cases.
CONCLUSIONS: It is important to understand the aetiology of malocclusion. The well-accepted theory of malocclusion has genetic as well as environmental factors. However, all patients who needed serial extractions as IOT were in need of COT later. The extractions can be undertaken in combination with COT to save time and resources.

106 FRONTAL SINUS MORPHOLOGY IN ANTERO-POSTERIOR CEPHALOMETRIC RADIOGRAPHS OF TURKISH ORTHODONTIC SUBJECTS: A FORENSIC GLANCE
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AIM: To investigate frontal sinus morphology on antero-posterior cephalometric radiographs of Turkish orthodontic subjects.
SUBJECTS AND METHOD: Seventy subjects divided into two groups (male 35 subjects; mean age: 14.91 ± 1.77 years; female 35 subjects; mean age: 15.19 ± 1.31 years). The right and left maximum height and width of the frontal sinus, maxillary width, nasal width, cranial width and antegonial

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width parameters were measured on 70 antero-posterior cephalometric radiographs. The data were analyzed using independent *t*- and Mann Whitney *U* tests. Pearson and Spearman correlation analyses were used to evaluate the relationships of the frontal sinus measurements and transverse cephalometric parameters.
RESULTS: The mean values of the right frontal sinus width, nasal width, maxillary width, antegonial width and cranial width were larger in males than females ($P < 0.05$). In males, the right maximum height of the frontal sinus (r = 0.368; $P = 0.030$) and left maximum height of the frontal sinus variables (r = 0.387; $P = 0.022$) were positively correlated with cranial width. In females, there was no correlation between frontal sinus parameters and cranio-skeletal parameters.
CONCLUSIONS: The frontal sinus dimension and associated cranio-skeletal parameters can probably be used as an additional indicator for forensic dentistry.

107 EVALUATION OF THE EFFECTS OF RAPID MAXILLARY EXPANSION ON PAIN AND CYTOKINE LEVELS

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AIM: To evaluate the effects of rapid maxillary expansion (RME) on bone metabolic activity in the early active period and after 3 months of retention, and also to examine pain levels in the first week of activation.
SUBJECTS AND METHOD: Fourteen patients (mean age 12.9 ± 0.6 years) with skeletal maxillary deficiency were treated with an acrylic bonded expansion device which was activated twice per day. The devices were kept on the mouth as a retainer for 3 months. Clinical periodontal parameters were recorded at baseline and after the retention periods. Gingival crevicular fluid (GCF) samples were collected from the maxillary first molars from the compression sites at baseline and on the 1st and 10th day and after retention, while tension site samples were obtained at baseline and after retention. Changes in the levels of Interleukin 1beta (IL-1β), transforming growth factor beta1 (TGF-β1), prostaglandin E_2 (PGE_2) and nitric oxide (NO) were detected in GCF. Pain scores in the first week of activation were also assessed.
RESULTS: Periodontal parameters increased significantly at the end of retention in relation to baseline levels. Increased levels of IL-1β, TGF-β1 and PGE_2 were evident at day 10, with a decrease after retention at the compression site. However, NO levels were elevated on day 10, and remained at high levels after retention at the compression site. Tension site cytokine levels were significantly elevated after the retention period in comparison to baseline levels. The results related to pain scores were found to be significantly high on the first day of screw activation.
CONCLUSIONS: Bone metabolic activities reveal different responses at the compression and tension sites of supporting teeth with RME. Bone remodelling still continues after 3 months of retention at the tension site. This finding indicates the importance of periodontal tissue remodelling and for clinicians to consider the correct duration of retention after RME treatment. Additionally, patients should be informed that pain might be high on the first day of activation but will eventually decrease.

108 EFFICACY AND STABILITY OF A FUNCTIONAL CLASS II APPLIANCE IN GROWING PATIENTS

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AIM: To evaluate the efficacy of a Class II removable appliance to treat Class II malocclusions in growing patients.
SUBJECTS AND METHOD: This prospective controlled study included 52 subjects (29 boys, 23 girls) with a skeletal Class II division I malocclusion. Twenty six patients were consecutively treated with the PUL appliance (PG) and then a full multibracket appliance was used. PUL treatment started at a mean age of 11.3 years and therapy ended at a mean age of 14.3 years. The PUL group was

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compared with a longitudinal group (CG) of untreated Class II division 1 patients (26 cases of the American Association of Orthodontists Foundation legacy collection). Customized cephalometric examinations were undertaken. Lateral cephalograms of the PUL group were analyzed before the start of treatment (T0), at the end of the protocol (T1) and after multibracket therapy (T2). PUL patients wore the removable appliance for a mean of 9 months while the mean treatment time for multibracket therapy was 14 months. Blinded comparison between skeletal and dentoalveolar effect starting forms and on the T1-T0 or T2-T0 changes in each group was performed. Statistical significance was tested at $P < 0.05$. Baseline difference were tested using *t*-test and interaction analysis was also carried out to determine whether the PUL parameters in treatment groups were different according to the placement times, using the linear mixed-effects model. The likelihood ratio (LR) test was used as a test of statistical significance and *P*-values were adjusted for multiple comparisons using the Bonferroni correction method.
RESULTS: Significant ANB, overjet and Wits differences existed between the PUL and CG groups. In particular at T1, the PUL group showed a significant decrease of ANB angle, overjet and Wits (–1.58, –4.27 and –2.38., respectively). At T2 correction of sagittal intermaxillary relationships was stable: the reduction of the same parameters was statistically significantly higher in the PUL group (–2.08, –5.12 and –2.50, respectively). Moreover PUL had an efficiency of 0.25 mm/month.
CONCLUSIONS: The functional appliance efficiently corrected the Class II malocclusion with predominant dentoalveolar effects.

109 ATTRACTIVE PERCEPTION OF CLASS II PATIENTS TREATED WITH EXTRACTIONS VERSUS INTERMAXILLARY OR OTHER MANDIBULAR ADVANCEMENT DEVICES

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AIM: To compare the aesthetic perception of profile silhouette photographs of Class II patients before and after treatment (extractions or mandibular advancement), according to a visual analogue scale (VAS) among orthodontists, general dentists and lay people.
MATERIALS AND METHOD: A presentation of 18 pre-treatment silhouette tracings with a facial profile line of Class II adult patients was shown to three groups of participants (25 orthodontists, 25 general dentists and 25 lay people) and a month later to the same groups, 18 post-treatment tracings of the same patients. Nine tracings (5 males, 4 females) were of subjects with four extracted teeth (maxillary first premolars and mandibular second premolars) and nine (4 males, 5 females) of patients who had undergone dentoalveolar mandibular advance (Forsus and Class II elastics). An ANOVA test was performed to compare the pre- and post-treatment scores. Independent variables studied were: gender, age and previous or present orthodontic treatment of participants
RESULTS: All groups scored the post-treatment silhouette significantly higher ($P < 0.001$). Advancement treatment scored significantly higher than extractions ($P < 0.001$), especially among lay people ($P < 0.001$). Orthodontist gave the lowest scores regardless of treatment ($P < 0.001$). No differences were found between the scores of males and females ($P > 0.05$). Participants 30-39 years old gave higher scores than the other age groups ($P < 0.001$).
CONCLUSIONS: Class II orthodontic treatment always improved the profile aesthetic of patients. Advancement treatment resulted in a better aesthetic perception than extractions especially among lay people.

110 SHORT-TERM EVALUATION OF SURGICALLY ASSISTED RAPID MAXILLARY EXPANSION WITH A BONE-BORNE APPLIANCE; MAXILLARY BENDING OR BODILY EXPANSION? – A PILOT STUDY

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AIM: To assess the skeletal and dentoalveolar changes observed with surgically assisted rapid maxillary expansion (SARME) with a bone-borne (BB) appliance without influence of orthodontic appliances using three-dimensional cone beam computed tomography (CBCT) evaluation.
SUBJECTS AND METHOD: Ten consecutive patients were included in this retrospective cohort study. CBCT scans were taken following the ALARA principle and Helsinki guidelines according with the treatment plan indication at two time points: the first (T1) before the start of orthodontic treatment and the second (T2) at the end of the SARME retention phase. The time span between T2-T1 was on average 188.8 (±26.7) days corresponding to approximately 6 months. The studied outcome variables were linear measurements of the maxillary width at different height levels: nasal floor (NF); hard palate (HPPA); alveolar crest (BACLAC) and crown teeth (DAE2DAI2) at the first (1PM), second (2PM) premolar, first (1M) and second (2M) molar. Segmental alveolar tipping (HPPABACLAC) and dental tipping (HPPADAE2DAI2) were also measured as a difference in millimetres between HPPA and BACLAC as well as HPPA and DAE2DAI2, respectively. Wilcoxon statistics were chosen to evaluate observed differences in the variables and the Dahlberg formula to assess observer reliability.
RESULTS: The mean transverse skeletal expansion at 1PM and NF, HPPA, BACLAC, DAE2DAI2 were 3.1 ± 5.2, 5.7 ± 0.9, 6.3 ± 1.7 and 6.3 ± 2.2 mm, respectively. All these results were statistically significant. 2PM and NF, HPPA, BACLAC, DAE2DAI2 were 2.3 ± 2, 4.8 ± 2.1, 5.2 ± 1.6 and 5.6 ± 1.9 mm, respectively. All these results were statistically significant with the exception of 2PM-HPPA. 1M and NF, HPPA, BACLAC, DAE2DAI2 results were 1.7 ± 2.3, 3.0 ± 1.8, 4.5 ± 1.8 and 5.6 ± 1.9 mm, respectively. All these results were statistically significant except for 1M-HPPA. 2M and NF, HPPA, BACLAC, DAE2DAI2 were 2.2 ± 1.9, 2.9 ± 1.0, 3.1 ± 1.5 and 3.5 ± 1.6 mm, respectively. All these results were also statistically significant. HPPABACLAC was shown to be statistically significant only at the level of 1M, indicating an oral/inward tipping. HPPADAE2DAI2 at 1PM, 2PM, 1M and 2M were not statistically significant, indicating no tipping.
CONCLUSIONS: Statistically differences on segmental and dental tipping were not observed with the exception of HPPABACLAC 1M. Instead of maxillary alveolar bending, a translation displacement of the maxillary skeletal, alveolar and dental components was observed. The BB appliance avoided relapse in the retention phase after SARME for up to 6 months.

111 EFFECTS OF DIFFERENT CONDITIONING TECHNIQUES PRIOR TO APPLICATION OF A SELF-ETCHING BOND SYSTEM ON AESTHETIC BRACKET BOND STRENGTH

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AIM: To evaluate shear bond strength (SBS) of Clarity Advanced brackets bonded with the APC flash-free system (3M Unitek Dental Products), using different enamel conditioning techniques.
MATERIALS AND METHOD: Seventy five bovine incisors were divided into three groups (n = 25). Group 1: Transbond™ Plus Self Etching Primer was applied (TSEP, 3M Unitek Dental Products) and Clarity Advanced bracket with the APC flash free system were bonded following the manufacturers' instructions. Group 2: samples were etched with 37 per cent phosphoric acid for 30 seconds, washed and dried. Then TSEP was applied and Clarity Advanced brackets with APC flash free were bonded as in Group 1. Group 3: Samples were polished with prophylaxis paste and brackets were bonded as in Group 1. The teeth were submerged in distilled water at 37°C for 24 hours. SBS was measured using a universal test machine (Autograph AGS-1KND, Shimadzu, Japan) with a crosshead speed of 1 mm/minute. After debonding, the teeth were examined under a stereomicroscope (Nikon SMZ-U zoom 1:10) and an Adhesive Remnant Index (ARI) score was assigned to each tooth (Årtun and Bergland, 1984). Shear bond strength data were analyzed applying single factor analysis of variance and a least significant difference test ($P < 0.05$). Pearson's chi-squared test was applied to compare ARI values between groups ($P < 0.05$).
RESULTS: Bond strength values in groups 2 (18.51 ± 6.25) and 3 (19.89 ± 4.90 MPa) were significantly higher than in group 1 (14.59 ± 5.76 MPa). Groups 1 and 3 tended to present lower ARI scores than group 2.

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CONCLUSIONS: Both etching enamel with phosphoric acid, and polishing enamel with prophylaxis paste before TSEP application significantly improved the bond strength of Clarity Advanced brackets with APC flash free. Enamel conditioning with phosphoric acid tended to increase bond retention on the dental enamel surface.

112 THE RELATIONSHIP BETWEEN THE IDIOPATHIC SCOLIOSIS AND DENTOFACIAL ASYMMETRY

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AIM: To establish the relationship between idiopathic scoliosis and dentofacial asymmetry in young people.
SUBJECTS AND METHOD: Ten patients (2 males, 8 females) aged between 15 and 28 years from the Centers of Medical Rehabilitation in the North-East region of Romania (the cities Iasi and Bacau), with idiopathic scoliosis and malocclusions. Primary curvature of the spine was measured on radiographs using the Cobb method. The patients were wearing orthopaedic corsets and were having physiotherapy exercises and massage. The orthodontic diagnosis was established by clinical and complementary examinations.
RESULTS: All patients were diagnosed with idiopathic scoliosis around the age of 15 years. Six were identified with spine primary curvature under 20 degrees, two patients had curvature between 20 and 40 degrees and two curvature of over 40 degrees. The patients were also diagnosed with malocclusions: Angle Class I (the most frequent - 50%), Class II (30%) and Class III (20%). Facial asymmetry was identified in eight patients (80%). No relationship between orientation of the scoliosis curvature and the side of facial asymmetry or segmentary asymmetries of the body was identified.
CONCLUSIONS: The misalignment of the spine affects the posture of the whole body, of the head and the jaw, leading to the occurrence of component segments asymmetries.

113 TECHNIQUES OF IMAGE PROCESSING ON DIGITAL X-RAYS FOR THE ANATOMIC STRUCTURES AUTOMATED DETECTION

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AIM: To demonstrate the utility of image processing techniques in order to emphasize automatically certain anatomic structures: teeth, tissues and bone contour which help in establishing faster and more accurately the correct diagnosis.
MATERIALS AND METHOD: The focus was on a specific technique – image segmentation using masks and thresholding. This technique was used on five digital radiographs in order to detect automatically the teeth, tissues and bone contours. The images were pre-processed through regular procedures in order to equalize the histogram and to adjust optimally the contrast and brightness.
RESULTS: The teeth were identified with acceptable precision, as well as the bone contours. It was more difficult to identify specific tissues, because their shape is not regular; the only available searching criteria was based on the grey levels, and the differences between nuances were very small.
CONCLUSIONS: Automated image processing on radiographs is an important step in establishing the right diagnosis, but has certain limitations. This method is suitable as a preliminary step of analysis, being able only to provide some hints and focus the physician’s attention on certain interest areas.

114 THE ALVEOLAR ENVELOPE IN GROWING UNILATERAL COMPLETE CLEFT LIP AND PALATE PATIENTS

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AIM: To investigate the alveolar envelope i.e. malocclusion, alveolar bone and lip in growing unilateral cleft lip and palate (UCLP) patients, affecting the difficulty of orthodontic treatment.
MATERIALS AND METHOD: This retrospective research was an integration of four studies of UCLP patients aged 8-13 years. Thirty samples from each study were assessed for the following purposes: 1) Comparison of malocclusions in the early mixed dentition after one- versus two-stage lip and palate repair using models and a three-dimensional (3D) scanner. The first group had the lip and palate repaired simultaneously at an average age of 12 years. The second group had the lip repaired at a mean age of 4 months and the palate repaired at 18 months. An independent *t*-test was employed to determine differences in arch width, overjet, overbite and anterior and posterior crossbites. Pearson's chi-square test was used to detect intergroup differences between the one- and two-stage surgical repair. 2) Comparison of malocclusions in the late mixed to early permanent dentition after surgery using a 3D scanner, same as 1). 3) Comparison of maxillary bone thickness at the infrazygomatic crest on the cleft versus non-cleft side using cone beam computed tomography images. A paired *t*-test was used to reveal the mean differences between the sides. 4) Relationship of upper lip thickness and force magnitude load on the maxillary alveolar bone using 3D finite element models.
RESULTS: 1. Differences of the malocclusions were not detected statistically in the early mixed dentition stage; however, these were revealed in the late mixed to early permanent dentition. A more negative overjet was found in the group which had the lip repaired sooner while a more posterior crossbite was shown in the group which had the palate repaired earlier. 2. The bone on cleft side was statistically thicker than on the non-cleft side for almost all measurements. 3. The thinner the upper lip, the stronger the force on the maxillary bone.
CONCLUSIONS: More treatment difficulty was detected with age in aspects of malocclusion, lip and bone thickness.

115 DIGITAL DYNAMIC THREE-DIMENSIONAL MONITORING OF LOWER INCISOR INTRUSION IN LINGUAL ORTHODONTICS: A PILOT STUDY

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AIM: To propose a three-dimensional (3D) dynamic evaluation of lower incisor intrusion obtained with lingual orthodontics, considering not only dental crowns but also their roots with respect to the alveolar bone limits.
SUBJECTS AND METHOD: Nine adult patients who underwent fixed lingual orthodontic treatment with i-TTя lingual brackets system for the correction of crowding in the lower arch associated with an increased overbite. The appliance was set from the lower second right premolar to the lower left second premolar. Initial records, consisting of photographs, cone beam computed tomography (CBCT) scans (Newtom, Giano, Cefla S.C., Cefla Dental Group, Imola, BO, Italy; 90 KV, 10 mA, 18 seconds) and intraoral scans (3Shape Trios®, 3Shape A/S, Copenhagen K, Denmark) were collected. Threshold segmentation of the CBCT scan was performed to generate a 3D virtual model of each of the teeth of the lower arch, superimposed with the crowns of the same teeth obtained by intraoral surface scan models to generate a complete set of digital composite lower arch. The same procedure was performed to monitor the steps of treatment at T1. T0 and T1 3D superimposition and colour displacement maps were generated to measure and evaluate the movements obtained in the lower arch.
RESULTS: Comparison of T0 with T1 showed that the lower incisors intruded 0.8 mm (range 0.3-1.00 mm) with no clinically significant bodily translation towards the buccal (range 0.2-0.7 mm). Root displacement of the incisors during intrusion in the early stage was totally 'bone-safe' in 88.9 per cent (8 of 9) of the cases observed. No significant extrusion of the premolars used as anchorage units was measured. The interpremolar diameter remained stable suggesting that the functional anchorage used during treatment was reliable.
CONCLUSIONS: This method has proved to be an accurate and reliable approach to dynamically visualize the 3D positions of the teeth, including their roots, with no additional radiation for in-progress treatment monitoring. 3D evaluation showed that the employed lingual appliance allowed

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significant lower incisor intrusion to be obtained with negligible undesired extrusion of the premolars used as anchorage teeth.

116 COMPARISON OF FRICTIONAL RESISTANCE BETWEEN LOW-FRICTION AND CONVENTIONAL ORTHODONTIC LIGATION METHODS

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AIM: Recently, various innovative ligation systems have been introduced to reduce frictional resistance in orthodontic treatment mechanics, resulting in a reduction of force magnitude. However, it has not been proven that the frictional property of those ligation systems actually decrease frictional resistance compared to conventional ligation systems. Thus, the aim of this study was to compare static friction between low-friction and conventional orthodontic ligation methods on stainless steel bracket.

MATERIALS AND METHOD: Forty 0.021 × 0.025-inch straight stainless steel wires (Ormco) were ligated on 40 maxillary right premolar stainless steel brackets with 0.022 × 0.028 inch slots (Metal Bracket, Dentsply Sankin) using four types of ligature: 0.010 inch stainless steel ligature (Preformed Lig Ties Shorty®, Ortho Technology) and three elastomeric ligatures: conventional elastomeric ligature (Standard Mini Stix, TP Orthodontics), polymeric-coated elastomeric ligature (Super Slick Mini Stix, TP Orthodontics), and low-friction elastomeric ligature (Slide®, Leone S.p.A.). Each type consisted of 10 samples. The frictional resistance of each sample was measured using an experimental model mounted on the crosshead of an Instron testing machine with a 100 N load cell, while 10 mm of wire was drawn through the brackets at a speed of 10 mm/minute in the wet state. Statistical comparisons of mean static friction among the groups were analysed using one-way analysis of variance followed by Tukey's Honestly Significance Difference (*post hoc* test) for multiple comparisons.

RESULTS: The mean static friction of the low-friction elastomeric ligature group (10.65 ± 7.42 g) was significantly less than that of the conventional elastomeric ligature group (124.38 ± 26.22 g) and the polymeric-coated elastomeric ligature group (184.99 ± 34.42 g) ($P < 0.05$). However, it was not significantly different from the stainless steel ligature group (32.60 ± 23.33 g). In addition, the mean static friction of the polymeric-coated elastomeric ligature group was significantly greater than that of the conventional elastomeric ligature group.

CONCLUSIONS: The types of ligation method significantly affected frictional resistance. The low-friction elastomeric ligature was found to have the least static friction and was not significantly different from the stainless steel ligature, whereas, the polymeric-coated elastomeric ligature had the greatest static friction and was significantly different from conventional elastomeric ligature.

117 THREE-DIMENSIONAL SHAPE VARIATION OF THE MAXILLA AND MANDIBLE USING GEOMETRIC MORPHOMETRICS

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AIM: To examine the shape variation of the maxillary and mandibular bone surface by means of three-dimensional (3D) geometric morphometric analysis.

MATERIALS AND METHOD: Available pre-treatment cone beam computed tomographic scans of the whole head of 45 patients were used. After rendering and 3D skull reconstruction, a 3D mesh of the craniofacial complex was created and the maxillary and mandibular bones were isolated. The mandible was digitized using an available 3D template, while for the maxilla a novel 3D template was created. Fixed, semi and surface landmarks with 3D coordinates (*x, y, z*) were used to describe maxillary and mandibular shape. Procrustes superimposition and principal component (PC) analysis were performed to analyze the shape data. For method error estimation, 15 randomly selected cases were redigitized and interclass correlation was calculated. Sexual dimorphism was tested with unpaired *t*-tests. The effect of age on the size and shape was estimated by correlation analysis.

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RESULTS: The first four PCs accounted for about 50-60 per cent of the total shape variance. Shape variation in the maxilla was mostly evident in the maxillary width and alveolar height. In the mandible the shape variation was depicted in the width and length of the mandible, the gonial angle, the height and inclination of the condyles, the height and inclination of the symphysis, the height of the alveolar and the coronoid process, the degree of divergent condyles, the height and thickness of the ramus of the mandible and the intense Go point. A significant correlation of PC2 (P = 0.028 < 0.05) and of the size of the mandible was found with age (P = 0.025). Shape and size differences between males and females were not significant. A strong association between shape components of the maxilla and the mandible was evident.
CONCLUSIONS: The first four PCs seem to be the most significant components for shape description. The maxillary and mandibular bone showed a wide shape variation among individuals, accumulated in specific areas, while presenting a strong association with each other, implying their common ontogenic origin and the possible role of function and growth on their adjunct morphology.

118 COMPARISON OF OCCLUSION IN PATIENTS WITH COMPLETE UNILATERAL CLEFT LIP AND PALATE BETWEEN ONE-STAGE AND TWO-STAGE SURGICAL REPAIRS USING A THREE-DIMENSIONAL SCANNER

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AIM: To compare the maxillary dental arch and occlusion in the late mixed to early permanent dentition stage in patients with complete unilateral cleft lip and palate (UCLP), treated by one- and two-stage surgical repair.
SUBJECTS AND METHOD: Thirty subjects were treated by one-stage surgery of the lip and palate with simultaneous closure at mean age 12.63 months and 34 subjects underwent two-stage surgical repair; the mean age of lip closure was 4.29 months and the mean age of palate closure 17.82 months. The overjet, overbite, maxillary anterior arch width, posterior arch width, anterior crossbite, and posterior crossbite were measured on digital dental models (R700 3D; 3Shape, Copenhagen, Denmark) with impressions taken at 8 to 13 years of age. The results were analyzed with independent t- and chi-square tests to assess intergroup differences between the one- and two-stage surgical repair.
RESULTS: In the late mixed to early permanent dentition stage, overjet in the one-stage surgical repair was significantly more favourable than that of the two-stage surgical repair (–2.03 mm and –3.21 mm for one- and two-stage surgical repair, respectively). Conversely, the posterior arch width of the two-stage surgical repair was significantly greater than that of the one-stage surgical repair (43.39 mm and 46.38 mm for one- and two-stage surgical repair, respectively). Nevertheless, no significant differences were observed in overbite (4.35 mm and 4.25 mm for one- and two-stage surgical repair, respectively), anterior arch width (31.26 mm and 32.60 mm for one- and two-stage surgical repair, respectively) or anterior and posterior crossbite between the two groups.
CONCLUSIONS: One-stage surgical repair has a considerable benefit for the antero-posterior plane, and two-stage surgical repair has a benefit for the transverse plane in the occlusion of patients with complete UCLP compared with each other.

119 ACCURACY OF THREE-DIMENSIONAL FACIAL SIMULATION FOLLOWING ORTHOGNATHIC SURGERY IN SKELETAL III CHINESE PATIENTS

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AIM: To determine the validity of a three-dimensional (3D) orthognathic planning software in predicting soft tissue outcome of Chinese patients undergoing orthognathic surgery for correction of Skeletal III dentofacial deformity.
MATERIALS AND METHOD: Pre- and post-operative 3D facial stereophotogrammetric scans and time-matched cone beam computed tomograms (CBCT) were taken for 10 Chinese patients who had undergone orthognathic surgery for the correction of a Skeletal III dentofacial deformity. The pre-

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operative 3D facial scan was fused with the pre-operative CBCT using the Synthes ProPlan CMF (Materialise, Leuven, Belgium) software. Virtual osteotomies were simulated using the pre-operative CBCT with the bony segments moved to match the post-operative CBCT, resulting in a textured soft tissue prediction. The simulated soft tissue 3D face was then compared with the actual 3D facial scan obtained at least 6 months post-operatively. The mean absolute difference, root mean square error and the percentage of 3D points where the distance was less than 2 mm between the predicted and actual soft tissue surface meshes were calculated for six specific anatomic regions (nose, upper lip, right paranasal, left paranasal, lower lip and chin).
RESULTS: The mean absolute difference and RMS error between the predicted and actual soft tissue surface meshes for the six anatomic regions ranged from 0.97 to 1.60 mm and 1.06 to 1.80 mm, respectively. The percentage of mesh points with less than a 2 mm error for the six anatomic regions ranged from 90.9 to 66.0. The lower lip had the greatest mean absolute difference (1.60 ± 0.74) and the least percentage of mesh points with less than 2 mm error (66.0).
CONCLUSIONS: Using Synthes ProPlan CMF, the accuracy of 3D soft tissue predictions for orthognathic surgery in Chinese Skeletal III patients was clinically inadequate especially for the lower lip region. More studies on 3D soft tissue response to orthognathic surgery in Chinese subjects are needed to provide soft tissue simulation algorithms for 3D prediction software.

120 AGE ESTIMATION USING THE MAXILLARY CANINE PULP/TOOTH RATIO BY CAMERIER'S METHOD: A CONE BEAM COMPUTED TOMOGRAPHIC BUCCOLINGUAL AND HORIZONTAL SECTION IMAGE ANALYSIS

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AIM: To use the buccolingual sectional image of the maxillary canine for age estimation and to establish an age estimation model from cone beam computed tomographic (CBCT) buccolingual and horizontal sectional images in the Korean population.
SUBJECTS AND METHOD: Two hundred and twenty-four Korean patients (mean age: 45.7 ± 15.8 years; age range: 20-77 years) with CBCT data were retrospectively enrolled. These subjects were selected from patients who attended the dental clinic in Pusan national university hospital between January 2014 and December 2015. The CBCT images were taken for routine therapeutic treatment and clinical evaluation. A useful method for age estimation that relies on measurements of the pulp/tooth ratio taken from the horizontal view of the cemento-enamel junction (CEJ) and the root half portion is proposed. These areas are where the highest level of calcified precipitation occurs. In addition, using CBCT to measure the buccolingual section, the widest part of the tooth on the long axis, could solve the problems caused by traditional two-dimensional radiographs. Horizontal section images were obtained from the CEJ and 1/2 of root length positions, where the greatest degree of calcification takes place.
RESULTS: Age can be estimated by the following formula: age = (–0.937) * HA + (–1.138) * HC + (–1.566) * S + (–3.231) * Gender + (0.315) * S * Gender + 81.307 (Gender: male = 1, female = 0). This model involved the use of the MATLAB software, which is quick and easy to use. Therefore this method was fast and very accessible for clinical and forensic application.
CONCLUSIONS: Age estimation with the 3D CBCT method of was used to obtain images without loss of tooth structure. Additionally, this research used the pulp/tooth ratio obtained from buccolingual sectional images that can reflect the degree of pulp calcification accurately because they show more area in the tooth and pulp. As a result, this method could quickly estimate age using 3D CBCT buccolingual images of the right maxillary canine.

121 INNOVATIVE EDUCATION METHODS IN ORTHODONTICS

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AIM: Evaluation of the efficiency of new methods of teaching in orthodontics.
MATERIALS AND METHOD: Three movies presenting procedures were produced in two languages. Four groups of students were in included in the study: A1, A2, B1 and B2. A1, A2 - English division and B1, B2 - Polish students. A1, B1 groups observed procedures during normal dental appointments with dental procedures performed live A2 and B2 watched the movies. Questionnaires were completed by all groups. The questionnaires were assessed and numerous elements were measured e.g. time of production, time which students had to spend on lectures and procedures.
RESULTS: Watching movies during the learning process was perceived by students as more attractive and was their preferred way of learning. Moreover, the results of the study show that this way of learning was more effective than traditional methods and the students who watched the movies achieved better results in the questionnaires.
CONCLUSIONS: Watching movies about dental procedures is an effective way of learning. Students can watch material whenever they need to and repeat it as often as necessary.

Project financed by Santander Universidades BZ WBK in cooperation with Dental Movies at Wroclaw Medical University.

122 A COST MINIMIZATION ANALYSIS OF LARGE OVERJET REDUCTION WITH TWO REMOVABLE FUNCTIONAL APPLIANCES BASED ON A RANDOMIZED CONTROLLED TRAIL

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AIM: To assess and relate the societal costs of reducing large overjets with a prefabricated functional appliance (PFA), or a slightly modified Andresen activator (AA), using a cost-minimisation analysis.
SUBJECTS AND METHOD: A multicentre, prospective randomized clinical trial was conducted with patients from 12 general dental practices. Ninety-seven patients with an Angle Class II division 1 malocclusion and an overjet of ≥ 6 mm were randomly allocated by lottery to treatment with either a PFA or an AA. The PFA and AA groups consisted of 57 and 40 subjects, respectively. The duration of treatment, number of scheduled/unscheduled appointments, and re-treatment were registered. Direct and indirect costs were analysed with reference to intention-to-treat (ITT), successful and unsuccessful outcomes. Societal costs were described as the total of direct and indirect costs, not including re-treatments.
RESULTS: The direct and societal costs were significantly lower for the PFA than for the AA group. The number of visits was lower in the PFA group when ITT was considered, and also for the unsuccessful cases. No difference in re-treatment rate could be seen between groups.
CONCLUSIONS: PFA is the preferred approach for reduction of a large overjet in the mixed dentition, since it minimizes costs and there is no difference in clinical outcome between PFA and AA.

123 THE INCIDENCE, AETIOLOGY AND TREATMENT OF IMPACTED AND TRANSMIGRATED MANDIBULAR CANINES: A SYSTEMATIC REVIEW

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AIM: The incidence of impacted and transmigrated mandibular canines is not as high as in the maxilla; consequently, it is more difficult to find clinical guidelines derived from sound studies based on large patient samples. The aim of this systematic review was to summarize currently available data pertaining to the incidence and aetiology of impacted and transmigrated mandibular canines and the success rates of different treatment strategies.
MATERIALS AND METHOD: This review was registered with PROSPERO (CRD42014006175) and was conducted using Prisma and the Centre for Reviews and Dissemination, University of York statement. A computerized search of studies published up to November 2016 was conducted using

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the following databases: PubMed, Cochrane Central Register of Controlled Clinical Trials, ISI Web of Knowledge and Scopus. To identify any relevant publications not included in this list, the reference lists of the selected articles were manually searched. The Newcastle-Ottawa Scale quality assessment tool was utilized to classify the included papers.
RESULTS: In total, 651 articles were identified after the removal of duplicates. A total of 15 studies published between 2001 and 2016 met all the eligibility criteria and were included for the final analysis. The sample size in these studies ranged from 9 to 112,873 teeth, while their methodological quality ranged from low to medium.
CONCLUSIONS: According to the findings, the incidence of canine impaction in the mandible ranges from 0.92 to 5.1 per cent, while that of canine transmigration ranges from 0.1 to 0.31 per cent. Various aetiologies may play a role, including odontomes (up to 20%) and lateral incisor anomalies (16%). Surgical extraction (89% in some studies) and orthodontic traction (20 to 32%) are the most commonly used treatment strategies, with the latter showing a failure rate of 17 per cent in two studies.

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124 GINGIVAL CREVICULAR FLUID ANALYSIS BY VIBRATIONAL SPECTROSCOPY DURING ORTHODONTIC TOOTH MOVEMENT

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AIMS: The gingival crevicular fluid (GCF) is a site-specific exudate deriving from the epithelium lining of the gingival sulcus. Biochemical analysis of GCF has been used as a simple and non-invasive diagnostic procedure to evaluate biologically active substances expressed in the periodontal ligament and alveolar bone after mechanical stimuli. The GCF composition changes at different times of the fixed orthodontic treatment were evaluated with the Fourier transform infrared (FTIR) microscopy and micro-Raman spectroscopy (μ-RS).
MATERIALS AND METHOD: GCF samples were collected from patients between 10 and 21 years of age before (T0) and after 2 (T1), 7 (T2) and 14 (T3) days of fixed orthodontic treatment. Standardized filter paper cones inserted 1 mm into the gingival crevice were used. The samples were analyzed by FTIR and μ-RS. A Perkin Elmer Spectrum One FTIR spectrometer was used in specular-reflection mode for FTIR spectroscopy analysis, whereas the μ-RS analysis was performed using a Jobin-Yvon TriAx 180 system with a He-Ne laser as excitation source.
RESULTS: FTIR spectra in the range of 4000 to 600 cm^{-1} with 4 cm^{-1} of spectral resolution were obtained from GCF samples. Significant changes in proteins were estimated by analyzing amide I and II bands and changes of lipid and carbohydrates contents were also observed. Raman spectra in the range of 500-3000 cm^{-1} with 4 cm^{-1} of spectral resolution were obtained by μ-RS. A suitable data treatment was used in order to subtract the substrate signal. The main vibrational modes of proteins (amide I, CH3 bands) and lipids were identified. The changes of μ-RS analysis indicated a modification of the secondary structure of proteins, as underlined by the decrease of α-helix mode compared to other secondary structures. Moreover, an increase of carotenoid content in GCF was observed in the samples.
CONCLUSION: The FTIR and μ-RS can give a consistent contribution providing a valuable insight into the nature of GCF and its changes at different phases of orthodontic tooth movement, whereas further investigations are required to use the vibrational spectroscopies as easy methods to assess the periodontal status during different types of treatments.

125 ANALYSIS OF PERIODONTAL LIGAMENT CHANGES BY ORTHODONTIC FORCE USING MICRO-RAMAN SPECTROSCOPY

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AIM: To analyze the micro-structural changes in the periodontal ligament (PDL) after orthodontic force application using micro-Raman spectroscopy (μ-RS).
SUBJECTS AND METHOD: Patients between 13 and 21 years, treated with extraction of upper and/or lower premolars, were selected. Bands and brackets with power pins were applied on upper and/or lower first molars and premolars, respectively. Before extractions, a Sentalloy® 50 g closed coil spring was attached between the molar and premolar after unilateral interproximal reduction of the premolar, using the contralateral side as controls. Patients were randomly assigned to four groups whose extractions were performed after 2, 7, 14 and 21 days, respectively, of force application. A PDL scarification of the extracted premolars was performed. Each PDL sample was fixed in 4 per cent paraformaldehyde, stored in 100 per cent alcohol and examined by μ-RS using a Jobin-Yvon TriAx 180 system with a He-Ne laser as excitation source. The main molecular bond vibrations were estimated from Raman spectra by deconvolution in Lorentzian shaped peaks. Raman spectra in the range of 500-3000 cm^{-1} with 4 cm^{-1} of spectral resolution were obtained for each PDL sample.
RESULTS: The main vibrational modes of proteins and lipids (Amide I, CH3 bands) were identified in the Raman spectra. Analysis showed a modification of the molecular secondary structure in the PDL sample subjected to orthodontic force. After 2 days a decrease and broadening of the Amide I band occurred, whereas a readjustment of the protein structure with relocation and bond formation of H atoms occurred after 7 days. After 14 and 21 days the Raman signal showed some additive mechanisms probably due to protein denaturation, showing a larger β-sheet/random disorder component than ordered α-helix component in the Amide I band.
CONCLUSIONS: μ-RS analysis is useful to investigate the complexity of orthodontic tooth movement providing a valuable insight into the molecular interchain arrangements and conformation changes in the PDL after different times of orthodontic force application.

126 CORRELATION OF THE SINGLE NUCLEOTIDE POLYMORPHISMS OF FGFR1 AND FGFR10 WITH NON-SYNDROMIC CLEFT LIP WITH OR WITHOUT CLEFT PALATE

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AIM: To evaluate the association of FGFR1 and FGFR10 gene variants with non-syndromic cleft lip and palate (NSCLP).
MATERIALS AND METHOD: DNA samples of 25 subjects with NSCLP and 25 unrelated controls were used for the study. The extracted DNA samples were subjected to polymerase chain reaction in which amplification of the selected gene segments was undertaken; later these amplified products were subjected to DNA sequencing.
RESULTS: The findings suggest that the likelihood of NSCLP is higher in subjects having CC ($P = 0.02$) and TC ($P = 0.03$) genotype for FGFR1 gene variant rs13317 and AA ($P = 0.001$) genotype for FGFR10 gene variant rs1448037.
CONCLUSIONS: FGFR1 gene variants rs13317 and FGFR10 gene variant rs1448037 can be used as genetic markers for NSCLP in a local population.

127 EFFICIENCY AND INFLUENCING FACTORS OF HEAD ORTHESIS THERAPY IN INFANTS WITH POSITIONAL PLAGIOCEPHALY

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AIM: To evaluate the efficiency of individual head orthesis therapy in infants with positional plagiocephaly using a non-invasive three-dimensional imaging system and to assess prognostic factors.
MATERIALS AND METHOD: A retrospective analysis of 148 head scans of infants with plagiocephaly between 2009-2015 was performed. One hundred and fourteen infants (74 boys/40 girls) with a

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median age of 6.6 ± 1.6 months were treated with head orthesis and 34 infants with physiotherapy, osteopathy and/or positioning (control group). Cephalic index and 30 degree diagonal difference were measured at the start, after 6 weeks and at the end of therapy. Bootstrapped *t*-tests with corresponding 95 per cent confidence intervals (mean difference) were used for intergroup comparisons and ANOVA with Gabriel *post-hoc* tests to evaluate influencing factors.
RESULTS: The initial 30 degree diagonal difference was >5-10 mm in 14 (12.3%), >10-16 mm in 65 (57.0%) and >16 mm in 35 (30.7%) infants. The initial cephalic index was <98 per cent in 99 (86.8%), 98-102 per cent in 12 (10.5%) and >102 per cent in three (2.6%) infants. The achieved reduction of the cephalic index was significantly greater in the head orthesis group than in the control group (M ± SD: –1.8 ± 3.2% versus –0.3 ± 2.1%; $P = 0.002$). Also the decline of the 30 degree diagonal difference was more pronounced in the orthesis group (–1.9 ± 2.9 mm versus –0.9 ± 2.8 mm; $P = 0.081$). Infants with an initial 30 degree diagonal difference of >16 mm had a significantly higher reduction of head asymmetry than infants with a difference of >5-10 mm (–6.6 ± 2.5 mm versus –2.6 ± 2.8 mm; $P = 0.006$) during head orthesis therapy. The reduction of the cephalic index was significantly higher in subjects with an initial cephalic index >102 per cent than with an index <98 per cent (–13.2 ± 8.1% versus –2.7 ± 2.9%; $P < 0.001$). In addition, a distinct trend towards an increased reduction of the 30 degree diagonal difference was found with decreasing age at the start of therapy ($P = 0.072$), whereas no effect of gender or treatment duration on therapy outcome could be determined.
CONCLUSIONS: The data indicate that head orthesis therapy is a successful treatment option for positional plagiocephaly. In the study, infants with more severe deformations and of a younger age showed major improvement.

128 CRANIAL BASE ANGLE IN PATIENTS WITH ACHONDROPLASIA – CEPHALOMETRIC OBSERVATIONS

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AIM: To present the results of cephalometric measurements in group of patients with achondroplasia and comparison with the available literature.
MATERIALS AND METHOD: Cephalograms were obtained of 18 achondroplastic dwarfs. Achondroplasia was genetically confirmed for every patient. Two cephalometric parameters were analyzed: N-S-Ba and N-S-Ar angles, which describe skull base flexure. The mean normal values are 131 degrees (SD 4.5) for N-S-Ba and 124 degrees (SD 5) for N-S-Ar. During the analysis the mean values with standard deviations for these angles were calculated. Calculations were made for whole group and for genders separately.
RESULTS: Calculated mean angles values in the studied group were: 128 degrees (± 9.1°) for S-N-Ba angle and 117.8 degrees (±10.5°) for S-N-Ar angle. A difference in mean angle values between genders was observed. For females these values were 126.7 degrees (±9.5°) for N-S-Ba angle and 115.3 degrees (±11.2°) for N-S-Ar angle and for males 129.6 degrees (± 8.8°) and 120.8 degrees (± 9.2°), respectively.
CONCLUSIONS: Closing of cranial base angle is shown in the literature for subjects presenting achondroplasia. Cranial base angle in achondroplasts may also be within the norm range and higher. A search should be undertaken to determine factors of the characteristic profile of the faces of achondroplastic dwarfs.

129 EVALUATION OF THE EFFECTS OF INTERMAXILLARY INTRAORAL MOLAR DISTALIZATION WITH MINISCREWS ON DENTOFACIAL STRUCTURES

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AIM: Molar distalization is one of the treatment modalities for a Class II malocclusion. The aim of this study was to evaluate the influence of a newly designed intramaxillary intraoral molar distalization appliance on dentofacial structures. This design applies force from the both palatal and

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buccal sides by passing through the centre of resistance of the molar teeth using miniscrews and coil springs on each side.
SUBJECTS AND METHOD: Nine girls and nine boys with a skeletal Class I or Class II malocclusion, Angle Class II dental malocclusion, well aligned mandibular dental arches and erupted maxillary second molars. Individuals with a Class II division I monobloc indication were not included. The control group consisted of the archived records of five girls and five boys having similar dental, skeletal and growth characteristics to the treatment group. The mean chronological age was 13.85 ± 1.16 years in treatment group and 13.77 ± 1.06 years in the control group. Lateral cephalometric radiographs were taken at the beginning and end of the distalization protocol. Radiographs were also taken of patients in the control group. Angular, linear and proportional parameters related to skeletal structures, dentoalveolar structures and soft tissue profile were measured on the lateral cephalometric radiographs. The intraoral molar distalization protocol finished after a Class I molar relationship was obtained with a 1-2 mm overcorrection. The distalization protocol was completed in 5.2 ± 0.24 months in the treatment group. The average control time was 11.87 months.
RESULTS: In the treatment group the mean first upper molar distalization was 5.36 ± 0.73 mm and for the second molar 4.92 ± 0.7 mm. Distalization was achieved without molar tipping. The changes in the upper incisors, SNA, SNB and ANB angles, overjet and overbite was not statistically significant. On the other hand ın the treatment group anterior lower face height, posterior face height and GoGn/SN angle increased significantly.
CONCLUSIONS: The newly designed maxillary molar distalization system with miniscrews achieved molar distalization and provided a Class I molar relationship successfully without patient cooperation or anchorage loss.

130 EVALUATION OF TRANSPORT MEDIUM FOR EXTRACTED PREMOLARS PRIOR TO CRYOPRESERVATION: AN *IN VITRO* STUDY

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AIM: Prior to cryopreservation the extracted tooth is transported from a contaminated oral environment to the tooth bank. Today, there is no consensus on the transport protocol or the transport medium used for this purpose. The aim of this study was to compare the antimicrobial efficacy of different transport protocols on *Streptococcus Oralis* (*S. Oralis*) grown on sterilized premolars.
MATERIALS AND METHOD: *S. Oralis* (ATCC 6249) biofilms were grown on 10 sterile premolars, incubated for 48 hours and subjected to the following test groups: an untreated (contaminated) control group, a group rinsed with physiological water, a group transported in physiological water, and a group transported in Dulbecco's Modified Eagle's medium (DMEM) with antibiotics (the current protocol). Surviving bacteria were harvested, and the number of colony forming units per disc was determined by plate counting.
RESULTS: There was no significant reduction in contamination after rinsing of the tooth, or transportation of the tooth in physiological water. Significant reductions in viable counts were observed for transport in DMEM with antibiotics when compared to the control group (independent samples test, $P < 0.05$).
CONCLUSIONS: Within the limitations of this laboratory set-up, DMEM with antibiotics was the most effective in *S. Oralis* biofilm elimination. However it could not be concluded that rinsing of the tooth gives an additional reduction. The current protocol (DMEM with antibiotics) was in terms of reducing the contamination the most optimal procedure. A simpler protocol for daily practice cannot yet be proposed.

131 THE INFLUENCE OF CRYOPRESERVATION ON THE SURFACE AND MECHANICAL CHARACTERISTICS OF DENTAL HARD TISSUES: AN *IN VITRO* STUDY

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AIM: Cryopreservation has no adverse effect on dental soft tissues. Research on the influence of cryopreservation on dental hard tissues is scarce. The objective of this *in vitro* study was to investigate the influence of cryopreservation on dental hard tissues by measuring the shear bond strength (SBS) of orthodontic brackets and evaluating the formation and modification of enamel cracks.
MATERIALS AND METHOD: Two experiments were conducted to test the characteristics of the enamel. In the first experiment 66 premolars were randomly allocated to two groups. Stainless steel brackets were bonded with Transbond XT™. A universal testing machine (LRXplus, Lloyd Instruments, Bognor Regis, UK) was used to determine the SBS at a crosshead speed of 1 mm/minute. In group 1, the SBS of the bonded brackets was tested without cryopreservation, in group 2 the evaluation was performed after a cryopreservation procedure of the premolars. After debonding, two examiners determined the adhesive remnant index (ARI) to define the mode of bond failure. In a second experiment the premolars were scanned in a microcomputed tomograph (Hector, XRE bvba, Ghent, Belgium) at 5.5 µm resolution before and after cryopreservation. After three-dimensional reconstruction and image processing (Octopus imaging software) the difference in percentage volume of the enamel cracks was calculated. Data were compared using Fisher's-exact, independent samples *t*-and paired samples *t*-tests. The significance level was set at $P \leq 0.05$.
RESULTS: Although the mean SBS after cryopreservation was lower than without cryopreservation, no significant difference ($P > 0.05$) in SBS was found between cryopreserved and non-cryopreserved premolars. The majority of ARI scores were 1, indicating that failure occurred at the enamel-adhesive interface. There was no significant difference in ARI scores between the cryopreserved and non-cryopreserved premolar groups ($P > 0.05$). In the second experiment the difference in percentage volume of the enamel cracks in premolars before and after cryopreservation was not significant.
CONCLUSIONS: According to the results of this study the cryopreservation procedure had no influence on the surface and mechanical characteristics of the enamel.

132 THE QUADHELIX APPLIANCE: AN ACTIVATION PROTOCOL

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AIM: To systematically review the literature on activation procedures of the quadhelix appliance.
MATERIALS AND METHOD: A literature search was performed in PubMed and Google Scholar databases, and complemented with a manual search in basic orthodontic books, non-indexed Spanish dental journals and orthodontic PhD theses. Inclusion and exclusion criteria were applied when considering the studies to be included in this review.
RESULTS: The quadhelix appliance is a tooth supported device commonly used in both mixed and permanent dentition orthodontic treatments. It is applied for the treatment of malocclusions in the transverse plane and therefore it is used to treat unilateral or bilateral posterior crossbites. Depending on the orthodontic necessities, different activations (symmetrical or asymmetrical) can be performed by the orthodontist. The activations at the anterior sector are recommended to achieve posterior expansion while the activations at the posterior zone produce effects on the anterior area. The first activation of the quadhelix appliance is done extraorally and it is mandatory to adjust it throughout treatment at intervals ranging from 40 to 60 days until the desired expansion is obtained.
CONCLUSIONS: Based on the available evidence in the literature, following the right activation protocol will provide correct use and a better clinical practice. For maximum control, activations should be calibrated and undertaken progressively and extraorally, thus reducing the secondary effects.

133 EFFECT OF DIFFERENT MASTICATORY FUNCTIONAL DEMANDS ON THE THREE-DIMENSIONAL MANDIBULAR CONDYLE MORPHOLOGY OF GROWING RATS USING POSTERIOR BITE-BLOCKS

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AIMS: Apart from the primary effect of bite-blocks on tooth position, they may also influence the mandibular condylar growth. The aim of this study was to investigate the influence of bite-blocks on the condylar morphology, in the context of variable masticatory forces.
MATERIALS AND METHOD: Fifty-two four-week old male rats were divided into hard and soft diet groups in order to create individuals with different masticatory muscle capacity. Two weeks later, they were equally divided into bite-block and control groups. Bite-blocks were made of resin glued to the upper molars. After a total of six weeks experimental time, the animals were sacrificed. The mandibles were scanned with high resolution microcomputed tomography (Perkin Elmer® Quantum GX) and three-dimensional analysis was performed on the condylar neck and head of the condyle. The volume and the length of the condylar process were measured. Statistical analysis was done with a one-way ANOVA.
RESULTS: The use of bite-blocks decreased the length of the condylar process ($p = 0.001$) as well as the volume of the condylar neck ($P = 0.001$) and head ($P = 0.006$). The soft diet decreased the volume of the condylar neck ($P < 0.001$) and head ($P < 0.001$) two to three times more than the bite-blocks but did not affect the condylar process length. The interaction between the two variables was not statistically significant.
CONCLUSION: Both the bite-block appliance and weak masticatory muscle function reduced the volume at all regions of the condylar process, although the functional factor had a substantially greater effect. However, only the bite-block appliance affected the condylar process length. In the presence of both factors, an additive effect was found but no interaction detected.

134 A LONGITUDINAL STUDY ON TIMING AND VELOCITY OF RAT MOLAR ERUPTION

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AIM: Several studies have mentioned approximate eruption times of certain rat molars, but there are no comprehensive studies regarding the eruption timing and velocity rate of these teeth. The aim was to quantify the eruption patterns of the upper and lower three molars from infancy to the end of adolescence in the rat.
MATERIALS AND METHOD: Fourteen male and female Wistar rats were monitored from post-natal day (PND) 12 to 70. They were scanned daily by micro-computed tomography *in vivo* with Perkin Elmer Quantum GX and analyzed with Osirix software. The pre- and post-emergent eruption of the three maxillary and mandibular molars with reference points at the hard palate and mandibular canal were measured. The post-emergent eruption was subdivided into pre- and post-occlusal phases with in respect to the first occlusal contact between two antagonist teeth. Statistical analysis was performed with one-way ANOVA and Tukey *post-hoc* test.
RESULTS: The post-emergent phase of the rat molar eruption is as follows: the first molar erupts on average on the 15th PND, the second molar on the 18th and the third molar on the 24th. The eruption velocity of the first molar was 107.7 microns/day, for the second molar 85.9 microns/day and for the third 68.2 microns/day. The first molar was significantly faster than the two others ($P = 0.02$). Taking into account all molars, on average the pre-occlusal phase had the highest velocity at 84.7 microns/day, the pre-emergent was 67.3 and the post-occlusal was the lowest at 24.6. The differences between the three phases were statistically significant ($P < 0.001$).
CONCLUSIONS: The post-emergent phase of rat molar eruption starts on the 15th PND and continues into the third week. The eruption velocity varies depending on the phase of eruption and also on the tooth. The first erupting teeth had higher eruption velocity than the following teeth.

135 ARE WE COMPLIANT WITH CONE BEAM COMPUTED TOMOGRAPH GUIDELINES?

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AIM: To retrospectively assess compliance with SEDENTEXCT guidelines on cone beam computed tomography (CBCT) requests regarding justification, prior two-dimensional (2D) image acquisition and reporting and to review the number and type of CBCT referrals from the orthodontic department at Guy's and St Thomas's Hospital over a one year period. The gold standard was set as 100 per cent compliance on justification, prior 2D film request and assessment and reporting of CBCT radiographs according to SEDENTEXCT guidelines and Ionising Radiation (Medical Exposure) Regulations.
MATERIALS AND METHOD: The medical records of patients for whom a CBCT was requested between July 2015 and August 2016 were assessed. Data collected included details about the referrer, which 2D images where taken/available before the request, the justification for the CBCT request and if it was reported on.
RESULTS: Eighty three patients were referred for CBCTs within the time period assessed. The reasons for referral were often multiple and included the following out of all cases included in the audit: impacted teeth 77.2 per cent, root resorption 45.8 per cent, dilaceration 21.7 per cent, supernumeraries 16.8 per cent and craniofacial syndromes 1.2 per cent. Incidences of which teeth were impacted, if single/multiple and incidences on root resorption and which teeth were affected were also calculated. In all but one case (99.9%) a 2D image was available before the CBCT request was made. Of the 2D images available for the patients included 85 per cent were dental pantomograms (DPTs), 56.6 per cent lateral cephalometric radiographs, 31.3 per cent upper standard occlusal and 36.1 per cent periapicals. All CBCTs were reported by the radiology team on the patient's electronic record, achieving the gold standard of 100 per cent reporting.
CONCLUSIONS: The gold standard of 100 per cent compliance with SEDENTEXCT guidelines for justification and reporting of CBCTs was achieved. All except one patient (99.9%) had a 2D radiograph prior to referral, not quite achieving the gold standard. The majority of the 2D images requested prior to CBCT were DPTs and lateral cephalometric radiographs. The majority of patients referred for CBCT were for root resorption and impacted teeth.

136 VALIDITY AND RELIABILITY OF THE SWEDISH VERSION OF THE CHILD PERCEPTIONS QUESTIONNAIRE IMPACT SHORT FORM (CPQ11–14–ISF:16)

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AIM: To examine the validity and the reliability of the Swedish version of the Child Perceptions Questionnaire 11-14 – Impact Short Form (CPQ11–14–ISF:16).
SUBJECTS AND METHOD: A sample comprising 257 children [121 (47%) boys and 136 (53%) girls; mean age 11.5 years, SD 0.8] was sourced from three Swedish Public Dental Service clinics. Oral health related quality of life was assessed by asking the children to complete the Swedish version of the CPQ11–14–ISF:16. Twenty seven children presenting for examination were asked to complete the instrument a second time within 2-4 weeks for a test-retest analysis.
RESULTS: Construct validity was tested, and significant correlations were observed between subscale scores and the global ratings of oral health and overall wellbeing. Regarding reliability, Cronbach's alpha was 0.81 for the total scale but lower for the subscales (0.53-0.77); the lowest values were found for oral symptoms (0.53) and functional limitations (0.57). Test-retest reliability was excellent for the total scale [intraclass correlation (ICC) 0.77] and good for the subscales (ICC 0.62-0.74).
CONCLUSIONS: The Swedish version of CPQ11–14–ISF:16 is both valid and reliable, but the subscales should be used with caution.

137 CHANGES IN INCISOR POSITION AFTER TREATMENT WITH MYOFUNCTIONAL APPLIANCES

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AIM: To determine the changes of incisor position after treatment with Myobrace® myofunctional appliances.
SUBJECTS AND METHOD: Forty nine children (6-12 years of age) all treated with Myobrace® myofunctional appliances (Myofunctional Research Co. Australia). At the start and after the end of treatment a full orthodontic analysis of each patient was made. The analyses were based on plaster models, photographic documentation and radiographic diagnostics. The incisor position was evaluated before and after treatment on lateral cephalograms using I/SN, I/ F, I/ANS-PNS, I/i and i/M angles. The data was entered into special tables and statistically processed.
RESULTS: The upper and lower incisor position was changed in 100 per cent cases. The values for I/SN, I/F, I/ANS-PNS and I/i after treatment showed statistically significant improvement to the normal values. The changes of i/M angle showed an overcorrection of buccal inclination and higher values than normal at the end of treatment.
CONCLUSIONS: The Myobrace® system is a good choice for myofunctional treatment of children. The appliances can guide the processes of jaw growth and development in the right direction and reduce the necessity for fixed appliances at later age.

138 THE NECESSITY OF AN INTERDISCIPLINARY TREATMENT APPROACH IN ADULT ORTHODONTIC PATIENTS

Miroslava Dinkova, Department of Orthodontics, Faculty of Dental Medicine, Medical University of Sofia, Bulgaria

AIM: To determine the necessity for an interdisciplinary treatment approach in adult orthodontic patients.
SUBJECTS AND METHOD: One hundred and forty one adult orthodontic patients (21-55 years of age). Full orthodontic and periodontal analyses were made before and after treatment of each patient. The patients were categorized into four different treatment protocols according to the necessity for an interdisciplinary approach (Protocol 1: orthodontic treatment, Protocol 2: orthodontic-periodontal treatment, Protocol 3: orthodontic-prosthodontic treatment and Protocol 4: orthodontic-periodontal-prosthodontic treatment) and into four groups according to age (group 1: 21-34, group 2: 35-45; group 3: 46-55; group 4: over 55 years of age). The data for necessity of interdisciplinary treatment was processed using the statistical package SPSS PC plus (version 4.0.1).
RESULTS: The distribution of the patients according to age and the severity of the treatment protocol (from 1 to 4) were evaluated. In the Protocol 3, patients aged 21-34 years were statistically significantly less than those of group 2 (35-45 years of age). For Protocol 1, group 1 patients were a statistically higher proportion to the elderly groups. Patients with Protocols 2, 3 and 4 were of a significantly greater age. There were no statistically significant relationships between the other treatment protocols and the age groups.
CONCLUSIONS: Adult orthodontic patients need an interdisciplinary approach to treatment for optimized and long-term results.

139 PREDICTION OF THE LATERAL MESIODISTAL WIDTH IN THE SPANISH POPULATION: A SYSTEMATIC REVIEW‡‡‡

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AIM: To evaluate the applicability of Moyers analysis in the Spanish population.
MATERIALS AND METHOD: A literature search was performed in the following online databases: Cochrane Database of Systematic Reviews, PubMed and Scopus. Revista Española de Ortodoncia was also manually searched. Predetermined keywords, inclusion and exclusion criteria were used.
RESULTS: Fourteen articles were identified, seven of which were selected after the inclusion/exclusion criteria and finally only two were eligible for the final analysis. Both articles

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evaluated the applicability of Moyers analysis, and concluded that Moyers predictions underestimate the lateral mesiodistal widths when the sum of the mesiodistal widths of the four inferior incisors is less than 24 mm. They also agreed that males have larger tooth sizes and that the upper lateral arch is bigger than the lower. Each article proposed new regression equations to predict the mesiodistal tooth size of the lateral arch, based on a correlation coefficient.
CONCLUSIONS: According to the articles included in this systematic review, Moyers analysis is unsuitable for the Spanish population. Both regression equations should be compared in the same population to determine their validity. Should they fail, a new regression method should be proposed.

140 ENAMEL MICROCRACKS IN TERMS OF ORTHODONTIC TREATMENT: A NOVEL METHOD FOR THEIR DETECTION AND EVALUATION

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AIM: To present a method for direct qualitative and quantitative evaluation of enamel microcracks (EMCs) employing scanning electron microscopy (SEM) before and after bracket removal and, additionally, to determine the versatility of this technique by applying the same analysis for the teeth from various age groups (younger and older age groups possessing enamel with different mechanical and optical properties).
MATERIALS AND METHOD: Measurements of the detailed EMCs characteristics (location, length, and width) were obtained from the consolidated images (stitching of high resolution SEM micrographs) of the buccal tooth surface (teeth extracted from two age groups of patients) and the derived formulas ($x = h/30$, $l = n*x$) before and after ceramic bracket removal. For statistical analysis, descriptive statistics, a paired samples *t*-test and an independent samples *t*-test were applied.
RESULTS: The measured parameters of EMCs (mean overall values) for the younger age group were 2.41 µm (width), 3.68 mm (length) before and 2.73 µm, 3.90 mm after debonding; for older age group 4.03 µm (width), 4.35 mm (length) before and 4.80 µm, 4.37 mm after bracket removal. EMCs from the older age group showed higher width ($P < 0.05$) and length values. Following debonding EMCs increased for both groups, however the changes in width and length were statistically insignificant. The appearance of new EMCs was recorded for 3 out of 15 (20%) teeth for the younger and 4 out of 15 (26.67%) teeth for the older age group. Newly formed EMCs possessed a lower length and width compared with the characteristics of pre-existing EMCs before the bonding procedure, with a significant result for the width parameter found in the older age group.
CONCLUSIONS: The proposed method, combining SEM mapping and deduced formulas, enabled precise detection of the distinct EMC before and after debonding, qualitative and quantitative examination of its characteristics. This technique can be applied for accurate evaluation of EMCs possessing parameters: width range 0.28-35.94 µm and length range 0.90-9.17 mm, independently of patient age and optical visibility of the tooth surface.

141 A STUDY OF SKULL PARAMETER DIFFERENCES IN NORMAL AND CLASS II DIVISION 2 SUBJECTS

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AIM: To study age-related intensity changes in the skull and faces of Class II division 2 children to detect the morphologic structures differing from normal growth intensity in the primary dentition.
MATERIALS AND METHOD: Seventy four teleroentgenograms of the head in lateral projection. Thirteen longitudinal and 14 vertical parameters of the face and cerebral parts of the skull of 38 (7-12 years of age) during the primary dentition period and of 36 children (12-15 years of age) after this period were studied.

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RESULTS: The intensity of age related changes of many longitudinal and vertical parameters of the skull significantly differed from normal. This intensifies abnormality of the facial skull section resulting in occlusion and abnormality of the facial configuration.
CONCLUSIONS: Data obtained showed that children with a Class II division 2 malocclusion should be treated as early possible.

142 THE NECESSITY FOR EARLY TREATMENT OF DISTAL OCCLUSION AND RETRUSION OF THE UPPER ANTERIOR TEETH

Maria Dushenkova, Marina Pavlova, Tatiana Klimova, Maria Markova, Irina Rubleva, Moscow State University of Medicine and Dentistry, Russia

AIM: To study of intensity the age related changes of linear and angular parameters of the skull in children with distal occlusion and retrusion of the upper anterior teeth compared with children without a malocclusion, to detect some distinctive features of the anterior teeth to compare them with normal and to determine some distinctive features of age-related changes of individual areas of the skull that can perfect diagnosis and help in determination of the most favourable age when orthodontic treatment should be started to obtain stable results.
MATERIALS AND METHOD: Seventy four teleroengenograms of the head in lateral projection of children with distal occlusion and a deep incisor disocclusion (Angle Class II division 2) were obtained and carefully studied. Thirty eight of them were made during the time of change from the primary dentition to the permanent dentition period (7-12 years of age) and 36 after the completion of the primary dentition (12-15 years of age). Nineteen linear and 16 angular parameters of the cerebral and facial skulls sections were determined.
RESULTS: The data obtained on the intensity of age-related changes in the skull and angular linear parameters indicated that orthodontic treatment for children with distal occlusion and retrusion of the upper anterior teeth is necessary at an early age. In diagnostics attention should be paid to the linear and angular parameters of the age-related intensity changes which differ considerably from normal.
CONCLUSIONS: Because of the findings orthodontic appliances of an optimal design can be chosen to improve treatment.

143 COMPARISON OF SCANNING ACOUSTIC MICROSCOPY VERSUS LIGHT MICROSCOPY FOR DETERMINATION OF PERIODONTAL GAP SIZE – RESULTS OF A PILOT STUDY IN DOGS

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AIM: To analyse the performance of different bone replacement materials (BRMs) versus an autologous bone transplant in critical size defects. The original goal was to test if different BRMs can be used as an alternative for augmentation of critical size defects (CSDs) in cleft palate patients followed by tooth movement into the former defect area. In the frame of this study scanning acoustic microscopy (SAM) as a new method was used to measure the size of the periodontal gap (PG). The results should be compared with the conventional light microscopy method.
MATERIALS AND METHOD: In a pilot study Bio-Oss® and NanoBone® were used to fill CSDs in the mandibles of four beagle dogs. Autologous bone transplantation on the contralateral side served as the control. After 7 weeks an orthodontic appliance was placed intraorally to move the second premolar into the former augmented area. Scanning acoustic and light microscopy were used to measure the widths of the PG at six points around the root of the tooth. Due to the characteristics of this pilot study only mean and standard deviations were calculated.
RESULTS: Both methods revealed differences with regard to the dimensions of the PG on the pressure and tension side of the tooth during tooth movement. The quality of the histological samples determined precision of the SAM results.

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CONCLUSIONS: Both microscopic methods to measure dimensions of the PG around the root showed limitations. With good sample quality, SAM can be an alternative to light microscopy. Nevertheless, additional studies should be carried out to gain further experience with SAM.

144 EFFECT OF SURFACE COATING OF ORTHODONTIC MINI-IMPLANTS ON MICROBIOLOGICAL COMPOSITION AND THEIR NUMBER INVESTIGATED IN DOGS – PROOF OF PRINCIPLE

Kathrin Duske[1], Katharina Wegner[2], Andreas Podbielski[3], Jan-Hendrik Lenz[4], Franka Stahl[1], [1]Poliklinik für Kieferorthopädie, Rostock, [2]Fraunhofer IKTS, Dresden, [3]Institut für Medizinische Mikrobiologie, Virologie und Hygiene, Rostock and [4]Klinik und Polikliniken für Zahn-, Mund- und Kieferheilkunde Universitätsmedizin Rostock, Germany

AIM: The failure rate of mini-implants is described in literature up to 55 per cent, most of them as a consequence of bacterial inflammation. Therefore, current concepts used in surgery (use of inorganic metal-ion based implant coating with antimicrobial properties) could be implemented for orthodontic indications to reduce mini-implant failure rate. Additionally, improvement of cell adhesion caused by surface modification could also help to reduce failure rate.
MATERIALS AND METHOD: Mini-implants with two nanocoatings (adhesive plasma polymer layer (PPAAm, n = 6) and anti-microbial copper/titanium-oxide coating (Cu, n = 6)) were compared to uncoated mini-implants (C, n = 4). Two screws on each side of the lower jaw were implanted between the first and second molar (n = 4). At two timepoints (6 weeks, 7 months) the bacterial load was analyzed. The biopsies were cultured on pre-reduced chocolate agar-plates. After five days of cultivation, viable bacterial counts of each species were determined. Afterwards, morphologically variable colonies were identified und sub-cultivated for molecular biological species identification via 16S-rRNA sequencing. Descriptive statistics were used for statistical analysis.
RESULTS: No significant differences between C and Cu were observed for viable bacterial counts at either timepoint. For PPAAm, viable bacterial counts were similar to C. Furthermore, bacterial loads in the regions of insertion showed no significant differences between C, Cu and PPAAm. The analysis of species sequencing showed representative species of *Bacteroides*, *Porphyromonas*, *Fusobacterium*, *Peptostreptoccus* and *Actinomyces*. It was noticeable that each coating supported the improved adhesion of a different species, depending on the regions of insertion.
CONCLUSIONS: In contrast to the hypothesis that copper-ions represent a promising metal ion with antimicrobial effects for usage of mini-implants, the results show no antimicrobial effect of Cu in a time period of seven months. Both coatings showed similar results with regard to microbiological composition and their number.

145 EFFECTS OF PREBIOTICS (XYLOOLIGOSACCHARIDE) ON THE JAW BONE OF OBESE INSULIN-RESISTANT RATS

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AIM: Obesity is the major risk factor for several diseases including osteoporosis. Previous studies indicated that long-term consumption of a high-fat diet (HFD) induced not only obese-insulin resistance, but also reduced jaw bone density. The alteration of gut microbiota (GM) played an important role in the development of obesity-insulin resistance and osteoporosis in several studies. Furthermore, the modification of GM by prebiotic treatment can improve metabolic and inflammatory status in various animal models. However, the effects of prebiotics on the jaw bone in obese-insulin resistant rats have not been investigated. Therefore, the aim was to determine the effects of xylooligosaccharides on metabolic status, systemic inflammation, and jaw bone density in the obese-insulin resistant condition.

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MATERIALS AND METHOD: Twenty-four rats were randomized into two groups, to receive either a normal diet (ND) or HFD for 12 weeks. The rats in each group were then subdivided into two subgroups (n = 6/subgroup), treated with either a vehicle or prebiotics (10% xylooligosaccharides; XOS) for other 12 weeks. Blood was collected at week 12 as pre-treatment data, and at the end of treatment (week 24) to analyse the metabolic parameters and systemic inflammation, as indicated by lipopolysaccharide (LPS) levels. The animals were then sacrificed and the jaw bones collected for microcomputed tomographic analysis.
RESULTS: After 12 and 24 weeks of HFD consumption, it was found that rats were induced to be obese-insulin resistant, as indicated by increased body weight, dyslipidemia, and decreased insulin sensitivity as well as increased LPS levels. At week 24, jaw bone of vehicle-treated HFD-fed rats developed osteoporosis with decreased bone mineral density and increased trabecular space, when compared with vehicle-treated ND-fed rats. The treatment with prebiotics in HFD-fed rats significantly reduced body weight, visceral fat, LPS level as well as improved dyslipidemia and insulin sensitivity, but did not alter bone density.
CONCLUSIONS: The findings suggest that an obese-insulin resistant condition leads to osteoporosis. Although prebiotic treatment alone in this condition can improve metabolic parameters and systemic inflammation, it is not sufficient to improve jaw bone quality.

146 MATERNAL SUPPLEMENTARY FOLATE INTAKE, METHYLENETETRAHYDROFOLATE REDUCTASE C677T AND A1298C POLYMORPHISMS AND THE RISK OF OROFACIAL CLEFT

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AIM: To describe the association of methylenetetrahydrofolate reductase (MTHFR) gene single nucleotide polymorphisms (C677T and A1298C) and maternal supplementary folate intake with orofacial clefts in the Iranian population.
MATERIALS AND METHOD: Peripheral venous blood was taken from 65 patients with orofacial clefts (CL/P) and 215 unaffected controls for DNA extraction. Genotyping was carried out using polymerase chain reaction. Data were analyzed using Chi square and logistic regression tests.
RESULTS: Genotype frequencies of 677TT were 13.5 and 36.1 per cent in the controls and CL/P patients, respectively. Conversely, 1298CC with frequencies of 10.8 and 12.7 per cent in the controls and patients, respectively, showed no significant difference compared to AA (P = 0.123). Comparing patients whose mothers did not report folate supplement intake during pregnancy with the controls, it was observed that a lack of folate intake was a predisposing factor for having a child with an oral cleft (OR = 5/718, P = 0.000).
CONCLUSIONS: Children carrying the 677TT variant of the MTHFR gene may have an increased risk of CL/P. In addition, the finding that the risk associated with this allele was higher when the mothers did not use folic acid, supports the hypothesis that folic acid may play a role in the aetiology of CL/P.

147 OBSTRUCTIVE SLEEP APNOEA IS ASSOCIATED WITH REDUCED MANDIBULAR CORTICAL THICKNESS IN CHILDREN

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AIM: Mandibular cortical thickness has been strongly linked to skeletal bone density. Preliminary evidence suggests that obstructive sleep apnoea (OSA) negatively affects bone growth and mineralization and hence bone density. It was hypothesized that children with OSA therefore have a decreased mandibular cortical thickness, and that cortical thickness thus might be a useful diagnostic measure for OSA.
MATERIALS AND METHOD: Mandibular cortical thickness was retrospectively determined using the mandibular cortical width (MCW) and the panoramic mandibular indices (PMI) obtained from panoramic radiographic images of 27 children with polysomnographic (PSG)-diagnosed OSA Eighty one age- and gender-matched children, without sleep disordered breathing (SDB) signs and

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symptoms, were used as the controls. Factorial analysis of variance was used to compare MCW and PMI measurements between the two groups.
RESULTS: Reliability assessment was found to be excellent (intraclass correlation coefficient values were above 0.9). As expected, increases in MCW and PMI values emerged with increasing age in both OSA (MCW, R = 0.72, $P < 0.01$; PMI, R = 0.55, $P < 0.01$) and control children (MCW, R = 0.66, $P < 0.01$; PMI, R = 0.57, $P < 0.01$). However, MCW and PMI were significantly lower in OSA children (MCW = 3.1 ± 0.06 mm; PMI = 0.32 ± 0.04) compared to control children at all ages (MCW = 3.6 ± 0.06 mm; PMI = 0.38 ± 0.05; $P < 0.05$).
CONCLUSIONS: Within the limitations of this study, the present results suggest that children with OSA may have thinner mandibular cortex (based on MCW and PMI measurements) compared to children with no reported SDB. Further studies are needed to confirm these preliminary findings and validate whether MCW and PMI could be used as accessory diagnostic tools.

148 DOES TREATMENT TIME AFFECT DEVELOPMENT OF WHITE SPOT LESIONS?
Emel Eker, Ahmet Yalcin Güngör, Department of Orthodontics, Akdeniz Universty, Antalya, Turkey

AIM: To investigate and compare how treatment time affects white spot lesions (WSLs) in patients treated with fixed orthodontic treatment.
MATERIALS AND METHOD: The records 220 patients (152 females, 68 males) treated by only fixed orthodontic appliances were obtained and examined to determine WSL development. Patients were divided into two groups according to treatment time (group 1:15 months or less; group 2:16 months or more). The labial surfaces of 1760 teeth on pre- and post-treatment photographic records were scored using the Gorelick WSL index. For statistical analyses intragroup comparisons were analysed using the Wilcoxon test and intergroup comparisons using the Mann-Whitney *U* test.
RESULTS: The WSL index scores were significantly increased in group 1 compared with group 2 ($P < 0.05$).
CONCLUSIONS: An increase in the length of treatment time increases the development of WSL.

149 ARE THERE ANY DIFFERENCES BETWEEN REGULAR AND SELF-LIGATION IN TERMS OF WHITE SPOT RISK?
Emel Eker, Ahmet Yalcin Güngör, Department of Orthodontics, Akdeniz University, Antalya, Turkey

AIM: To investigate and compare the incidence of white spot lesions (WSLs) in patients treated with regular or self-ligating appliances during fixed orthodontic treatment.
MATERIALS AND METHOD: The records of 52 randomly selected patients (35 females, 17 males) treated with regular appliances (group 1) and 168 patients (116 females, 52 males) treated with self-ligating appliances (group 2) were examined to determine WSL development. The labial surfaces of 1760 teeth on pre- and post-treatment photographic records were scored using the Gorelick WSL index. For statistical analyses intragroup comparisons were analysed using the Wilcoxon test and intergroup comparisons using the Mann-Whitney *U* test.
RESULTS: No differences were found in terms of WSL risk between the regular and self-ligating appliances in fixed orthodontic treatment.
CONCLUSIONS: Neither regular nor self-ligating appliances affected the development of WSL during fixed orthodontic treatment.

150 EVALUATION OF PIEZOCISION IN RAPID CANINE RETRACTION
Ahmed Elkalza, Department of Orthodontics, Alexandria University, Egypt

AIM: To evaluate the efficiency of piezocision in rapid canine retraction.
SUBJECTS AND METHOD: Twenty four patients (16-25 years old) with a Class II division 1 malocclusion. The suggested treatment plan was extraction of the maxillary first premolars with subsequent canine retraction. One side of the maxillary arch was randomly chosen for treatment with piezocision by making microsurgical openings in the buccal gingivae to allow the piezoelectric knife to create the bone injury that will lead to transient demineralization and subsequent

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accelerated tooth movement. The contralateral side served as the control. Before starting canine retraction, maximum anchorage was ensured by placing miniscrews between the maxillary second premolars and first molars on both sides. The rate of canine movement was assessed every month after the start of canine retraction. A paired *t*-test was used to compare the experimental and control sides.
RESULTS: Piezocision produced a greater rate of canine movement than on the control side.
CONCLUSIONS: Piezocision is an efficient treatment modality for accelerating canine retraction.

151 REDUCING OVERLOADING OF INDIVIDUAL INCISORS BY UTILIZING NOVEL THIN LEVELLING ALIGNERS †††
Fayez Elkholy, Bernd G. Lapatki, Department of Orthodontics, University of Ulm, Germany

AIM: Recent studies have indicated application of excessive forces and moments to individual teeth by aligners made of available Polyethylene terephthalate glycol (PET-G) foils with a thickness ≥0.5 mm. The aim of this study was to assess the possibility of load reduction by utilizing novel thinner aligners with a thickness of 0.3 or 0.4 mm.
MATERIALS AND METHOD: The setup included an acrylic upper jaw model with tooth 11 separated and fixed via a three-dimensional force-moment sensor to a Hexapod for experimental movement. Aligners to be tested were fabricated on duplicate stone models using commercially available PET-G-foils with thicknesses between 0.5 and 0.75 mm, as well as novel 0.3 and 0.4 mm-thick foils. With each test aligner seated, tooth 11 was translated in a labio-palatal direction in the range of ±0.25 mm, while all six force and moment components exerted on this tooth were registered.
RESULTS: With the thinnest commercially available 0.5 mm aligner *in situ*, relatively high labio-palatal forces of 7.82 ± 0.1 N and 8.04 ± 0.4 N were measured for the maximum 0.25 mm movement of tooth 11 in the labial and palatal direction, respectively. In comparison, force values were 60 and 25 per cent lower for the novel 0.3 and 0.4 mm aligners, respectively.
CONCLUSIONS: Application of thinner 'levelling aligners' may be an efficient strategy for reducing overloading of individual teeth during aligner therapy. Due to form instability of the 0.3 mm aligners observed in this study, a novel sequence of 0.4/0.5/0.75 mm for aligner systems based on sequentially increasing material thickness within single setup steps is suggested. Such a sequence would combine low stiffness of the initial aligner with relatively constant load increases. This might reduce the risk for root resorption and maximize treatment efficacy.

††† Winner of an EOS Scientific Poster Award

152 DETERMINATION OF SPACE REQUIREMENT IN THE DENTAL ARCH USING THE ANATOMICAL CONTACT POINTS DURING THREE-DIMENSIONAL SIMULATION OF ARCH WIDTH CHANGES
Fayez Elkholy, Catrin Bacher, Bernd G. Lapatki, Department of Orthodontics, University of Ulm, Germany

AIM: Traditionally, the widest mesiodistal dimensions of the teeth are used for space analysis in treatment planning. In the real situation, however, the contacts between the adjacent teeth determine the required spaces for teeth in the dental arch. Interproximal contacts depend on post-therapeutic arch form. The aim of this study was to evaluate the influence of expansion and constriction of dental arch form on the spaces required for the upper and lower teeth based on analysis of interproximal contact points in digital set-ups.
MATERIALS AND METHOD: Thirty digital patient models were segmented with a three-dimensional (3D) analysis program (OnyxCeph 3D™, Image Instruments, Germany). The digital set-up included correction of the axes of the anterior teeth, aligning of the dental arches and determination of the actual interproximal contact points. The space required for each tooth was determined by the linear distance between the actual interproximal contact points, after their projection on the occlusal plane. Subsequently, the arch was expanded and narrowed in 2 mm increments and the contact points and their corresponding space requirement were determined after each increment.

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RESULTS: There was a significant dependency of the actual space requirement, measured at the actual contact points of each tooth, on arch width. An average increase in space requirement of 1.02 ± 0.12 mm and 0.94 ± 0.18 mm was observed during a 4 mm expansion of the maxillary and mandibular arches, respectively. The corresponding values for 4 mm narrowing of the arches were: 1.14 ± 0.15 mm and –1.12 ± 0.21 mm for the maxilla and mandible, respectively.
CONCLUSIONS: Current orthodontic analysis software allows precise individual- and arch-form dependent space analyses. The influence of dental arch form on the space requirement of teeth is relatively small, but not negligible. Hence, in borderline cases regarding requirement for premolar extractions, this relationship should be additionally considered in planning the individually optimal treatment approach.

153 EFFECTS OF BRACKET TYPE ON ROOT RESORPTION AND TREATMENT DURATION

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AIM: Decreasing orthodontic treatment duration enhances patient cooperation and prevents tedium. Eliminating side effects of orthodontic treatment means long-term satisfaction. The aim of this study was to investigate changing ligating technique on treatment time and effectiveness.
MATERIALS AND METHOD: Conventional appliances versus self-ligating active and passive systems were compared. Forty-five patients who had 4 to 6 mm of crowding, between 12 to 20 years of age and a Class I molar relationship were included in this study. They were randomly divided into three groups. Group 1 were treated with the passive self-ligating Damon 3mx system (Ormco, California, USA), group 2 with active ligating Empower brackets (American Orthodontics, Wisconsin, USA) and group 3 with conventional ligating Avex brackets (Opal Orthodontics, Ultradent Products, Utah, USA). All patients were bonded, followed and finished by the same operator. Initial and final root lengths were compared on cone beam computed tomographic images.
RESULTS: At the beginning of treatment, the root lengths were similar for the three groups except for teeth 24, 32 and 44. All teeth showed a significant length reduction [Avex: mean: 0.63, standard deviation (SD) 0.23; Damon: mean: 0.535, SD: 0.177; Empower: mean: 0.65, SD: 0.209].
CONCLUSIONS: Orthodontic treatment causes root resorption of all teeth, with most root resorption observed on the upper lateral and lower central incisor.

154 EFFECT OF CASEIN PHOSPHOPEPTIDE PASTE WITH AND WITHOUT CO_2 LASER IRRADIATION ON DEMINERALIZED ENAMEL MICROHARDNESS AND BRACKET SHEAR BOND STRENGTH

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AIM: Many patients seeking orthodontic treatment already have incipient enamel lesions on their teeth and should be placed under preventive treatment. The aim of this *in vitro* study was to evaluate the effect of Casein phosphopeptide amorphous calcium phosphate (CPP-ACP) paste and CO_2 laser irradiation on demineralized enamel microhardness and shear bond strength (SBS) of orthodontic brackets.
MATERIALS AND METHOD: Eighty caries-free human premolars were subjected to a demineralization challenge using a caries model. After demineralization, the samples were randomly divided into five equal experimental groups. Group 1(control): The brackets were bonded without any surface treatment. Group 2 (CPP-ACP paste): The enamel surfaces were treated with CPP-ACP paste for 4 minutes before bonding. Group 3 (CO_2 laser): The teeth were irradiated with CO_2 laser beams at a wavelength of 10.6 μm. The samples in groups 4 and 5 were treated with CO_2 laser either before or during CPP-ACP application. The brackets were bonded to the buccal enamel using a conventional method. SBS of brackets and adhesive remnant index (ARI) scores were measured. Vickers microhardness was measured on the non-bonded enamel surface. Data were analyzed with ANOVA and Tukey test at the $P < 0.05$ level.

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RESULTS: The mean SBS and microhardness of the laser group was higher than that in the control group and this difference was statistically significant ($P < 0.05$). All the groups showed a higher percentage of ARI score 4.
CONCLUSIONS: CO_2 laser at a wavelength of 10.6 μm significantly increased demineralized enamel microhardness and enhanced bonding to demineralized enamel. The fractures occurred at the composite resin-enamel interface.

155 PREDICTION OF CLASS II IMPROVEMENT AFTER RAPID MAXILLARY EXPANSION IN THE EARLY MIXED DENTITION

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AIM: It is suggested that after rapid maxillary expansion (RME) treatment of the upper arch a 'spontaneous' correction of Class II might take place due to forward posturing of the mandible to a more comfortable position. The possibility to find any predictive variables that might help clinicians distinguish favourable and unfavourable situations to determine when further correction of a Class II malocclusion after RME would be needed. The aim of this cephalometric investigation was therefore to identify possible pre-treatment parameters for the prediction of individual Class II improvement induced by RME in early mixed dentition patients.
MATERIALS AND METHOD: Lateral cephalograms of 61 patients (mean age 8.3 ± 1.6 years) showing a Class II molar relationship and who had undergone to RME on the upper primary molars were traced before treatment and molar relationship changes were evaluated on dental casts before and after treatment. Good responders showed an improvement of at least 2.50 mm and bad responders showed no improvement, improvement less than 2.50 mm or worsening of the molar relationship after treatment. A Student's *t*-test was used to assess the significance of differences between groups and discriminant analysis allowed identification of predictive pre-treatment variables.
RESULTS: Articulare angle, superior gonial angle and mandibular dimensions (Co-Gn, S-Ar, Ar-Go, Go-Me) showed significant differences between the groups. Mandibular length Co-Gn and superior gonial angle were selected as significant predictive variables for discrimination.
CONCLUSIONS: The classification power of the model for predicting success or failure was 83.3 per cent for each new patient. Spontaneous correction of a Class II malocclusion after RME in the early mixed dentition might be favourable when a patient's cephalometric records show a decreased mandibular length and more acute superior gonial angle at the start of treatment. The important role of mandibular dimensions and vertical skeletal relationships in diagnostic and prognostic evaluation of Class II patients deserves to be emphasized. Sagittal skeletal measurements before treatment are not able to improve this prediction based upon mandibular dimensions and superior gonial angle.

156 RADIOGRAPHIC EVALUATION OF MANDIBULAR MORPHOLOGICAL CHANGES ACCORDING TO AGE

Anita Fekonja, Department of Orthodontic, Healthcare Centre Maribor, Maribor, Slovenia

AIM: To evaluate mandibular morphology in relation to gender and age using dental panoramic radiographs and cephalographs.
MATERIALS AND METHOD: Radiographs of 140 subjects between the ages of 4-24 years acquired as part of the diagnostic records before orthodontic treatment. The radiographs were divided into seven age subgroups. Each dental panoramic radiograph and cephalograph was traced. The bigonial width, mandibular corpus height, ramus width, ramus height, mandibular length and gonial angle were measured and the data were analyzed. The significance level was set at $P \leq 0.05$.
RESULTS: The bigonial width, mandibular corpus height, ramus width, ramus height, ramus length increased in both genders with increasing age. Males showed higher measurements than females. Ramus heights were the most significant predictors for gender. The gonial angle decreased with increasing age but without a statistically significant difference. The mean values in females were greater than in males but without a significant difference.

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CONCLUSIONS: The assessment of mandibular morphology through radiographic measurements may be useful in estimating an individual's age and gender. Knowledge of mandibular growth is also important in planning timely orthodontic treatment.

157 CORRELATION BETWEEN RAPID MAXILLARY EXPANSION AND NOCTURNAL ENURESIS IN CHILDREN

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AIM: To review the literature on the impact of rapid maxillary expansion (RME) in the intensity levels of nocturnal enuresis (NE) in children.
MATERIALS AND METHOD: A systematic literature search in PubMed and Web of Science was conducted for studies published up to October 2016, using predetermined keywords. The inclusion criteria for treatment with RME were 6-18 years of age, presence of NE and non-responders to first-line medical treatment. Articles with children with concurrent urological, renal or neuropsychiatric disorders were excluded. The references of the selected articles were reviewed to find additional useful publications.
RESULTS: Four articles were included in the qualitative synthesis. One hundred and seventeen children were diagnosed with NE, of which 92 were treated with RME and 25 children received no orthodontic treatment. NE decreased significantly in children who underwent RME, irrespective of the occurrence of upper jaw narrowing. Relapse of the dental overexpansion was noted in a normal transversal occlusion within 1 year. Younger children responded better to the treatment. A follow-up was made (1-10 years) by direct interviews or by telephone questionnaire and no adverse reactions were reported.
CONCLUSIONS: RME has a positive effect in children with NE. Normal transverse occlusion does not seem to be a contraindication for moderate maxillary expansion in an attempt to decrease NE in children. RME could cause complete dryness in children.

158 HOW EFFICIENT ARE LINGUAL ORTHODONTICS? AN ASSESSMENT OF TREATMENT OUTCOME BY COMPARING SET-UPS AND POST-TREATMENT CASTS

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AIM: To assess the efficacy of lingual orthodontics by comparing set-ups and post-treatment casts.
SUBJECTS AND METHOD: Thirty two consecutive patients (mean age 28.4 ± 9.2 years) treated in a postgraduate clinic with a customized lingual orthodontic appliance (Incognito™) were included in this retrospective study. Post-treatment casts and set-ups were scanned and the resulting digital models were analyzed (bucco-lingual angulation of all teeth; mesio-distal angulation of anterior teeth, intercanine and intermolar distances, overjet, overbite, molar relationship, and midline deviation). Comparisons between set-ups and post-treatment casts were performed via paired *t*-tests ($P < 0.05$).
RESULTS: The mean treatment duration was 2.2 ± 0.9 years. Statistically significant differences in bucco-lingual torque were found between the set-ups and post-treatment casts, for all upper teeth (largest difference: second premolars: 6.1 ± 6.2°), except for the central incisors. In the lower arch, statistically significant differences in bucco-lingual torque were found between the set-ups and post-treatment casts for the incisors and molars (largest difference: central incisors: 3.7 ± 5.8°), but not for the canines and premolars. Regarding the mesio-distal angulation of the anterior teeth, no statistically significant differences were found between set-ups and post-treatment casts in either the upper or lower arches. The mean upper and lower intercanine distances, as well as the lower intermolar distance did not vary significantly between the set-ups and post-treatment casts. The upper intermolar distance was significantly but not clinically different on the post-treatment casts compared to the set-ups (1.1 ± 1.8 mm). No statistically significant differences in overjet (0.3 ± 0.9 mm) and overbite (0.1 ± 0.6 mm) were found between the set-ups and post-treatment casts. The post-treatment molar relationship was as predicted on the set-up, except in four cases where there

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was a unilateral difference of a quarter cusp (3 cases) or half-a-cusp (1 case). The midline was corrected in 24 cases, whereas in eight cases out of 32, a deviation of more than 1 mm was still present after treatment.
CONCLUSIONS: Orthodontic treatment using a customized lingual appliance is very efficient in terms of control of mesio-distal angulation of all anterior teeth, intercanine and intermolar distances, molar relationship, overjet and overbite. Bucco-lingual torque is less efficiently controlled, especially in the upper arch.

159 CHILDREN'S SUBJECTIVE EXPERIENCE OF EARLY TREATMENT OF PRENORMAL OCCLUSION WITH A RAPID MAXILLARY EXPANDER IN COMBINATION WITH A FACEMASK

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AIM: To evaluate children's perception of satisfaction/discomfort before and after treatment of anterior crossbite in Class III malocclusions, with a rapid maxillary expander (RME) combined with a facemask, using a questionnaire (CPQ 8-10).
SUBJECTS AND METHOD: Thirty-five consecutive subjects, aged 7-10 years, diagnosed with a skeletal Class III malocclusion with an anterior crossbite, were offered and accepted orthodontic treatment. The objective measurement was done on lateral radiographs of the head. Inclusion criteria: The outcome of treatment (children 7-10 years) with a RME with buccal hooks and orthopaedic maxillary protraction with a facemask. Subjects with a dental Class III or physical impairment were excluded from the study. All subjects were asked to answer a questionnaire before the onset of treatment and after the end of treatment. This questionnaire, CPQ 8-10 is specially designed for children and was used for assessment of the quality of life and the child's experience of treatment. Descriptive statistics was applied on the answers. The results are presented at the group level and answering was anonymous. This study has been approved by the local ethical committee Linköping University (Dnr. 2013-175-31).
RESULTS: In total 35 questionnaires was collected at the end of treatment and from 17 subjects there was also a start-up questionnaire (the remaining 18 start-up questionnaires were collected before the approval from the ethical committee). Patients' experience of treatment results were unanimous improvement in bite off, chewing ability, and facial appearance. All treated subjects experienced that treatment caused small problems. But, nevertheless all said that they would do the same thing again. All the subjects would choose the same treatment once more.
CONCLUSIONS: The questionnaire showed that the quality of life was improved overall, regarding perception of satisfaction with the result, and that the appliances were tolerated.

160 RELATIONSHIP BETWEEN THE GUBERNACULAR CORD AND IMPACTED CANINES‡‡‡

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AIM: The canine is the most frequently impacted tooth, and maxillary canine impaction induces resorption of the incisor root. Therefore, it is important to be able to predict canine impaction. Gubernacular canals are in the alveolar bone crest, behind the upper or lower primary incisors, and are thought to be related to tooth eruption. This study examined the relationship between the gubernacular cord and impacted canines using cone beam computed tomography (CBCT).
MATERIALS AND METHOD: A total of 196 canine teeth in patients aged 7 to 9 years were examined in a basic clinical and radiographic investigation (dental pantomographs and CBCT). Among these, 70 teeth were predicted to become impacted (impacted group: IG) and 129 were predicted to erupt normally (control group: CG). Subjects were classified into three groups based on CBCT data. Type 1 consisted of canines that had the gubernacular cord, type 0 canines with the gubernacular cord collapsed and type N canines with no gubernacular cord. The frequency of type N in IG and CG was then compared by year of age.

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RESULTS: The rate of type N in 9-year-olds in the CG was significantly larger than other types in 8-year-olds. The rate of type N in 8-year-olds in the CG was significantly larger than in the IG; however, the rate of type N in 9-year-olds in the CG was not significantly larger than in the IG.
CONCLUSIONS: In the CG, the rate of gubernacular canal disappearance increased over time, and the rate in 9-year-olds was significantly larger than in 8-year-olds. The canines predicted to become impacted lost the gubernacular canals at an earlier time than normal canines. Based on these findings, the gubernacular canal in upper canines predicted to become impacted will often disappear by 8 years of age, thus indicating whether a particular maxillary canine will become impacted.

161 ORTHODONTIC TOOTH MOVEMENT THROUGH ALVEOLAR GRAFTED SITES: A SYSTEMATIC REVIEW

Anabel Galan-Ortiz, Nuno Gustavo d'Oliveira, Josep Maria Ustrell-Torrent, Ortodoncia, Universitat de Barcelona, L'Hospitalet del Llobregat, Spain

AIM: To determine the ideal bone graft material to perform subsequent orthodontic tooth movement.
MATERIALS AND METHOD: PRISMA (Preferred Reporting items for Systematic Reviews and Meta-analyses) guidelines for systematic reviews was used. A literature search of articles published from 2009 to 2016 was performed using Medline (PubMed), Web of Science (Scopus) and Cochrane. The following search strategy was used: ('bone graft' OR 'bone regeneration' OR 'guided tissue regeneration') AND 'orthodontic movement'. Some publications were also obtained manually from reviewed references. Studies using autogenous, allogenic, xenogenic and alloplastic bone grafts followed by orthodontic tooth movement were included.
RESULTS: The initial search resulted in 304 publications. After screening and determination of eligibility, six articles were finally included in this review. Autogenous bone grafts, bovine bone mineral material (Bio-oss®), bioactive glass material and nanocrystalline hydroxyapatite (Nanobone®) showed effectiveness in case series with uneventful adverse effects. Demineralized freeze-dried bone allograft (Cenobone®) and calcium phosphates (BoneCeramic®) showed encouraging results in animal experiments. BoneCeramic® had higher osteoconductive potential and induced less root resorption compared with Bio-Oss®.
CONCLUSIONS: Available evidence is low and does not demonstrate significant differences in the results regardless of the bone graft material used before orthodontic movements. Therefore, further detailed investigations in humans are needed to establish firm conclusions.

162 A NOVEL METHOD FOR SUPERIMPOSITION AND MEASUREMENTS ON MAXILLARY DIGITAL THREE-DIMENSIONAL MODELS – STUDIES ON VALIDITY AND RELIABILITY †††

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AIMS: Treatment effects or changes during retention can be analysed using serial three-dimensional (3D) study models. But, 3D study models need to be superimposed correctly before measurements can be assessed and earlier studies have shown that literally every anatomical structure in the palate could change due to growth or treatment. A new method for superimposition and measurement of maxillary 3D models that compensates for morphological changes has been developed. Changes are detected by deformation analysis. This analysis is based on an algorithm that identifies areas of deformation and therefore, in a second step, only unchanged areas are used for superimposition. The purpose of this study was to investigate the validity and reliability of a novel method for superimposition and measurement of serial 3D models.
MATERIALS AND METHOD: After sample size calculation 3D models from 16 patients were derived from an on-going study on anchorage. These 16 3D models were modified to simulate space closure and growth by an independent 3D engineer. Thus, true values for tooth movements on each model could be used as a reference. Four senior consultant orthodontists performed the measurements.

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Repeated measurements were carried out after at least two weeks. Statistical analysis was performed with linear mixed models using R.
RESULTS: Translational measurements had a mean error of 0.000851 mm (SD 0.03 mm). The range of the measurement error was 0.15 mm. The intraclass correlation coefficient (ICC) was 0.9996. Rotation measurements had a mean error of 0.024 degrees (SD 0043°), a range of 0.46 degrees and an ICC of 0.9999.
CONCLUSION: The tested method is a valid and reliable tool for measuring tooth movements in the maxilla. The method produces results with excellent accuracy and precision even when changes occur through growth or orthodontic treatment.

†††Winner of the Houston Oral Research Award

163 ASSESSING TEMPOROMANDIBULAR JOINT PAIN AND FUNCTION BEFORE AND AFTER THE USE OF POLARIZED LIGHT

Umberto Garagiola, Paolo Cressoni, Rossano Soldo, Ettore del Rosso, Giampietro Farronato, University of Milan, Italy

AIM: To assess the effectiveness of a therapy using low energy polarized light (PL) devices, in reducing pain, promoting healing of soft tissue injuries and reducing inflammation and improving function and quality of life of temporomandibular joint disorders (TMD) patients.
SUBJECTS AND METHOD: Thirty five patients (20 females), with TMD diagnosed using standard criteria, were assessed using electromyography (EMG) and a computerized mandibular scan (K6). Eight minute PL therapy was applied three times per week for 4 weeks. No other treatment was given and patients were asked to refrain from taking analgesics during the study. PL therapy uses a non-invasive optical device to project a beam of light on to the skin and mucosa. This light has four characteristics: polarization; polychromy; incoherency; low energy density. Patient-reported questionnaires (PROs) and performance measures were used to assess TMD pain and function in clinical practice. PROs assess the patient's perspective, while performance measures assess functions such as mandibular kinesiology (mouth opening and closing or other standardized manoeuvres) in a controlled setting. Standardized assessment of patient outcomes allows physicians to measure the success or failure of diagnostics and treatments that TMD patients receive.
RESULTS: Statistically significant reductions in pain and muscular spasms, improvements in function and increases in muscular strength were reported (compared to baseline measures; $P < 0.01$).
CONCLUSIONS: Joint pain, typically involving the temporomandibular joint, is the predominant complaint of people living with TMD. Pain is what drives patients to seek medical care. People with TMD are most distressed by the intensity, quality, and predictability of their joint pain, as well as its impact on physical function, sleep, fatigue, and mood. Valid and reliable PROs and performance measures are available to assess these aspects of the pain experience. The PL characteristics enable penetration of the skin and underlying tissues in order to stimulate various biological processes. PL improves microcirculation, stimulates regeneration and repair, promotes wound healing and relieves pain, with no adverse effects. PL could be a valid alternative or concomitant treatment of temporomandibular joint disorders.

164 THREE-DIMENSIONAL VERSUS TWO-DIMENSIONAL CEPHALOMETRIC ANALYSIS: A MORE SIMPLIFIED AND ACCURATE PROTOCOL

Umberto Garagiola, Giampietro Farronato, University of Milan, Italy

AIM: To combine the data on low dose cone beam computed tomography (CBCT) with a simplified cephalometric protocol.
SUBJECTS AND METHOD: One hundred and thirty randomly selected patients (80 females, 50 males) ranging in age from 8 to 42 years. Each patient had lateral and posteroanterior cephalograms taken less than 6 months previously. The cephalometric analysis was performed by three operators repeating the measurements twice (15 days apart) with a calibration meeting. The positions of the maxilla and mandible in three-dimensional (3D) space were determined using low-dose CBCT by

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assigning three reference planes to obtain the (*x, y, z*) position of each point of the skull relative to point S with coordinates (0, 0, 0), which were automatically determined by the computer as the intersection of the reference planes. The position of the jaws in 3D space was determined by assigning 18 easily identified, repeatable cephalometric points, to establish two solid figures representing spatial changes of points of orthodontic interest in terms of the shape or position of the jaw bones.
RESULTS: Statistically significant differences were found between cephalometric angular and linear measurements taken with conventional radiographs versus those taken with CBCT ($P < 0.01$). In contrast to those on radiographs, the angular and linear measurements three-dimensionally detected, became 'real', moreover the selection of fewer points and the automatic measurements made by the computer reduced human error, for a more reliable and repeatable diagnosis ($P < 0.01$).
CONCLUSIONS: 3D imaging provides information and images of craniofacial structures free from perspective distortion, with none of the magnification or superimposition associated with two-dimensional images. Another aid to the clinician is the repeatability and reproducibility of this method, which reduces human error in cephalometric analysis. This method saves time and increases precision, offering a valuable aid to orthodontic diagnosis. The value of a 3D image model directly corresponds to the quality of the information, the accurate anatomic data derived, and its collection in a 3D anatomic database. Used appropriately, 3D cephalometrics allows clinicians to analyze, diagnose, plan, and communicate.

165 DENTAL ENAMEL COMPOSITION AFTER INTERPROXIMAL REDUCTION AND DEMINERALIZATION CYCLES

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AIM: To evaluate quantitatively and qualitatively the changes produced to enamel after interproximal reduction and subjected to demineralization cycles.
MATERIALS AND METHOD: Eighty interproximal dental surfaces were divided into four groups: 1) Intact enamel; 2) Intact enamel and demineralization cycles; 3) Interproximal reduction; 4) Interproximal reduction and demineralization cycles. Interproximal reduction was performed with a 0.5 mm cylindrical diamond bur. Groups 1 and 3 were kept in artificial saliva at 37°C for 8 days. The saliva pH was adjusted and maintained at 6.57. Group 2 and 4 samples were submerged in artificial saliva at 37°C for 8 days, and subjected to demineralization cycles as follows: samples were placed in a demineralizing solution for 2 hours, three times per day, and returned to artificial saliva between the 2 hour cycles. The pH of the demineralization solution was adjusted to 4.5. The weight percentage of calcium (Ca) and phosphorous (P) were quantified by energy-dispersive X-ray spectrometry. Samples were examined under scanning electron microscopy (SEM).
RESULTS: The weight percentage of calcium was significantly higher ($P < 0.05$) in groups 1 and 2 than in group 4. No significant differences were detected in the weight percentage of Ca between group 3 and the other groups ($P > 0.05$). The weight percentage of P was similar among all groups ($P > 0.05$). SEM images of group 2 showed a process of early demineralization. In group 3 grooves and irregularities could be seen caused by the bur. In group 4 images, areas with preferential destruction of the centre of the prism nuclei and indiscriminate destruction could be observed in some areas.
CONCLUSIONS: The surface with enamel reduction was more susceptible to demineralization than the intact enamel surface.

166 APICAL RESORPTION OF UPPER INCISORS DURING ORTHODONTIC TREATMENT IN CLASS III ORTHOGNATHIC SURGERY PATIENTS – CONE BEAM COMPUTER TOMOGRAPHY STUDY

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AIM: To identify risk factors for apical root resorption of maxillary incisors as a result of orthodontic and surgical treatment of Class III malocclusions involving a Le Fort osteotomy.

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MATERIALS AND METHOD: The root lengths of the upper central and lateral incisors were measured on cone beam computed tomographic scans obtained from a database of orthognathic surgery patients. The measurements were performed on the scans taken before orthodontic treatment (T1), before surgery (T2) and after treatment (T3) for 28 subjects, aged 20.5 ± 3.1 with a mean T2 treatment time of 19.9 ± 8.8 months and a post-surgery time of 7.1 ± 3.1 months. Changes in root lengths at different time spans were correlated with the initial crown/root ratio and the severity of malocclusion (Wits appraisal, ANB angle, overjet) and considered significant at $P < 0.05$.
RESULTS: During T1-T2 the roots of lateral incisors shortened by 0.78 ± 0.83 mm ($P < 0.001$), and the roots of the central incisors by 0.62 ± 0.64 ($P < 0.001$), at a rate of 0.04 mm and 0.03 mm per month, respectively. The difference was not statistically significant. During T2-T3 the lengths of the central incisor roots decreased by 0.49 ± 0.52 ($P < 0.001$) and the lateral incisors by 0.42 ± 0.48 ($P < 0.001$), at a rate of 0.07 mm and 0.06 mm per month, respectively. There were statistically significant correlations between the crown/root length and decrease of the root length during treatment for the lateral (r = 0.319) and central (r = 0.303) incisors. The associations for the decrease in root length at different time spans for different teeth and the severity of malocclusion were inconsistent.
CONCLUSIONS: Overall the decrease in the root length of the upper incisors during combined orthodontic-surgical treatment was insignificant: 1.1 mm and 1.2 mm for the central and lateral incisors, respectively. After surgery the rate of the root shortening per month increased. The teeth with initially shorter roots showed more resorption during treatment.

167 A SYSTEMATIC APPROACH FOR INTERPROXIMAL ENAMEL REDUCTION: *IN VITRO* AND *IN VIVO* EVALUATION OF DIAMOND COATED STRIPS

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AIM: To test *in vitro* and *in vivo* the wear performance of diamond coated strips by means of tribological testing and scanning electronic microscopy (SEM).
MATERIALS AND METHOD: To evaluate the *in vitro* wear performance, a tribological test was performed using a standard Tribometer. The abrasive strips slid against stationary freshly extracted premolars fixed in resin blocks, at a 2 Newton load. At the end of the tribological test, the residual surface of the strip was observed by means of SEM. The SEM analysis was performed every 50 metres until reaching 300 metres. For the *in vivo* analysis, the strip was used for 300 seconds corresponding to 250 metres.
RESULTS: The strips presented a fenestrate structure characterized by diamond granules alternated with empty areas. After the first 50 metres, it was possible to observe tooth material deposited on the surface of the strips and a certain amount of abrasive grains detached. The surface of the strip after 250 metres appeared smoother and therefore less effective in its abrasive power. After 300 seconds of *in vivo* utilization of the strip, it was possible to observe detachment of diamond abrasive grains, the almost absence of the grains and therefore, the loss of strip abrasive power.
CONCLUSIONS: Under ideal conditions, after 5 minutes (30 metres) of use, the strip loses its abrasive capacity by about 60 per cent. *In vivo*, a quicker loss of the abrasive power was observed due to the greater load applied by the clinician forcing the strip into the contact point.

168 EXPERIMENTAL DETERMINATION OF CREEP BEHAVIOUR OF ALVEOLAR BONE

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AIM: To determine the creep behaviour of alveolar human bone
MATERIALS AND METHOD: For traditional materials the viscoelastic behaviour is well formulated and the temperature dependency is not an issue. Hence the viscoelastic behaviour will be referred to as 'creep behaviour'. Creep behaviour traditionally means that a specimen will have a continuously changing strain while being subjected to a constant load. In a conventional set-up creep data are obtained with a tensile test. However dimensions of porcine or human alveolar bone samples are such (10 × 10 × 10 mm at maximum) that the boundary conditions (clamping - applying

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of load) would greatly influence the experimental stress strain data (Bidez, 1994; Van Eijden, 2000; Misch *et al*., 1999). This conventional approach was changed to a compressive test (Ohman *et al*., 2007). The alveolar samples were placed in a compressive test machine. The machine was given a displacement which was maintained constant in time. The force was measured as a function of time given a constant displacement. The magnitude of displacement was varied in subsequent tests. After testing, reverse engineering transformed the experimental results to obtain conventional creep data (strain versus time given a constant stress). A compressive deformation of 0.1 mm was applied at a strain rate of 1 mm/second and then maintained for 600 seconds. The strain was applied in the direction aligned with the occlusal axis (approximately the principal orientation of the trabeculae).
RESULTS: It was found that the elastic modulus ranged from 3.5 to 125.6 MPa, with a mean value of 56.0 MPa (SD = 29.6). The ultimate compressive strength of the trabecular bone ranged from 0.22 to 10.44 MPa, with a mean value of 3.9 MPa (SD = 2.7). A correlation was found between the creep behaviour of alveolar bone and the creep behaviour of the viscoelastic reference model (r = 0.63) with $P < 0.005$.
CONCLUSIONS: This analysis indicated that the mechanical response of the tissue can be simulated using a viscoelastic model. This assumption reduced the number of material coefficients in the formulation and decreased the complexity of the problem.

169 THREE-DIMENSIONAL EVALUATION OF THE UPPER ARCH AND PALATE IN UNILATERAL CLEFT LIP AND PALATE SUBJECTS USING DIGITAL DENTAL CASTS

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AIM: To investigate arch width, palatal surface area and volume in unilateral cleft lip and palate (UCLP) children and a control group (without a UCLP) using a three-dimensional (3D) laser scanning technique.
SUBJECTS AND METHOD: A total of 38 subjects (Caucasian origin), 5.63 to 11.9 years of age (mean, 9.33 ± 1.67 years), were included: 19 in each group (UCLP and control). Digitized dental casts were obtained using a 3 Shape R700 laser scanner. Intercanine and intermolar widths (cusp and gingival levels); palatal surface area and volume were recorded. An independent sample Student's *t*-test and analysis of variance (ANOVA) were undertaken with significance set as $P < 0.05$.
RESULTS: The intercanine widths at the cusp ($P < 0.001$) and at the gingival level ($P = 0.014$), palatal area ($P = 0.009$) and volume ($P = 0.029$) were significantly lower in the UCLP compared to the control group.
CONCLUSIONS: 3D evaluation of upper arch and palate highlighted significant differences between UCLP and control subjects in young children.

170 THREE-DIMENSIONAL EVALUATION OF ALVEOLAR BONE CHANGES IN RESPONSE TO DIFFERENT RAPID PALATAL EXPANSION ACTIVATION RATES

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AIM: To quantify, in a multicentre retrospective study, changes in alveolar bone height and thickness as well as the adverse effects after using two different rapid palatal expansion (RPE) activation protocols and to determine whether a more rapid rate of expansion is likely to cause more adverse effects such as alveolar tipping, dental tipping, fenestration and dehiscence of anchorage teeth.
MATERIALS AND METHOD: Pre- and post-expansion records of 40 subjects (age 8-15 years) who underwent RPE using a four-banded Hyrax appliance as a part of their comprehensive orthodontic treatment to correct a bilateral buccal crossbite. The subjects were divided into two groups according to their RPE activation rates (0.5 mm/day and 0.8 mm/day; n = 20 each group). Three-

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dimensional images for all included subjects were evaluated using Dolphin Imaging Software 11.7 Premium. Maxillary base width, buccal and palatal cortical bone thickness, alveolar bone height, and root angulations and length were measured. Significance of the changes in the measurements was evaluated using Wilcoxon Signed Rank tests and comparisons between groups using ANOVA. Significance was accepted at $P \leq 0.05$.
RESULTS: RPE activation rates of 0.5 mm per day (group 1) and 0.8 mm per day (group 2) caused a significant increase in arch width following treatment; however, group 2 showed greater increases compared to group 1. Buccal alveolar height and width decreased significantly in both groups. Both treatment protocols resulted in significant increases in buccal-lingual inclination of teeth; however, group 2 showed greater increases compared to group 1.
CONCLUSIONS: Both activation rates (0.5 and 0.8 mm/day) are associated with a significant increase in intra-arch widths; however, 0.8 mm/day resulted in greater increases. More rapid activation rates also resulted in increased dental tipping.

171 OVERALL AND ANTERIOR TOOTH SIZE RATIOS IN A GROUP OF EMIRATIS

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AIM: To study overall and anterior tooth size ratios in a group of Emiratis with different types of occlusion.
MATERIALS AND METHOD: Consecutive patient files, including dental casts, were selected from the archives of the Dubai Health Authority. Following application of inclusion and exclusion criteria a sample was formed of healthy patients, 13-18 year-old, of Emirati origin and with a complete permanent dentition. The sample consisted of 521 pairs of dental casts (males: 188; females: 333) and different occlusion groups (Class I malocclusion: 288; Class II malocclusion 110; Class III malocclusion: 30; Class I normal occlusion: 93). All dental casts were scanned by one author and digitized using Ortho Insight 3D laser scanner (3D Motion View, Chattanooga, Tennessee, USA). Measurements were made regarding maxillary and mandibular sums of mesiodistal tooth dimension of the overall (6-6) and anterior (3-3) groups of teeth. Statistical analysis included descriptive statistics, paired *t*-tests and ANOVA. Intraexaminer reliability was confirmed by re-measuring 50 pairs of casts and by using a paired *t*-test. The level of significance was set at $P < 0.05$.
RESULTS: The mean values of overall tooth size ratios for the Class I normal occlusion group was 91.41 and for the malocclusion groups 91.57 for Class I, 91.54 for Class II and 90.21 for Class III. The mean values of anterior tooth size ratios for the Class I normal occlusion group was 77.54 and for the malocclusion groups 78.05 for Class I, 79.14 for Class II and 77.54 for Class III. There was a statistically significant difference among malocclusion groups. Comparison of overall and anterior tooth size ratios between the sample with a Class I normal occlusion and Bolton standards showed no statistically significant differences.
CONCLUSIONS: The Emirati sample of this study presented Class I normal occlusion cases with similar overall and anterior tooth size ratios to Bolton standards. However, the overall and anterior tooth size ratios among the different occlusion groups showed statistically significant differences.

172 SPONTANEOUS EFFECT IN MANDIBULAR DIMENSIONS CAUSED BY A RAPID MAXILLARY EXPANSION: A SYSTEMATIC REVIEW

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AIM: To investigate spontaneous changes in mandibular dimensions after rapid maxillary expansion (RME) and to evaluate whether or not to combine a rapid palatal expander with a lower appliance.
MATERIALS AND METHOD: Literature research in PubMed, Cochrane, Web of Science and Scielo up to October 2016, using as first topic 'rapid maxillary expansion OR rapid palatal expansion' and as second topic 'mandib* dimension'. Articles from October 2006 to October 2016 with at least 10

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patients were included without language limitations; studies with surgical or asymmetric expansion and syndromic patients were excluded.
RESULTS: Seventy eight potentially relevant publications were identified and seven articles were finally included. Two compared a bonded maxillary expander with a banded maxillary expander; one compared mandibular expansion produced by RME with and without a Schwartz appliance. The remaining four articles analysed the symmetric expansion of the mandible with banded, bonded, or acrylic splint appliances; and two of these studies had fixed appliances after the RME. Six of the articles demonstrated a significant spontaneous increase of the mandibular dimension. Expansion of the upper molars applied occlusal forces to the lower molars thus expanding the mandibular arch. This expansion can solve a mild tooth size-arch discrepancy (<3 mm), and was greater in banded appliances than in bonded type.
CONCLUSIONS: As a potential clinical implication, the review shows that it is possible to resolve mandibular mild discrepancy without using appliances in the lower arch as a spontaneous change after RME. A moderate mandibular tooth size discrepancy (>3 mm) can be treated combining RME with a Schwarz mandibular appliance or RME followed by fixed appliances.

173 ASSESSMENT OF PERIODONTAL BIOMARKERS IN GINGIVAL CREVICULAR FLUID DURING ORTHODONTIC TOOTH MOVEMENT. A SYSTEMATIC REVIEW

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AIM: To systematically search the literature and assess, in a qualitative and quantitative manner, the secretion of periodontal biomarkers in human gingival crevicular fluid (GCF) in patients of any age during the course of orthodontic treatment.
MATERIALS AND METHOD: The following electronic databases with no language or publication date restrictions were searched: Medline, Embase, Cochrane Trials Register and Central. Electronic searches of unpublished literature were also performed, while the reference lists of all eligible studies were hand-searched. Two review authors performed data extraction independently and in duplicate using data collection forms. Randomised controlled trials (RCTs) were evaluated according to the Cochrane risk of bias tool, while non-randomised prospective and retrospective clinical trials were evaluated with ACROBAT-NRSI (A Cochrane Risk of Bias Assessment Tool for Non-Randomised Studies of Interventions).
RESULTS: One hundred and four studies satisfied the inclusion criteria. Seven RCTs assessing inflammation and another eight assessing bone remodelling were identified. Overall, 53 studies evaluated bone and tissue remodelling, 41 inflammation and pain, seven root resorption and three skeletal maturation through biologic indices in GCF. The quality of the included studies ranged from low to moderate. Significant elevations in the concentrations of GCF components such as cytokines, neurotransmitters, growth factors and arachidonic acid metabolites were reported.
CONCLUSIONS: The data retrieved from this review suggest that knowledge or information on periodontal biomarkers of GCF may prove useful in the clinical setting leading to the correct choice of mechanical stress; this may, in turn, improve treatment outcomes, may shorten treatment time and, at the same time, assist in avoiding side effects.

174 PERCEIVED FACIAL CHANGES OF A CONVEX PROFILE IN CLASS II DIVISION 1 PATIENTS AFTER FUNCTIONAL ORTHOPAEDIC TREATMENT FOLLOWED BY FIXED ORTHODONTIC APPLIANCES

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AIM: To investigate the perceived facial changes in the convex profile of Class II division 1 patients after functional orthopaedic treatment followed by fixed orthodontic appliances.

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MATERIALS AND METHOD: Pre- and post-treatment profile photographs of 12 Class II division 1 patients treated with an activator, 12 Class II division 1 patients treated with a Twin Block and 12 normal profile controls treated without functional appliances, were presented in pairs to 10 orthodontists, 10 patients, 10 parents and 10 laypersons. The raters assessed changes in facial appearance on a visual analogue scale (VAS). Two-way MANOVA was used to evaluate differences among group ratings.
RESULTS: Intrarater reliability was strong in most cases (intraclass correlation coefficient > 0.7). The internal consistency of the assessments was high ($\alpha > 0.87$), both within and between groups. The raters consistently perceived more positive changes in the Class II division 1 groups compared to the control group. However, this difference hardly exceeded 1/10th of the total VAS length, at its highest value, and was mostly evident in the lower face and chin. No significant differences were found between the activator and the Twin Block groups.
CONCLUSIONS: Although the raters perceived an improvement of the facial profile after functional orthopaedic treatment followed by fixed orthodontic appliances, this was quite limited. Thus, orthodontists should be tentative when predicting significant improvement of a patient's profile through this treatment option.

175 ASSESSMENT OF DIFFERENT TECHNIQUES FOR THREE-DIMENSIONAL SUPERIMPOSITION OF SERIAL DIGITAL MAXILLARY DENTAL CASTS ON PALATAL STRUCTURES

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AIMS: To identify a simple, efficient, and accurate way to assess tooth movement in growing patients through superimposing serial digital three-dimensional (3D) dental models.
MATERIALS AND METHOD: Ten pre- (T0; median age: 8.0, range: 6.0-9.3 years) and follow-up post- (T1; median time lapse: 10.2, range: 7.2-21.6 months) treatment maxillary dental casts of patients with a dental anterior crossbite at T0. Four different superimposition techniques (A: medial two-thirds of the third ruga and a small area dorsal to it; B: area A plus a 6 mm width line on the midpalatal suture extending posteriorly; C: similar to area 'A', but starting anteriorly from the middle two-thirds of the second rugae; D: almost the whole palate) were assessed. Area A was considered the gold standard technique, due to high anatomical form stability. The distance between superimposed datasets in this area (MAD) was used to measure accuracy. Precision was measured by quantifying the 3D movement of three teeth. Non-parametric multivariate models and Bland-Altman difference plots were used for analyses.
RESULTS: There was no difference among operators, between time points or between two groups of settings on the accuracy of each technique ($P > 0.05$). Technique A was the most accurate (MAD = 0.077 mm), closely followed by technique B (MAD = 0.078 mm). C (MAD = 0.095 mm) and D (MAD = 0.138 mm) superimpositions were the least accurate. Small differences were detected among operators in the precision of each superimposition technique ($P < 0.05$) but no differences between two time points or settings ($P > 0.05$). The detected tooth movements differed significantly between different techniques ($P < 0.05$), reflecting the differences in accuracy.
CONCLUSION: Technique A is suggested as the reference area to be used when superimposing 3D digital dental models. Further research should be performed in other groups to generalize these findings.

176 ASSESSMENT OF BONE ACTIVITY CHANGES OF THE TEMPOROMANDIBULAR JOINT WITH FUNCTIONAL ORTHOPAEDIC TREATMENT BY RADIONUCLIDE BONE SCANNING

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AIM: Identification of cellular response of the temporomandibular joint (TMJ) after experimental repositioning of the mandible. Radionuclide bone scanning is an extremely sensitive method that

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can detect the osteoblastic activity of bones earlier than it can be seen on radiographs. The aim of this study was to evaluate osteogenic activity of biomechanically induced condyle using an activator by means of single photon emission computed tomography bone scintigraphy (SPECTBS) labelled with 99m Technetium methylene diphosphonate (99m Tc-MDP).
MATERIALS AND METHOD: Material of the prospective study consisted of bone scintigraphy scans taken from 18 patients (control group: 9.8 ± 0.50) having a Class II division 1 malocclusion in the pubertal growth period. The treatment group consisted of 10 patients (7 girls, 2 boys, mean age: 11.2 ± 0.40 years) treated with an Andresen activator. The control group (5 girls, 4 boys; mean age: 9.8.2 ± 0.40 years) had no orthodontic treatment during the study period. After obtaining ethical approval, SPECTBS labelled with 99mTc-MDP was obtained from bilateral TMJs to determine bone activity changes before and six months after activator therapy. Coronal slices of the scintigraphy scans were used for quantitative evaluation. The bone activity index was defined on bilateral TMJ areas. Non-parametric statistics were used due to the small sample size. Data were analyzed by Friedman two-way ANOVA test. Changes in measurements between pre- and post-activator for each of the study groups were analyzed using Friedman's two-way ANOVA by ranks with a level of significance set at $P < 0.05$.
RESULTS: Osteogenic activity of the right side of TMJ in treatment group showed a statistically insignificant increase after six months of activator therapy. In the control group, bone activity of the TMJ on both the right and left sides demonstrated a statistically insignificant increase during the study period.
CONCLUSIONS: It is proposed that the statistically insignificant increased uptake of radiopharmaceutical in the TMJs is due to early metabolic and positional changes of the condyle resulting from forward movement of the mandible by means of Activator.

177 BONE ACTIVITY ON CIRCUMMAXILLARY SUTURES WITH CONSECUTIVE MAXILLARY EXPANSION AND CONSTRICTION BY SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY
Hatice Gökalp, Ecem Efe, Department of Orthodontics, Ankara University, Turkey

AIM: Radionuclide bone scanning is an extremely sensitive method that can detect the osteoblastic activity of bones earlier than it can be seen on radiographs. The aim of this prospective study was to evaluate whether osteogenic activity in a biomechanically induced mid-palatal suture influences the surrounding maxillary sutures by single photon emission computed tomography bone scintigraphy (SPECTBS) labelled with 99m Technetium methylene diphosphonate (99m Tc-MDP).
MATERIALS AND METHOD: Bone scintigraphy scans taken of seven patients (mean age: 11.3 ± 0.86 years) having a Class III malocclusion associated with maxillary deficiencies in the pubertal growth period treated by consecutive rapid maxillary expansion and constriction (CRMEC). After obtaining ethical approval, SPECTBS labelled with 99mTc-MDP was obtained before CRMEC, after CRMEC and six months later at the end of CRME to determine bone activity changes both mid-palatally and in the surrounding maxillary sutures. A McNamara type expansion appliance with CRME protocol was used to separate the maxilla from the circummaxillary sutures by means of expansion of the mid-palatal suture. CRME was started by opening two turns in the morning and in the evening of the screw in first week. It was closed two turns in the morning and in the evening in second week. It was repeated consecutively during seven weeks. Coronal slices of the scintigraphy scans were used for quantitative evaluation. The bone activity index was defined on mid-palatal, zygomatico- maxillary, fronto-maxillary and temporo-maxillary sutures of the right and left sides of the maxilla. Repeated measures analysis of variance (ANOVA) was used to analyse the difference between the periods.
RESULTS: Osteogenic activity of the right side of the posterior part of the mid-palatal suture and both sides of the zygomatico-maxillary suture became increasingly apparent just after CRMEC despite a decrease after six months later. Similar results were found on the left side of the temporo-maxillary suture during CRMEC.
CONCLUSIONS: It is suggested that the increased uptake of radiopharmaceutical in the mid-palatal and surrounding maxillary sutures may be due to early metabolic and biomechanical changes in the sutures resulting from transverse force application on the maxilla with CRMEC.

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178 ASSESSMENT OF CONDYLE AND GLENOID FOSSA POSITION AFTER CHIN CUP THERAPY

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AIM: To retrospectively assess the influence of chin cup therapy on positional changes of the mandibular condyle and glenoid fossa.
MATERIALS AND METHOD: Pre- and post-treatment lateral cephalometric radiographs of 23 patients (14 girls, 9 boys; mean age: 9.19 ± 0.45 years) with mandibular prognathism who were treated with a chin cup. The control group consisted of 23 subjects (12 girls, 11 boys; mean age: 8.72 ± 0.44 years) with skeletal and dental Class I occlusions. A total of 12 parameters were measured, including both skeletal as well as temporomandibular joint (TMJ) parameters. Descriptive statistics and repeated measurement analysis of variance (ANOVA) was used to compare the differences pre- and post-treatment between the treatment and control groups.
RESULTS: Skeletal changes were observed in the chin cup group, including a significant decrease in SNB and gonial angles and a significant increase in ANB angle and effective mandibular length. An increase in mandibular length was observed inspite of the chin cup. Mandibular growth in the chin cup group was compared with that in the control group during the prepubertal growth period but statistically insignificant differences were recorded. Maxillary length was increased by chin cup therapy. It was observed that while the mandibular condyle and glenoid fossa displaced postero-inferiorly in the chin cup group, they were displaced antero-superiorly in the control group.
CONCLUSIONS: Mandibular length increase was restricted while maxillary length increase was accelerated by the chin cup. Both condyle and glenoid fossa displacement was observed following chin cup therapy.

179 ALVEOLAR BONE GRAFT, OSTEOGENESIS DISTRACTION AND ORTHOGNATHIC SURGERY IN PATIENTS WITH CLEFT LIP-ALVEOLAR AND CLEFT PALATE

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AIM: To assess differences between distraction osteogenesis or orthognathic surgery and to compare the effectiveness and safety of different methods of bone grafting side (right time, source and graft technique) by means of a literature review.
MATERIALS AND METHOD: A manual search of articles from the last 5 years in a dental library was performed. A search on various electronic resource databases such as Cochrane, PubMed, ScienceDirect and Medline was carried out. The inclusion criteria were: patients with a cleft lip and palate, all age ranges, and orthodontic-orthopaedic-surgical treatment. After performing the search strategy, 582 publications were found, of which 553 were excluded after reviewing the title and abstracts. For the 29 remaining, full texts were obtained.
RESULTS: The timing and sequence of orthodontic treatment can be divided into four periods of development. These periods are defined by age and tooth development. From the 1950s two criteria were in place: neonatal or pre-surgical orthodontics and conservative treatment (including osteogenesis distraction and orthognathic surgery). All authors conclude with the elective placement of the alveolar bone graft intermediate or secondary. However, the timing of grafting is another source of disagreement and so, while some authors recommend secondary graft procedures around 5 or 6 years, others prefer to postpone until 8 or 9 years to avoid interfering with maxillary growth. Whilst distraction osteogenesis and orthognathic surgery have been widely used in the treatment of cleft-palate patients, there is uncertainty as to the optimal correction method.
CONCLUSIONS: More randomised clinical trials on the optimal time for surgery are required, especially studies investigating new artificial materials.

180 CEPHALOMETRIC EFFECTS OF COMBINED RAPID PALATAL EXPANSION AND FACEMASK THERAPY

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AIM: To contribute to the knowledge of sagittal and vertical effects of combined treatment with a rapid palatal expander (RPE) and a facemask.
SUBJECTS AND METHOD: Twenty one consecutive Class III patients (10 males, 11 females) with a mean age of 10 years. The mean activation of the RPE was 6 mm. The mean treatment time with the facemask was 11 months. The mean registered daily use and activation force of the facemask was 12 hours and 680 g per side, respectively. One hundred and thirty pre- and post-treatment lateral cephalometric measurements were compared, and the results statistically analyzed.
RESULTS: Some significant changes were observed: 1. Sagittal: Skeletal: Maxillary protrusion and mandibular retrusion. B. Dental: Upper incisor protrusion and lower incisor retrusion. C. Soft tissues: The skeletal changes were reflected in the soft tissues, especially in the lips. 2. Vertical: An increase of the vertical dimension was found as a result of treatment.
CONCLUSIONS: The use of a RPE in combination with a facemask for the treatment of Class III patients is not only clinically, but also cephalometrically, remarkable. It is a non-invasive method that should not be forgotten but remembered as an early treatment option for these patients. Further research must be performed to obtain larger samples and for long-term and three-dimensional observations.

181 OUTCOME OF ORTHODONTIC CARE IN THE SWEDISH PUBLIC DENTAL SERVICE

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AIM: Orthodontic care is provided by the Swedish Public Dental Service to children and adolescents with orthodontic treatment need. The purpose of the study was to assess the outcome of orthodontic care by registering residual need and demand for orthodontic treatment in 19-year-olds.
MATERIALS AND METHOD: The dental records of 207 (107 males, 100 females) 19 years of age registered at one general public dental clinic in Linköping were evaluated. Orthodontic treatment need was clinically examined using the Index of Complexity, Outcome and Need (ICON). The subjects also completed a questionnaire regarding orthodontic treatment demand.
RESULTS: Out of all 207 participants, 86 (38 males, 48 females) individuals (41.6%) had received orthodontic appliance treatment. Twenty-six (17 males, 9 females) of those had been treated by general practitioners, and 60 (21 males, 39 females) by orthodontists. Orthodontic treatment need (ICON index value ≥43) was registered in 28 (22 males, 6 females) individuals (13.5%). Eight of those had previously received orthodontic treatment by general practitioners, but none had been treated by orthodontists. Orthodontic treatment demand was expressed by nine (3 males, 6 females) individuals (4.3%). Eight (2 males, 6 females) of those had no residual need for treatment. The only (1 male) individual with a residual treatment need as well as demand for treatment had previously been offered fixed appliance treatment but declined the offer. The proportion of males (35.5%) who had experienced orthodontic treatment was not significantly lower (P = 0.069) than among the females (48.0%). However, a lower (P = 0.009) proportion of treated males (55.3%; n = 21 out of 38) than of treated females (81.3%; n = 39 out of 48) had received treatment by orthodontists. At 19 years of age, the proportion of males with a treatment need (20.6%) was higher (P = 0.002) than among the females (6.0%).
CONCLUSIONS: The public dental service had successfully discovered orthodontic treatment need and offered orthodontic treatment to those in need in the studied population. Notable differences between genders regarding treatment modalities and orthodontic treatment need at age 19 were found.

182 LOCAL INJECTION OF REVEROMYCIN A PREVENTS ALVEOLAR BONE LOSS IN OSTEOPROTEGERIN KNOCKOUT MICE WITH PERIODONTAL DISEASE

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AIM: Osteoprotegerin knockout (OPG-/-) mice commonly develop severe osteoporosis caused by significant enhancement of bone resorption by osteoclasts. The aim of this study was to examine the periodontal tissue reaction course of an experimental model of periodontitis using OPG-/- mice and to investigate the effect of local injection of the osteoclast specific inhibitor Reveromycin A (RMA) on the alveolar bone.
MATERIALS AND METHOD: Eight-week-old male OPG-/- mice and Wild type (WT) mice were ligated with wire around contact points on the left first and second molars under anaesthesia. The mice were locally injected with RMA for 8 weeks. Then, under anaesthesia, the mandibular bones of the mice were collected. The remaining alveolar bones between the first and second molars were measured using image analysis software and histological analysis was performed.
RESULTS: At 8 weeks after ligation, in both OPG-/-mice and WT mice, the remaining alveolar bone was higher in the RMA-administered group than in the non-administered group. Histologically, progression of the attachment loss was suppressed in the RMA-administered group, and reduction of alveolar bone loss was also significantly observed.
CONCLUSIONS: Local injection of RMA inhibits the activity of osteoclasts and prevents loss of alveolar bone during periodontal disease progression in OPG-/- mice.

183 PREVALENCE OF TEMPOROMANDIBULAR DISORDERS IN PATIENTS WITH HASHIMOTO'S THYROIDITIS – A PILOT STUDY

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AIM: Autoimmune thyroid disease or Hashimoto's thyroiditis (HT) is the most prevalent autoimmune disorder, affecting about 10 per cent of the population and is a recognized cause of fibromyalgia and chronic widespread pain. The aim of this study was to determine the frequency of temporomandibular disorders (TMD) in patients suffering from HT.
SUBJECTS AND METHOD: A total of 113 female patients aged between 18 and 60 years were allocated into two groups. The study group consisted of 47 female patients diagnosed with HT, while the control group comprised 66 healthy individuals of which 14 were excluded. Serum concentrations of free T3, free T4, TSH and thyroglobulin and thyroperoxidase antibodies were determined. The temporomandibular jaws and muscles were clinical examined. The Research Diagnostic Criteria for TMD (RDC/TMD) was used to assess TMD. Standardized questionnaires implying epidemiological criteria, state and treatment of the thyroid disease, Helkimo Index (HI), Fonseca Anamnestic Index (IAF) and General Health Questionnaire 12 (GHQ12), were completed by all patients.
RESULTS: When measuring the correlation between TMD and HT patients, the outcome was found significant in the total cohort ($T = 6.88$, $P < 0.001$). TMD symptoms were observed in both groups, 46 (97.87%) of the clinical but only 25 (48%) of the control group. Similar pattern was seen in both groups according to muscle pain ($T = 5.0$, $P > 0.001$). While only two (3.84%) of the control group suffered muscle stiffness and pain without jaw participation, this was observed in six (13.04%) of the study group. No significant correlation could be found in IAF and clinical examination of the temporomandibular region.
CONCLUSIONS: The results confirm the validity of the main assumptions, which builds a meaningful base for further experiments concerning this field of research. The frequency of TMD and musculoskeletal complaints seems to be higher in patients suffering from HT. Patients with TMD who do not respond to common therapy should be questioned for thyroid disease and referred to a specialist if necessary.

184 MAXILLARY EXPANSION WITH LEAF EXPANDER: A PRELIMINARY LONGITUDINAL STUDY ON CONE-BEAM COMPUTED TOMOGRAPHY IN GROWING PATIENTS

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AIM: To examine the maxillary response on the transverse dimensions to the new Leaf Expander (LE) using cone beam computed tomographs (CBCT) in growing patients.
SUBJECTS AND METHOD: Ten children (7.5 ± 1.5 years) with a transverse maxillary deficiency of 5 mm and problems regarding an unerupted maxillary tooth, who required expansion. In accordance with the recommendations concerning the use of CBCT (ALARA), when conventional radiography cannot supply satisfactory diagnostic information, CBCT of the maxilla were obtained before treatment (T1) and immediately after expansion (T2) for all patients. The LE, which is a palatal expander characterized by applying light (450 g) and constant forces by means of two leaf springs compressed by a screw were used. It has a maximum expansion of 6 mm and was applied using bands on the second primary molars. The pre-compressed leaves deliver 3 mm of expansion with 8-10 activations necessary per month in a single appliance, reaching the maximum number of activations of 35 (1 hole/turn = 0.1 mm). The duration of active treatment was on average 6 months and the LE was maintained for retention for 3 months. For each patient the width of the nasal cavity, the maxillary basal bone and the midpalatal suture at the level of the second primary molars at T1 and T2 were measured, together with the intermolar diameter measured at the second primary molars.
RESULTS: From T1 to T2 the mean increase in nasal width was 2.6 mm, maxillary basal bone had a mean increase of 3.1 mm and the mean opening of the midpalatal sutures was, on average, 3.7 mm. The intermolar diameter increased, on average, 6 mm.
CONCLUSIONS: After LE treatment significant increases in the transverse dimensions of the nasal cavity, maxillary basal bone and midpalatal suture were found. The intermolar diameter increased almost exactly the expansion of the screw. These first results suggest that LE could be considered effective for the treatment of constricted maxillary arches as an alternative no compliance to the rapid palatal expander.

185 CONE-BEAM COMPUTED TOMOGRAPHY TO EVALUATE CONDYLAR POSITION BEFORE AND AFTER ORTHOGNATHIC SURGERY

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AIM: Conventional radiographic examinations are two-dimensional representations of three-dimensional objects, thus exhibiting several limitations. These techniques are insufficient in the diagnosis, treatment planning and orthodontic prognosis, especially in complex cases which require orthognathic surgery. The aim of this study was to analyse the effectiveness of cone beam computed tomographs (CBCT) in the evaluation of the position, angulation and displacement of the condyles, before and after orthognathic surgery.
SUBJECTS AND METHOD: Condylar changes were evaluated in 20 patients (27.0 ± 6.51 years) undergoing orthognathic surgery between December 2013 and April 2016. The angulation, condylar position and intercondylar distance were measured on CBCT before (T1) and after (T2) surgery. Also the position of the condyle was further classified according to the Pullinger and Hollender's formula in both phases. A MANOVA repeated measures and *post hoc* set of tests were conducted to ascertain if there were statistically significant differences between T1 and T2 variables. A statistical analysis of Kappa was conducted to determine the concordance of condylar position classification before and after the intervention.
RESULTS: The preliminary results show that there were no statistically significant differences between the values of the angulation and position of the condyles as well as of the intercondylar distance in the T1 and T2 phases. Analysing the average values, there was an increase of the axial angle of the left condyle and the frontal angle of both condyles, while there was a decrease of the axial angle of the right condyle, the sagittal angle of both condyles and intercondylar distance. Both condyles moved from an anterior position to a concentric position after surgery.
CONCLUSIONS: CBCT are useful for assessing variations of condylar position pre and post-surgery. It was found that, after the surgery, the condyles showed a posterior and inferior movement. Long-term studies with larger sample sizes are needed to ascertain the eventual recovery of the original condylar position and the maintenance of post-surgical stability.

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186 RELATIONSHIP BETWEEN FACIAL MORPHOLOGY AND TONGUE THICKNESS MEASURED BY ULTRASONOGRAPHY

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AIM: To evaluate the reliability of ultrasonographic tongue thickness measurement and to determine the relationship between vertical facial characteristics and tongue thickness measured by ultrasonography.

SUBJECTS AND METHOD: Ultrasonographic and cephalometric measurements were carried on 68 patients aged between 14-18 years old. Patients with craniofacial deformity, tongue disorders or severe skeletal discrepancy were excluded from study. Vertical facial characteristics of patients were evaluated on lateral cephalometric radiographs using *Y* axis, SN-GoGN, SN-palatal plane and palatal plane-mandibular plane angles. Tongue thickness measurements were performed between the mylohyoid muscle and the highest point of tongue dorsum with a B-mode ultrasonography device using a 3.5-14 MHz linear probe. The probe was positioned on the submental region at the distal point of mandibular premolar teeth and perpendicular to the Frankfort Horizontal Plane. Ultrasonographic measurements were repeated three times at 2 week intervals. Pearson correlation test were used for statistical analysis.

RESULTS: There was a high reliability coefficient for repeated ultrasonographic measurements (r = 0.99). There were negative and significant correlations between tongue thickness and SN-GoGn, palatal plane-mandibular plane angles ($P < 0.05$) while negative correlations between tongue thickness and *Y* axis, SN-palatal plane angles were not statistically significant.

CONCLUSIONS: Measurement of tongue thickness with the ultrasonographic technique was found clinically reliable and reproducible. The results revealed that the thickness of tongue has a negative relationship with vertical facial morphology.

187 EFFECT OF HETEROLOGOUS BONE MARROW MONONUCLEAR CELL TRANSPLANTATION ON MIDPALATAL EXPANSION IN RATS

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AIM: To explore whether bone marrow mononuclear cell (BMMC) transplantation can accelerate the bone remodelling induced by midpalatal expansion in rats

MATERIALS AND METHOD: A total of 48 male Sprague Dawley rats (mean weight, 208.36 ± 7.32 g) were divided into control and midpalatal expansion with or without BMMC transplantation groups. Histological and morphological changes were observed in each group. The osteogenic activities and differential potentials of the transplanted BMMCs labelled with bromodeoxyuridine in the midpalatal bone tissue were assessed by osteocalcin expression. The receptor activator of nuclear factor κB ligand (RANKL)/osteoprotegerin (OPG) ratio was determined by reverse transcription quantitative polymerase chain reaction (RT qPCR) to reflect the equilibrium between bone resorption and formation.

RESULTS: The width of the maxillary dental arch increased distinctly within 2 weeks of midpalatal expansion with BMMC transplantation. The morphology of the midpalatal suture in this group changed significantly; the cartilage was completely replaced by fibrous-like tissue expressing osteocalcin. The palatal bone was reorganized from a cancellous form into a mature compact structure after an additional 2 week relapse period. Immunostaining results indicated that the heterologous transplanted BMMCs survived and differentiated into osteoblasts during the remodelling induced by midpalatal expansion. The RANKL/OPG expression ratio significantly decreased after 2 weeks of midpalatal expansion with BMMC transplantation due to the inhibition of RANKL expression.

CONCLUSIONS: Heterologous BMMC transplantation appears to accelerate the midpalatal bone remodelling induced by expansion of the rats by increasing the number of osteoprogenitor cells and regulating the RANKL OPG signalling pathway.

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188 CRANIOFACIAL CHARACTERISTICS OF ADULTS WITH TEMPOROMANDIBULAR JOINT DISORDERS

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AIM: To evaluate the relationship between temporomandibular joint (TMD) symptoms and craniofacial characteristics in adult patients

SUBJECTS AND METHOD: Thirty adults with TMD symptoms (group 1) and another 30 adults who had a skeletal Class I malocclusion without TMD symptoms (group 2). Craniofacial cephalometric variables (horizontal, vertical, craniocervical posture analysis – upper part of the cervical spine (CVT) and odontoid line (OPT) were measured on lateral cephalograms. The difference between the two groups was tested with an independent samples *t*-test at a significance level of $\alpha = 0.05$. In group 1, Pearson correlation analysis was undertaken to find correlations between dentofacial characteristics and craniocervical posture. Intraclass correlation coefficients for the reliability of tracing and measurements were calculated.

RESULTS: Most TMD patients (group 1) had a skeletal Class II malocclusion with a hyperdivergent pattern (ANB = 5.00, antero-posterior dysplasia indicator (APDI) = 77.59, FMA = 30.22) and their mandibular body and ramus height were shorter than in group 2 (body to anterior cranial base ratio = 1.10, ramus height = 46.42). In terms of craniocervical posture, group 1 showed approximately a 4 degree more extended head posture than group 2. In correlation analysis, CVT-FH, CVT-PL, OPT-PL had significant correlation with ANB and APDI in TMD patients.

CONCLUSIONS: TMD is associated with dentofacial morphology and extended craniocervical posture. There is more potential for TMD in skeletal Class II malocclusions subjects who have a hyperdivergent pattern. It would be helpful for orthodontists to consider these results to identify potential patients with TMD from initial orthodontic records and manage temporomandibular joint problems in orthodontic treatment.

189 THE RELATIONSHIP BETWEEN SOFT TISSUE THICKNESS AND SOFT TISSUE CHANGES RESULTING FROM LE FORT I MAXILLARY SURGERY

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AIM: To evaluate the relationship between soft tissue thickness and soft tissue changes resulting from Le Fort 1 maxillary surgery at the upper lip and point A region.

MATERIALS AND METHOD: The soft tissue response to maxillary advancement at the Le Fort I level of 37 patients was evaluated on lateral cephalometric radiographs. Linear measurements and soft tissue change to hard tissue change ratios were calculated for upper lip and point A. Soft tissue change to hard tissue change ratios of point A and upper lip were calculated using hard and soft tissue changes as the result of surgery. Soft tissue thickness of point A and the upper lip were measured from hard tissue point A to soft tissue point A, from upper lip point to upper incisor, respectively. The relationship between soft tissue change to hard tissue change ratios and soft tissue thickness was analyzed using Pearson correlation test.

RESULTS: Soft tissue point A response to maxillary surgery had a positive and significant correlation with the amount of maxillary movement ($P < 0.05$). There was a negative and significant correlation between soft tissue thickness and soft tissue change to hard tissue change ratios of point A ($P < 0.05$). A negative correlation was also found for upper lip thickness and soft tissue response to surgery, although the correlation was not statistically significant.

CONCLUSIONS: Soft tissue point A to the maxillary advancement surgery appeared to be predictable, and the soft tissue thickness of point A region affected soft tissue response to surgery negatively while the relationship between the thickness and surgery response of upper lip were unpredictable.

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190 ORTHODONTIC TREATMENT NEED, OUTCOME AND RESIDUAL TREATMENT NEED IN 15- AND 20-YEAR-OLDS IN JÖNKÖPING COUNTY, SWEDEN

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AIM: To investigate orthodontic treatment need and outcome of orthodontic treatment in 15- and 20-year-olds in Jönköping, Sweden with special reference to residual treatment need.
SUBJECTS AND METHOD: An offer to participate in a clinical investigation was extended to random samples of 130 15-year-olds and 130 20-year-olds. Ninety-four of the 15-year-olds (72.3%, 48 boys and 46 girls) and 63 of the 20-year-olds (48.5 %, 21 males and 42 females) accepted and presented for examination. The participants filled in a questionnaire and impressions were taken for study models, which were graded according to the Index of Complexity, Outcome and Need (ICON). Differences were compared by three different observers ranking 30 models for calibration. One observer then ranked all the study models.
RESULTS: The Spearman correlation coefficient between observers varied between 0.85 and 0.92. In the 20-year-olds, 89.5 per cent of those who had not undergone orthodontic treatment were satisfied with their occlusion. Out of the same group 22.8 per cent would like to get orthodontic treatment if it was offered to them. Of the orthodontically treated cases 6 per cent felt that treatment goals were not attained. Six per cent felt that there had been considerable post-treatment changes. Nine per cent felt that the orthodontic treatment was not worth the effort. Forty-eight per cent of the 20-year-olds reported that they had received some form of orthodontic treatment, 14.1 per cent in an orthodontic clinic and 34.4 per cent by a general practitioner under the supervision by an orthodontist. Among the 20-year-olds 3.3 per cent had an ICON value >43 indicating a treatment need, but 17.2 per cent reported a treatment demand.
CONCLUSIONS: This study indicates a residual treatment need among 20-year-olds in 3.3 per cent but a higher treatment demand.

191 SLEEPINESS, QUALITY OF LIFE, HEAD POSTURE AND AIRWAY DIMENSIONS IN OBSTRUCTIVE SLEEP APNOEA PATIENTS

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AIM: To 1) compare daytime sleepiness and quality of life (QoL) in patients with obstructive sleep apnoea (OSA) with healthy controls, 2) compare sleepiness and quality of life in OSA patients before and after treatment with a mandibular advancement device (MAD), 3) analyze associations between head posture/airway dimensions and sleepiness/QoL in OSA patients
SUBJECTS AND METHOD: In 27 OSA patients (18 men, 9 women, mean age 52.3 years) at baseline and after MAD treatment and at baseline in 32 matched healthy controls (20 men, 12 women, mean age 51.1 years) daytime sleepiness and QoL were recorded using the Epworth Sleepiness Scale and Short Form-36 questionnaires. Lateral cephalograms were taken of OSA patients at baseline and head posture and airway dimensions were analyzed. Differences between the groups, before and after treatment and associations between head posture/airway dimensions and sleepiness/QoL were tested and adjusted for age and gender by multiple regression analyses.
RESULTS: Daytime sleepiness occurred significantly more often ($P < 0.05$) and QoL in general was significantly poorer ($P < 0.05$) in the OSA patients compared to controls at baseline. After MAD treatment daytime sleepiness decreased ($P < 0.01$) and QoL domain 'vitality' increased ($P < 0.01$) in the OSA patients compared to baseline. Craniovertical head posture was negatively associated with QoL domains 'physical limitations' ($P < 0.05$) and 'mental wellbeing' ($P < 0.05$) in OSA patients. The nasopharyngeal airway dimensions were positively associated with QoL domain 'social functioning' ($P < 0.05$). The oropharyngeal airway dimensions were negatively associated with 'physical limitations' ($P < 0.05$).
CONCLUSIONS: The results confirm previous findings of daytime sleepiness and QoL in OSA patients before and after MAD treatment. New results indicate that OSA patients with extended

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craniovertical head posture, small nasopharyngeal airway dimensions and large oropharyngeal airway dimensions have a poorer QoL.

192 THE APPLICABILITY OF CAMERIERE'S EUROPEAN FORMULA OF OPEN APICES FOR DENTAL AGE ESTIMATION IN 5-17 YEAR OLD NORTH GERMAN CHILDREN

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AIM: To test the accuracy of Cameriere's European formula on a sample of north German children based on dental age (DA) for chronological age (CA) assessment. In addition, to adapt the formula used, in case there are regional peculiarities in this group of children for further clinical use.
MATERIALS AND METHOD: Dental pantograms of 1000 children (444 males, 556 females) aged 5-17 years were used. The roots of seven left mandibular teeth were evaluated. The number of teeth with complete root development was counted (N0). Teeth with incomplete root development were examined and the distance between the inner sides of the open apex was measured and normalized by dividing by the tooth length to avoid error due to magnification factor. DA was calculated using Cameriere's European formula. The obtained DA was compared with CA for each child. The significance of the difference between CA and DA was statistically analyzed for each age cohort and gender separately by the paired *t*-test. A multiple linear regression model with first-order interactions was used to adapt the formula on a group of 800 German children. Dental pantograms of another group of 200 children were used to evaluate the accuracy of the new adapted formula.
RESULTS: Cameriere's European formula underestimated the mean CA of boys by 0.58 ± 1.02 years and of girls by 0.34 ± 0.96 years. The results of the regression analysis showed that gender (g), sum of normalized open apices (s), number of teeth with closed apices (N0) and the first-order interaction between the normalized apex width of the canine (X3) and N0 contributed significantly to the fit in German children formula. All previous mentioned were included in the regression model, yielding the following formula: DA = 9.829 + 0.632 N0 –1.037 s + 0.686 g –1.582 N0. X3, where g is a variable: 1 for males and 0 for females.
CONCLUSIONS: Cameriere's European formula when applied to north German children underestimated most age cohorts for both genders. The new adapted formula explained 84.1 per cent of the total difference and was more suitable for CA estimation of north German children.

193 EFFECT OF LIGATION FORCE ON ANTERIOR TORQUE CONTROL DURING SPACE CLOSURE – SIMULATION OF LONG-TERM TOOTH MOVEMENT USING THE FINITE ELEMENT METHOD-

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AIM: Various types of ligation materials, for example, elastomeric ring, ligature wire or self-ligating bracket, have been used to engage an archwire into brackets in orthodontic treatment. In general, tight ligation of the archwire is considered to be effective to control anterior torque during anterior retraction. However, the effect of tight ligation on movement control of anterior teeth over a long period of time is still unclear. The purpose of the present study was to clarify the effect of ligation force on anterior torque control.
MATERIALS AND METHOD: A three-dimensional finite element (FE) model for a maxillary dentition was constructed wherein the first premolar was extracted. The model had 0.022 inch brackets and a 0.019 x 0.025-inch archwire. Three types of ligation method simulating elastomeric ring, ligature wire and self-ligating bracket, were tested. Sliding mechanics were employed to close the extraction space, and a retraction force of 2 N was applied. Simulation of long-term tooth movement was performed using a time-dependent FE method. After the space was closed, the retraction force was removed to upright the incisors. The degree of lingual crown tipping of the central incisor was analyzed both during space closure (tipping phase) and after space closure (tooth uprighting phase).

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RESULTS: During space closure, lingual crown tipping of the central incisor occurred with every ligation method. The degree of lingual crown tipping was largest in the self-ligating bracket model, and the ligature wire model showed the smallest degree of tipping. However, the difference in values between the methods was small, especially between elastomeric ring and ligature wire. In the uprighting phase, the degree of lingual crown tipping decreased the most for the ligature wire model, followed in order by the self-ligating bracket model and the elastomeric ring model.
CONCLUSIONS: The findings suggest that a ligature wire and elastomeric ring can control the tipping of anterior teeth more effectively than a self-ligating bracket during space closure. On the other hand, in the uprighting phase after space closure, a ligature wires causes the incisors to be uprighted more effectively than elastomeric rings.

194 STABILITY OF MOLAR DISTALIZATION USING ORTHODONTIC MINISCREWS

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AIM: Molar distalization using orthodontic miniscrews is a popular way to relieve crowding or resolve lip protrusion. However, molar distalization may be unstable as it has an opposite directional vector to the physiological mesial movement. Therefore, this study was performed to evaluate long-term stability of molar distalization and to compare the amount of movement during retention among patients who had been treated with molar distalization, four premolar extractions, and minor tooth movement of the anterior teeth as a control.
SUBJECTS AND METHOD: Subjects who had lateral cephalograms before (T0), immediately after (T1), and at least 2 years after (T2) treatment were retrospectively collected and assigned to three groups according to treatment methods and results: distalization group (n = 23) who had been treated with molar distalization using orthodontic miniscrews; extraction group (n = 26) who had been treated with four premolar extractions; and control group (n = 27) who showed less than 1 mm movement of the posterior teeth. Based on vertical (SE-PTM) and horizontal (S-N) reference planes (VRP and HRP, respectively), the following linear and angular measurements were performed: the perpendicular distance from the most distal point of the crown and the distobuccal root apex of the first molar (U6) to the VRP; and angle formed by the first molar long-axis based on the HRP.
RESULTS: The U6 crown moved 3.63 mm distally in the distalization group ($P < 0.05$), while it moved 2.17 mm and 0.45 mm mesially ($P < 0.05$) in the extraction and control groups, respectively, during T0-T1. The U6 root moved slightly less in the same direction than the crown in all three groups ($P < 0.05$) during T0-T1. During T1-T2, the crown and root moved mesially in all the three groups ($P < 0.05$), but there were no significant differences among the three groups ($P > 0.05$). The axis did not change significantly in the three groups ($P > 0.05$) during T0-T1 and T1-T2, which was not significantly different among the three groups ($P > 0.05$).
CONCLUSIONS: Molar distalization using orthodontic miniscrews did not show any differences in tooth movement in the extraction or control groups during retention. Therefore, molar distalization can be considered a stable treatment modality.

195 COMPARISONS OF SKELETAL CLASS III CORRECTION BY TWO-JAW SURGERY VERSUS A MODIFIED C-PALATAL PLATE COMBINED WITH BILATERAL SAGITTAL SPLIT RAMUS OSTEOTOMY

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AIM: To evaluate the treatment effects of a modified C-palatal plate (MCPP) combined with a bilateral sagittal split ramus osteotomy (BSSRO) in Class III patients and to compare it to that of two-jaw orthognathic surgery.
SUBJECTS AND METHOD: The MCPP group consisted of 11 subjects and the two-jaw surgery group comprised 16 adult patients. Twenty six skeletal, dental and soft tissue cephalometric variables were

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measured on the pre- (T1) and post- (T2) treatment cephalographs. A paired *t*-test was used to evaluate the changes in the selected variables from T1 to T2 within each group. A multivariate analysis of variance (MANOVA) was performed to evaluate the differences in T1, T2 and treatment effects between the groups.
RESULTS: There were no significant differences in either the T1 or T2 skeletal, dental and soft tissue measurements between two groups. All skeletal variables showed significant changes between T1 and T2 in both groups except the facial angle in the MCPP group, which showed no significant changes. SNA angle decreased significantly within each group but no significant difference was found in the amount of reduction between the groups. MCPP showed a greater amount of distal movement by the maxillary first molars than the two-jaw surgery group ($P = 0.002$).
CONCLUSIONS: The application of the MCPP combined with BSSRO may be a viable treatment alternative to two-jaw surgery in the correction of severe skeletal Class III malocclusions.

196 ROMSE- A DATABASE FOR OROFACIAL MANIFESTATIONS IN PATIENTS WITH RARE DISEASES AND A SET-UP OF A UNIFIED CLASSIFICATION FORM OF DYSGNATHIA

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AIM: Around four million people are affected by a rare disease and 15 per cent can become manifest in the orofacial region, e.g. craniofacial dysplasia such as cleft lip and palate, dysgnathia and hypodontia. Orthodontics forms a major field in rare diseases. Dentists and orthodontists are often the first to come into contact with young patients who are affected by a rare disease. There are no guidelines in dentistry on how to treat patients with rare diseases or which orofacial manifestation can help to find a diagnosis. The aim is to establish a 'database for orofacial manifestations in people with rare diseases-ROMSE' in order to improve diagnosis and treatment. To allow a standardised documentation of orthodontic cases, it is necessary to unify the classifications of dysgnathia.
MATERIALS AND METHOD: Since 2011 material from various databases such as Orphanet, OMIM, as well as PubMed, was evaluated. Starting in 2013 the gathered information was incorporated into the web-based, freely accessible database at http://romse.org. The dysmorphological classification should be the guideline for orthodontists to classify the dysgnathia and to standardise the documentation of people with rare diseases. The classification form is freely available at the ROMSE website.
RESULTS: So far 529 rare diseases with orofacial manifestations have been listed in the ROMSE database. About one-third of those diseases or syndromes show dysgnathia. Especially the sub-classification of dysgnathia seems to be difficult since most of the patients were not analysed according to a standardised classification. Wrong or double assignments are the result.
CONCLUSIONS: Rare diseases and their symptoms come with difficult challenges regarding their therapy. By setting up a ROMSE a platform is provided for dentists and orthodontists to work on interdisciplinary treatment strategies. A consistent and beyond dentistry classification of dysgnathia can avoid wrong assignments.

197 REPORTED SLEEPING DISORDERS DURING EARLY OR LATE CERVICAL HEADGEAR TREATMENT – A RANDOMIZED CLINICAL TRIAL

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AIM: To compare the prevalence of sleeping disorders during cervical headgear treatment in children with a Class II occlusion after early or late headgear treatment.
SUBJECTS AND METHOD: Sixty seven children (39 boys, 28 girls) with a Class II malocclusion were randomly divided into two groups. Headgear treatment was started at the age of 7.8 years (SD 0.53) in the early group (EG). In the late group (LG) treatment was started at the age of 9.5 years (SD 0.59).

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Headgear treatment was continued in both groups until a Class I tendency was gained. Questionnaires completed by parents, were obtained at the beginning of follow-up (EG: at the age of 7.7, SD 0.52; LG: 8.9, SD 1.15), during the headgear treatment (EG: 8.8, SD 1.79; LG 10.2, SD 0.81) and after headgear treatment (EG: 10.3, SD 0.89; LG 11.4, SD 0.72). Groups were compared at the time point T1 where the headgear treatment was started only in the early group. The answers to the questionnaires were compared between groups of early and late treatment using cross tabulation. Fisher's exact test was used to compare the groups.
RESULTS: Statistically significant differences were found between the groups of early and late treatment. At the T1 there was more restless sleeping ($P = 0.041$) and it was more common to sleep in deviant positions such as pulling the head forwards or backwards ($P = 0.049$) in the early group.
CONCLUSIONS: Early headgear treatment might cause more sleeping disorders than late headgear treatment. The sleeping disorder might influence co-operation during the headgear treatment.

198 EFFECTS OF RAPID MAXILLARY EXPANSION ON IMPACTED MAXILLARY CANINES

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AIM: Impacted canines are usually associated with crowding, so relief of crowding prior to eruption can achieve spontaneous improvement. Most Japanese patients have buccally impacted canines. However, few reports have described the treatment of buccally impacted canines, whereas many have described treatment for palatally impacted canines. This study aimed to clarify the effectiveness of rapid maxillary expansion (RME) on buccal canines at risk of impaction because of crowding.
SUBJECTS AND METHOD: According to Anand *et al*. (2012), the risk of impacted canines is judged as the distance from the tip of the canine to the occlusal plane. Participants in this study comprised 115 Japanese patients (230 teeth; age range, 7-10 years) at risk of impacted canines according to the criteria of Anand *et al*. (2012) and 442 Japanese patients (884 teeth; age range, 7-11 years) with normal occlusion and sufficient canine space for eruption. Only patients at risk of canine impaction underwent RME. Panoramic radiographs before and after treatment for the treated group, or once for the untreated group, were traced to evaluate the positions of the maxillary canines. Impacted canines were evaluated by the distance to the occlusal plane, the angle between the axis of the canine and midline, and the distribution of canine in different sectors depending on location of the tip of the tooth. The effectiveness of RME was then compared against the untreated group.
RESULTS: At all ages, a significant difference existed between before and after treatment in terms of distance to the occlusal plane and angle between the axis of the canine and the midline. The untreated group showed the same tendency for erupted canines described by Anand *et al*. (2012) in terms of distance to the occlusal plane. Conversely, untreated canines showed a different tendency to become erupted canines in terms of angle between the axis of the canine and the midline and the distributions of canines.
CONCLUSIONS: RME expansion achieved better facilitation of eruption of canines at risk of impaction compared to that achieved without treatment.

199 FOUR-YEAR EXPERIENCE OF THE USE OF CONE BEAM COMPUTED TOMOGRAPHY IN ORTHODONTICS: A SERVICE EVALUATION AND AUDIT

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AIM: Cone beam computed tomography (CBCT) is gaining popularity for radiographic imaging in orthodontics. The aims were of this research were to evaluate current practice regarding orthodontic CBCT referrals from secondary care services in the West Midlands, UK and to compare the regional use of CBCT in orthodontics to European guidelines.
MATERIALS/SUBJECTS AND METHOD: All orthodontic consultants in the West Midlands were surveyed using a questionnaire regarding their use of CBCTs in 2012. Details of patients who had a CBCT, between January 2012 and December 2015, for orthodontic purposes were gathered from the radiology logbook at Birmingham Dental Hospital. The relevant data was obtained from a

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retrospective review of the case notes using a standard data collection sheet. The gold standard for the audit was set using the Radiation Protection: No 172. Cone Beam CT for dental and maxillofacial radiology (2012).
RESULTS: A response rate of 100 per cent was achieved with the consultant questionnaire. Fifty five per cent of consultants had requested a CBCT in 2012. Most consultants (77%) informed patients of the increased dose of CBCT compared to conventional radiographs but only 60 per cent quantified the additional radiation. In the time frame, a total of 125 CBCTs were taken for orthodontic purposes. The mean age of patients was 14 years 5 months. The most common indication for requesting a CBCT in orthodontics was localisation of an impacted tooth and assessment of root resorption of the adjacent teeth. The majority of images were focused on the anterior maxilla. In each case, clinical examination and relevant conventional dental radiographs had been taken prior to a CBCT. All CBCTs delivered the additional information that clinicians were hoping to obtain. This information helped to make a treatment plan in 70 per cent of cases, confirmed a provisional plan in 20 per cent and resulted in a change of treatment plan in 10 per cent of cases.
CONCLUSIONS: CBCTs requested for orthodontic purposes in the West Midlands are being used in line with evidence-based guidelines, ensuring patients are treated appropriately and in a safe manner.

200 CONE BEAM COMPUTED TOMOGRAPHY REFERRAL PATHWAY AND TIMELINE: ARE WE COMPLIANT WITH CURRENT GUIDELINES?

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AIM: To evaluate the patient pathway following cone beam computed tomography (CBCT) referral and to determine compliance with the recently published British Orthodontic Society (BOS) guidelines on the use of radiographs in orthodontics.
MATERIALS AND METHOD: A retrospective review was conducted of all consecutive CBCT referrals from April 2014-November 2015 in the orthodontic department at the Eastman Dental Hospital. The gold standard was set at 100 per cent compliance with the following: 1. University College London Hospital radiography timeline; 2. All CBCTs should have a formal radiology report; 3, BOS orthodontics radiography guidance. A list of relevant patients was obtained from the radiography department, and CBCT referral request forms were reviewed to obtain the necessary data. Following dissemination of results and key recommendations, further data was prospectively gathered for an 8-month period to determine any changes. Data collection and analysis was performed on Microsoft Excel.
RESULTS: Initial results were obtained over a 20-month period from 41 patients. Evaluation of the demographics showed that 59.5 per cent of patients referred were female and the average age was 14 years with a range of 7-27 years. One hundred per cent compliance was achieved when evaluating for the presence of patient identifiable information and the justification for the CBCT scan. An indication of previous radiography was present in 54.8 per cent of requests and a formal CBCT report was present in 83.9 per cent of CBCT scans undertaken. The average time between T0 (date of referral) and T1 (date of CBCT scan) was 36.5 days and the average time between T1 and T2 (date CBCT report was available) was 36.9 days. Prospective collection of CBCT referrals is ongoing and a second audit cycle will be conducted once an appropriate number of CBCTs have been completed following implementation of key recommendations.
CONCLUSIONS: The results demonstrate that 100 per cent of CBCT scans had an appropriate justification. This audit has also highlighted the need to implement a more structured and efficient pathway for patients undergoing CBCTs.

201 GENETIC RESPONSE OF THE MASSETER MUSCLE AFTER ORTHOGNATHIC SURGERY IN COMPARISON WITH HEALTHY CONTROLS – A MICROARRAY STUDY‡‡‡

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AIM: One-third of adult patients with orthognathic surgery of a prognathic or retrognathic mandible show relapse. The aim of this microarray study was to analyze the general genetic response of the masseter muscle in patients with mandibular retrognathism or prognathism six months after surgery in comparison with healthy untreated controls.
MATERIALS AND METHOD: Tissue samples of the masseter muscle were taken from six adult patients requiring orthognathic surgery (3 prognathic/3 retrognathic) before and six months after surgery and from three healthy controls during extraction of the third molars without orthodontic treatment or orthognathic surgery. Total RNA from the muscle biopsies was isolated with peqGOLD TriFast™ (peqLab, Erlangen Germany). Reverse-transcribed polymerase chain reaction was performed with RevertAid™ First Strand cDNA Synthesis Kit (Fermentas GmbH, St. Leon-Rot, Germany) according to the manufacturers' instructions. Analysis was carried out with the microarray technique (SurePrint G3 Human Gene Expression 8 × 60K Microarray Design ID 02800).
RESULTS: The expression differences from pre- to six months post-surgery can be demonstrated between both patient groups versus controls with an unpaired *t*-test under the condition gene expression >2 fold change ($P < 0.05$). Masseter muscle tissue samples showed a reduction of different entities between patients and controls but less in retrognathic than in prognathic patients (274/429). The different entities to controls in prognathia were reduced from 1862 to 1749 but increased in retrognathia from 1070 to 1563. It was considered that the total amount of different entities to the controls was higher in patients with a prognathic mandible (7364) because of their strong genetic controlled development than in patients with a retrognathic mandible (4126) which is more environmentally influenced. It is remarkable that after selection of special genes (fold change >2), those responsible for inflammatory or immunologically mediators are the down regulated in Class III and where higher than in Class II.
CONCLUSIONS: In retrognathic patients the adaptation could be delayed or the capacity of regeneration potential is not sufficient.

202 PATIENTS' PERCEPTION OF RECOVERY AFTER SURGICAL EXPOSURE OF IMPACTED MAXILLARY CANINES WITH OPEN AND CLOSED TECHNIQUE

Lynn Hauspy, Liesbeth Temmerman, Guy De Pauw, Department of Orthodontics, Ghent University, Belgium

AIM: In this prospective observational study patients' perceptions of recovery after surgical exposure of palatally impacted canines treated with a closed or an open technique was evaluated.
SUBJECTS AND METHOD: In 14 patients (11 females, 3 males; mean age 17 years) a palatally impacted canine was diagnosed. To expose the canine, the surgeon could select a closed or open technique. All patients received a Health-Related Quality of Life (HRQoL) questionnaire to complete from the day of exposure until 6 days after surgery. In the questionnaire patients' perceptions of recovery regarding pain, swallowing, bleeding and comfort was assessed. Secondary, the impact of different parameters such as gender, age and duration of surgical exposure were evaluated. Statistical analysis was performed using the Mann-Whitney *U*-test within a statistical software package (SPSS 24.0 for Windows'). Significance level was set at $P = 0.05$.
RESULTS: Overall recovery time, set as the day a patient scored 1 or 2 out of 10 regarding pain, was found in most patients after 3 days. Between the closed and the open group no significant differences were found ($P = 0.635$). Oral discomfort such as bleeding after exposure and swallowing was low in all patients from day 3 after surgical exposure. For both parameters (bleeding and swallowing) no significant differences were found between the closed and the open group. The median duration of surgical exposure was 17 minutes for the open group and 26 minutes for the closed group, a difference that was statistically significant ($P = 0.024$).
CONCLUSIONS: According to the results of the questionnaires there was no significant difference in the perceptions of patients treated with an open or closed technique. The duration of surgical exposure was significantly shorter in the open technique.

203 CANINE IMPACTION IN PATIENTS WITH UNILATERAL CLEFT LIP AND PALATE AFTER SECONDARY ALVEOLAR BONE GRAFTING: A RETROSPECTIVE STUDY

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AIM: To retrospectively evaluate clinical and radiographic differences between impacted and spontaneously erupted canines in unilateral cleft lip and palate (UCLP) patients after secondary alveolar bone grafting.
SUBJECTS AND METHOD: Eighty seven non-syndromic UCLP patients divided into two groups according to canine eruption. Group A included 39 patients with unilateral impacted canines on the cleft side (A1) and spontaneously erupted canines on the non-cleft side (A2). Group B included 48 patients with spontaneously erupted canines on both the cleft (B1) and non-cleft sides. Groups A1 with A2 were compared with a split-mouth design and group A1 with B1. Clinical records, study models, panoramic and cephalometric radiographs and cone beam computed tomograms were used to evaluate the following parameters: presence of a crossbite, history of interceptive treatment, occlusion and skeletal relationship, development, position and angular measurements of the canine, resorption and condition of the lateral incisor. A generalized linear mixed model for binomial responses with a logit-link was used for statistical analysis.
RESULTS: Cleft-associated impacted canines could be distinguished from spontaneously erupted canines by a less developed root, frequently by a higher position in the maxilla and a higher sector score ($P < 0.05$). Angular measurements (canine to midline and canine to lateral incisor) were significantly larger for impacted canines than for spontaneously erupted canines ($P < 0.001$).
CONCLUSIONS: Based on these measurements, the eruption of the maxillary canine in the bone grafted region requires careful follow-up in UCLP patients. These measurements are a valuable tool to support the diagnosis of impacted canines.

204 PERIODONTAL OUTCOMES OF TREATED IMPACTED PALATAL MAXILLARY CANINES: A SYSTEMATIC REVIEW

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AIM: To compare the periodontal parameters of unilateral impacted maxillary canines treated with a combined surgical-orthodontic approach (experimental group) with normally erupted contralateral canines (control group).
MATERIALS AND METHOD: PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for systematic reviews were used. Publications in PubMed, Web of Science and Scopus were searched from October 2006 to October 2016. The quality of the selected articles was assessed. The following keywords search and strategy was used: (canine*[TI] AND orthodontic* AND periodontal status) OR (canine*[TI] AND orthodontic AND periodontal state) OR (canine*[TI] AND orthodontic*[TI] AND periodontal disease) OR (canine*[TI] AND orthodontic AND aesthetic. Potential relevant publications were analyzed in detail using predetermined inclusion and exclusion criteria. The periodontal outcomes reviewed were sulcus probing depth, bone loss, oral hygiene, bleeding on probing and clinical attachment level. Due to the heterogeneity between articles, only sulcus probing depth was meta-analyzed. Other variables were assessed by a descriptive analysis.
RESULTS: Of 100 publications potentially relevant to this review, four studies were included. Only pocket depth was evaluated in all the studies and was significantly higher in the experimental group (0.21 mm, 95% CI = 0.01 to 0.41 mm, $P = 0.04$). The three studies that assessed bone loss exhibited significant differences when compared with the contralateral side. No significant differences between groups were found for oral hygiene, bleeding on probing, clinical attachment level or recession.
CONCLUSIONS: Impacted canines treated with a combined surgical-orthodontic approach showed poorer periodontal parameters (bone loss and pocket depth) when compared with the contralateral tooth. High quality clinical trials are needed to evaluate the impact of other parameters on periodontal outcomes.

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205 CLASS II: EARLY VERSUS LATE TREATMENT

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AIM: To evaluate, in a literature review, the advantages and disadvantages of early and late Class II orthopaedic treatment.
MATERIALS AND METHOD: A digital search for articles published in the last 15 years was performed with the following keywords: 'Orthodontics' AND 'Class II treatment' AND 'Dentofacial orthopaedics' AND 'growth spurt' AND 'early orthodontic treatment'. Databases searched were: Google Scholar, Cochrane and PubMed-Medline.
RESULTS: Using functional devices before the growth spurt does not seem to produce long-term skeletal changes. The most effective appliance for Class II treatment is Herbst followed by the Twin-Block during the growth spurt.
CONCLUSIONS: Starting treatment at an early stage may lengthen treatment by up to 9 years. On the other hand, waiting for the late mixed dentition has the disadvantage that girls may have passed the growth peak.

206 DO THE FACES OF GENETICALLY IDENTICAL TWINS GROW SIMILARLY? A LONGITUDINAL GROWTH STUDY ON MONOZYGOTIC TWINS †††

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AIMS: A longitudinal analysis of untreated monozygotic twins was to investigate the change of the facial soft tissues during the growth period, to identify distinct facial patterns, and to assess the genetic component of soft tissue development.
MATERIALS AND METHOD: Lateral cephalograms of 33 pairs of untreated monozygotic twins (70% male, and 30% female) from the Forsyth Moorrees Twin Study taken between 1959-1975, who were followed annually from childhood to early adulthood (6-18 years of age). Radiographs were taken on the same machine with 6 per cent magnification at three-year intervals and traced to assess various soft tissue measurements. Statistical analysis included the assessment of longitudinal changes and their 95 per cent confidence intervals (CIs) with a three-level nested mixed-effects linear model, while the intraclass correlation coefficient (ICC) was calculated to measure concordance between twins for each variable.
RESULTS: Considerable variability existed among soft tissue measurements during the growth period. The nasolabial angle and chin thickness remained stable overall during the growth period, while a trend for increase over time was seen for the facial convexity (change = 3.3°; 95% CI = 0.1, 6.6°; $P = 0.049$), nasal prominence (change = 6.6 mm; 95% CI = 3.9, 9.3 mm; $P < 0.001$), and upper lip length (change = 4.7 mm; 95% CI = 2.6, 6.8 mm; $P < 0.001$). The facial growth pattern showed statistically significant differences in magnitude and direction depending on the patient's gender and the underlying sagittal maxillomandibular relationship (measured with ANB angle). Although considerable variations were detected during the growth period even between monozygotic twins, the concordance between monozygotic twins at 18 years of age for the studied variables was moderate to high, ranging from 0.37 for the soft tissue chin thickness to 0.87 for the facial convexity angle. Finally, the concordance between monozygotic twins was higher for females than for males, and higher for Class II and Class III than for Class I patients.
CONCLUSION: Although monozygotic twins possess the same genetic material, differences in the soft tissues are found during and after growth, to a varying degree according to the various components of the face. This supports the complex developmental mechanism of the human face and the varying influence of genetic and environmental factors.

††† Winner of the W J B Houston Poster Research Award

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207 CAN WE EFFECTIVELY TREAT ORTHODONTICALLY-INDUCED WHITE SPOT LESIONS IN AN EVIDENCE-BASED MANNER? A SYSTEMATIC REVIEW AND META-ANALYSIS

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AIM: In a systematic review to assess the therapeutic and adverse effects of interventions to treat post-orthodontic white spot lesions (WSLs) from randomized trials on human patients.
MATERIALS AND METHOD: An unrestricted electronic search of eight databases from inception to May 2016. After duplicate study selection, data extraction, and risk of bias assessment according to the Cochrane guidelines, random-effects meta-analyses of mean differences (MDs), standardized mean differences (SMDs), and odds ratios (ORs), including their 95 per cent confidence intervals (CIs) were performed, followed by subgroup and sensitivity analyses.
RESULTS: A total of 20 unique studies and a total of 942 (42% male/58% female) patients were included, with an average age of 16.2 years and a mean number of 8.2 WSLs (range 2.2 to 45.4) per patient. These were allocated to adjunct treatment with casein phosphopeptide-stabilized amorphous calcium phosphate creams, external tooth bleaching, low or high-concentration fluoride films, gels, mouthrinses or varnishes, resin infiltration, miswak chewing sticks, bioactive glass toothpaste or to no adjunct treatment (i.e. conventional oral hygiene). The monthly use of fluoride varnish was the best supplement to improve WSLs in terms of lesion area (1 trial; MD = –0.80; 95% CI = -1.10,–0.50; $P < 0.05$; high quality) and enamel fluorescence (3 trials; SMD = –0.92; 95% CI = –1.32,–0.52; $P < 0.05$; high quality), followed by the use of fluoride film. WSL treatment did not provide a considerable improvement in their clinical evaluation (3 trials; OR = 0.97; 95% CI = 0.60,1.56; $P > 0.05$; moderate quality), with imprecision due to small sample size being the main limitation of existing evidence.
CONCLUSIONS: Based on existing trials, interventions for post-orthodontic WSLs, mainly fluoride varnish, seem to be effective, but further research is needed to elucidate their clinical relevance.

208 TYPES OF TOOTH MOVEMENT DO NOT AFFECT DISPLACEMENT OF THE CENTRE OF RESISTANCE BUT DO ALVEOLAR BONE RESORPTION IN A RAT MODEL‡‡‡

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AIM: To investigate how the types of tooth movement, bodily or tipping, influence the displacement of the centre of resistance (CR) in teeth, and alveolar bone resorption.
MATERIALS AND METHOD: Ten-week old female Wistar rats were divided into eight groups of different factors: types of movement (bodily and tipping) and force magnitudes (10, 25, 50, and 100 g). The maxillary left first molars were moved mesially with nickel-titanium coil springs for 28 days. Microcomputed tomographic (μCT) images were taken before and after tooth movement. The position of the CR was determined using finite element models constructed from the μCT image. The displacement of the CR and the volume of alveolar bone resorption were measured.
RESULTS: Displacement of the CR showed no significant difference between the bodily and tipping groups. The displacements of the CR were increased with force magnitudes of 10 and 25 g, whereas conversely, they were not further increased at 50 and 100 g. On the other hand, cervical alveolar bone resorption was significantly greater in the tipping group than in the bodily group.
CONCLUSIONS: Displacement of the CR was not influenced by the types of tooth movement. However, the volume of cervical alveolar bone resorption was greater with tipping movement than with bodily movement.

209 CONTINUOUS ERUPTION OF MAXILLARY TEETH DURING A TEN YEAR PERIOD IN A FEMALE ADULT SAMPLE

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AIM: Continuous physiologic eruption of teeth was initially thought to be a mere compensative mechanism for occlusal wear, occurring in ancient populations with an abrasive diet. More recently it has been found that teeth tend to erupt with their periodontal support while the location of the mucogingival junction remains constant, independently from diet and occlusal wear. The aim of this investigation was to study maxillary tooth eruption during a 10 year period by three-dimensional (3D) superimposition of digital dental casts.
MATERIALS AND METHOD: Alginate impressions were taken at both baseline and at the 10-year follow-up in a sample of adult Swedish women (average initial age 48 years, range 33-58 years). The plaster casts of the upper arch were digitized by means of a 3D scanner and then superimposed on the palate and the palatal rugae. Occlusal and gingival markers were digitized for each tooth from first molar to first molar. After setting the reference axis parallel to the occlusal plane, the vertical changes of recorded markers gave an indication of toot extrusion and gingival apical or coronal displacement.
RESULTS: A trend was found for an increasing extrusion of teeth from the first molars (+0.05 mm) to the central incisors (+0.34 mm). Vertical displacement of the gingival margin also showed a positive trend from first molars to incisors, comparable to that shown by the corresponding occlusal points. Negative values (corresponding clinically to gingival recession) were more commonly found on first molars (–0.36 mm) and premolars (–0.15 mm), canines were neutral (–0.01 mm) while slight coronal displacement of the gingival points in the incisor area was observed (+0.09 mm for central incisors). The pattern of eruption of occlusal points and vertical movement of gingival points was almost parallel and showed that clinical crown lengthening occurred mainly due to gingival recession for first molars and premolars, while for the incisors crown eruption was coupled to a slight equivalent gingival coronal migration.
CONCLUSIONS: During a 10 year period, continuous eruption takes place in female adult patients, especially in the upper incisor area.

210 CHANGES OF SELF-FACIAL RECOGNITION AND EYE-GAZE PATTERN ASSOCIATED WITH INDIVIDUAL PSYCHOLOGICAL CONDITION AFTER ORTHODONTIC TREATMENT

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AIM: To characterize changes of cognitive and eye-gaze pattern during face recognition in adult orthodontic patients with aesthetic demands along with its association to individual psychological scales.
SUBJECTS AND METHOD: Sixteen orthodontic patients with demands for aesthetic improvement and 23 healthy volunteers as controls. All participants completed eight psychological questionnaires to evaluate basal psychological condition. To determine the differences in cognitive behaviour, a self-face recognition task was composed to select self-image among morphed combination photographic sets of self and others' faces in different proportional ratios. While the participants took the self-face recognition task, the individual eye gaze pattern was also monitored by the eye tracking device. After orthodontic treatment, the same task and questionnaires were conducted in one follow-up patient to investigate the change of eye gaze pattern and psychological conditions.
RESULTS: Orthodontic patients indicated higher social interaction anxiety and brief fear of negative evaluation compared to controls, indicating that they were more anxious of social interaction, and stressed over negative evaluations by others. The self-face recognition task indicated that orthodontic patients tend to be more sensitive to self-recognition and cautious in recognition with a longer reaction time. Orthodontic patients gazed more on the mouth region with more fixation than controls. In the one follow-up patient, there was no significant difference in psychological conditions. However the patient exhibited less interest on the mouth region with reduced eye gaze and fixations.
CONCLUSIONS: Orthodontic patients were more sensitive to negative evaluation by others and more cautious in self-recognition. There were significant differences in eye-gaze pattern between orthodontic patients and controls. Patients gazed more and had more fixation on mouth region. The

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one follow-up patient showed decreased gaze and fixation on the mouth after orthodontic treatment.

211 MECHANICAL PROPERTIES OF A SCREW EXPANDER WITH BUILT-IN SUPERELASTIC NICKEL TITANIUM COIL SPRINGS

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AIM: A rapid maxillary expansion using screw expander has long been popular in clinical orthodontics. Recently, a new screw expander with built-in superelastic nickel titanium (NiTi) coil springs has been introduced. The purpose of this study was to investigate the forces delivered by the screw expander with built-in superelastic NiTi coil springs. Conventional screw expanders were used for comparison.

MATERIALS AND METHOD: Three commercially available screw expanders (Memory Anatomic Expander; Anatomic Expander; Snap Lock Expander, Forestadent, Pforzheim, Germany) were selected. The arms of the screw expanders were standardized (intermolar distance: 37.5 mm) and held with a pair of grips attached to a universal testing machine (EZ test, Shimadzu, Kyoto, Japan). All the screw expanders were first activated 1 or 2 quarter-turns and the forces delivered were measured for 10 minutes at room temperature (25°C; n = 5). This process was repeated to five times and total activations of the screw expanders were 5 or 10 quarter-turns, which corresponded to 0.875 to 2.25 mm activations. The results were compared using ANOVA and Tukey's test, with *P* set at < 0.05 for statistical significance.

RESULTS: The forces delivered were increased with increasing activation in all screw expanders. The variation of mean force with the first activation ranged from 0.34 to 0.59 kgf for one quarter-turn and from 0.82 to 1.65 kgf for two quarter turns. With second activations, the variation of average forces ranged from 0.78 to 1.50 kgf for one quarter-turn and from 1.57 to 3.98 kgf for two quarter-turns. The Memory Anatomy Expander showed significantly lower forces than the other two screw expanders in all conditions of activation.

CONCLUSIONS: The forces delivered by screw expander increase with increasing each activation but are almost constant right after each activation. The force level delivered by screw expanders is dependent on the products. The Memory Anatomy Expander produces significantly lower forces due to the effect of the built-in superelastic NiTi coil spring.

212 EFFECT OF TEMPERATURE ON THE DYNAMIC MECHANICAL PROPERTIES OF COMPOSITES USED FOR LINGUAL RETAINER BONDING

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AIM: To comparatively evaluate the dynamic mechanical properties of a resin composite orthodontic adhesive for lingual retainer bonding with composite restoratives and luting agents after water storage at various temperatures.

MATERIALS AND METHOD: The light-cured composite materials tested were: Transbond LR (TL, orthodontic adhesive), P-60 (PS, high viscosity) and Voco x-tra base (VE, low viscosity) composite restoratives, and Rely-X Unicem (RX, self-adhesive resin cement). The properties tested were the dynamic shear modulus (or storage modulus G1) and the dynamic viscosity (n*). All tests were performed in water at 21°C, 37°C and 50°C (n = 4 per material and temperature group).Statistical analysis was performed by two-way ANOVA and Bonferroni *post-hoc* tests.

RESULTS: G1 (GPa, 21→50°C) ranged between 5.12-2.64 (TL), 6.61-5.56 (PS), 4.82-2.59 (VE) and 4.45-2.85 (RX). For n* (MPa ×s, 21→50°C) the results were 1.66-1.04 (TL), 12.73-11.22 (PS), 17.32-11.44 (VE) and 9.47-7.89 (RX). Temperature strongly reduced G1 and n*. PS was the least affected material in both properties. For G1, TL ranked after PS at 21°C, after PS, VE at 37°C, and after PS with no statistically significant difference from the rest at 50°C. For n*, TL showed the smallest values at all temperatures. The highest n* value was recorded from VE at 21 and 37°C. No statistically

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significant difference was found between PS and VE at 50°C. RX showed statistically significant differences from the high n* group (PS, VE) and the low TL at 50°C.
CONCLUSIONS: Although TL showed high G1 value at 21°C (ranked second after the highly filled posterior restorative P-60), at intraoral (37°C) and higher temperatures (50°C, simulating a hot drink) it demonstrated the greatest G1 reduction from all materials. This reduction along with the very low n* values imply that TL is very sensitive to a temperature-dependent plasticization in water.

213 EVALUATION OF ORAL HEALTH KNOWLEDGE OF TEACHERS FROM TWO PRIVATE KINDERGARTEN SCHOOLS IN SÃO PAULO

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AIM: Strengthening oral health education for children in schools through the evaluation of teachers' knowledge on the subject
MATERIALS AND METHOD: Approved by the research ethics committee with protocol number 25972817/09 a questionnaire with 34 multiple choice questions, a free consent form and guidelines to not consulting any textbook, didactic material or internet to fill it in was delivered to 40 kindergarten teachers of two private schools of São Paulo state and collected after 15 days. The answers to each question were categorized and submitted to descriptive statistical analysis.
RESULTS: Ninety three per cent of teachers knew where fluoride was found but were divided in their views as to the amount of toothpaste ideal for brushing. Forty per cent considered that it should be equivalent to a canary grain and 40 per cent that it should cover all bristles. Eighty per cent answered that caries was a multifactorial disease and 40 per cent a transmittable disease while 40 per cent considered caries to be non-transmittable. Sixty per cent of teachers considered a baby's first visit to the dentist should be when they the first teeth are erupted and 73 per cent considered that oral hygiene was required for a baby without teeth. Regarding children with oral breathing, 86 per cent answered that they know how to identify a child who breathes through the mouth, while but 40 per cent did not know the consequences of oral breathing for school learning.
CONCLUSIONS: There is a need to teach and improve relevant oral health concepts for teachers so that they can teacher the child population early.

214 PREDICTION OF DENTOFACIAL CHANGES INDUCED BY ARTICULATOR INTENDED FOR ORTHOGNATHIC SURGERY

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AIM: During collaboration between orthodontists and oral surgeons, patients' cooperation is essential in orthognathic surgery. Furthermore, the surgeons and patients should have a common therapeutic goal, which should be discussed in detail at the start of treatment. The objective of this study was to verify the reproducibility of a treatment involving the use of surgical plates and articulators specialized to surgical-orthodontic treatment by making a pre-operative prediction and conducting a post-operative comparative review.
MATERIALS AND METHOD: Using an articulator intended for orthognathic surgery (F4 articulator), pre-operative prediction for skeletal mandibular protrusion was made between orthodontists and oral surgeons. Patients were provided with a pre-operative explanation, and surgical splints were prepared and used. A comparative analysis of pre-operative cephalometric values, metrics obtained via 'paper surgery' and post-operative cephalometric values was conducted. Furthermore, the orthognathic surgery was compared using pre- and post-operative data. Moreover, pre-operative, predictive and post-operative cephalometric parameters of six patients with dentofacial deformities, who underwent orthognathic surgery were measured and examined and the reproducibility of the treatment involving the use of surgical plates was subsequently verified.
RESULTS: Post-operative metrics were similar to the pre-operative predictive values. With regard to the means of each measurement parameter across all patients, ANB angle ranged from –3.5 to +2.9

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degrees. The tendency to mandibular prognathism was improved, and no significant difference was observed in any measurement parameter with regard to estimates or treatment results.
CONCLUSIONS: Judging by the results of the measurements across all patients and since tendencies toward mandibular prognathism were improved, and because no significant difference regarding estimates and treatment results were observed, surgical plates, prepared using this articulator, were deemed to have reproducibility as a treatment for dentofacial deformities. From the above, it was concluded that surgical plates prepared using this articulator are efficacious and the method is useful for making a post-operative prediction not only for surgeons, but also in providing explanations to patients and for postgraduate education.

215 ALTERATION OF SURFACE HARDNESS OF HUMAN ENAMEL AFTER ETCHING AND DEBONDING OF ORTHODONTIC BRACKETS. AN *EX VIVO* STUDY

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AIM: To investigate the Vickers microhardness of untreated enamel in comparison to enamel after etching and bracket debonding procedures.
MATERIALS AND METHOD: Twelve extracted human premolars were equally divided into two groups: group 1 comparison of untreated and etched enamel; group 2 untreated versus etched, bonded and debonded enamel. Embedded and horizontally cut specimens were prepared and bucco-orally two zones were separated. For both groups an untreated (U) zone was defined. The opposing zone was either defined as etched (E for group 1) or etched, bonded and debonded (D for group 2). E and D were etched with 37 per cent phosphoric acid (Pegasus; Astek Innovations Ltd, Altrincham, UK). D of group 2 was further treated: bonding (OrthoSolo Universal Bonding Enhancer; Ormco Corp., Glendora, California, USA), application of flowable composite (Enlight Light Cure Adhesive; Ormco Corp.) and subsequently removal of the composite with an adhesive removal bur (Renew System, Reilance Orthodontic Products Inc., Illinois, USA). Vickers microhardness (HV100) applying a load of 100 g with a contact time of 15 seconds was performed employing 10 indentations per zone. An independent *t*- or Mann-Whitney rank sum test was applied to investigate the differences in HV100 at a = 0.05.
RESULTS: For group 1 the HV100 mean values ranged from 379 to 464 in zone U and from 95 to 400 in zone E. The comparison of the untreated (U) and the etched (E) zones within the same specimen, indicated that in 5 of the 6 treated specimens, the microhardness was significantly decreased by the etching procedures. In analogy for group 2 the mean values ranged from 336 to 438 in zone U and from 320 to 401 in zone D. Within the same group, the comparison revealed that for 3 out of 6 treated teeth the initial hardness level was not restored contrary to the other three.
CONCLUSIONS: HV is significantly decreased in the intermediate etched stage while full restoration after bracket debonding remains questionable.

216 COMPARISON BETWEEN THE CARRIÈRE DISTALIZER AND EXTRAORAL TRACTION CONCERNING MOLAR DISTALIZATION, APICAL ROOT RESORPTION AND PATIENT PERCEPTION

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AIM: To evaluate the distalizing effect, orthodontically induced inflammatory root resorption (OIIRR) and patient perception when comparing extraoral traction (EOT) with a Carrière Distalizer appliance (CDA).
SUBJECTS AND METHOD: In the Centre for Orthodontics in Linköping, Sweden, 17 subjects were assigned to the study. The inclusion criteria were a Class II molar relationship and the treatment objective was to establish a Class I molar relationship by distalization. The subjects were allocated, either to the CDA (n = 11) or the EOT (n = 6) group. Selection was based on the position of the maxillary canine. Registrations were made at the start of treatment (T0) and after 6-9 months of treatment (T1), for both groups. The following variables were measured: 1) the distalizing effect of

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the first maxillary molar (mm) 2) OIIRR (Levander and Malmgren, 1988) and 3) patient perception (questionnaire).
RESULTS: Four patients from the CDA group were excluded from the study. The distribution of gender and age were random. The mean distalizing effect on the first maxillary molar, measured in the CDA group, was 4.2 mm on the right side and 3.6 mm on the left side. The EOT group showed 2.0 mm on the right side and 1.2 mm on the left side. There was a significant difference in distalizing effect in favour of the CDA group ($P < 0.05$). At T0 all 22 teeth in the CDA group and all 12 teeth in the EOT group were classified as scale 0 (Levander and Malmgren, 1988). At T1 no apical remodelling could be detected in either the CDA or EOT group. Patient perception when comparing the two appliances showed similar answers although a higher dissatisfaction concerning sleep and tooth brushing was noted in the EOT group.
CONCLUSIONS: The CDA was more effective in maxillary first molar distalization. No detectable difference was found in OIIRR. Patient perception did not differ in any major aspect between the two groups.

217 THE INCREASE OF MAXILLARY LATERAL EXPANSION LIMIT BY TOPICAL APPLICATION OF FLUVASTATIN

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AIM: To examine the possibilities to prevent root surface exposure when the maxillary lateral expansion limit is exceeded during orthodontic treatment and to increase the expansion limit by topical application of fluvastatin (statin).
MATERIALS AND METHOD: The optimal statin concentration was examined *in vitro* by cell proliferation test, mRNA evaluation of osteogenic markers, calcification ability by alkaline phosphatase (ALP) and Alizarin red staining, using MC3T3-E1 cells. *In vivo*, bone labelling was performed 7 and 13 days after attachment of a maxillary lateral expansion device by an orthodontic wire on 10-week old male C57BL/6J mice. The mice were sacrificed on day 14, and non-demineralized specimens of the first molar buccal alveolar bone were prepared and evaluated for the bone remodelling of the statin. Sham, and control groups were also prepared for bone specimens after maxillary enlargement, and evaluation of root surface exposure and lateral expansion were also prepared. Furthermore, the number of osteoclasts around the periodontal roots was measured by tartrate resistant acid phosphatase staining. In the statin group, 10 µl of 100 nM statin was injected into the gingiva every 48 hours.
RESULTS: There were no significant effects of statin on the cell proliferation ability; mRNA expression of BMP2, Runx2, ALP, OPN, BSP and OCN were increased in the 100 nM statin-administered group compared with the control group. In addition, ALP activity and calcification ability increased in the 100 nM statin compared with those in the control group. *In vivo*, there were no significant differences in the expansion level, but the tooth root exposure area was significantly smaller in the statin group than in the control group, and the amount of bone addition in the buccal alveolar bone was statistically higher in the statin group than in the control group. However, there was no change in the number of osteoclasts around the tooth root.
CONCLUSIONS: Fluvastatin topical application on the buccal alveolar projection during maxillary lateral expansion prevented root surface exposure by buccal alveolar bone resorption, suggesting the possibility of increasing the lateral expansion limit without disturbing bone remodelling of the tooth root.

218 ELUCIDATION OF CARTILAGE DIFFERENTIATION CONTROL MECHANISM BY FLUVASTATIN APPLICATION

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AIM: In recent years it has been shown that statins may be effective for treating bone disorders caused by FGFR3 gene mutation, achondroplasia and thanatophoric dysplasia. However, not only

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FGFR3 but also factors involved in cartilage differentiation are expected to be complicatedly related. In this study, how fluvastatin regulates the autonomous progression of chondrocyte multistage differentiation programme using ATDC5 clonal cell line, derived from mouse EC (Embryonal Carcinoma) were examined.
MATERIALS AND METHOD: ATDC-5 Cells were cultured for a maximum of 21 days. For cell proliferation assay WST-1 was used and for cell staining Alcian Blue, Alizarin Red and alkaline phosphatase staining. The real-time polymerase chain reaction method was used on day 1 to 3 and days 7, 14 and 21 with several primers. For statistical processing, multiple tests were performed using the Tukey-Kramer test.
RESULTS: Cartilage formation was comparable by the addition of statin, although ATDC5 calcification was suppressed. However, when the mRNA expression level was considered, statin acted on the differentiation of cartilage, as the expression level of Col2a1, which is a cartilage substrate, also increased. In SMO and Ptch1, contradictory mRNA expression was observed. An increase in transcription factors such as Sox9, Runx2, which are at the downstream of the Ihh pathway via Gli, also occurred.
CONCLUSIONS: It is suggested that fluvastatin has an effect on Ihh and PTHrP, which are important factors in endochondral ossification. Especially since Ihh undergoes palmitoylation and cholesterol modification, there is a possibility that fluvastatin affects its suppression, activity enhancement and diffusibility. It is considered that expression of PTHrP is increased and apoptosis due to FGFR3 increased activity is suppressed.

219 THE EFFICACY AND EFFECTIVENESS INDUCED BY DIODE LASER BIOSTIMULATION ON THE RATE OF ORTHODONTIC TOOTH MOVEMENT

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AIM: Reduced treatment duration and adverse events such as discomfort, pain and external apical root resorption are important factors for care providers and orthodontic patients. The diode laser has been indicated to have the capability to facilitate the differentiation of osteoclastic and osteoblastic cells which could be responsible for the bone remodelling process and the rate of orthodontic tooth movement (OTM). The aim of this study was to evaluate of the efficacy of low-intensity laser therapy (LILT) in reducing orthodontic treatment duration and pain.
SUBJECTS AND METHOD: In this randomized split-mouth double blind clinical trial, 18 patients aged 14 to 25 years (mean 16.2 ± 3.32 years), who required canine retraction following four first premolars extraction, were selected. The diode laser (Wiserlaser Doctor Smile; Lambda SPA, Brendola, VI, Italy), set at 980 nm, 100 mW, 5.6 J/cm^2, three points from the buccal side and three from lingual side of the tooth, 58 seconds, running in continuous mode, was used for canine retraction in the test maxillary quadrant. The other maxillary quadrant served as the control using the laser pseudo-application. Laser irradiation was applied on days 0, 7, 14, 21 and 28 of each month during the canine retraction phase. Canine retraction was done using a closed coil spring with a force of 150 g after alignment and levelling.
RESULTS: Although the mean rate of canine retraction was higher in the test (0.95 mm) than the control group (0.62 mm) at 28 days and there was a tendency for more canine retraction in the test group, there was no significant difference between the mean rate of canine retraction in either group (P = 0.066).
CONCLUSIONS: LILT is a good option to reduce treatment duration even if there were no clinically statistically significant changes in the rate of the OTM during the early phase of orthodontic treatment.

220 FACIAL ASYMMETRY IN SKELETAL CLASS III PATIENTS TREATED WITH ORTHODONTIC-ORTHOGNATHIC SURGERY

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AIM: To investigate the frequency, site and possible causes of facial asymmetry and its management among skeletal Class III orthodontic-orthognathic treated patients
SUBJECTS AND METHOD: Forty patients (24 females, 16 males) aged 17-38 years who underwent orthognathic surgery in the period June 2011 to February 2016. Subjects with a deviation of more than 2 mm from the facial midline associated with any of the four landmarks (ANS, U1, L1 and Me) were classified as asymmetric and the asymmetry was measured on a postero-anterior cephalogram. Patients with facial asymmetry were investigated if they had: 1) received orthodontic treatment (2) exhibited clinical symptoms of temporomandibular joint (TMJ) disorder; (3) reported a history of maxillofacial trauma; (4) had a radiographic abnormality of the condyles or (5) a family history. SPPS software was used to analyse the data.
RESULTS: Facial asymmetry was present in 20 per cent of the Class III orthodontic-orthognathic treated patients. Lateral displacement toward the left side of the face occurred more often than right side deviation. Maxillofacial trauma and family history were the most prevalent causes. Orthodontic treatment and bimaxillary surgery were undertaken most frequently.
CONCLUSIONS: Facial asymmetry due to its complexity must be identified and treatment planned carefully before initiation.

221 REPORTED CHANGES IN ORAL HEALTH-RELATED QUALITY OF LIFE IN CHILDREN DURING AND AFTER ORTHODONTIC TREATMENT: A LONGITUDINAL STUDY

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AIM: To investigate whether there is a change in reported Oral Health Related Quality of Life (OHRQoL) before, during and after orthodontic treatment, to find out whether there is a relationship with the original treatment need and to evaluate the influence of personality traits and/or self-esteem.
MATERIALS AND METHOD: In this cross-sectional study the results of questionnaires given to 302 11 to 16 year-old children (140 boys, 162 girls) at baseline, 1 year after the start of treatment (88.41% response rate) and after completion treatment (45.03% response rate) were compared. The OHRQoL was scored using the Child Perception Questionnaire (CPQ), self-esteem was assessed by the Dutch adaptation of the Harter's Self-Perception Profile for Adolescents and the need for treatment was defined by the Index of Orthodontic Treatment Need (IOTN). The questionnaires also included questions about motivation and expectations towards treatment and the final result. To analyse the data, Spearman correlations, Mann-Whitney *U*-tests, and regression models were used.
RESULTS: A significant increase in the CPQ-score was observed during orthodontic treatment in the subdomains functional limitations, oral symptoms and social well-being. Children with high self-esteem at baseline showed lower variability in OHRQoL measures during treatment. After treatment CPQ scores decreased again. Only a slight decrease in total CPQ score was found after orthodontic treatment compared to pre-treatment.
CONCLUSIONS: OHRQoL deteriorates during orthodontic treatment, whereas after treatment OHRQoL ameliorates again. Compared to baseline results, OHRQoL only slightly improves after treatment.

222 SURGICALLY ASSISTED MAXILLARY PROTRACTION VERSUS LE FORT 1 OSTEOTOMY IN CLEFT LIP AND PALATE PATIENTS

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AIM: Surgically assisted maxillary protraction is rapidly becoming a mainstream surgical technique for correction of maxillary deficiency. Maxillary constriction is a common finding in cleft palate patients. The aim of this study was to compare the results of surgically assisted maxillary protraction with a conventional Le Fort 1 osteotomy in maxillary advancement of cleft lip and palate patients (CLP).

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SUBJECTS AND METHOD: All the unilateral CLP patients had a skeletal Class III malocclusion with an ANB of ≤ 0° and a Wits of ≤ 0° on the initial lateral cephalograms and a concave profile with no facial asymmetry. The surgically assisted group consisted of 10 subjects (7 males, 3 females) with a mean age of 21.2 (SD 4.2) years. In these patients, a tooth borne distraction device which exerted force anteroposteriorly was cemented after mobilization of the maxilla. After a latency period of 7 days, the distractor was activated twice daily by a total amount of 0.5 mm per day. The activation was continued for 3 weeks. After an 8-week consolidation period, the distraction appliance was removed. Cephalograms of surgically assisted patients were obtained at the start of distraction and at the end of consolidation. The Le Fort 1 group consisted of 11 subjects (6 males, 5 females) with a mean age of 22.3 (SD 3.7) years. All Le Fort 1 patients underwent maxillary advancement. Pre- and post-surgical lateral cephalograms were obtained. *T*- and paired *t*-tests were used to evaluate the data.
RESULTS: At the end of treatment, the SNA angle of the Le Fort 1 patients increased by 5.5 degrees (SD 2.3°; $P< 0.001$) while that of the surgically assisted patients increased by 3.4 degrees (SD 2°; $P < 0.001$).
CONCLUSIONS: Current evidence suggests that both a conventional Le Fort 1 and a tooth-borne osteogenic distraction device can effectively advance the maxilla forward in patients with a CLP. In the latter technique, surgery is simple, and custom-made intraoral devices are easy to handle with minimal discomfort for the patients.

223 SYSTEMATIC REVIEW OF ORTHOPAEDIC TREATMENT FOR CLASS III MALOCCLUSION: OVERVIEW OF SYSTEMATIC REVIEWS

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AIM: In an overview of systematic reviews to investigate methodological quality and outcome of current systematic reviews reporting on orthopaedic treatment for Class III malocclusions.
MATERIALS AND METHOD: Computerized and manual searches were performed in Medline, Google Scholar, Cochrane Library, Embase, Lilacs, SciELO, American Journal of Orthodontics and Dentofacial Orthopedics, Angle Orthodontist, European Journal of Orthodontics, Journal of Orthodontics, Conference abstracts and grey literature. No restrictions were set on language or date of publication. The search covered the starting date of the relevant databases until April 30, 2015. MeSH terms and free-text terms included 'malocclusion', 'Angle Class III', 'orthodontic appliances', 'functional', facemask, review, and meta-analysis. Screening of eligible studies, assessment of the methodological quality of the systematic reviews and data extraction were conducted in duplicate and independently by two reviewers. Methodological quality was assessed using the assessment of multiple systematic reviews (AMSTAR).
RESULTS: A total of 222 studies were retrieved and after removal of duplicates, irrelevant studies, literature reviews and surgical approach treatments, 14 systematic reviews and/or meta-analyses were included for qualitative synthesis. The mean AMSTAR score was 7.7/11 with a range of 3-10. There was evidence to demonstrate that facemask therapy can move the maxilla forward whilst causing a backward rotation of the mandible and increased face height. There was also some evidence of mandibular growth retardation with chin cup therapy.
CONCLUSIONS: Orthopaedic appliances can improve a Class III malocclusion in growing patients over the short-term; however, each appliance has a characteristic effect on the underlying skeletal pattern.

224 CHANGES OF THE OCCLUSAL PLANES FOLLOWING ORTHODONTIC TREATMENT AND THEIR RELATIONSHIP TO THE CHANGE OF MANDIBULAR POSITION

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AIM: To compare the occlusal planes before and after orthodontic treatment in adult patients and to determine their relationship to the change of mandibular position.
MATERIALS AND METHOD: The cephalograms of 40 adult patients before and after orthodontic treatment were superimposed at Nasion and the anterior wall of the sella turcica. The occlusal plane angles, including conventional occlusal plane, anterior occlusal plane, posterior occlusal plane and alveolar vertical heights of the maxillary premolar and the second molar were measured and compared before and after orthodontic treatment by means of a paired *t*-test. The relationship of the change of each measurement and the change of SNB was assessed for correlation.
RESULTS: The posterior occlusal plane angle significantly decreased following orthodontic treatment. The conventional occlusal plane and anterior occlusal plane angles significantly increased following orthodontic treatment, except the conventional occlusal plane angle of the Class III group. U7 to PP value increased but not significantly. However U5 to PP value significantly decreased. All measurements, including occlusal plane angles and alveolar vertical heights, showed week negative correlation with the change of SNB, but they were not statistically significant.
CONCLUSIONS: POP angle decreased after orthodontic treatment. There was no direct relationship between the change of occlusal plane angles and mandible position change.

225 ACTIVITY OF MASSETER AND TEMPORAL MUSCLE DURING DAYTIME CLENCHING IN ADOLESCENT AND ADULT SLEEP BRUXERS

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AIM: To retrospectively (1) evaluate the electromyographic activity of masseter and temporal muscles during daytime clenching in patients with a sleep bruxism habit, and (2) to compare muscle activity between adolescent and adult bruxers.
MATERIALS AND METHOD: The pre-treatment surface electromyography (EMG) recordings of the masseter muscle (MM) and anterior temporal muscle (TA) obtained from orthodontic patients from 2010 to 2013 years with a sleep bruxism habit. EMG when clenching with maximum intercuspation was recorded, and the ratio of TA activity to MM (T/M ratio) was calculated. Sixty eight samples were divided into four groups according to their gender and age. The Mann-Whitney *U* test was used for comparisons of T/M ratios between the groups.
RESULTS: The mean T/M ratio of bruxism group was significantly lower than that in non-bruxism group. However, in bruxers, there was no significant difference in T/M ratio between the adolescent and adult female bruxsim groups. T/M ratio in the adult male group was significantly greater than that in the adolescent male group. The T/M ratios of the male group tended to be lower than those of the female groups.
CONCLUSIONS: Adolescent male subjects with a bruxism habit showed greater activity in the masseter muscles than in the temporal muscles, compared to non-bruxers. A bruxism habit may not affect the masticatory muscle balance in adults.

226 EXPRESSION OF TFGβ, CD34, NESTIN AND KI67 IN CLEFT-AFFECTED TISSUE

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AIM: To investigate cleft-affected tissues in children with a cleft lip and palate (CLP) in order to detect the appearance of transforming growth factor β1 (TGFβ1), transforming growth factor β3 (TGFβ3), transforming growth factor β receptor 3 (TGFβR3), ki67 protein, cluster of differentiation 34 (CD34) and nestin.
SUBJECTS AND METHOD: The study group included 10 patients with CLP. Tissue samples were stained with immunohistochemistry for TGFβ1, TGFβ3, TGFβR3, ki67, CD34 and nestin. The data were analyzed using descriptive and analytical statistical methods.
RESULTS: From all TGFβ markers used the most prominent was TGFβ1 positive cells (mean value 18.6 ± 3.93). TGFβ3 positive cells (mean value 3.53 ± 2.59) and TGFβ3R positive cells (mean value 6 ±

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5.51) were similar with slightly less pronounced immunoreactivity of TGFβ3. A significant number of CD34 positive cells were observed with mostly numerous and moderate positive structures in the visual field. CD34 positive cells were seen in endothelial and smooth muscle cells in the walls of blood vessels and connective tissues. The appearance of nestin was less pronounced than CD43 and TGFβ1 but almost equal with TGFβ3 and TGFβ3R positive cells. A weak ki67 positive reaction was seen in epithelium in all tissue samples from no positive structures to a few positive structures in the visual field.
CONCLUSIONS: Low positive cell numbers of TGFβ3 and TGFβ3R indicates that tissue remodelling in patients with a CLP may not be so successful. Mostly indistinct nestin, ki67 and CD34 positive cells might be an indicator of not complete cellular differentiation, proliferation and migration events in cleft disordered soft tissues.

227 COST ANALYSIS OF ORTHOGNATHIC SURGERY IN CLEFT LIP AND CLEFT PALATE PATIENTS

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AIM: To determine the cost of orthognathic surgery in cleft lip (CL) and/or cleft palate (CP) patients.
MATERIALS AND METHOD: This was a charge cost analysis of orthognathic surgery performed at the in-patient department, Dental hospital, Prince of Songkla University, which is the tertiary care institution of Thailand's oral health system. The population was 139 CL and/or CP patients referred from 14 southern provinces of Thailand between the fiscal years 2013-2015. This study included all orthognathic surgery cases during these three years (14 cases). The medical and transaction records of all patients were identified by their ICD-10 code and reviewed. The demographic data was abstracted from medical record while payment information was obtained from the accounts unit. The charge costs were divided into sub-categories according to Thailand comptroller general department's in-patient department expense categories. Costs were adjusted to present values using 2016 Thailand consumer price index and converted into Euros (1 baht = €0.027). Cost analysis was calculated based on conventional cost analysis.
RESULTS: There were 14 CL and/or CP patients who underwent orthognathic surgery (1 CL and 13 cleft lip and cleft palate), 11 females and three males, aged between 14-34 years (20.4 ± 6.0 years). Among these, eight subjects had two jaw surgery and six only maxillary surgery. The average charge costs for orthognathic surgery, two jaw surgery and maxillary surgery were €1681.66, €1921.74 and €1361.55, respectively. The first three ranks of compositions of the charge cost were operation and anaesthetic cost (56.80%), surgical materials cost (31.76%) and room cost (4.56%).
CONCLUSIONS: The cost of surgery was very high compared to the compensation supported by the National Health Security Office according to Thai diagnosis related groups method of payment (€760.75 on average) for each orthognathic surgical operation.

228 COMPARISON OF MEDIAL ASPECT OF THE RAMUS FOR SAGITTAL SPLIT RAMUS OSTEOTOMY IN PATIENTS WITH DIFFERENT SKELETAL PATTERNS

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AIM: Sagittal split ramus osteotomy (SSRO) is one of the most commonly used surgical techniques for the correction of mandibular deformities. The 'RAI triangle' is a newly defined anatomic landmark on the medial surface of the mandibular ramus. This anatomic landmark may have a definite advantage when it is identified and taken into consideration. The base of the triangle will be towards the anterior border of ramus formed by the mandibular ridge and tip pointing towards the posterior border. Its superior and inferior arm is formed by elevation of lingula on medial surface of ramus merging in the coronoid process and mylohyoid ridge, respectively. The hypothesis tested was that the rami of prognathic mandibles are thinner than retrognathic and orthognathic mandibles. Therefore the aim of this retrospective study was to evaluate and compare the RAI triangle areas and volumes of skeletal Class I, II and III patients.

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SUBJECTS AND METHOD: The mandibular rami of 35 patients (17 females, 18 male) of three groups were evaluated by computed tomography (CT) scans and 3D-Doctor software. The study groups were: group 1: skeletal Class II (n = 11; ANB: 5.17°); group 2: skeletal Class III (n = 11; ANB: –2.57°) and group 3: skeletal Class I (n = 13; ANB: 1.03°, control). Group 1 and 2 patients had mandibular osteotomies and some had bimaxillary osteotomies. The mediolateral width of the RAI triangle area and the distance between the fusion point of the external and internal cortical plates above and posterior to the mandibular lingual were measured. The findings were analyzed by two-way ANOVA.
RESULTS: The mean thickness of the RAI triangle area for Groups 1, 2 and 3 was 114,7795 mm^2, 109,3350 mm^2, 123,3558 mm^2, respectively. The mean volumes of the RAI triangle were 16,3015 mm^3, 15,7595 mm^3 and 13,8486 mm^3 for groups 1,2 and 3, respectively. No statistically significant differences were observed in the thickness and volumes of the rami between the groups.
CONCLUSIONS: Despite clinical observation and the hypothesis, the radiological examination showed no statistically significant difference in the RAI triangle area and volume of the patients with different sagittal skeletal relationship.

229 PALATAL IMPLANTS VERSUS PALATAL MINISCREWS FOR REINFORCEMENT OF ANCHORAGE DURING ORTHODONTIC TREATMENT. A SYSTEMATIC REVIEW

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AIM: To systematically search the literature and assess the available evidence regarding the clinical effectiveness of both palatal implants and palatal miniscrews for the reinforcement of anchorage during orthodontic treatment.
MATERIALS AND METHOD: Electronic database searches of published and unpublished literature were performed in the following electronic databases without language or publication date restrictions: Medline (via Ovid and PubMed), Embase (via Ovid), the Cochrane Oral Health Group's Trials Register and Central, ClinicalTrials.gov, the National Research Register, and Pro-Quest Dissertation Abstracts and Thesis database. The reference lists of all eligible studies were checked for additional studies. Two review authors performed data extraction independently and in duplicate using data collection forms. Disagreements were resolved by discussion or the involvement of an arbiter. The risk of bias of randomised controlled trials (RCTs) and prospective studies was assessed using the Cochrane risk of bias tool. Retrospective studies were evaluated with the Bondemark scale.
RESULTS: Twenty eight studies were considered eligible for inclusion in this review out of which 14 were prospective and 11 were retrospective randomised controlled trials (RCTs). The lack of standardized protocols and the high amount of heterogeneity precluded a valid interpretation of the actual results through pooled estimates. The number of palatal implants or miniscrews per study ranged from 9 to 384. Great differences were observed in follow-up periods among studies. Among RCTs the rate of failure for palatal implants ranged from 4.5 to 8.7 per cent and among prospective studies from 0 to 14.2 per cent. On the other hand, the failure rate of miniscrews among retrospective studies ranged from 2.1 to 9.13 per cent.
CONCLUSIONS: Palatal implants or miniscrews exhibit high success rates that are comparable. Their usefulness for the reinforcement of orthodontic anchorage is unquestionable. The choice between the two treatment modalities still remains a subjective issue, since no significant difference seems to exist based on current knowledge.

230 CHANGES IN MANDIBULAR EXTRACTION SPACES FOLLOWING PREMATURE LOSS OF FIRST PRIMARY MOLARS: A SYSTEMATIC REVIEW AND META-ANALYSIS

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AIM: Studies investigating dental arch spatial changes following premature loss of the first primary molar are controversial regarding clinical significance. The purpose of this review was to systematically investigate the available literature to assist clinical management decisions.
MATERIALS AND METHOD: Controlled studies investigating changes before and after mandibular first primary molar extraction, earlier than the expected occurrence of normal exfoliation were searched in various databases. Split-mouth design studies were considered eligible for inclusion. The risk of bias and the overall level of certainty in the evidence were assessed according to the American Dental Association Clinical Practice Guidelines.
RESULTS: Only two analyzable split-mouth studies on mandibular first primary molar loss were identified. Space loss on the extraction side was greater at the 2, 4, 6 and 8 month follow-ups, reaching a –1.5 mm difference at the final examination (95% confidence interval: –2.080 to –0.925; *P* = 0.000; random effects model). Studies were judged to be at an unclear risk of bias and the overall level of certainty in the evidence to be moderate.
CONCLUSIONS: The amount of space lost could have management implications under certain circumstances. Comprehensive assessment of the various characteristics of each patient should precede management decisions in individual cases.

231 ASSESSMENT OF THERAPY CHARACTERISTICS OF CLASS I MALOCCLUSIONS TREATED WITH THE CONVENTIONAL STRAIGHTWIRE METHOD OR THE DAMON TECHNIQUE: A RANDOMIZED TRIAL

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AIM: Elaboration and projection of available data into future clinical trials has indicated that treatment of patients with self-ligating brackets may result in both shorter and longer treatment times compared with conventional fixed orthodontic appliances. The aim of this two-arm, parallel, randomized clinical trial was to compare therapy characteristics of Class I malocclusions treated with a conventional straightwire (CG) method or the Damon technique (DT).
SUBJECTS AND METHOD: Patients recruited from the waiting list of a postgraduate clinic were randomly allocated to treatment with the CG method or the DT. Eligibility criteria included a balanced facial profile, full permanent dentition and a Class I malocclusion with moderate crowding. Twenty-two patients were randomized in a 1:1 ratio to either the CG method or the DT group. The primary outcome was the duration of orthodontic treatment in months. Final Peer Assessment Rating (PAR) Index and Gingival Index (GI) scores throughout treatment were secondary outcomes. Randomization was accomplished using a table of random numbers and the allocation was concealed in sequentially numbered and opened, opaque, sealed envelopes. Blinding was applicable for PAR assessment only. Comparison of data between groups was performed with appropriate tests for independent samples.
RESULTS: The age at the start of treatment, initial PAR and GI scores were similar between groups. All patients completed the study but the total duration of orthodontic treatment was almost half of the initial assumption used for sample size calculation. No statistically significant differences were observed in treatment duration [CG: mean = 14.5 months, standard deviation (SD) = ± 3.03; DG: mean = 12.25 months, SD = ± 2.93; 95 per cent confidence interval: –0.40-4.90; *P* = 0.093; *t*-test]. The two groups did not differ statistically regarding the final PAR and GI scores during the observation period. No serious harm was observed other than gingival inflammation associated with oral biofilm accumulation.
CONCLUSIONS: No statistically significant differences were revealed between the CG method and the DT in the treated Class I malocclusion groups regarding total treatment duration, GI and final PAR scores.

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232 ARE ERUPTION GUIDANCE APPLIANCES CLINICALLY EFFECTIVE? A SYSTEMATIC REVIEW

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AIM: Eruption guidance appliances (EGAs) aim to correct the sagittal and vertical occlusal relationships together with improving incisor alignment in mixed dentition children. The objective of this study was to systematically investigate the available data regarding their effects.

MATERIALS AND METHOD: An electronic search without restrictions for published and unpublished literature, accompanied with complementary hand searching, was carried out until September 2016. Only randomized controlled trials (RCTs) and prospective non-RCTs investigating the dentoskeletal treatment effects of EGAs were included in the present review. Following risk of bias assessment, the overall quality of evidence (confidence in the observed effects) was assessed according the Grades of Recommendation, Assessment, Development and Evaluation approach.

RESULTS: The initially identified records were finally reduced to three trials presenting the results from two study samples involving children at the beginning of the mixed dentition stage (191 patients treated with EGAs and 126 untreated controls). At the end of appliance use, towards the completion of the first phase of the mixed dentition, overjet, overbite and mandibular anterior crowding were reported to be significantly lower in the treated subjects compared to the controls and a significant shift to a Class I molar relationship in the former group was observed. As far as the cephalometric outcomes are concerned, greater condylion-gnathion distance and smaller Wits appraisal, as well, labial tipping and linear protrusion of the mandibular incisors was demonstrated in children using EGAs. Overall, the quality of the available evidence (confidence in the observed effects) was considered low.

CONCLUSIONS: According to the existing low quality evidence, EGAs seem to effect favourable changes with regard to overjet and overbite, Class II malocclusion, and mandibular anterior crowding correction in the short-term.

233 OCCLUSAL TRAITS OF A SAMPLE OF 153 DENTAL STUDENTS WITH A PAST ORTHODONTIC HISTORY

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AIM: To evaluate the occlusal characteristics of a sample of dental students with a past orthodontic history and to analyse the relationship between the persistence of bonded retainer(s) and the long-term incisor alignment.

SUBJECTS AND METHOD: Volunteer dental students who had orthodontic treatment were included in the study. Their past orthodontic history was defined through a questionnaire and their occlusion was evaluated with plaster models. After calibration of a unique operator, occlusal traits were defined according to the World Health Organiser charter. A Fisher exact test was used to verify if the persistence of fixed retainers had an impact on long-term incisor alignment.

RESULTS: Of the dental students 74.6 per cent had undergone orthodontic treatment. One tooth was missing in at least 5 per cent of the males and 9 per cent of the females ($P > 0.05$). Teeth were extracted in 15.7 per cent of the treatments. Mandibular incisor crowding greater than 2 mm was present in 13.6 per cent of males and 18.6 per cent of females ($P > 0.05$). In the maxilla, incisor alignment was considered as 'perfect' in 26.9 per cent of males and 7 per cent of females ($P = 0.006$), whereas in the mandible the figures were 20.9 and 10.5 per cent for males and females, respectively ($P > 0.05$). A fixed retainer was bonded in the maxilla in 21 per cent of males and 13 per cent of females ($P > 0.05$); in the mandible the percentages were 49 and 51 per cent for males and females, respectively ($P > 0.05$). In the absence of a bonded retainer, incisor crowding greater than 2 mm was more frequent in the mandible ($P < 0.01$). The average overjet was 2.8 ± 0.9 mm. An

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excessive overbite was observed in 13.8 per cent of males and 7.2 per cent of females ($P > 0.05$). An open bite was encountered in 3 per cent of males and 4.7 per cent of females ($P > 0.05$). A molar Class I relationship was observed on the right side in 77.6 per cent of males and 77.9 per cent of females ($P > 0.05$), whereas the left molars were in Class I in 82.1 per cent of males and 84.9 per cent of females ($P > 0.05$). A prevalence of a posterior crossbite was 6 per cent for males and 16 per cent for females ($P > 0.05$).
CONCLUSIONS: The observed results were globally satisfactory, even if they did not always match theoretical ideals. In the absence of a bonded retainer, incisor crowding greater than 2 mm was more frequent in the mandible.

234 FACIAL PROFILE AS RELATED TO SEVERITY OF OVERJET AND OVERBITE

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AIM: To explore the correlation of soft tissue profile and severity of overbite and overjet in a large adult population.
SUBJECTS AND METHOD: One thousand six hundred and thirty one adult subjects aged 46 years (712 males, 919 females), who were all part of the Northern Finland Birth Cohort 1966. Individuals with craniofacial syndromes, a history of facial plastic or reconstructive surgery, or visible deformations of the face were excluded from the investigation. All subjects participated in a clinical oral and dental examination, including recording of occlusal parameters (overjet and overbite). In addition, digital facial (frontal and profile) photographs were obtained using a standardized protocol. A multivariate regression model was developed to study the correlation of soft tissue measurements (independent variables) to overjet and overbite (dependent variables), taking into consideration the effect of gender. All analyses were performed at the 0.05 level of statistical significance.
RESULTS: The regression model, including all profile measurements (independent variables), explained approximately 30 per cent of the variability in overjet within this sample population, and approximately 22 per cent of the variability in overbite. Overjet was related more significantly to upper and lower antero-posterior (A-P) lip position, and upper and lower face height ($P < 0.05$). Overbite showed a stronger association to A-P position of the lower lip, pogonion and soft tissue point B ($P < 0.05$)
CONCLUSIONS: Moderate correlation was found between soft tissue profile measurements and severity of overjet and overbite in this mature adult population. Overjet appeared to affect facial profile more than overbite.

235 MECHANICAL PROPERTIES AND ION RELEASE FROM NICKEL-TITANIUM WIRES WITH VARIOUS SURFACE COMPOSITIONS IN ARTIFICIAL SALIVA

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AIM: To explore ion release, surface roughness, hardness and Young's modulus from nickel-titanium (NiTi) wires with different coatings in artificial saliva.
MATERIALS AND METHOD: Uncoated NiTi, nitride-coated (NNiTi) and rhodium-coated (RhNiTi) nickel-titanium wires were immersed in artificial saliva solutions (1.5 g/l KCl, 1.5 g/l $NaHCO_3$, 0.5 g/l, NaH_2PO_4–H_2O, 0.5 g/l KSCN, 0.9 g/l lactic acid). The pH of the artificial saliva was adjusted to 5.1 with the use of lactic acid and NaOH. Wire specimens were incubated in artificial saliva for 28 days at 37°C. Inductively coupled plasma-optical emission spectroscopy was used for measurement of the released ions. Three parallel experiments were conducted for every wire. The surface roughness (variables: Rq, root mean squared roughness; Ra, arithmetic average surface roughness; RZ, maximum height) of the wire samples was measured by the atomic force microscopy on 30 × 30 μm surfaces, whereas Young's moduli and the hardness were determined by nanoindentation tests

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performed with a peak load of 20 mN and 100 mN. Data was analysed with ANOVA and Student-Newman-Keuls post hoc test.
RESULTS: The release of titanium ions from the RhNiTi was significantly higher when compared to titanium ion release from NiTi and NNiTi ($P = 0.020$). Significant differences were not found between wire types for nickel ion release. At peak load of 20 mN there were significant differences in hardness between all three wires while at peak load of 100 mN differences were between NiTi and RhNiTi on one side, and NNiTi on the other (all $P < 0.001$). At a peak load of 20 mN there were significant differences in Young's moduli between RhNiTi on one side, and NiTi and NNiTi on the other ($P < 0.001$). At peak load of 100 mN no differences were found between wires with various coatings. Significant differences found in surface roughness parameters between RhNiTi on one side, and NiTi and NNiTi on the other (Rq, $P = 0.004$; Ra, $P = 0.005$; Rz, $P < 0.001$).
CONCLUSIONS: Titanium ion release, hardness, Young's moduli and surface roughness parameters are all influenced by the changes in surface coating.

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236 QUANTIFYING DIFFERENCES IN FACIAL MORPHOLOGY IN CROATIAN, ENGLISH AND WELSH CAUCASIAN POPULATIONS

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AIM: To compare the soft tissue facial surfaces of a sample of Croatian, English and Welsh populations.
SUBJECTS AND METHOD: Seventy three 73 Croatian (52% females, average age 23 years); 80 English (50% females, average age 16 years); and 50 Welsh (46% females, average age 16 years) Caucasian subjects. Facial shells were acquired using three-dimensional cameras in the natural head posture and with a neutral facial expression. A total of 21 landmarks were identified on each shell and six average faces were produced for the three populations considering gender. The facial shells were divided into eight regions (forehead, right eye, left eye, right cheek, left cheek, nose, upper lip and philtrum, lower lip and chin); surface based comparisons explored regional differences. Landmark based comparisons explored differences between facial shapes in three spatial dimensions (nose, eyes and mouth width; full face, nose, upper lip, and lower lip and chin height; protrusion of forehead, eyes, nose, and chin). All comparisons were performed separately for male and female population groups using ANOVA at $P < 0.05$.
RESULTS: The Croatian females had more protruded regions of the nose, upper lip and lower lip and chin, when compared to the English and Welsh females [concordance range 15-56.2% (at 0.5 mm tolerance)]; their eyes and cheeks were retruded more compared to the English females (concordance range 38.5-72.8%).The Croatian males had more protruded regions of the forehead, nose and lower lip and chin, as compared to the English and Welsh males (concordance range 33.9-58.6%); their eyes were more retruded, as compared to the Welsh males (concordance range 18.2-24.4%). The Croatian males and females had smaller mouth widths when compared to their English counterparts; on average –5.45 mm in males, and –6.06 mm in females ($P < 0.05$). The Croatian females had narrower noses than the English females (–1.58 mm) and Welsh females (–1.46 mm), while the Croatian males had wider noses than the English males (1 mm) and Welsh males (0.82 mm) (all $P < 0.05$). Nose height was smaller in the Croatian males and females as compared to their Welsh counterparts (–0.83 mm for both; $P < 0.05$).
CONCLUSIONS: There are identifiable measurable facial differences between Croatian, English and Welsh populations.

237 RELATIONSHIP OF CHRONOLOGICAL AGE WITH REFERENCE TO CRANIOFACIAL MORPHOLOGY IN CHILDREN WITH OBSTRUCTIVE SLEEP APNOEA

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AIM: To evaluate the relationship between chronological age and the craniofacial skeleton, pharyngeal airway space and hyoid bone position in children with obstructive sleep apnoea (OSA).
SUBJECTS AND METHOD: Forty two children (mean age: 6.6 years) with OSA were enrolled in the study and monitored at home during nocturnal sleep for three nights by their parents, who were instructed in the use of portable polysomnography. The control subjects included 42 children (mean age 6.7 years) without OSA. The lateral cephalograms were taken with the Frankfort horizontal plane parallel to the floor. The radiographs of all subjects were selected according to the head position in the range of ± 5 degrees between the bottom plane of the radiograph and the FH plane. The variables of the craniofacial skeleton pharyngeal airway space and hyoid bone position were measured using cephalometric landmarks.
RESULTS: A statistical analysis of the results indicated that, compared with the control group, the OSA group had underdeveloped mandibles, an elongated anterior face height as well as narrow pharyngeal airways and an anterior hyoid bone position. In addition, there was a significant correlation between chronological age and the mandible, pharyngeal airway space or hyoid bone position in control group. However, there was no significant correlation between chronological age and pharyngeal airway, or hyoid bone position in the OSA group.
CONCLUSIONS: The lack of a normal pharyngeal airway space and hyoid bone position in children with OSA may be related to abnormal mouth breathing. Therefore, it may be necessary to control both the narrowed pharyngeal airway space and abnormal hyoid bone position in the clinical management of children with OSA.

238 BIOCHEMICAL EXPRESSION OF VASCULAR ENDOTHELIAL GROWTH FACTOR WITH NEOVASCULARIZATION DURING OCCLUSAL HYPOFUNCTION: A MOUSE EXPERIMENTAL STUDY
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AIM: To determine whether occlusal hypofunction and its recovery affect the structure of the periodontal ligament (PDL) and expression of vascular endothelial growth factor (VEGF) in mice.
MATERIALS AND METHOD: Five-week-old C57BL/6J mice (Jackson Laboratory, Bar Harbor, Maine, USA) were used and randomly divided into three groups: a hypofunctional group (HG), recovery group (RG), and control group (CG). In HG and RG, appliances were attached to the maxillary and mandibular incisors. These appliances were set for 11 weeks in HG and 7 weeks in RG. Appliances were then removed after 0, 7, 14, and 28 days. Untreated mice served as the CG. Histological sections were prepared and immunohistochemically stained for VEGF. The PDL area and the number of VEGF immunopositive cells in the PDL were evaluated in the three groups.
RESULTS: The number of VEGF immunopositive cells and PDL area were significantly larger in CG while the RG were larger than in HG; the PDL area in RG was similar to that in CG. In the recovery process, the PDL area and number of VEGF positive cells in the PDL increased from days 0 to 7 and decreased from days 7 to 28. The results suggest that occlusal stimuli regulate the PDL area through the expression of VEGF in the mouse PDL.
CONCLUSIONS: The clinical relevance of occlusal stimuli is their ability to regulate the expression of VEGF in PDL cells and these growth factors may lead to alveolar bone remodelling in the PDL.

239 ASSESSMENT THE RELIABILITY OF THREE DIFFERENT MIXED DENTITION ANALYSIS METHODS IN A TURKISH POPULATION
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AIM: To evaluate reliability of three different analysis methods frequently used in the mixed dentition in a Turkish population.
MATERIALS AND METHOD: Archived plaster models of 147 individuals between 12-22 years of age in the complete permanent dentition up to first molar. The mesio-distal widths of teeth on study casts were measured with a digital calliper with an accuracy of 0.01 mm. Moyers probability tables, Tanaka-Johnston, Bernabé and Flores-Mir regression equations were used in the prediction of the

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mesio-distal width of unerupted canine and premolar teeth. A Student's *t*-test was used when comparing tooth widths between gender and dental arches. Linear regression analysis was undertaken for specifying the equations for the predicted size for canine and premolar teeth.
RESULTS: The predicted sizes determined by Bernabé and Flores-Mir regression equations and Tanaka-Johnston were more than the actual sizes. The difference between actual and predicted sizes that were stated by Moyers probability tables at the 75th percentile on the maxilla and at the 50th percentile on the mandible in females; 50th percentile both in the maxilla and mandible in males, was not statistically significant.
CONCLUSIONS: The results obtained were found to be close to the actual size with Moyers probability charts at 75th percentile for the maxillary and 50th percentile for the mandible in females; 50th percentile both in the maxilla and mandible in males in this Turkish population.

240 CLINICAL COMPARISON OF THE EFFICACY OF SPACE CLOSURE IN FIRST PREMOLAR EXTRACTION CASES BY ELASTOMERIC CHAIN AND ELASTIC MODULE

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AIM: Both elastomeric chains and elastomeric modules are used for space closure in sliding mechanics; one relies on patient cooperation and each has its pros and cons. Moreover, different archwires are used for space closure in sliding mechanics. In this study, the aim was to compare the rate and efficacy of space closure by combinations of different archwires and elastics.
SUBJECTS AND METHOD: A total of 27 bimaxillary dentoalveolar protrusion patients without any crowding or spacing were recruited (inclusion criteria: U1 to SN ≥112, IMPA ≥100). All first premolars were extracted. After initial alignment and levelling, base archwires for sliding mechanics were inserted. On the lower left side, a 1/8 inch 3.5 oz. medium sized elastic was used from the first molar to a hook between the lateral incisor and canine and instructions were given to the patients to change them every 24 hours. On the right side, a four loop closed chain was used in the same fashion as the left side. The elastic chain was changed every four weeks. For every third of the patients, 0.018 inch stainless steel (ss), 0.017 × 0.025 inch ss and 0.019 × 0.025 inch ss was used as the base archwire and the days required for complete space closure were recorded. To compare the parallelism of the roots after space closure, a panoramic radiograph was taken for each patient and was graded from A to C on each side.
RESULTS: Space closure was faster on the elastomeric chain side than the elastic module side (193.7 ± 31.24 versus 272.44 ± 43.02 days). Regarding parallelism of the roots, there were no statistically significant differences between the two methods ($P > 0.05$). By comparing the rate of space closure between the three archwires, by using elastomeric chain for space closure, there was no statistically significant difference between 0.017 × 0.025 inch ss (187.78 ± 22.61 days) and 0.018 inch ss (175.89 ± 24.48 days) archwires ($P > 0.05$).
CONCLUSIONS: Based on the results of this study, space closure by means of an elastomeric chain along with 0.018 ss or 0.017 × 0.025 ss as the base archwires for sliding mechanic is faster when compared to elastic modules and using 0.019 × 0.025 inch ss, as the base archwire.

241 NASOLABIAL SYMMETRY IN CLEFT PATIENTS BEFORE AND AFTER BONE GRAFT PLACEMENT: TWO-DIMENSIONAL PHOTOGRAPHY

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AIM: Alveolar bone grafting in cleft lip and palate (CLP) patients has many clinical advantages, including bone support for the eruption of the canine into the cleft, stability of the maxillary segments, and closure of the oronasal fistula which could improve speech. The nasal base and piriform rim are also constructed during this procedure. The augmentation of the alar base could improve the symmetry with the non-cleft side, thereby improving facial symmetry. The purpose of this clinical study was to evaluate the influence of an alveolar bone graft on the nasolabial symmetry in CLP patients, measured on photographs.

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MATERIALS AND METHOD: Nasolabial symmetry was measured on photographs before and 6 months after alveolar bone grafting. The study group comprised 10 subjects with a complete CLP. Nasolabial symmetry was evaluated on photographs using the technique of Fudalej *et al*. (2012). The following variables were measured according to reference lines: nose height (A), nose width (B), lip height (C), lip width (D), upper lip height relative to nose bottom (E), upper lip width relative to midsagittal reference line (F). The control group consisted of 29 patients of the same age from the University hospital of Ghent. SPSS Statistics 24 was used to perform the date analyses.
RESULTS: No statistical significant difference before or after bone graft placement could be found for any variable in the experimental group (Wilcoxon test). The differences between the nasolabial symmetry of the control group and the experimental group (before bone graft) were not statistically significant for variables B, C, D and F. (independent Student's *t*-test). Variables A and E showed a tendency to less symmetry in the cleft patients. The means of each variable were clearly higher in the experimental group, indicating less nasolabial symmetry in cleft patients.
CONCLUSIONS: Bone graft placement has no influence on nasolabial symmetry in CLP patients. The cleft patients showed a tendency to less nasolabial symmetry compared to the control group.

242 A COMPARISON OF DIFFERENT RADIOGRAPHIC METHODS FOR DENTAL AGE ESTIMATION IN 5-17 YEAR OLD NORTH GERMAN CHILDREN

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AIM: To evaluate the applicability and compare three radiographic dental age (DA) estimation methods in north German children.
MATERIALS AND METHOD: Dental pantograms of 1000 children (444 males, 556 females) aged 5-17 years were evaluated. Seven mandibular teeth were staged according to Demirjian's dental maturity scale and DA was calculated using Demirjian's, Chaillet's and Willems' methods, including an adapted Demirjian's method with a specific formula for the southwest German population by Frucht *et al*. DA for each method was compared with chronological age (CA) for each patient. The significance of the difference between CA and DA was statistically analyzed for each method with the paired *t*-test. Absolute accuracy was determined by means of the absolute differences of DA-CA. All statistical tests were performed for girls and boys, and age cohorts separately.
RESULTS: Demirjian's method overestimated the mean age of girls by 0.50 ± 0.90 years and of boys by 0.35 ± 0.84 years. The adapted Demirjian's method using Frucht *et al*.'s specific formula for southwest German children overestimated the mean age of girls by 0.80 ± 0.99 years and of boys by 0.65 ± 0.92 years. Willems' method underestimated the mean age of girls by 0.15 ± 0.88 years and overestimated that of boys by 0.01 ± 0.83 years. Chaillet's method underestimated the mean age of girls by 0.30 ± 0.88 years and of boys by 0.19 ± 0.87 years. All methods showed significant differences between DA and CA with P values < 0.001 except for Willems' method for boys, which showed no significant difference with a P value 0.36.
CONCLUSIONS: Accuracy was different between genders, performing best for boys with all tested methods. Willems' method was the most accurate for estimating CA in north German children using dental pantograms followed by Chaillet's method. Demirjian's method and the adapted Demirjian's method for southwest German children both showed significant overestimation in both genders. Therefore, further research should be undertaken to adapt Demirjian's method for the north German population.

243 A STUDY OF THE HORIZONTAL REFERENCE PLANES ON LATERAL CEPHALOGRAM IN KOREAN CHILDREN

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AIM: To investigate the angle formed by the Sella-Nasion (SN) plane and the Frankfort-Horizontal (FH) plane and to evaluate the angles formed by the FH plane and other horizontal reference planes in relation to different skeletal maturity and malocclusion types.
SUBJECTS AND METHOD: Five hundred and forty subjects with no orthodontic treatment history (270 males, 270 females). Hand-wrist and lateral cephalometric radiographs were taken. According to the skeletal maturity index (SMI) of Fishman, the subjects were classified into three skeletal maturity groups (SMI 1-4 for group A, SMI 5-7 for group B, SMI 8-11 for group C). A second classification was made according to cephalometric analysis of the lateral cephalograms. The subjects were classified into Skeletal Class I, II and III malocclusion groups. Ten measurements were evaluated. A Student's *t*-test was used to examine gender differences and ANOVA and Duncan's multiple range test to examine differences among the groups.
RESULTS: 1. The angle formed by the SN plane and FH plane showed no difference among the skeletal maturity and malocclusion groups, or between genders. 2. The angle formed by the SN plane and FH plane was 8.27 ± 2.31 degrees for males and 8.59 ± 2.24 degrees for females. The average value was 8.42 ± 2.28 degrees. 3. The angle formed by the FH plane and palatal plane was almost constant showing no difference among skeletal maturity and malocclusion groups or between genders (1.09 ± 3.21°).
CONCLUSIONS: The angle formed by the SN plane and FH plane, and by the FH plane and palatal plane was constant regardless of the patient's skeletal maturity, malocclusion classification, and gender.

244 NASAL CHANGES AFTER SURGICAL CORRECTION OF SKELETAL CLASS III MALOCCLUSION IN KOREANS

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AIM: To evaluate the secondary changes in the nose following bimaxillary surgery to correct skeletal a Class III malocclusion and to evaluate whether additional cinch sutures were effective in preventing these changes.
SUBJECTS AND METHOD: Sixty five adult Korean skeletal Class III patients (29 males, 36 females) who had received maxillary advancement/impaction and mandibular set-back surgery with alar base cinch suture. Direct measurements of the anthropometric variables of the nasal region were made on the soft-tissue surface with a digital sliding calliper (Japan, Mitutoyo) before and 6 months after surgery. A Student's *t*-test was used to examine the gender differences and a Mann-Whitney *U* test to examine the susceptibility to nasal widening after surgery.
RESULTS: The nose/alar width and the alar base width after bimaxillary surgery showed a significant increase of 2.02 ± 0.93 mm and 1.24 ± 0.93 mm, respectively ($P < 0.001$). Nasal tip protrusion was lowered. The nostril was widened. Females with a narrow alar width pre-surgically showed a tendency to a larger amount of nasal widening compared with those with a broader alar width ($P < 0.05$).
CONCLUSIONS: Widening of the alar and nostril was observed after bimaxillary surgery of Korean skeletal Class III malocclusion patients, even though cinch sutures had been carefully performed. Alar cinch suture had a positive effect in limiting nasal widening to the minimum and would be beneficial as routine application during bimaxillary surgery for skeletal Class III especially for female patients with a narrow nose who are more susceptible to alar widening.

245 SYMPHYSIS MORPHOLOGY AND DIMENSIONS IN HYPERDIVERGENT PATIENTS WITH DIFFERENT ANTEROPOSTERIOR SKELETAL RELATIONSHIPS‡‡‡

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AIM: To compare the difference of mandibular symphysis morphology and dimensions in hyperdivergent patients with various anteroposterior skeletal relationships.
MATERIALS AND METHOD: Lateral cephalograms and cone beam computed tomography scans were obtained from 69 adults who were diagnosed with a hyperdivergent skeletal pattern. Mandibular symphysis morphology and dimensions were measured by a single observer, and were compared between Class I, II, and III skeletal relationships.
RESULTS: A larger angle of concavity of the chin ($P < 0.001$), a higher inclination of the alveolar part toward the mandibular plane ($P < 0.05$), and larger vertical dimensions ($P < 0.05$) were found in Class III subjects compared to Class I and Class II relationships. Higher inclination of the skeletal part toward the mandibular plane ($P < 0.05$) was found in Class II subjects compared to the other groups.
CONCLUSIONS: The alveolar part of mandibular symphysis compensated for the skeletal relationship in Class III patients. The chin point of Class II patients showed the least anterior growth. The vertical dimension of mandibular symphysis was largest in Class III patients.

246 FLUORIDE VARNISH EFFICACY IN PREVENTING WHITE SPOTS AND GINGIVITIS DURING FIXED ORTHODONTIC TREATMENT – A PROSPECTIVE RANDOMIZED CONTROLLED TRIAL

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AIM: During fixed orthodontic treatment emerging white spot lesions (WSL) in the periphery of brackets and accompanying gingivitis are undesired, but frequent side effects. Fluoride-containing agents are often applied by the orthodontist at the start of therapy to minimize the risk of their occurrence. At present, however, it is uncertain, whether an application of fluoride varnish at an interval of 6 months, corresponding to current clinical recommendations (American Dental Association), has an additional protective effect over sufficient domestic dental hygiene with fluoride toothpaste (1500 ppm F−) in patients with a low to moderate caries risk.
SUBJECTS AND METHOD: In a single-centre prospective randomized double-blind placebo-controlled clinical trial 90 adolescents with a low to moderate caries risk without previous caries or periodontal disease and scheduled for fixed orthodontic treatment with the buccal technique were randomized to three groups of 30 patients each: standardized dental hygiene (at home) with fluoride toothpaste (no additional fluoride sources) and standardized application of (1) placebo varnish (70% w/v ethanol, control) or (2) elmex® fluid (10.000 ppm F−; GABA GmbH, Germany) or (3) Fluor Protector S (7.700 ppm F−; Ivoclar Vivadent GmbH, Liechtenstein) on all dental surfaces with brackets at the beginning of therapy. Enamel demineralization and gingivitis were quantified with the International Caries Detection and Assessment System (ICDAS) and the gingivitis index (GI, Löe) at baseline and after 4, 12 and 20 weeks of orthodontic treatment.
RESULTS: A significant increase in mean ICDAS index and frequency of higher ICDAS values was observed in each treatment group over the course of time with no significant alteration in mean GI or frequency of GI values. No significant intergroup differences were detected at any of the four timepoints evaluated (baseline, after 4, 12 and 20 weeks).
CONCLUSIONS: There seems to be no additional preventive advantage of a one-time application of fluoride varnish (elmex® fluid, Fluor Protector S) within the recommended 6 month application interval in patients with a low to moderate caries risk over sufficient dental hygiene with fluoride toothpaste regarding the formation of WSL and gingivitis. Patients and legal guardians should be informed about the general risk of enamel demineralization during orthodontic treatment with fixed appliances.

247 FOLLOW-UP STUDY OF BONE ANCHORED MAXILLARY PROTRACTION TREATMENT OF THE HYPOPLASTIC MAXILLA WITH DIFFERENT TYPES OF CLEFT LIP AND PALATE PATIENTS

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AIM: To evaluate the effect of the bone anchored maxillary protraction (BAMP) treatment on cleft patients.

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SUBJECTS AND METHOD: This retrospective study comprised five cleft patients (mean age of 10.8 ± 0.6 years, 2 boys and 3 girls with isolated cleft palate, submucous cleft patient or two unilateral cleft lip and palate). Before treatment all patients showed an anterior crossbite, maxillary hypoplasia, a mild Class III jaw relationship and concave facial profile. All were treated according to De Clerck's instructions with Bollard-type skeletal anchorage (miniplates and intermaxillary traction; De Clerck *et al*., 2009). Treatment outcome was followed for five years. The documentation (plaster model or dental cast, lateral cephalogram and three-dimensional computed tomograph) were taken before treatment (T1, at mean age of 10.8 ± 0.6 years.), after active treatment, when the elastics were used all day (T2, at mean age of 12.3 ± 0.2 years) and after the retention period, when the elastics were used only at night (T3, 15.05 ± 2.3 years.). The mean of total treatment time (T1-T3) was 4 years 4 months.
RESULTS: During T1-T3 the anterior crossbite was corrected in all cases and the intermolar relationship improved (2.5 mm). On average the horizontal overjet increased from –1.6 mm to +1.5 mm and the vertical overbite decreased from 2.6 mm to 1.5 mm. Cephalometric treatment outcome showed that maxillary protrusion (SNA) increased during T1-T2 (+2.70°), and remained stable during T2-T3. During T1-T3 mandibular retrusion (SNB) remained unchanged and interjaw relationship (ANB angle) decreased –1.4°) and the angle between the mandibular plane to SN closed (–2.4°) and facial convexity (gl/sn/pg) became straighter (–7.1°). The upper and lower incisors proclined during the T1-T3 period (2°).
CONCLUSIONS: BAMP treatment for cleft patients is a suitable and stable method to stimulate maxillary growth and to correct mild maxillary hypoplasia.

248 ADVANCED TREATMENT OPTIONS WITH THE C-PLATE – SKELETAL ANCHORAGE IN THE MANDIBLE

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AIM: To clinically evaluate the continuous use of the C-plate in a dental practice and its suitability for skeletal anchorage in the mandible and to assess treatment options, especially as an anchorage appliance for direct molar distalization in the lower jaw.
SUBJECTS AND METHOD: Fifty five patients between 11 and 20 years of age, treated with 90 C-plates within the last 1.5 years were analyzed; the survival rate and stability of the C-plate was evaluated. The amount of molar mesialization and distalization in the mandible was measured. Indication for use of the C-plate as an anchorage appliance were: space closure in cases of unilateral or bilateral missing lower premolars or spacing after extraction of decayed first molars (mesialization); crowding in the anterior segment (distalization). Different treatment mechanics and insertion localization were required. All C-plates were inserted by an oral surgeon under local anaesthesia.
RESULTS: Regardless of C-plate positioning the typical post-operative complications such as dental injury, wound infection, bleeding and nerve injury was avoided in all cases. The current loss rate of the C-plate was below 5 per cent. Co-factors were lack of dental hygiene, compliance of the patient and smoking. On average the molars were mesialized 8 mm and distalization of 3 mm was achieved. Side effects, such as a shift of the midline, especially in cases of a unilateral aplasia were not observed.
CONCLUSIONS: C-plates can be considered as a promising appliance in space management. They can be used for molar distalization and to regain space. They can be seen as a secure anchorage appliance in the mandible.

249 QUANTIFICATION OF DENTAL PLAQUE IN MULTIBRACKET APPLIANCE PATIENTS: IS THERE A RELIABLE METHOD?

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AIM: To present the results of a cross-sectional *in vivo* study in multibracket (MB) appliance patients to compare plaque detection and quantification by quantitative light-induced fluorescence-digital (QLF-D) with conventional digital photographs of disclosed plaque.
SUBJECTS AND METHOD: Twenty patients fulfilling the following inclusion criteria were selected: (1) MB appliance in both upper and lower jaws, (2) age ≥16 years, (3) presence of all permanent canines, lateral and central incisors, (4) no developmental defects, carious lesions, labial surface fillings, crowns or recessions >1/3 of root length of these teeth and (5) written informed consent signed by patients and parents. Plaque coverage of the oral and buccal surfaces of canines, lateral and central incisors was analyzed planimetrically on QLF-D and conventional photographs taken under standardized conditions. Plaque staining with Miratone solution [Mira-2-Ton®, Hager & Werken GmbH & Co KG, Duisburg, Germany] before the conventional photographs served as the gold standard. Statistical analysis was performed with Wilcoxon's rank sum test.
RESULTS: The mean area of plaque covered tooth surface was 19.2 ± 3.9 per cent for QLF-D and 36.2 ± 4.3 per cent for Miratone stained conventional photographs. Very large intra- and interindividual differences were seen for both imaging modalities. Significant differences between QLF-D and conventional images existed for teeth (canines versus incisors), jaws (upper versus lower) and surfaces (oral versus buccal) ($P < 0.001$).
CONCLUSIONS: In MB appliance patients, no clinically significant agreement between QLF-D and conventional images of stained plaque (plaque-covered tooth surface percentage) could be detected.

250 THE EFFECT OF CERVICAL HEADGEAR ON DENTAL ARCH AREA

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AIM: To determine the effect of early cervical headgear treatment on the maxillary and mandibular dental arch area.
SUBJECTS AND METHOD: Sixty eight children (28 girls, 40 boys) aged 7.6 years (SD 0.3) with a Class II malocclusion. The children were randomly divided into two groups. In the first group cervical headgear treatment was started immediately or after eruption of the first maxillary molars. In the control group only minor interceptive procedures were performed during the follow-up period. Fixed appliance treatment, if needed, including extraction of permanent teeth due to crowding, was undertaken after completion of early treatment. The records were available from the start of early treatment and at follow-up after 2, 4, 8, and 13 years. In this study the first 4 years of treatment and follow-up groups were monitored. Dental casts were taken and scanned with 3Shape three-dimensional (3D) scanner of both groups at the beginning of treatment (T0) and at the two- (T1) and four (T2) year follow-up. 3D landmarks describing the positions of the maxillary and mandibular incisors, canines, first and second premolars and first molars were used to calculate the maxillary and mandibular dental arch areas. These results were compared between the treatment and control group and between boys and girls. An independent samples *t*-test was used to compare the means of the groups.
RESULTS: At T2, the maxillary dental arch area showed a 12.3 per cent (SD 9.7, $P < 0.001$) growth in the treatment group, whereas in the control group the change was only 1.3 per cent (SD 11.1). Also in the treatment group, the change in mandibular dental arch area was 4.2 per cent (SD 9.6, $P < 0.001$), whereas in the control group the area decreased by 5.6 per cent (SD 8.0). In the treatment group, boys showed greater changes in both maxillary (12.0%, SD 10.4, $P < 0.05$) and mandibular (5.8%, SD 9.0, $P < 0.01$) dental arch area compared to girls.
CONCLUSIONS: Headgear induces both maxillary and mandibular dental arch growth changes.

251 WEAR-TIME REGISTRATION DURING ORTHOPAEDIC TREATMENT WITH THE MODIFIED FRÄNKEL 3 APPLIANCE – A 24 MONTH MICROELECTRONIC EVALUATION

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AIM: To objectively evaluate the wear-time during orthopaedic treatment with the modified Fränkel function regulator type 3 (FFR3).
SUBJECTS AND METHOD: The wear-times of 55 patients (26 boys, 29 girls) undergoing orthopaedic treatment with the modified FFR3 by Farčnik (2007) were measured, registered and analysed using the TheraMon microelectronic device (Gschladt, Hargelsberg, Austria) over a 24 month treatment period. Wear-time was registered every month and statistically evaluated. The values were compared with the recommended wear-time values.
RESULTS: The mean value wear-time in the 55 patients was 8.9 hours per day, which is a significantly lower value compared with 20 hours/day prescribed. The wear-time behaviour of the patients was mainly at night, with some days without wearing the appliance and some afternoon wearing periods. The highest measured wear-time was in a female patient with a mean value over 21 hours/day, and the lowest in a female patient with a mean value of 1.8 hours/day. The duration of daily wear-time was much shorter than the night wear-time. The difference was statistically significant.
CONCLUSIONS: Irregular orofacial functions, especially irregular tongue posture on the mouth floor, are diagnosed in the majority of patients with Class III malocclusion. Lingual shields as well as the acrylic pad on the palatal arch of the modified FFR3 appliance are used as a muscle training device for physiotherapy of the tongue muscle and may therefore improve the dynamic imbalance of the orofacial area due to the irregular tongue posture and function. Orthopaedic treatment with functional appliances demands good cooperation regarding wear-time during the day to establish dynamic balance of the orofacial area. However, measured wear during the day time in these patients was lower than prescribed. Microelectronic wear-time of the modified Frankel 3 functional appliance may in the future standardize the optimal wear-time in Class III patients. According to the effectiveness and quality of treatment outcome using the modified FFR3 the standard wear-time may be in the future objectively prescribed.

252 A GEOMETRIC MORPHOMETRIC EVALUATION OF HARD AND SOFT TISSUE PROFILE CHANGES IN EXTRACTION VERSUS NON-EXTRACTION PATIENTS.

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AIMS: To evaluate the hard tissue and facial profile changes in matched extraction and non-extraction Class I patients with the use of geometric morphometrics.
SUBJECTS AND METHOD: From a parent sample of 542 Class I patients, been subjected to discriminant analysis in a previous study, a subsample of 68 borderline cases, with regards to extraction modality, was obtained and analyzed. Of the borderline patients 34 were treated with extraction and 34 without extraction of the four first premolars. The validity of the discriminant analysis in successfully identifying a borderline group of morphologically similar patients was examined by geometric morphometric methods (Procrustes superimposition and Principal Component Analysis). Inter- and intragroup skeletal and facial profile changes were evaluated morphometrically using pre- and post-treatment cephalometric radiographs. Permutation tests were conducted to test statistical significance, based on the Procrustes distances between group means. Multivariate regression analysis was conducted between linear and angular cephalometric measurements of incisal position and changes in the Principal Components of soft tissue shape before and after treatment.
RESULTS: The discriminant analysis was validated. The non-extraction group showed an increase in overall hard tissue height ($P < 0.00$, 10000 permutations), with slightly retruded upper and slightly protruded lower ($P = 0.027$, 10000 permutations) lips. The extraction group showed a significant retraction of the hard tissue and facial profile outline ($P < 0.00$, 10000 permutations). The post-treatment soft tissue differences were marginally significant ($P = 0.053$, 10000 permutations), but not in the hard tissue skeletal component ($P = 0.078$, 10000 permutations). Changes in the position of the lips correlated significantly with changes in the position of the upper and lower incisors.

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CONCLUSION: The choice of treatment modality in regards to extractions has a definite impact on the skeletal and soft tissue profile in Class I borderline patients. In patients treated non-extraction a vertical increase of the skeletal structures was observed, whereas facial profile altered slightly. Patients treated by extractions presented similar changes in the vertical direction in addition to retroposition of the maxillary and mandibular alveolar osseous contours, accompanied by lip retrusion.

253 EVALUATION OF PATIENT DISCOMFORT AND PAIN AFTER PIEZOELECTRIC CORTICOTOMY

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AIM: Rapid orthodontics with flapless piezoelectric corticotomies accelerates tooth movement. The aim of this study was to evaluate patient discomfort and pain after piezoelectric corticotomies.
SUBJECTS AND METHOD: Forty subjects (27 females, 13 males) treated by extraction of two or four premolars. After extraction of the premolars, canine distalization was commenced. Preadjusted MBT brackets (0.022 × 0.028 slot) were used. After levelling and alignment, two orthodontic self-drilling type mini-implants, having conical shape, with 1.6 mm diameter and 8 mm length were implanted into the buccal alveolar bone between the first molars and second premolars. A 0.017 × 0.025 inch archwire with anterior hooks was used for incisor retraction. A force of 250 g was applied on each side with a nickel-titanium coil spring (closed) from miniscrew to anterior hooks. In group 1 (control group; age 16.4 ± 1.72 years; 13 females, 7 males) incisor retraction was undertaken with miniscrew anchorage and in group 2 (16.5 ± 1.08 years; 14 females, 6 males) incisor retraction with miniscrew anchorage reinforced with piezoincision. Piezoincisions were performed distal to the lateral incisors on each side under the local anaesthesia. The miniscrews were loaded shortly after piezoincisions. The subjects were requested to mark a line which represented their level of pain intensity using a visual analogue scale immediately, and 4 hours, 12 hours, and 3 days after application of retraction force. The patients were requested not to take any pain medication.
RESULTS: There was no significant difference in the level of pain between the two groups ($P > 0.05$). The pain score in both groups peaked 4 hours after retraction. In both groups, there was a significant increase between immediate pain measurement and measurement after 4 hours, and a significant decrease between measurements after 12 hours and 3 days. However, there was no significant change between measurements after 4 hours and 12 hours in either group.
CONCLUSIONS: Piezoincision is a comfortable method for acceleration of tooth movement in orthodontics since pain level decreases to bearable values within a day.

254 PREVALENCE OF MALOCCLUSION TRAITS AND ORTHODONTIC TREATMENT IN A FINNISH ADULT POPULATION

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AIM: To examine the prevalence of occlusal abnormalities and the extent of previous orthodontic treatment in a northern Finnish adult population. Furthermore, the objective was to investigate differences in the prevalence of malocclusions between genders and between treated and untreated groups.
SUBJECTS AND METHOD: The study population was part of an unselected population cohort, the Northern Finland Birth Cohort 1966. Of the 12,058 individuals of the entire cohort, 3,150 lived in the city of Oulu or within 100 km of it and were invited to take part in a clinical oral and dental examination. Of these 3,150 individual, 1964 (912 males, 1052 females) volunteered to participate in the clinical oral and dental examination which was carried out in 2012 in connection with a 46-year follow-up survey. The examination was performed by six calibrated dentists and included registration of overjet, overbite, lateral crossbite and scissor bite. Information about previous orthodontic treatment was gathered with a questionnaire at the time of the clinical examination. Pearson's Chi-square test was used to calculate differences between genders and between treated and untreated groups.

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RESULTS: In this study, 39.5 per cent of the subjects had at least one malocclusion trait. The most frequent malocclusion traits were lateral crossbite (17.9%), overbite ≥6 mm (11.7%) and overjet ≥6 mm (9.7%). Males presented with an increased overbite, negative overjet and crossbite on the left premolars significantly more than females. The prevalence of malocclusion traits was at the same level in the treated and untreated groups. Overall, 18.6 per cent of the subjects had undergone orthodontic treatment. Females showed a significantly higher prevalence of orthodontic treatment.
CONCLUSIONS: The most common malocclusion trait in the present study was a lateral crossbite. Significant male dominance in the prevalence of malocclusion was observed, which has not been reported earlier in Finland. Orthodontic treatment of malocclusion traits was more common among females in northern Finland. This study indicates that orthodontic treatment provided in childhood was, on average, adequate in reducing malocclusion traits to the level observed in the general population.

255 SUBJECTIVE JUDGMENT AND OBJECTIVE MEASUREMENT OF PROFILE CHANGES DURING SURGICAL OR NON-SURGICAL TREATMENT OF ADULT CLASS II DIVISION 1 FEMALES

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AIM: To assess the relationship between objective assessment and judgment by laymen and orthodontists of surgical and non-surgical treatment changes in Class II division 1 adult females.
SUBJECTS AND METHOD: Sixty adult Class II division 1 females, 30 with combined surgical-orthodontic treatment and 30 with orthodontics only. Objective measurements were carried out on standardized profile photographs. Subjective judgment was performed in two consecutive sessions and carried out by 19 orthodontists and 20 laymen. Attractiveness of 10 surgical and 10 non-surgical patients shown on a set of photographs was assessed on a visual analogue scale (VAS). During the first session pre- and post-treatment photographs were shown separately and at random and a general judgment was given. During the second session pre- and post-treatment photographs were shown simultaneously and judges were asked to show the preference between pre- and post-treatment and to assess the extent of improvement on a VAS.
RESULTS: According to objective assessment in the surgery group, plica mentalis and upper and lower lip became flatter and the chin and lower lip became more prominent. Only dorsal movement of the upper lip in the non-surgery group was significantly correlated to attractiveness improvement as assessed by laymen. No differences in improvement between surgery and non-surgery patients were found either by laymen or orthodontists. There were a few small differences in judgment between laymen and orthodontists for pre- and post-treatment assessment of both groups. Generally orthodontists gave higher scores than laymen. Mostly the improvement score was higher when pre- and post-treatment photographs were shown simultaneously than when shown separately. However for the non-surgery group laymen scored the same improvement for simultaneously and separately shown pre- and post-treatment photographs. When pre- and post-treatment photographs of surgery patients were shown simultaneously orthodontists gave higher scores than laymen for post-treatment attractiveness.
CONCLUSIONS: Laymen and orthodontists scored an equal improvement in attractiveness in both groups of patients despite the differences between the groups in objectively assessed treatment changes. Dorsal movement of the upper lip was the only objective variable significantly associated with facial improvement in non-surgery patients as assessed by laymen.

256 SOFTWARE DIAGNOSTIC FEATURES AND ALIGNER CONSTRUCTION

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AIM: Systemization of diagnostic methods using SimplyCeph-software (Russia) technology; analysis of examinations results and planning of virtual orthodontic treatment and aligner construction.
SUBJECTS AND METHOD: A clinical examination was undertaken of 43 patients aged 18-25 years with anomalies of tooth position, dentition shape and size. Computer tomograms were studied to determine the morphological status of periodontium, presence of tooth root convergence and their

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position in the anterior and posterior segments. Anthropometric analysis of virtual models of the dentition was performed after measuring points positioning. SimplyCeph allowed the study of TRH data, to upload the TRH in the lateral projection from the photographic album or email, to adjust the radiographic scale, to determine the position of 15 anthropometric points, to obtain the contours of the bony structures and the soft tissue profile of the patient and to select one or more of the techniques. In the 'patient card' section we included: personal data; photographs; radiographic examinations; virtual diagnostic models.
RESULTS: Correlation analysis results were compared with the norm mean values. N-Se, N-Gn, Go-Pg, U1-NL, U6-NL, L1-ML, L6-M in individuals with physiological occlusion reduced from 1.5 to 13.7 per cent compared to the age norm. A'-SnP, Co-Go increased 4.6-5.1 per cent ($P > 0.05$).If compared with the age norm of TRH angular parameters, significant differences were not observed in the lateral projection. Deviations from the age norm were marked as positive from 0.6 to 5.4 per cent and as negative from 0.2 to 4.9 per cent ($P > 0.05$). Anthropometric analysis was performed after positioning of the measuring points on vestibular, cutting edges and chewing surfaces of tooth crowns. Using potential of the diagnostic techniques, allows a complete virtual orthodontic treatment plan.
CONCLUSIONS: SimplyCeph, the software instrument based on a compiled orthodontic treatment plan, defines the stages of tooth movement, normalization of dentition form and occlusion in three mutually perpendicular planes. SimplyCeph applies methodology and order of virtual tooth movement in accordance with the fundamental techniques of tooth movement, taking into account the anatomy and features of the morphology of the teeth, dentition and jaw bones of each patient, which ensures precision of aligner making and of obtaining optimal treatment results.

257 INFLUENCE OF ORTHODONTIC TREATMENT ON THE FUNCTIONAL STATE OF THE DENTAL JAW SYSTEM IN THE DEVELOPING DENTITION

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AIM: To examine the right and left masseter muscle at a relative physiological rest of the mandible, at the first occlusal contact of the teeth and at maximal contraction. A further aim was to estimate the difference in contracted and relaxed muscles and the difference in right and left masseter muscle tone for estimation of myodynamic balance.
SUBJECTS AND METHOD: Forty five patients aged 7-12 years. The functional state of the masseter muscles was studied by myotonometry (Myoton 3-c) and electromyography (Electromyography BKN 16) before and after treatment of mesioclusion.

RESULTS: Myotonometry before and after treatment (tone):

	Before treatment		After treatment	
	Right masseter	Left masseter	Right masseter	Left masseter
Relative physiological rest of the mandible	146	142	140	139
First occlusal contact of the dentition	160	145	151	140
Maximal contraction	184	187	188	190
Contractile ability of muscles	41	51	48	51

Electromyography revealed a decrease of biopotential of the right temporal and left masseter muscle of 33 and 17 per cent, respectively, after treatment in the relative physiological rest of mandible. The sum of all examined muscle biopotentials after treatment was 38.1 ± 0.9 uV, which was for 9 per cent less than the total biopotential before treatment. Functional testing of the first occlusal contact of tooth antagonists at closing of the dentition also revealed a significant decrease of 16 per cent of the sum of the biopotentials of all examined muscles after treatment. The greatest decreases in biopotentials were found for the left masseter (30%) and right sternocleidomastoid muscle (18%) after treatment. In the functional test of maximal contraction the biopotentials of all examined muscles after treatment were higher than before treatment for 55 per cent.

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CONCLUSIONS: The functional apparatus tone and biopotentials decreased: In the state of maximal contraction the tone and biopotentials of muscles lifting the mandible increased, but of muscles that lower mandible it decreased.

258 ANALYSIS OF BIOPOTENTIALS OF MUSCLES IN SUBJECTS WITH MESIOCLUSION

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AIM: To explore and compare the biopotentials of the right and left masseter, temporal, suprahyoid and sternocleidomastoid muscles during physiological rest of the mandible, at the first occlusal contact of antagonist teeth during closure and at maximal contraction.
SUBJECTS AND METHOD: Thirty seven children aged 7-12 years with a mesioclusion, divided two groups: group I, 20 children aged 7-9 years; group II, 17 children aged 1-12 years. The biopotentials of muscles were determined using the Electromyograph BKN (Biotronic, Italy). The meaning of the muscle biopotential was an average square value of the signal (RMS), unit in uV. Statistical data processing was undertaken with correlation and regression analyses.
RESULTS: Group I, the biopotentials of the examined muscles were not significantly different. Group II, the biopotentials of the left temporal and sternocleidomastoid muscles were 43 per cent more than the index of the right side. The muscle biopotentials in groups I and II were 41.7 ± 0.8 uV and 35.3 ± 1.2 uV ($P > 0.05$), respectively, which was higher than the average norm rate by 2.5 times in group I and by 2.0 times in group II. The biopotentials of the muscles at the first occlusal contact of the antagonist teeth showed significant differences in both age groups. The meanings of the biopotentials of the right and left sides of the sternocleidomastoid muscles differed for 24.0 per cent; the biopotential of left side was higher than that of the right side in both age groups. The muscle biopotentials in both age groups were greater than those in subjects with a physiological occlusion. Comparison of total muscle biopotentials of children with a mesioclusion showed an excess of 3 times than those with a physiological occlusion. In maximal willed contraction in both age groups there were significant differences in the meanings of biopotentials between all examined muscles. The greatest differences were determined for the right and left masseter muscles in 43 per cent in group I.
CONCLUSIONS: Muscle biopotentials of the right and left sides had high meanings and increased from physiological rest to maximal willed contraction at children with mesioclusion.

259 ASSESSMENT OF HEAD ASYMMETRY IN PREMATURELY BORN CHILDREN DURING EARLY CHILDHOOD USING THREE-DIMENSIONAL PHOTOGRAPHY

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AIM: To assess symmetry of head shape using three-dimensional (3D) photography at 3, 6 and 12 months and 3 years of age in prematurely born children and compare it to children born full-term.
SUBJECTS AND METHOD: Thirty four pre- and 33 full-term children born in Oulu University Hospital, Finland attended the clinical study at the age of 3 (T1), 6 (T2) and 12 (T3) months and 3 years (T4). At each visit, 3D photographs of the head were obtained using a 3dMD head five-pod camera system (3dMD, Atlanta, Georgia, USA). For quantification of symmetry, the oblique cranial length ratio was calculated; a score >=104% was used to define plagiocephaly. The images were processed and analyzed with RapidForm 2006 (Geomagic, Rock Hill, South Carolina, USA) software, and the custom macros were written with Visual Basic for Applications. More complex mathematical analyses were performed with Matlab R2014b (MathWorks, Natick, Massachusetts, USA). Statistical work was carried out with SPSS v. 22.0 (IBM, Armonk, New York, USA).
RESULTS: The mean [standard deviation (SD)] gestation weeks at birth were 32.7 (3.2) weeks for pre-term and 40.0 (1.3) weeks for full-term children. The mean (SD) birth weight, length and head circumference of pre- versus full-term children were 2006.5 (712.3) versus 3508.6 (399.7) g, 42.0

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(5.0) versus 50.2 (1.7) cm and 30.6 (3.2) versus 34.8 (1.3) cm ($P < 0.001$). At T1, 39.39 per cent of the pre- and 27.27 per cent of the full-term infants had plagiocephaly ($P > 0.01$). At T2, 24.13 per cent of the pre-and 18.18 per cent of the full-term children ($P > 0.01$), at T3 24 per cent of the pre- and 15.15 per cent of the full-term children ($P > 0.01$) and at T4, 30 per cent of the pre-term versus 13.63 per cent of the full-term children had plagiocephaly ($P > 0.01$).
CONCLUSIONS: Pre-term children were more prevalent to deformational plagiocephaly. The oblique cranial length ratio in pre-term children decreased from T1 to T2, was stable from T2 to T3 and increased from T3 to T4, while it only decreased in full-term children.

260 COMPARISON OF THREE-DIMENSIONAL SKELETAL AND DENTAL CHANGES IN MAXILLARY EXPANSION TREATMENT WITH THE HYRAX OR DAMON SYSTEM

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AIM: To determine three-dimensional skeletal and dental changes in maxillary expansion orthodontic treatment using a tooth-anchored (Hyrax) expansion appliance versus the Damon system.
MATERIALS AND METHOD: Cone-beam computed tomographs (CBCT) from 40 patients treated for maxillary expansion were analyzed. These patients were randomly assigned to one of two groups (20 in the Hyrax group and 20 in the Damon system group). CBCTs were viewed and analyzed using the software platform AVIZO®. Forty-nine landmarks were chosen, defined and then placed on the initial and final recall CBCT images for each patient. Landmark coordinates were obtained and analyzed using linear and angular measurements. Prior to this, 10 additional images were first analyzed three times each to determine the reliability and measurement error of each landmark using intraclass correlation coefficient (ICC). Descriptive statistics, ANOVA and paired *t*-tests were used for statistical analysis.
RESULTS: ICC values were excellent for all landmarks in all axes (≥0.998) with the lowest value for the right greater palatine foramen landmark in the *z*-axis. The greatest measurement error was seen in the *y*-axis of the buccal alveolar cortical bone landmark of the upper left first molar (0.76 ± 0.76 mm). ANOVA testing showed there to be a statistically significant difference between the two techniques in expanding the maxilla ($P < 0.05$). The Damon system showed a mean increase of 2.24 ± 1.82 mm between the mesiobuccal pulp horns of the upper first molars (UMBP) but a 1.21 ± 1.45 mm decrease between the mesiobuccal pulp horns of the lower first molars (LMBP) whereas the Hyrax system showed a 5.79 ± 1.90 mm increase between UMBP but no significant change between the LMBP.
CONCLUSIONS: Both techniques expanded the maxilla. The Hyrax appliance demonstrated greater overall maxillary expansion than the Damon system in the overall treatment. However, the Damon system caused greater lingual tipping of the lower molars.

261 EFFECT OF A FLUORIDE-RELEASING VARNISH ON SHEAR BOND STRENGTH OF BRACKETS BONDED ON DEMINERALIZED ENAMEL

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AIM: To evaluate shear bond strength (SBS) of brackets bonded onto demineralized enamel after applying fluoride varnish (Clinpro XT Varnish, 3M Espe) using a conventional bonding system.
MATERIALS AND METHOD: Eighty bovine incisors were divided into four groups (n = 20). Group 1: enamel was etched with 37 per cent orthophosphoric acid for 30 seconds, washed and dried. Transbond XT Primer (3M Unitek) was applied to the whole vestibular surface and photopolymerized for 10 seconds. Then, brackets (Victory Series, 3M Unitek) were bonded using the Transbond XT paste and photopolymerized for 20 seconds. Group 2: the enamel was etched, washed and dried as in group 1. Clinpro XT varnish was brushed onto the tooth's vestibular surface and photopolymerized for 20 seconds. Then, brackets (Victory Series, 3M Unitek) were bonded using Transbond XT paste and photopolymerized for 20 seconds. Groups 3 and 4: The teeth in both groups were placed in a demineralizing solution for 48 hours. Afterwards, the brackets were bonded following the

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procedures as in groups 1 and 2, respectively. SBS was measured using a universal test machine (Autograph AGS-1KND) with a crosshead speed of 1 mm/minute. SBS values were analyzed with the Kruskal Wallis test ($P < 0.05$) and the Mann Whitney test, applying Bonferroni correction ($P < 0.008$).
RESULTS: Statistically significant differences were found between the four groups ($P < 0.05$). No significant differences were found in bond strength between groups 1, 2, and 3 ($P > 0.008$). Bond strength values in groups 1 and 2 were significantly higher than in group 4 ($P < 0.008$). No significant difference was found between groups 3 and 4 ($P > 0.008$).
CONCLUSIONS: The application of Clinpro XT varnish to intact enamel produced bond strength values that were similar to conventional orthodontic cement. While the bond obtained with Clinpro XT varnish on demineralized enamel was significantly lower than on intact enamel, the values obtained by conventional adhesive on demineralized enamel were comparable to those obtained on intact enamel.

262 SPEECH DISORDERS, EAR, NOSE AND THROAT CONDITIONS AND TONGUE POSTURE IN ANTERIOR OPEN BITE PRESCHOOL CHILDREN

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AIM: An anterior open bite (AOB) is defined as a vertical gap between the upper and lower incisors with the teeth in centric occlusion. Heredity and multifactorial aetiology play an important role in early diagnosis. AOB is one of the most difficult problems in growing children. Irregular tongue posture is stressed in the aetiology of AOB, speech disorders and post-treatment stability. The assessment of tongue posture in growing children is unreliable due to anatomical limitations. The aim of this study was to assess the prevalence of AOB and speech disorders in children with orofacial disorders and impaired ear, nose and throat (ENT) conditions. The assessment of tongue posture was performed in preschool children with and without AOB using three-dimensional (3D) ultrasonography (US).
SUBJECTS AND METHOD: Four hundred and forty six children from a regional kindergarten, aged 3-7 years (236 boys, 210 girls) were examined for speech disorders, ENT conditions, malocclusions and oral habits. Questionnaires were answered by the parents. Orthodontic examination, facial and intraoral photographs and dental casts were obtained in AOB subjects only; an ENT specialist examined ENT conditions and a speech therapist phonetic and speech disorders. A 3D US of tongue posture was assessed by a radiologist and orthodontist independently using 3D US Voluson 730 Expert with 3D convexconductor (RAB 2-5 MHz,GEH). The tongue posture data were analysed with the 4DView Program, Version 5.0. The R-Program (R-project.org) was used for statistical analysis of the data with Mann-Whitney, Chi square Fisher's exact, McNemar tests and the multiple logistic regression model was used (confidence interval 95%, statistical significance $P < 0.05$).
RESULTS: An AOB in the primary dentition was present in 32 children (7.2 %) aged 3-7 years (4.9 years). Orthodontic findings included an inappropriate facial appearance (72%), incompetent lip seal (97%), improper tongue posture and swallowing (97%). In subjects with an AOB more phonetic and articulation speech disorders were found (84%): sigmatism, rotacism, gamacism, kapacism, lambdacism and combinations. ENT and breathing disorders together with oral habits, thumb sucking, bottle feeding and prolonged pacifier use were the most important aetiological factors in children with an AOB. 3D US of tongue posture showed the tongue to be on mouth floor which differed significantly from the referential tongue posture in the non-AOB group.
CONCLUSIONS: 3D US assessment of tongue posture is an important tool to identify tongue irregularities and the role of the tongue in the aetiology of AOB in children. The main advantage of the method is that it is non-invasiveness.

263 REDUCTION OF GINGIVAL RECESSIONS BY ORTHODONTIC TREATMENT

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AIM: To quantify the change in dimensions of gingival recessions following orthodontic root movement towards the centre of the alveolar envelope.
SUBJECTS AND METHOD: Nine consecutive adult patients with a mean age of 33 years (22-61 years) presented with one lower incisor with either buccal or lingual gingival recession of Miller Class I, II or III. In all cases the root was positioned outside the boundary of the alveolar bone. Treatment was performed with a segmented orthodontic appliance, consisting of a torque arch and a base arch delivering a force that moved the displaced root toward the centre of the alveolar envelope. Baseline and post-orthodontic clinical measurements comprised 1) recession depth from the free gingival margin to the cementoenamel junction (CEJ), 2) recession width at the CEJ and 3) height of keratinized tissue from the free gingival margin to the mucogingival junction. The measurements were performed by the referring periodontist and the orthodontist treating the patient. The measurements were calibrated at baseline and post-orthodontic standardized intraoral photographs were adjusted for magnification. The area of baseline and post-orthodontic recession was calculated on the clinical photographs with an image analysing software.
RESULTS: The width, depth and area of the gingival recessions were reduced in all patients. On average, the recession depth decreased by 25 per cent (range 14-38%) and the recession width by 41 per cent (range 27-67%). The height of the keratinized tissue increased in two patients and was unchanged in the rest of the sample. The area of the recession was on average reduced by 60 per cent (range 36-93%) of the baseline value.
CONCLUSIONS: Moving roots towards the centre of the alveolar envelope consistently reduces gingival recessions in depth and width. The orthodontic root movement is considered clinically important as the increased root coverage obtained through orthodontics improves the prognosis for a planned mucogingival grafting procedure.

264 ACCURACY OF THE COMPOSITE TOOTH MODEL FROM INTRA-ORAL SCANNED CROWN AND CONE-BEAM COMPUTED TOMOGRAPHY ROOT: AN *IN VIVO* STUDY

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AIM: During orthodontic treatment, various imaging modalities such as cephalograms and panoramic radiographs have been used for evaluation of tooth movement, including root position. The current methods for monitoring tooth movement, however, are unreliable and inaccurate in root position, especially. The purpose of this study was to evaluate a new methodology that can accurately identify root position in a clinical situation.
MATERIALS AND METHOD: A cone-beam computed tomography (CBCT) scan and intraoral scan images of 20 orthodontic patients were obtained pre- (T1) and post- (T2) treatment. Each tooth was isolated from the T1 CBCT images and the isolated CBCT teeth were superimposed onto the T1 intraoral scanned crown images. Thereafter, the crowns of the isolated CBCT teeth were removed. Thus these composite tooth models were composed of intraoral scanned crowns with high resolution sutured to the CBCT roots. After orthodontic treatment, the composite tooth models were registered to each tooth, one-to-one correspondence, to the intraoral scanned images at T2. To validate the composite tooth models, registered images using the composite tooth models and T2 intraoral scanned images were compared with the T2 CBCT scan images, which showed the true positions of the roots. Evaluations were performed using three-dimensional (3D) surface discrepancy and root apex position discrepancy.
RESULTS: The 3D surface discrepancy showed a relatively small value of shell/shell deviation between estimated root position using the composite tooth model and true root position using the T2 CBCT scan (0.28~0.38 mm). The 3D Euclidean distance between the estimated and true root apex also presented small values (1.15~1.98°). There were no significant differences between each tooth.

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CONCLUSIONS: This *in vivo* study shows that the methodology to visualize the 3D position including the roots of teeth using composite tooth models is accurate and reliable with no additional radiation exposure.

265 REPORTING EXPERT PANELS METHODOLOGY IN ORTHODONTIC RESEARCH: A PROPOSED CHECKLIST FOR IMPROVEMENT

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AIM: To investigate the expert panel methodology applied in orthodontics and to provide initial guidance on the use and reporting of panel assessment as a reference standard.
MATERIALS AND METHOD: PubMed was searched for orthodontic studies in which the final diagnosis/assessment was made by two or more experts published up to the 16th March 2015. Reference lists of the included studies were also screened. Using predefined forms, two calibrated reviewers undertook independent data extraction with conflict resolution by discussion. Reporting quality assessment based on an established modified checklist was also conducted.
RESULTS: Two hundred and thirty studies were identified with a mean score of 55.4 per cent (SD = 9.1). Critical information about panel methodology was missing in all studies. Only 17 (7.2%) studies reported sample size calculations to justify the panel size. The years of experience were reported in 47 (19.8%) studies. In eight (3.4%) studies no information about expertise was given. Calibration/familiarization procedures were reported in 47 (19.8%) studies. Panel members were identified as partly blinded in 65 (27.4%) studies. Only in 12 (5.1%) studies was information provided on how disagreements were handled across the panel members. Most studies failed to report which statistic was used to compute intrarater (65.8%) and interrater (66.2%) agreement.
CONCLUSIONS: Methods of panel diagnosis varied substantially across studies and many aspects of the procedure were either unclear or not reported. Areas for improvement were identified and a checklist for initial guidance for researchers conducting and reporting studies involving panel diagnosis was developed.

266 RECONSTRUCTION OF THE ALVEOLAR RIDGE BY TOOTH TRANSPLANTATION

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AIM: To show the potential of the periodontal ligament (PDL) for development of the alveolar process after tooth transplantation.
MATERIALS AND METHOD: From a database of over 600 transplanted teeth a retrospective selection was made of donor teeth placed into a recipient site where the original tooth was not present. Therefore the buccal bone plate was absent and the vertical dimensions of the remaining alveolar ridge were compromised.
RESULTS: Transplanting teeth into bone deficient areas, with either developing or fully developed roots, can create a bony alveolar ridge of the dimensions necessary to hold the transplanted tooth; this under the condition that repositioning the transplanted teeth starts six weeks after the transplantation. The PDL of the transplanted tooth reconstructed the lost bony support due to the physiological forces of remodelling.
CONCLUSIONS: Tooth transplantation combined with orthodontic tooth movement is a modality to reconstruct the alveolar process, better than any other technique.

267 A COMPREHENSIVE ORTHODONTIC DIAGNOSIS IN CHILDREN WITH 22Q11.2 DELETION SYNDROME

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AIM: 22q11.2 deletion syndrome (DS) is one of the most frequent microdeletion syndromes and presents with a highly variable and extensive phenotype. Facial features associated with this syndrome can however be very subtle and are not often objectively described. In order to construct a comprehensive orthodontic diagnosis, the craniofacial and dental characteristics of children with 22q11.2 DS were investigated.
MATERIALS AND METHOD: Clinical photographs, a panoramic and a cephalometric radiograph, dental casts and a three-dimensional (3D) facial surface scan of 20 children of west-European descent with a confirmed diagnosis of 22q11.2 DS were prospectively collected. 3D scans were compared to scans of a matched control group and analyzed using a spatially-dense analysis approach. Cephalometric radiographs were digitally traced and measurements were compared with normal values. Occlusal and dental features were studied on dental casts and panoramic radiographs.
RESULTS: 3D facial analysis showed a significant retrusion of the lower part of the face in children with 22q11.2 DS. Tracing of the cephalometric radiographs revealed that the skeletal relationship between the upper and lower jaw was a mild distal relationship and the cranial base angle was slightly enlarged. Measurements for molar occlusion, overjet and overbite did not differ significantly from normal values. Four patients presented with dental agenesis and one had a double tooth transposition.
CONCLUSIONS: The most important craniofacial and dental features found for this study group are a significant retrusion of the lower part of the face and an augmented prevalence of tooth agenesis.

268 THREE-DIMENSIONAL VOLUMETRIC ANALYSIS OF PHARYNGEAL AIRWAY VOLUME IN SKELETAL I, II AND III PATIENTS

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AIM: The evidence in the literature is inconclusive in relating airway volume to facial morphology. In addition, much of the available literature has been established with the use of two-dimensional (2D) lateral cephalometry. The aim of this study was to investigate pharyngeal airway volume among patients with different anteroposterior skeletal patterns, using three-dimensional (3D) cone beam computed tomography (CBCT).
MATERIALS AND METHOD: Pre-treatment CBCT records of 110 adult patients who sought treatment were included. The subjects were categorised into three groups based on their anteroposterior maxillomandibular skeletal relationship: Skeletal I subjects with an ANB angle of 1-4 degrees; Skeletal II subjects with an ANB angle >4 degrees; Skeletal III subjects with an ANB < 1 degree. The pharyngeal airway was divided into three areas of interest (nasopharynx, oropharynx and hypopharynx) demarcated by anatomical landmarks. The CBCT scans were analysed with the SimPlant® O&O 3D planning software (Materialise Dental). Data were analysed using the Kruskal-Wallis test with Bonferroni method. Correlations between variables were tested using Pearson's correlation coefficient. Significance level was set at $P < 0.05$.
RESULTS: In the region of the nasopharynx, there was no significant difference between airway volume and skeletal Class. However, significant differences were found among the three skeletal groups at the regions of the oropharynx and hypopharynx. Skeletal III subjects were found to have the largest airway volume in both the oropharynx and the hypopharynx. In addition, the lengths of the mandible and mandibular ramus were found to be moderately associated with volume of the oropharyngeal airway. Overall, Skeletal II subjects were found to have a significantly smaller total airway volume.
CONCLUSIONS: Airway volume can be affected by anteroposterior skeletal patterns. Analysis and assessment of maxillomandibular relationships and airway volume are important components in orthodontic diagnosis and treatment planning.

269 RELIABILITY OF AN INTRAORAL SCANNER: A COMPARISON BETWEEN *IN VIVO* AND *EX VIVO* SCANS

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AIM: To assess the reliability of *in vivo* versus *ex vivo* scans using an intraoral scanner.
SUBJECTS AND METHOD: Twenty adults with no missing teeth except for third molars. Alginate impressions were taken, and plaster models were made from the impressions. Each subject underwent full-arch intraoral scanning twice with a TRIOS scanner at an interval of 2 weeks. Plaster models were scanned at the same interval with the same scanner. The first images of each scan were superimposed on the second scanned images using surface-based registration. In each case the differences between the two scanned images were evaluated by means of colour-mapping. Average surface deviations were calculated to compare the reliability between the *in vivo* and *ex vivo* scans.
RESULTS: Discrepancies between the first and second images occurred more in the posterior than in the anterior regions for both the *in vivo* and *ex vivo* scans. Average surface deviations between the first and second images were greater for the *in vivo* scans (0.04 mm) than for the *ex vivo* scans (0.02 mm).

270 CONDYLAR DISPLACEMENT IN SAGITTAL SPLIT RAMUS OSTEOTOMY PATIENTS WITH FACIAL ASYMMETRY: COMPARISON BETWEEN CONVENTIONAL AND THE SURGERY-FIRST APPROACH

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AIM: To compare condylar displacement following sagittal split ramus osteotomy (SSRO) using the conventional or surgery-first approach and to determine whether condylar displacement is affected by asymmetric setback in SSRO patients.
SUBJECTS AND METHOD: This was a retrospective cohort study. The subjects consisted of skeletal Class III patients with facial asymmetry who underwent bilateral SSRO and had cone-beam computed tomographs (CBCT) taken before and 1 month after surgery. They were allocated into conventional (n = 18) and surgery-first (SF; n = 20) groups. Descriptive, independent *t*-test and Pearson correlation analysis were computed.
RESULTS: The condylar displacement in three-directions demonstrated a similar trend in both the conventional and SF groups. Condylar displacement occurred in the posterior and downward directions in both groups, although regarding *x*-directional displacement, only the SF group showed lateral directional displacement; condylar displacement in three-directions showed no statistically significant differences between the two groups. In the correlation analysis, right/left setback difference showed no significant correlation with condylar displacement in three-directions in either the conventional or SF groups. The amount of condylar displacement in the *x-, y-* and *z*-directions and Euclidean distance also showed no statistically significant differences between the groups.
CONCLUSIONS: Condylar displacement in three-directions and the distance of condylar displacement in SSRO patients with facial asymmetry showed no significant difference between the conventional and SF groups whether receiving pre-surgical orthodontic treatment or not.

271 PREDICTION OF COMBINED MESIODISTAL CROWN WIDTHS OF UNERUPTED PERMANENT CANINE AND PREMOLARS IN A SINGAPORE CHINESE POPULATION

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AIM: (1) To identify differences in the crown widths of the permanent teeth between males and females, and if differences exists, (2) to develop new prediction models based on actual dental crown widths and (3) to evaluate the clinical accuracy of the models for each gender.
MATERIALS AND METHOD: Dental casts from 200 Singapore Chinese orthodontic patients (100 male, 100 female) with significant tooth crowding were selected. The mesiodistal crown width of each tooth was measured using a sliding digital calliper. Predicted combined mesiodistal crown widths of the permanent canine and premolars were calculated using stepwise regression analysis

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for each arch of each gender. Forty additional sets of dental casts (20 males, 20 females) were used to validate the application of the regression equations.
RESULTS: Sexual dimorphism exists and multiple linear regression equations were determined specifically for each arch of each gender. For male subjects, the best combination of independent variables were the upper permanent lateral incisor (U2) and first molar (U6) for the maxilla (R2 = 0.49) and lower permanent lateral incisor (L2) and first molar (L6) for the mandible (R2 = 0.59). For female subjects, the best combination of independent variables were the upper permanent central and lateral incisors (U1, U2) and first molars (U6) for the maxilla (R2 = 0.54) and lower permanent central and lateral incisors (L1, L2) and first molar (L6) for the mandible (R2 = 0.55).
CONCLUSIONS: The multiple linear regression equations developed for each gender have similar high prediction accuracy. The models are clinically useful in assessing space requirements during the mixed dentition stage.

272 LOWER INCISOR INCLINATION AFTER TWIN BLOCK TREATMENT: A CLINICAL COMPARISON OF TWO ALTERNATIVE DESIGNS

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AIM: To investigate the effect of acrylic capping, treatment duration, overjet and lower incisor inclination on the post-treatment tooth position in patients treated with a Twin Block (TB) appliance.
MATERIALS AND METHOD: Cephalograms of 56 Class II malocclusion patients [21 males, 35 females; mean age before treatment (T1), 12.5 years; standard deviation, 0.7 years)] treated with a TB with acrylic capping on the lower incisors and of a conventional design were retrospectively collected and traced. Lower incisor inclination (L1-GoGn, L1-GoMe, L1-MP) was measured at T1 and after TB removal (T2). Regression analysis was performed to evaluate the effect on lower incisor inclination of appliance type, overjet, lower incisor inclination at T1 and treatment duration, after adjusting for baseline measurements.
RESULTS: Appliance design was not a significant predictor for either incisor inclination measurement ($P < 0.05$). T1 lower incisor inclination was the only factor significantly associated with final tooth inclination (L1-GoGn: $\beta = 0.57$; 95% CI: 0.30, 0.84; $P < 0.001$, L1-GoMe: $\beta = 0.56$; 95% CI: 0.28, 0.84; $P < 0.001$, L1-MP: 95% CI: $\beta = 0.46$; 0.17, 0.75; $P = 0.003$). There was weak evidence that treatment duration excluding L1-MP (95% CI: –1.85, –0.02; $P = 0.045$) and overjet might be associated with T2 inclination of the lower incisors.
CONCLUSIONS: A TB appliance design with acrylic capping on the lower incisors appears not to significantly control incisor proclination. Pre-treatment lower incisor inclination may be significantly associated with tooth inclination after active TB treatment and should be considered in treatment planning.

273 AN AUDIT OF ORTHOGNATHIC SURGERY WAITING TIME IN A UNITED KINGDOM NATIONAL HEALTH SERVICE HOSPITAL

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AIM: Orthognathic surgery patients can have a significant delay between their last orthodontic appointment and surgery due to theatre waiting lists. The aim of this audit was assess the pre-surgery orthodontic waiting time from the last multidisciplinary team (MDT) appointment to the date of surgery and secondarily to identify areas of delay. The objective was to compare local waiting times to published literature.
MATERIALS AND METHOD: A retrospective audit was carried out between January 2015 and February 2016 in a National Health Service district general hospital in the United Kingdom. All patients seen on the MDT clinic were included if they were deemed ready for surgery and subsequently placed on a theatre waiting list. The number of weeks between the MDT clinic and the first available surgery date was recorded. If a second surgery date was offered the reason was noted.

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The number of clinics and available surgeons was also recorded. Published clinical audits suggest that approximate theatre waiting time is 3 months. The gold standard was therefore that 90 per cent of patients should receive their surgery within 12 weeks of the last MDT clinic when they were placed on a theatre waiting list.
RESULTS: Data were collected from 25 patients seen on 16 MDT clinics. The gold standard was not met as no patient received surgery within 12 weeks of the last MDT clinic appointment. The average waiting time was 33 weeks and 4 days (range 21 weeks 4 days to 44 weeks). Patient rescheduling and hospital cancellation were the main causes of delay. There was one available surgeon.
CONCLUSIONS: Waiting time for orthognathic surgery exceeded the gold standard. The main reasons for delay included patient or hospital rescheduling but additionally the small number of clinics and available surgeons may have been significant. In order to be able to implement change, more data is needed. This audit is currently being repeated as a multicentre audit with five participating units. The aim is to use the collective data to plan a business case for further resources.

274 AUDIT TO ASSESS ORTHODONTIC REFERRAL PATTERNS AT STOKE MANDEVILLE HOSPITAL, UNITED KINGDOM

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AIM: To assess appropriateness and sources of orthodontic new patient referrals and outcome of consultation.
MATERIALS AND METHOD: A retrospective audit was carried out in the Department of Orthodontics at Stoke Mandeville Hospital. The gold standard was taken from the British Orthodontic Society guidelines: http://bos.org.uk/Information-for-Dentists/Making-an-Orthodontic-Referral/When-Should-I-Refer-for-an-Orthodontic-Assessment. The target was 90 per cent compliance with guidelines. New patients attending consultant clinics from 01/01/2015 to 31/05/2015 were identified from the electronic appointment booking system. Referrals were assessed for patient age and medical history, referrer type and reason for referral. Case notes were assessed for the outcome of the consultation.
RESULTS: One hundred and sixteen patients were identified. Thirteen were excluded as they were re-referrals. Data were collected for 103 patients. Fifty per cent were from general dental practitioners (GDPs), 33 per cent from orthodontic specialists and 17 per cent from other clinicians. Ninety three per cent met the target for compliance with the guidelines. Impacted canines were the most common reason for referral. Nineteen per cent of patients were placed on the treatment waiting list, 19 per cent were recalled for review, 17 per cent were referred back to their GDP for interceptive treatment and only 5 per cent were discharged due to inappropriate referral reason or unnecessary referral.
CONCLUSIONS: Hospital services seem mainly to be accessed for more complicated cases often involving multidisciplinary treatment. Compliance with data inclusion in referrals could be much improved, in particular regarding medical history. The outcomes of new patient assessments highlight the specialisation of the hospital department and that these services are being utilised appropriately with only 10 per cent of patients being discharged overall. These data have been distributed to all referring practitioners and a proposal has been made for a standard referral proforma to help streamline the service.

275 THE INFLUENCE OF NON-STEROIDAL ANTI-INFLAMMATORY DRUGS ON ORTHODONTIC TOOTH MOVEMENT– REVIEW OF THE LITERATURE

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AIM: To review articles from the last decade (2006-2016) to update knowledge about the influence of commonly used drugs (analgesics) on orthodontic tooth movement.

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MATERIALS AND METHOD: A review of the literature published in years 2006-2016 was carried out using the PubMed database. The initial number of results corresponding to the English query 'Non-steroidal anti-inflammatory drugs [MeSH]' was 45. The selection based on the titles, abstracts, and eventually whole articles, ultimately resulted in 17 papers covering the influence of non-steroidal anti-inflammatory drugs (NSAIDs) on tooth movement during orthodontic treatment.
RESULTS: Forty-five articles from the period of 10 years were identified. Only 17 were finally eligible for inclusion in this systematic review and carefully analysed. Aspirin, acetaminophen, ibuprofen, diclofenac, vadecoxib and celecoxib were the most commonly prescribed analgesics. NSAIDs such as aspirin and ibuprofen reduced orthodontic tooth movement, due to the decrease in the number of osteoclasts, possibly by inhibiting the secretion of prostaglandins, which plays a major role in bone resorption and results in the decrease of tooth movement pace. Acetaminophen did not affect orthodontic tooth movement, and it might be the medicament of choice for treating pain associated with orthodontic treatment. Five tests were performed on rats.
CONCLUSIONS: NSAIDs may have an important influence on the rate of tooth movement. NSAIDs effectively reduce the pain and discomfort connected with the therapy, but they also affect tooth movement by reducing or inhibiting the inflammatory or bone resorption process. Orthodontists should not only be aware of that but also update their knowledge about the mechanism of action of NSAIDS, as well as their dosage.

276 EFFICACY OF LASER IN PAIN CONTROL AND TOOTH MOVEMENT DURING ORTHODONTIC TREATMENT. A LITERATURE REVIEW

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AIM: One of these hypotheses says that low energy laser radiation interferes with the inflammation modulation, therefore the levels of cytokines and COX-2ARNm decrease. Other statements predict that low level laser (LLL) therapy reduces pain by alternating the conduction of action potentials in the peripheral nerves. Finally, there is a theory that implies that the low-power laser radiation can modulate the production of endogenous endorphins leading to a pain reduction. The aim of this research was to assess the existing evidence on the effectiveness of lasers in pain control and accelerating dental movement
MATERIALS AND METHOD: A digital search for articles published in the last 15 years was performed with the following keywords: 'orthodontics' AND 'tooth movement' AND 'lasers' AND 'pain*'. Databases searched were: Google Scholar, Cochrane and PubMed-Medline.
RESULTS: Most articles show that LLL therapy could accelerate orthodontic tooth movement, contradicting a single clinical trial in animals that stated the contrary. On the other hand, there was no evidence that LLL therapy damages roots, alveolar bone or periodontal tissues. All meta-analyses suggested that LLL was effective in orthodontic pain control. There are different hypotheses that state different mechanisms by which low energy laser radiation reduces pain.
CONCLUSIONS: LLL was effective in reducing the incidence of pain, bringing forward the most painful and end-of-pain days during orthodontic treatment. LLL increased tooth movement in orthodontic treatment. It seemed that this accelerating effect was more effective with a relatively lower energy density than a higher one.

277 PERCEPTION BY ORTHODONTISTS, GENERAL DENTISTS AND LAYPERSONS OF SMILE AESTHETICS WITH MANDIBULAR INCISOR EXPOSURE

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AIM: To analyze the perception of smile aesthetics with exposed mandibular incisors among orthodontists, general dentists, and laypersons.
MATERIALS AND METHOD: Intraoral and frontal extraoral photographs were taken of the smile of a female subject, without mandibular incisor exposure using a digital camera (Canon EOS 450D,

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Madrid, Spain). Both photographs were manipulated digitally with Adobe Photoshop CS3 (Adobe, Systems Inc. San José, California, USA) to create three images: A) without mandibular incisor exposure; B) with 2 mm mandibular exposure; C) with 4 mm mandibular exposure. The three images were shown to three groups of evaluators (n = 40): orthodontists with over 10 years' experience, general dentists with over 10 years' experience, laypersons aged between 40 and 50 years. Each image was given a score of 1-10, one being the least aesthetically favourable and 10 the most attractive. Data were analyzed using the Kruskal-Wallis test ($P < 0.05$) and Mann Whitney test for two independent samples with Bonferroni correction ($P < 0.016$).
RESULTS: Orthodontists awarded similar aesthetic evaluations ($P = 0.61$) to the three images. General dentists evaluated image A as significantly less aesthetic than image B ($P = 0.008$) but their evaluations of images B and C did not differ significantly ($P = 0.139$). The general population evaluated the aesthetics of the three images similarly ($P = 0.64$)
CONCLUSIONS: For both orthodontists and the general population, exposure of mandibular incisors did not influence the perception of smile aesthetics, but general dentists evaluated a smile with mandibular exposure as more aesthetic.

278 PREDICTION OF THE MESIODISTAL CROWN WIDTHS OF UNERUPTED CANINES AND PREMOLARS IN THE SINGAPORE MALAY POPULATION
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AIM: 1) To develop models to predict the mesiodistal (MD) crown widths of the unerupted canines and premolars in the mixed-dentitions in the Singapore Malay population. 2) To evaluate the prediction accuracy of the proposed models.
MATERIALS AND METHOD: Dental cast records were obtained from 150 Singapore Malay orthodontic patients (70 males, mean 22.9 years; 80 females, mean 21.4 years). MD crown widths, molar basal arch lengths and intermolar distances were measured in the permanent maxillary and mandibular dentitions on the dental casts with a digital calliper. Regression equations for estimating the sum of the crown widths of the unerupted canines and premolars were determined using a stepwise multiple regression analysis and tested for validity. Predicted values within 1.5 mm of the actual crown widths in the dental arch were deemed clinically acceptable and employed as a threshold criterion for determining prediction accuracy of the models.
RESULTS: For the male subjects, the maxillary equation of $\hat{Y} = 8.445 + 0.716 \times U2 + 0.870 \times U6$ had a R^2 of 0.49 and the mandibular equation of $\hat{Y} = 4.161 + 1.173 \times L2 + 0.996 \times L6$ had a R^2 of 0.63. For the female subjects, the maxillary equation of $\hat{Y} = 8.826 + 0.540 \times U2 + 0.607 \times U6 + 0.073 \times$ UIMD had R^2 of 0.42 and the mandibular equation of $\hat{Y} = 9.815 + 1.005 \times L1 + 1.081 \times L2$ had a R^2 of 0.44. $\hat{Y}$ represents the estimated sum of the MD crown widths of the unerupted canines and premolars. The prediction models had accuracies of 90-100 per cent.
CONCLUSIONS: The proposed models were found to be effective for clinical use for Singapore Malay orthodontic patients in the mixed-dentition.

279 ORAL FUNCTIONS AND ORTHODONTIC TREATMENT NEED: AN EPIDEMIOLOGICAL STUDY IN FRANCE
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AIM: To hierarchize the risk factors for orthodontic treatment with particular attention paid to dysfunctions among 11-year-old children in elementary schools in an average city located in the Alpes Maritimes (French Riviera).
SUBJECTS AND METHOD: This comprehensive epidemiological cross-sectional study involved 358 six-grade schoolchildren in Cagnes-sur-mer. The clinical examinations, conducted with disposable probes and mirrors, included: caries screening (decayed, missing, and filled teeth score), a quantification of dental plaque (plaque index of Silness and Loe) and orthodontic treatment need

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(according to the classification provided by the Haute Autorité de Santé HAS). The functional examination included incorrect mouth breathing (Rosenthal test), abnormal deglutition and incorrect position of the tongue at rest assessed by visual examination. Statistical univariate analyses were achieved using chi-square or Fisher's exact tests for qualitative variables and Student's *t*-test for quantitative variables. The significant cut-off was set at 0.05. Then, a multivariate analysis was conducted, with all significant variables ($P < 0.25$) in the univariate analyses.
RESULTS: Most children (88%) needed orthodontic treatment regardless of gender ($P = 0.912$). The examination of oral functions identified a number of deglutition (87%), and ventilation (50%) disorders. The position of tongue at rest was too low in most cases (85%). At a functional level, orthodontic treatment need was statistically linked to the low position of the tongue ($P < 0.001$), abnormal deglutition ($P = 0.03$), and improper mouth breathing ($P = 0.001$). The multivariate analysis revealed that ventilation [OR = 3.2 (1.4-7.3)] and low position of tongue at rest [OR = 3.43 (1.7-7.1)] were the two major factors in the prediction of emerging dysmorphia.
CONCLUSIONS: Primary deglutition and improper mouth breathing multiply by three the risk of developing malocclusions. The challenge is to intercept these dysfunctions at an early stage and rehabilitate them as soon as possible. Paediatricians, general practitioners and parents should be better informed.

280 PROGRESSION OF VOLUMETRIC AND SURFACE TOOTH WEAR IN PATIENTS HAVING UNDERGONE ORTHODONTIC TREATMENT: A SYSTEMATIC REVIEW AND META-ANALYSIS

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AIM: Tooth surface loss additional to the physiologic alterations of the dentition, may occur during orthodontic treatment due to interferences and functional changes, abrasion by orthodontic appliances and other factors. The aim of this study was to investigate systematically the relevant literature on the progression of volumetric and surface tooth wear in patients having undergone comprehensive orthodontic treatment.
MATERIALS AND METHOD: Search without restrictions for published and unpublished literature and hand searching took place. Data on volumetric and surface tooth wear in patients having undergone comprehensive orthodontic treatment were reviewed. The random effects method was used to synthesize results where appropriate and the Grades of Recommendation, Assessment, Development and Evaluation approach to assess the quality of evidence (confidence in the observed estimates).
RESULTS: From the initially identified publications, three studies investigating 308 patients were finally considered. Two assessed tooth surface loss by means of three dimensional volumetric measurements and one used grading scales. All three studies reported tooth surface loss. The mean volume reduction was 1.02 mm^3 for the incisors [95% confidence interval (CI): 0.84-1.20; 1 study, n = 30 participants and 194 teeth], 1.62 mm^3 for the canines [95% CI: 0.87-2.38; 2 studies, n = 86 participants and 342 teeth; I2 = 96%] and 0.95 mm^3 for premolars and molars [95% CI: 0.84-1.07; 1 study, n = 30 participants and 316 teeth]. The overall quality of evidence limited confidence in the observed estimates.
CONCLUSIONS: Varying degrees of tooth surface loss occurred after comprehensive orthodontic treatment. Further studies are needed to elucidate how much of the reduction is directly associated with orthodontic treatment and how much is due to physiologic alterations of the dentition.

281 MYOFIBROBLAST EXPRESSION DURING ORTHODONTIC TOOTH MOVEMENT

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AIM: To evaluate myofibroblast expression, both on tension and pressure sides, during orthodontic tooth movement.

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MATERIALS AND METHOD: Seventy male albino Wistar rats divided into a control group of 10 rats, and other groups of 15 animals each. Except the for the control group, all the other animals were submitted to an orthodontic force according to the method of Waldo and Rothblatt for 24, 48, 72 and 96 hours. Myofibroblast detection was done by immunohistochemistry analysis with α-smooth muscle actin antibody.
RESULTS: Immunohistochemistry analysis showed that α-smooth muscle actin was consistently expressed in smooth muscle cells of some blood vessels present in sections of all experimental groups. At 72 and 96 hours there were a few cells, presumably with a myofibroblast phenotype, positively expressing the protein, particularly along the root surface on both sides of orthodontic movement.
CONCLUSIONS: The observations at 72 and 96 hours of a small population of α-smooth muscle actin positive stained cells, adjacent to the root surface, indicates that during orthodontic tooth movement that repair in the periodontal ligament is not through differentiation of cells with a myofibroblast phenotype.

282 CAN WE GET ALL THE ANSWERS WITH ONLY ONE QUESTION?
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AIM: To determine adolescents' self-perception of dental aesthetics [Index of Orthodontic Treatment Need - Aesthetic Component (IOTN AC)], establishment of their frequency of dental visits, motivating factors, prior orthodontic experience, the need for orthodontic treatment and their impact on the self-perception of dental aesthetics.
MATERIALS AND METHOD: The research was conducted through a questionnaire among 295 randomly selected students of both genders aged 16-20 years from the Public High School 'Vasil Antevski Dren', Skopje. Self-rated (AC) IOTN was used to determine the adolescents' perception of malocclusion. For testing the significance of differences between certain variables, depending on the distribution of data, tests were used for independent samples (Chi-square test with Yates correction and without, *t*-test for independent samples, Mann-Whitney *U* test, Kruskal-Wallis test, analysis of variance, linear regression analysis).
RESULTS: More than half (56.95%) of the adolescents visited the dentist only when they had a problem, 60 per cent of them had no prior orthodontic experience and 45 per cent thought they might have need for treatment with aesthetics as the main motivating factor. The majority of respondents (84.75%) were grade I of the IOTN AC, or as having a minor degree of malocclusion. The frequency of dental visits, prior orthodontic experience, the need for treatment and motivating factors showed no statistically significant impact on the adolescents' perception of their dental appearance – IOTN AC.
CONCLUSIONS: The dental culture and oral health care among Macedonian adolescents is low. Most respondents visit the dentist irregularly, have no prior orthodontic experience, may have a need for treatment with aesthetics being the most important motivating factor for orthodontic treatment. We cannot rely only on the IOTN AC when trying to predict the psychosocial impact of dental aesthetics - malocclusion in adolescents.

283 COMPARISON OF CLINICAL OUTCOMES USING APPLIANCES FOR DISTALIZATION OF MOLARS WITH AND WITHOUT SKELETAL ANCHORAGE
Martin Mariyanov, Medical University Sofia, Bulgaria

AIM: To compare clinical outcomes using appliances for distalization of molars with either skeletal anchorage or anchorage on the teeth and/or palate.
MATERIALS AND METHOD: Distalization of molars was undertaken with the Pendulum, First Class, Distal Jet and Frog appliances with anchorage on the teeth and/or palate and the outcomes were compared. For this purpose, the results of 11 clinical studies were analyzed. The devices were

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divided into two groups: group 1, appliances with anchorage on teeth and/or palate; group 2, appliances with skeletal anchorage.
RESULTS: All authors established distalization of the molars with values ranging from 2.7 to 6.4 mm. The second molars were also distalized, where the values were identical. Significant differences were reported when examining the change in position of the second and first premolars. With the appliance anchorage on the teeth and/or palate they were mesialized, and with appliances with skeletal anchorage, the premolars were distalized simultaneously with distalization of the molars. In group 1 proclination of the incisors was observed and in group 2, retroclination.
CONCLUSIONS: The greatest challenge for orthodontist in distalizaton of molars with anchorage on teeth and/or palate is blocking the position of the molars while distalizing the premolars and retruding the anterior teeth. With skeletal anchorage spontaneous distalization of premolars and retroclination of the anterior teeth was observed.

284 EVALUATION OF THE CHANGES IN VERTICAL SKELETAL RELATIONSHIPS WITH THE USE OF THE SKELETAL FROG APPLIANCE

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AIM: To establish changes in the vertical skeletal relationship with the use of the skeletal Frog appliance.
SUBJECTS AND METHOD: Thirty one patients with a Class II molar relationship. It was decided to use the skeletal Frog appliance with two different modifications of the distalizing spring. In 15 subjects (48.4%) a distalizing spring with a U-loop open distally and a closed helix was used, and in 16 (51.6%) a distalizing spring with a U-loop open medially. The angles between the mandibular and palatal planes; between the mandibular plane and SN and the Index of Nahoum on lateral cephalograms before treatment and at the end of distalization were measured. The change in the position of the teeth in a vertical direction to the palatal plane was measured.
RESULTS: There was no statistically significant change in the angles and indices, which recorded changes in vertical skeletal relationships. There was a statistically significant reduction in the angle between the mandibular plane and the frontal line of the skull base (0.53°) with the use of the appliance with a U-loop open distally. The first and second molars were intruded 0.68 and 1.20 mm, respectively, and the canine extruded 1.54 mm.
CONCLUSIONS: Distalization of molars is often associated with an increase in the angles characterizing vertical skeletal relationships. That there was no change in the vertical direction is a major advantage of the skeletal Frog appliance, which favours its use in patients with a hyperdivergent face type.

285 EFFECTIVENESS OF ANTERIOR OPEN BITE TREATMENT FOR PATIENTS IN THE MIXED DENTITION WITH NON-NUTRITIVE HABITS: A LITERATURE REVIEW

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AIM: To review the existing literature on the effectiveness of several methods for anterior open bite (AOB) treatment and its possible combination for a better result.
MATERIALS AND METHOD: A literature search was carried out on PubMed, Medline, Web of Knowledge, Web of Science, Scopus, Google Scholar, Scielo, Sapiens and Elsevier, with the words: ‘open bite’, ‘open bite treatment’, ‘open bite spurs’, ‘open bite crib’, ‘open bite spurs crib’. Inclusion criteria were studies with samples of patients from 6 to 11 years old, in the mixed dentition, with an AOB equal to or greater than 1 mm related to a tongue thrusting habit, and who had not previously received orthodontic treatment. Exclusion criteria were studies involving individuals outside the age range, patients with severe crowding and temporomandibular dysfunction.
RESULTS: After one year of treatment with crib or spurs, all groups showed improvement in the overbite. The use of spurs combined with a high-pull chincup, corrected the AOB in 86.7 per cent of the patients, with a 5.23 mm overbite increase. There was a significant decrease of the gonial angle, palatal tipping of the maxillary incisors, and vertical dentoalveolar development of the maxillary and

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mandibular incisors. Both fixed and removable cribs induced favourable dental effects. However, the fixed one, produced more favourable vertical skeletal changes and greater extrusion of the maxillary incisors, and was 100 per cent effective in the early treatment of an AOB. The use of bonded spurs achieved favourable results in only 53.8 per cent of patients.
CONCLUSIONS: Fixed and removable cribs are simple and effective for AOB treatment, with fixed cribs being more advantageous. The use of bonded spurs showed palatal tipping of the maxillary incisors and increased dentoalveolar development of the maxillary and mandibular incisors. A simultaneous high-pull chincup used with spurs or cribs during therapy produced a significant decrease of the gonial angle.

286 SHORT- AND LONG-TERM EVALUATION OF MANDIBULAR DENTAL ARCH DIMENSIONAL CHANGES IN PATIENTS TREATED WITH A LIP BUMPER FOLLOWED BY FIXED APPLIANCES

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AIM: To evaluate short- and long-term mandibular dental arch changes in patients treated with a lip bumper during the mixed dentition followed by fixed appliances, compared with a matched control sample.
MATERIALS AND METHOD: Dental casts and lateral cephalograms obtained from 31 consecutively treated patients before (T0) and after (T1) lip bumper treatment, after fixed appliances (T2), and a minimum of 3 years after fixed appliances (T3) were analyzed. The control group was matched as closely as possible. Arch width, arch perimeter, arch length, and incisor proclination were evaluated. Repeated measures ANOVA was used to analyze changes in measurements over all four time points between the treatment and control groups.
RESULTS: Arch width and crowding were always significantly different except at T2-T1. At T1-T0, only crowding decreased 3.2 mm while intercanine, interpremolar, and intermolar widths increased by 3.8, 3.3, and 3.9 mm, respectively. Changes at T3-T2 showed a significant decrease of 2.1 mm for crowding and an increase of 3.5, 2.9, 2.7, and 0.8 mm for intercanine, interpremolar, and intermolar widths and arch perimeter, respectively. Finally, at T3-T0, the reduction in crowding of 5.03 mm was significant and clinically important in the treated group. The differences between intercanine, interpremolar, and intermolar widths were also significant (2.1, 3.8, and 3.6 mm, respectively). All differences favoured the treated group.
CONCLUSIONS: Mandibular dental arch dimensions were significantly changed after lip bumper treatment. At follow-up, all arch widths were slightly decreased, generating an increase of 0.4 mm in crowding, considered clinically irrelevant. Overall changes remained stable after an average follow-up of 6.3 years.

287 DENTAL ARCH DIMENSIONS ON THREE-DIMENSIONAL DIGITAL AND PLASTER STUDY MODELS IN INDIVIDUALS WITH A UNILATERAL CLEFT LIP AND PALATE

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AIM: To evaluate and compare three-dimensional (3D) digital models and conventional plaster models for the evaluation of dental arch dimensions for patients with a unilateral cleft lip and palate (UCLP).
MATERIALS AND METHOD: Digital 3D and plaster study models were obtained from UCLP and control groups. A total of 15 patients with a UCLP and 15 patients having a dentoskeletal Angle Class I occlusion with minimum crowding randomly selected from the department archives. Sagittal, transversal and vertical dimensional measurements were carried out on the 3D digital and plaster study models using software and a digital calliper, respectively. Statistical analysis involved descriptive statistics, paired *t*-test and Student's *t*-tests. Intra-observer reliability was also tested.

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RESULTS: Arch length dimensions were different between the 3D and conventional measurement methods in both groups ($P < 0.05$, $P < 0.01$). Intercanine and intermolar widths were similar between the 3D and conventional measurement methods in the UCLP group, while they were different in the control group ($P < 0.01$). Arch length and intercanine width dimensions were smaller in the UCLP group, with both methods ($P < 0.01$). Intermolar width was statistically smaller in the UCLP group only with the conventional measurement method ($P < 0.05$). Upper palatal height was similar in the UCLP and control groups (17.94 versus 17.59 mm, respectively).
CONCLUSIONS: Although 3D digital modelling can be regarded as an alternative to conventional plaster study models in patients with a UCLP, accuracy should be checked precisely.

288 IS OBESITY A RISK FACTOR FOR PERSISTENT POST-SURGICAL INFECTION IN ORTHOGNATHIC SURGERY?

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AIM: Obesity is an increasing public health problem and is a major risk factor for morbidity and mortality during orthognathic surgery. It can be measured using the Body Mass Index (BMI), skin fold thickness, waist circumference, waist to hip ratio and bio-impedance. BMI is the most widely used approach. The World Health Organisation classification system for adults categorises a BMI of 18.5-24.9 as being a healthy weight, with less than 18.5 as underweight and higher BMI scores of 30-34.9 as Obesity I, 35-39.9 as Obesity II and above 40.0 as Obesity III. The aim of this project was to identify if obesity is a risk factor for persistent infection following orthognathic surgery.
SUBJECTS AND METHOD: A cohort of 30 patients undergoing orthognathic surgery had their BMI calculated prior to surgery and two years post-surgery. Persistent post-operative infection requiring the fixation plates to be removed was assessed from operating theatre data. Data were analyzed using a spreadsheet (Excel, Microsoft, Redmond, California, USA) and the Fisher exact test ($P < 0.05$) to determine if higher BMI scores were linked to an increased requirement for fixation plates to be removed.
RESULTS: Of the 30 patients, 12 had a Class II malocclusion (2 males: 10 females) and 18 a Class III malocclusion (5 males: 13 females). Eleven patients required single-jaw surgery and 19 bimaxillary surgery. The mean BMI score before surgery was 26.1 which increased to 26.5 at the two year post-surgery review. Eleven patients were underweight, 16 were of healthy weight, six were obesity I but no patients were classified as obesity II or III. A total of seven patients required their fixation plates to be removed due to infection but mean BMI score was not found to be a risk factor for persistent post-surgical infection in orthognathic surgery ($P = 0.139$).
CONCLUSIONS: The mean BMI score for this cohort increased post-surgery but obesity was not found to be a risk factor for persistent post-surgical infection in orthognathic surgery.

289 ROLE OF CATHEPSIN S AND AUTOPHAGY IN ORAL INFLAMMATION AND INFECTION

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AIM: Cathepsin S (CTSS), a multifunctional cystein protease and an important regulator of autophagic processes, is a likely actor in health and disease of oral tissues, which has been neglected so far. This study was conducted to investigate if autophagy, the process of self-consumption, is involved in oral inflammation and infection.
MATERIALS AND METHOD: Human primary periodontal ligament (PDL) fibroblasts were cultured under inflammatory and infectious conditions, simulated by the use of interleukin (IL)-1β and *Fusobacterium nucleatum*. An array-based approach was used to identify regulated targets associated with autophagy. The targets, which were regulated most prominently *in vitro*, were further analyzed via RT-polymerase chain reaction, immunocytochemistry and enzyme-linked immunoassay. Furthermore an *in vivo* animal model was applied as well as human gingival biopsies

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from periodontitis patients and periodontally-healthy controls were analyzed by RT-PCR and immunoblotting. ANOVA and *post hoc* tests were used.
RESULTS: The inflammatory and infectious stimulants caused pronounced changes in gene expression in multiple genes. CTSS, whose expression changes were the largest, was significantly upregulated by both stimulants, underlining its critical role in infectious or inflammatory periodontal conditions. The stimulatory effects on CTSS were mediated by the MEK1/2 and JNK pathways. Furthermore, a significantly elevated expression of CTSS after 6, 8 and 12 days was found in gingival biopsies of rats suffering from experimental periodontitis as well as in human biopsies from periodontitis patients.
CONCLUSIONS: The findings provide the first evidence that CTSS levels are increased in PDL fibroblasts as a response to inflammation and infection, which suggest a critical role of autophagy-associated molecules in inflamed and infected periodontal tissues. As CTSS is an important player in the regulation of autophagy, these results suggest that autophagy might be strongly engaged in the complex machinery of the onset and/or progression of periodontal inflammation and infection.

290 INFLUENCE OF LONG-TERM *IN VIVO* EXPOSURE ON BRACKET SLOT CHARACTERISTICS – A MICROCOMPUTER TOMOGRAPHY ANALYSIS

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AIM: To assess the influence of long-term *in vivo* exposure on bracket slot characteristics using microcomputer tomography (µCT).
MATERIALS AND METHOD: µCT scans of 44 conventional brackets (CB) of the same manufacturer were analysed. The brackets were grouped according to type and exposure [CB1, n = 24 (4 new, 20 exposed) and CB2, n = 20 (4 new, 16 exposed)]. A three-dimensional analysis of the slot was performed by constructing ideal planes along the incisal and gingival walls and base of the slot; a qualitative and quantitative assessment was done. The areas of greater deviation were recorded and the average distances of the actual walls/base from the ideal planes were calculated. The angles between the incisal/gingival slot wall and slot base and the inter-wall angle were measured. Non-parametric tests were used for statistical analysis.
RESULTS: Significantly greater average distances between the slot walls /base and ideal planes were seen among *in vivo* exposed brackets ($P < 0.01$) with the greatest deviations at the edges of the slot. Although no significant difference was seen between the CB1 (30.3 ± 5.9) and CB2 (29.2 ± 6.6) *in vivo* exposure time, the slots of CB1 had significantly greater average distances between the slot walls/base and ideal planes than CB2 (4.7-11.6 µm and 4.0-4.4 µm, respectively). No significant differences were observed for angular measurements.
CONCLUSIONS: *In vivo* exposure of orthodontic material influences the bracket slot characteristics, mainly affecting the outer border as well as the incisal and gingival walls of the slot, which may affect sliding mechanics and torque expression. CB of the same manufacturer exhibit significantly different resistance to *in vivo* exposure.

291 THE EFFECT OF ORTHODONTIC TREATMENT ON THE POSITION AND SPACE AVAILABLE FOR UPPER AND LOWER THIRD MOLARS

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AIM: This retrospective study investigated the effects of headgear therapy and premolar extractions on the retromolar space and the position of third molars in growing patients.
SUBJECTS AND METHOD: To investigate the effects of headgear therapy, a sample of 294 Class II orthodontic non-extraction patients was collected, of which 160 patients had been treated with headgear. To investigate the effect of premolar extractions a sample of 353 patients was collected, of which 246 were treated without extractions and 107 with extraction of the first or second

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premolars. The eruption space for third molars was measured on pre- and post-treatment lateral cephalograms, whereas the angulation, vertical position and the mineralization status of third molars was evaluated using pre- and post-treatment panoramic radiographs.
RESULTS: In both samples, the eruption space for the third molars increased during treatment. In patients treated with premolar extractions this increase was significantly greater compared to those treated without extractions, whereas in patients treated with headgear the increase in eruption space for the upper third molar was significantly less compared to patients treated without headgear. Additionally, significantly fewer third molars of patients treated with premolar extractions were situated under the cementoenamel junction of the second molar after treatment. The change in angulation and the mineralization status did not significantly differ between patients treated with or without premolar extractions, or in patients treated with or without a headgear appliance.
CONCLUSIONS: The retromolar space and the position of third molars significantly changed during orthodontic treatment in growing patients. Orthodontic treatment with headgear has a negative effect on the eruption space for the upper third molars, whereas premolar extractions have a positive effect on the eruption space for the upper and lower third molars. It is therefore important to take into account the position of third molars during treatment planning.

292 TORQUE RECORDINGS OF ORTHODONTIC MINISCREWS AT THREE DIFFERENT TIMEPOINTS: PRELIMINARY RESULTS FROM A RANDOMIZED CLINICAL TRIAL

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AIM: To compare, in a randomized clinical trial, torque recordings of immediately loaded orthodontic miniscrews between insertion time and three different post-placement timepoints (2 weeks, 4 weeks and removal time respectively).
SUBJECTS AND METHOD: The eligibility criteria to enrol patients were need for of fixed orthodontic treatment, no systemic disease, absence of using drugs altering bone metabolism. All the enrolled patients were consecutively treated with the miniscrews placed by the same author. The patients received OrthoImplant (3M Unitek) 1.8 mm diameter miniscrews and they were blindly divided in three torque recording groups. Two locations were separately considered (the maxilla and the mandible). For each patient, maximum insertion torque was evaluated at baseline and the miniscrews were immediately loaded. Screw torque was measured again after 2 and 4 weeks in group 1 and 2, respectively. At the end of treatment, maximal removal torque was evaluated in group 3. Torque variation with respect to insertion time was considered as the primary outcome. Preliminary data were blindly analyzed by a statistician. Continuous variables were given as the median with range, whereas categorical variables as number and/or percentage of subjects. Baseline and longitudinal differences among groups were tested using Kruskal-Wallis rank sum test. Differences, with a *P*-value less than 0.05, were selected as significant and data were acquired and analysed in the R v3.3.1 software environment.
RESULTS: The sample that received the intended treatment and preliminary analysis included 26 patients and 26 miniscrews. The miniscrews used were nine for group 1, nine for group 2, and eight for group 3 and a separate analysis for the mandible and the maxilla was performed. No significant baseline differences were observed among groups ($P > 0.05$). No longitudinal differences were observed among groups ($P > 0.05$).
CONCLUSIONS: No significant differences among groups were detected up to now. Further analysis is required when the minimum sample size is reached.

293 ANALYSIS OF TORQUE EFFICACY IN FIXED VESTIBULAR ORTHODONTIC BRACKET-WIRE SYSTEM

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AIM: To analyse *in vitro* the different torque expression obtained in a vestibular appliance using: (1) archwires of different sizes, (2) archwires of different materials.

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MATERIALS AND METHOD: Eight extracted human teeth were positioned in a straight line and the tooth roots were incorporated in transparent orthodontic resin (methyl methacrylate). The teeth were bonded with vestibular brackets, 0.022 × 0.028 slot, without torque pre-information. The wires tested in the experiment were: Tru Chrome 0.018 × 0.025, 0.017 × 0.025 β-titanium, 0.016 × 0.022 stainless steel, 0.017 × 0.025 stainless steel and 0.019 × 0.025 stainless steel. The ligatures used were standard elastic ligatures. An extension was laser-welded to the missing tooth bracket in order to apply the forces necessary. The Zwick/Roell Z0.5 testing machine was used to apply forces from 0 to 1 N to the system. Specifications of the machine were: sensibility: <1%, displacement sensibility 1 µm, full scale range 500 N. The software used for data collection was TestXpert® II. The torque moment [Nmm] was calculated by multiplying the force applied through the arm, i.e. means the distance between the axis of rotation and the point of application of force. The torque angle [°] was algebraically calculated: the ZwickLine® machine was also able to measure the displacement performed by the extension, thus knowing the displacement (δ) and the arm (b) can the sine be derived. The value of the torque angle (θ) is then derived by the sine. Since it changes the angle between the extension and the machine also the arm of the force changes, thus the error was corrected after data collection
RESULTS: To obtain a 10 degree torque angle a torque moment of 0.52 Nmm was observed for stainless steel 0.016 × 0.022 wire; 0.71 Nmm for Tru-Chrome 0.018 × 0.025 wire; 0.79 Nmm for Beta-titanium 0.017 × 0.025 wire; 5.83 Nmm for stainless steel 0.019 × 0.025 wire and 2.60 Nmm for stainless steel 0.017 × 0.025 wire.
CONCLUSIONS: This experimental set-up resulted in an efficient description of torque expression of different archwire size and material. The larger the size of the wire the greater the force to obtain the same angulation. The stainless steel wires were stiffer than beta titanium wires

294 SKELETAL AND DENTOALVEOLAR CHANGES COMPARING EXTRACTION AND NON-EXTRACTION TREATMENT OF CLASS II MALOCCLUSION

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AIM: To determine the difference in skeletal and dentoalveolar parameters comparing extraction and non-extraction treatment of Class II malocclusion patients.
SUBJECTS AND METHOD: Fifty Caucasian patients with a Class II malocclusion (25 extraction cases treated with multibracket appliance and 25 non-extraction cases treated with a combination of Herbst and multibracket appliance). Profile cephalograms before and after treatment were analyzed. The angular and linear skeletal parameters measured on the cephalograms were: sagittal position and vertical position and development of the upper and lower jaw, and their relationships and dental parameters determining the position of the anterior teeth and molar relationship. For the comparison of parameters in each group before and after, as well as the both groups together, multivariance analysis of variance was used. Statistical significance was determined using the Wilks Lambda test, and the level of significance was < 0.005.
RESULTS: There were statistically significant differences in angular parameters before and after treatment in both groups, as well as when comparing the two groups of patients. In both groups of patients, angular parameters determining the sagittal relationship of the of upper and lower jaw, as well as the position of the upper incisor towards maxillary plane showed statistically significant differences (P < 0.005). ANB angle decreased after treatment, approaching the value that determines a Class I relationship. The value of angle I/SpP showed an increase in terms of correcting the protrusion of the upper incisors. However, when comparing the two groups of patients, a statistically significant difference was found only in the non-extraction group (decreased ANB angle, increased Go-Cd` length, which could be explained by mandibular growth initialization) and dental parameters (increased value of angle I/SpP and decreased value of angle i/MP due to protrusion, which is often an unwanted effect of the Herbst appliance).
CONCLUSIONS: The results showed significant differences in sagittal and dental parameters in both groups before and after treatment. The non-extraction group showed more pronounced changes.

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295 EXPECTATIONS OF PERIODONTALLY COMPROMISED PATIENTS REGARDING ORTHODONTIC TREATMENT AND ITS EFFECTS

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AIM: One of the main reasons why periodontally compromised patients seek orthodontic treatment is smile aesthetic improvement. The aim of this study was to evaluate patients' expectations regarding orthodontic treatment.
SUBJECTS AND METHOD: The survey included 58 periodontally compromised patients (43 females) treated with fixed appliances. The patients were classified according to gender, age, place of residence, education level and marital status. Respondents' expectations according to the undertaken orthodontic treatment were specified in terms of aesthetics, oral health, professional and social aspects, as well as the level of expected discomfort associated with the use of a fixed appliance. The results were statistically analyzed (critical significance level of $P \leq 0.05$).
RESULTS: Straight teeth were expected by 51.7 per cent of respondents, 37.9 per cent oral health improvement, 6.9 per cent facial appearance improvement and 1.7 per cent speech improvement. There were no statistically significant correlations between the main expectation regarding orthodontic treatment and gender, age, place of residence or education level (all $P > 0.05$). Analysis revealed that singles are significantly less concerned about oral health than people who are in a relationship ($P = 0.031$). An improvement of professional aspects was expected by 29.1 per cent of respondents, 49.1 per cent an improvement of social relations and 69.0 per cent an increase in self-confidence. There was no statistically significant correlation between expectation and gender, age, place of residence, education level and marital status ($P > 0.05$). Pain, sensitivity or tension of the teeth were less intensive in the group of patients aged 46-68 than those aged 38-45 years ($P = 0.024$, $P = 0.027$, $P = 0.020$, respectively). Pain lasted longer in patients aged 46-68 than in those aged 38-45 years ($P = 0.045$). Other socio-demographic aspects were not statistically significant ($P > 0.05$).
CONCLUSIONS: Expectations of periodontally compromised patients regarding orthodontic treatment, excluding the need for oral health improvement, does not depend on socio-demographic aspects. The pain associated with orthodontic treatment for respondents aged 38-45 years was more intensive, but lasted for a shorter period of time than for the group aged 46-68 years.

296 EVALUATION OF DIODE LASER AND PHOTODYNAMIC THERAPY ON REDUCTION OF GINGIVAL INFLAMMATION IN FIXED ORTHODONTIC PATIENTS

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AIM: Gingivitis is one of the most common side effects of orthodontic treatment. There has been a growing interest in the use of dental lasers for treatment of soft tissue problems. The aim of this study was evaluation of the effect of a diode laser and photodynamic therapy on gingivitis of orthodontic patients.
SUBJECTS AND METHOD: In this triple blind randomized clinical trial study, 60 orthodontic patients with treatment-resistant gingivitis were randomly allocated in a parallel design to one of three groups: (1) control group, (2) diode laser irradiation and (3) irrigation with Methylene blue and diode laser irradiation. The gingival index as the primary outcome, plaque index, bleeding on probing and probing pocket depth were measured at baseline and 1 month after treatment. Severity of *Porphyromonas gingivalis* contamination was measured at baseline, immediately after treatment and 1 month after treatment with the real time polymerase chain reaction method. Statistical analyses were performed using ANOVA and repeated measures ANOVA.
RESULTS: Clinical parameters and microbial evaluation showed no significant difference among the three groups. Any changes in the number of bacteria returned to the original value after 1 month.
CONCLUSIONS: A single diode laser dose and/or photodynamic therapy is not effective for the treatment of gingivitis in orthodontic patients; but it seems that more frequent photodynamic laser

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exposure may have positive effects to control bacterial population and probably beneficial clinical results.

297 SKELETAL AND DENTAL PATTERNS IN PATIENTS WITH OLIGODONTIA

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AIM: Oligodontia, defined as the congenital absence of six or more permanent teeth, causes various malocclusions. The purpose of this study was to identify the characteristic dental and skeletal features of oligodontia.

MATERIALS AND METHOD: Pantomograms and intraoral photographs of 10,069 orthodontic patients between the age of 5 and 43 years were examined for the prevalence of oligodontia, the number of missing teeth and the classification of malocclusion. Cephalograms for adult female oligodontia subjects were compared with Japanese control data.

RESULTS: The prevalence of oligodontia was 1.1 per cent (1.3% for males, 1.0% for females). The average number of congenitally missing teeth was 8.9 ± 3.3 (6〜22). The most frequently missing teeth were the mandibular second premolars, followed by the maxillary second premolars, maxillary first premolars, and mandibular first premolars. In contrast, the maxillary central incisors, the mandibular canines, the maxillary first molars and the mandibular first molars were rarely missing. An anteroposterior occlusal relationship was characterized by an anterior crossbite in 31.3 per cent, an acceptable overjet in 46.3 per cent and maxillary protrusion in 22.4 per cent. Vertically, a deep bite was noted in 38.8 per cent, an acceptable overbite in 53.7 per cent and open bite in 7.5 per cent. Most subjects had a spaced arch (68.4%). Only 11.9 per cent of the subjects had anterior crowding. Cephalometric measurements showed maxillary retrognathia. The mandibular basal bones were anteroposteriorly in a normal position, but the chin bones were protruded.

CONCLUSIONS: The maxillary basal bones of oligodontia patients were more retruded than normal. Characteristic malocclusions of oligodontia were spaced arch, deep bite and anterior crossbite.

298 EFFECTS OF B1 ADRENALINE RECEPTOR BLOCKER ON EXPERIMENTAL TOOTH MOVEMENT IN SPONTANEOUSLY HYPERTENSIVE RATS

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AIM: The number of adults who wish to have orthodontic treatment is recently increasing, and a considerable proportion of these adults are living with lifestyle diseases. It is known that hypertension, which is representative of a lifestyle disease, has a high relevance to osteoporosis, and its involvement in the sympathetic nervous system has been pointed out as one factor. In a previous study, tooth movement in spontaneously hypertensive rats (SHR) was examined and it was found that a β2 adrenaline receptor (β2AR) blocker reduced tooth movement and restored decreased maxillary alveolar bone volume. However, the relationship of β1 adrenaline receptor (β1AR) and bone metabolism is not clear. In this study, the effect of β1AR blocker on the degree of SHR tooth movement was examined.

MATERIALS AND METHOD: A group of SHR (n = 6) were administered Atenolol (β1AR blocker; ATN) at a dose of 1,10mg/kg (p.o.). A closed-coil nickel-titanium spring was connected between the maxillary first molar and maxillary central incisor teeth. After sacrifice, the distance of tooth movement, histological analysis, trabecular microarchitecture and plasma biochemical parameters were calculated.

RESULTS: SHR control showed an increase in mesial movement of the first molar tooth, and SHR treated with ATN showed a decrease. Bone mass measured by bone volume of the alveolar bone was significantly decreased in SHR control and increased in SHR treated with ATN. There was no significant difference between SHR control and SHR treated with ATN in bone resorption, but SHR treated with ATN showed an increase in bone formation. In addition, the expression level of sclerostin (SOST) that suppresses the osteoblast function produced from bone cells was suppressed by the ATN in SHR.

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CONCLUSIONS: In bone mass reduction of the alveolar bone through the sympathetic nervous system during tooth movement, the β1 blocker suppresses the expression amount of SOST of bone cells, increases the amount of bone formation and decreases the amount of tooth movement. From the above, it was shown that β1 blocker may be different from β2 blocker; its bone mass improving effect during tooth movement.

299 THE CENTRE OF RESISTANCE OF THE MANDIBULAR DENTITION WITHOUT THE FIRST PREMOLAR

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AIM: To investigate the three-dimensional (3D) position of the centre of resistance (CR) of the full mandibular dentition of a model with extraction of the first premolar and a model with the extraction space closed using 3D finite element (FE) analysis.
MATERIALS AND METHOD: The FE models included the whole lower dentition, periodontal ligament, and alveolar bone. The crowns of the teeth in each group were fixed with buccal and lingual archwires and lingual splint wires to minimize individual tooth movement and to evenly disperse the forces to the teeth. A force of 200 g was applied to the wire beam extended from the incisal edge of the lower central incisor, and the displacement of teeth was evaluated. The CR was defined as the point where the applied force induced parallel movement.
RESULTS: The CR of the full mandibular dentition group of the model with extraction of the first premolar was 13 mm apical and 25.5 mm posterior, and for the model with extraction space closed they were 13 mm apical and 20.5 mm posterior to the incisal edge of the lower central incisor.
CONCLUSIONS: It is thought that the results from these FE models will improve the efficiency of orthodontic treatment and planning.

300 A COMPARISON OF THE EFFECT OF CASEIN PHOSPHOPEPTIDE-AMORPHOUS CALCIUM PHOSPHATE, FLUORIDE AND A COMBINATION ON INITIAL CARIES LESION: FINAL OUTCOME

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AIM: To make a final outcome of the evaluation of the *in vitro* effects of fluoride, casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) and a combination of both (CPP-ACPF) and to compare these toothpastes with control groups with and without the use of a conventional toothpaste, on remineralisation of white spot lesions (WSL) after 6 and 12 weeks.
MATERIALS AND METHOD: WSL were created on 96 premolars (sectioned in two parts: buccal and palatal) with a demineralisation solution during 96 hours, a pH-cycling regime during 3 days. The premolar sections were divided into four groups: a fluoride group (Elmex medical gel®), a CPP-ACPF group (Mi Paste Plus™), a CPP-ACP group (Tooth Mousse™) as experimental groups and one control group without working agents. To evaluate the outcome, a new control group containing 26 premolars using only conventional toothpaste (1450 ppm) was added. Each group of teeth was treated according to the instructions of the manufacturer. All teeth were brushed daily with conventional toothpaste (1450 ppm) except for one control group. Eight different parameters were measured with transverse microradiography after 6 and 12 weeks: the depth of the total lesion and the basic mineral content, the depth of the body lesion and the minimum mineral content of the body lesion and the depth of the surface layer and the maximum mineral content of the surface layer. The volume of demineralisation and the amount of body lesions were also measured. Different statistical tests were performed with SPSS24 to compare all groups after 6 and 12 weeks. The significance level was $P < 0.05$.
RESULTS: There was a significant difference in remineralisation ($P < 0.001$) between 6 and 12 weeks in both the experimental and control groups. After 12 weeks, the depth of the WSL was significantly smaller in the experimental groups. There was a significant decrease ($P < 0.05$) in the volume of demineralisation between the experimental and control groups. There was no statistically significant difference between the three different experimental toothpastes.

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CONCLUSIONS: The results of this study showed more remineralisation in the experimental groups. The lesion depth of the WSL decreased significantly after 12 weeks with all experimental toothpastes.

301 OROFACIAL FUNCTION AND OCCLUSION IN A GROUP OF CHILDREN WITH SPEECH SOUND DISORDERS

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AIM: To investigate oral motor function and occlusion in a group of children with *s*peech sound disorders (SSD). Oral motor impairment has been reported in children with speech and language disorders of different aetiology. There are several reports that orofacial dysfunction can influence the development of occlusion.
SUBJECTS AND METHOD: Fifty-two children, 6-12 years, with SSD were included (40 boys, 12 girls). All were referred for an oral motor and speech motor examination. Assessment included oral motor screening test (NOT-S), a two-coloured chewing gum test and an articulation test (SVANTE). Dental examination of occlusion and orofacial morphology were carried out by an orthodontist.
RESULTS: The children with SSD had a higher score on NOT-S than expected according to age. There was a highly significant difference between the study group and typically developing children. A large number of children had difficulties in the domains involving 'sensory function', 'chewing and swallowing' and 'masticatory and jaw function'. There was also a significant difference in chewing efficacy between the study group and a control group. Malocclusions such as forced anterior crossbite and forced posterior crossbite were more common than expected.
CONCLUSIONS: Oral motor difficulties in children with SSD may not only affect speech but can also involve other orofacial functions such as chewing and occlusion.

302 ENAMEL SURFACE ROUGHNESS FOLLOWING ORTHODONTIC BRACKET DEBONDING AND COMPOSITE RESIN REMOVAL USING TUNGSTEN CARBIDE AND ARKANSAS BURS

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AIM: To assess the enamel surface roughness following the use of low speed tungsten carbide (TCB) and high-speed Arkansas burs (AB).
MATERIALS AND METHOD: This *in vitro* experimental study was performed on 72 first and second premolar teeth extracted for orthodontic purposes. The labial surfaces of the teeth were etched and brackets were bonded using light-cure composite resin. After 24 hours, orthodontic brackets were debonded by holding them from the mesial and distal and peeling the bracket base away from the tooth using a debonding fine cutter to minimize trauma to the enamel. The teeth were then randomly divided into two groups of 36. The composite remnants were removed using a 12-blade TCB and low speed hand piece in group 1 and AB and high-speed hand piece in group 2. The enamel surface roughness of specimens was evaluated under a stereomicroscope using the surface roughness index described by Howell and Weeks. The time required for complete adhesive removal from the enamel surface was recorded in seconds. Data were analyzed using non-parametric chi square test
RESULTS: In both TCB and AB groups, the enamel surface roughness significantly increased compared to the baseline value (P = 0.001 for TCB and P = 0.004 for AB). No significant difference was found in surface roughness between the two groups after the intervention (P = 0.431). The time spent for complete removal of remnants was significantly shorter with AB compared to TCB (P = 0.00).
CONCLUSIONS: Considering the same level of surface roughness caused by AB and TCB and faster removal, AB is recommended for composite remnant removal. However, further studies are required.

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303 EVALUATION OF ENAMEL SURFACE ROUGHNESS FOLLOWING ORTHODONTIC TREATMENT

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AIM: Achieving a smooth enamel surface after orthodontic bracket debonding is imperative. This study sought to compare the enamel surface roughness following orthodontic bracket debonding and resin removal using a white stone bur, tungsten carbide bur and tungsten carbide bur under loupe magnification.

MATERIALS AND METHOD: Thirty sound premolars were randomly divided into three groups and their buccal surfaces were subjected to atomic force microscopy (AFM) to measure initial surface roughness. Brackets were bonded to the buccal surfaces and debonded after 24 hours. Resin remnants were removed using a white stone bur, tungsten carbide bur or tungsten carbide bur under loupe magnification. The teeth were then subjected to AFM again. The time required for composite removal was calculated. Data were analyzed using repeated measure ANOVA, one-way ANOVA and Tukey's test.

RESULTS: Resin removal increased enamel surface roughness compared to the initial value ($P < 0.001$) however no significant differences were noted among the three groups in this respect after resin removal. The mean time required for smoothing by tungsten carbide bur and tungsten carbide with the use of dental loupe was similar ($P > 0.05$), being significantly lower than that with white stone bur. (both $P < 0.001$).

CONCLUSIONS: A tungsten carbide bur is still recommended for composite removal

304 MATURATIONAL CHANGES OF THE CERVICAL VERTEBRAE IN RELATION TO CRANIOFACIAL GROWTH SPURT IN ORTHODONTIC CLASS I

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AIM: To investigate the relationship between the cervical vertebrae maturational (CVM) changes and the growth spurt identified as the maximum increase in the maxillary and mandibular body lengths in Class I malocclusion

MATERIALS AND METHOD: This longitudinal retrospective study included 18 subjects (10 males ranging in age from 10-15 years old and 8 females ranging in age from 9-14 years) whose records had a lateral cephalographs taken at regular 1 year interval. The subjects included were all Class I cases who did not have orthodontic treatment. Skeletal CVM was assessed according to the method of Hassel and Farman that described six CVM stages. Mandibular and maxillary lengths; Condylion (Co)-Pogonion (Pog) and Condylion (Co)-Point A (A), respectively, were measured. Growth increments calculated for the annual age intervals were used to determine the peak in the growth spurt. The CVM stage at the beginning and end of the annual age interval corresponding to the largest increments of maxillary and mandibular growth was taken as CVM stages corresponding to the peak of the craniofacial growth spurt.

RESULTS: There was invariable coincidence between the maximum annual growth increment of maxillary body length (Co-A) and mandibular body length (Co-Pog). Five males out of 10 and five females out eight showed maximum annual growth in the interval between CVM3-CVM4 while four males out of 10 and three females out eight showed maximum annual growth in the interval between CVM2-CVM3. Only one male had his peak of growth spurt between CVM4-CVM5.

CONCLUSIONS: CVM3 was almost invariably included in the peak of the craniofacial growth spurt. However, the maximum growth interval included also either CVM2 or CVM4.

305 NON-SURGICAL MANAGEMENT OF DEVELOPING AND BORDERLINE CLASS III CASES

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AIM: The differential diagnosis of Class III cases is often complicated and confusing. Class III cases can be skeletal with the defect in the maxilla, mandible or in both arches. It can also be pseudo Class

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III where centric relation and centric occlusion do not coincide. However, advancement in orthodontic treatment modalities and the use of miniscrews has made treatment of Class III cases possible. This presentation looks at the differential diagnosis of Class III cases and how the alveolar envelope can be stretched to the limit using advanced techniques including miniscrews in an effort avoid surgical orthodontics.
MATERIALS AND METHOD: Fifteen cases were selected retrospectively which were categorised as short lower face height, normal lower face height and increased lower face height, maxillary hypoplasia, mandibular prognathism and a combination of both maxillary hypoplasia and mandibular prognathism. These cases were analyzed for the achieved results to suggest an index ranging from 1 to 10 where 1 is the least difficult and 10 the most complicated. The index will give an indication of which cases can be treated without involvement of a surgical option but by using advanced techniques such as miniscrews.
RESULTS: Patients with mandibular excess and increased lower face heights are the most difficult cases that may require surgical intervention, whereas a short lower face height with maxillary deficiency is the least difficult case.
CONCLUSIONS: Good diagnosis is an essential part of treating Class III cases. Maxillary deficiency with a decreased lower face height has a better chance of being treated without surgical intervention.

306 RAPID PALATAL EXPANSION WITH A HYRAX BANDED COMPARED IN THE PRIMARY AND PERMANENT DENTITION

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AIM: To compare the expansion gained with rapid maxillary expanders (RME) banded to upper first primary molars versus upper second permanent molars.
MATERIALS/SUBJECTS AND METHOD: Thirty five consecutive patients (13 males, 22 females, mean age 10.0 ± 1.6 years) with maxillary transverse deficiency problems. The convenience sample was divided in two groups: 1) Group RME anchored to permanent teeth (12 subjects); 2) Group RME anchorage to temporary teeth (23 subjects). Both RME were activated twice a day until overcorrection. They were left in place for 3 months for retention. Study models were obtained at the beginning and at the removal of the RME. The irregularity index, intermolar distances (d+d, e+e, 6+6) were measured pre- and post-treatment. A Student's *t*-test was performed to analyse differences when the distribution was normal and a Mann-Whitney test when it was a non-normal distribution.
RESULTS: A significant increase ($P < 0.001$) was observed in upper permanent intermolar distance in RME banded to permanent teeth versus RME banded to temporary teeth. In addition a significantly greater increase ($P < 0.01$) was observed in anterior arch length with the RME banded to temporary teeth.
CONCLUSIONS: Transverse deficiency can be treated successfully with a RME banded to the upper first permanent and temporary molars. The RME permanent anchorage group showed an increase of upper permanent molar width compared with the RME temporary group. Anterior arch length increased significantly in the RME banded to temporary teeth when compared with RME banded to upper first molars.

307 VALIDATION OF AN INSTRUCTION METHOD TO IMPROVE ORTHODONTIC DIAGNOSIS BY UNDERGRADUATES

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AIM: To determine if implementation of the Index of Orthodontic Treatment Need (IOTN) as a screening system is valid, when this index is applied by fourth year dental students.

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SUBJECTS AND METHOD: Fourth year dental students were randomly selected and divided into two groups in alphabetical order. Those students were instructed in the rudiments of the IOTN and were given the IOTN support rule (DHC ruler, Orthocare). Students were asked to diagnose the level of treatment need of 10 sets of patient models and 10 sets of intraoral frontal photographs, and to compare the results obtained with the assessments previously made by teachers and students of the Master of Orthodontics of Rey Juan Carlos University.
RESULTS: Statistical analysis of the results was carried out (ANOVA and Chi Square), which revealed that the students instructed in the IOTN made a correct diagnosis in 86.2 per cent of the cases using the functional component and 77 per cent of the cases when using the aesthetic component.
CONCLUSIONS: Training in the IOTN can improve the orthodontic diagnostic ability in students of fourth year of dentistry.

308 COMPARISON OF THE SUPERELASTICITY OF DIFFERENT NICKEL-TITANIUM ORTHODONTIC ARCHWIRES AND THE LOSS OF THEIR PROPERTIES BY HEAT TREATMENT

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AIM: To describe and compare the mechanical properties of eight widely used nickel-titanium (NiTi) orthodontic wires under uniform testing conditions and to determine the influence of heat treatment on the loss of superelasticity.
MATERIALS AND METHOD: Ten archwires from eight different manufacturers were evaluated. A three-point bending test was performed, ISO 15841:2006, on 80 round 0.016 inch NiTi archwire segments. Each segment was deflected to 3.1 mm and then unloaded until the force was zero. On the unloading curve, deflection at the end of the plateau and forces delivered at that point, and at 3, 2, 1 and 0.5 mm were recorded. Plateau slopes from deflection were calculated. Data were statistically analysed to determine inter-brand differences ($P < 0.05$). Twenty samples of NiTi archwires were tested to simulate the thermal procedure to change shape. They were heat treated at 400 and 600°C. Changes in surface were observed with transmission electron microscopy and mechanical properties were analyzed.
RESULTS: At 2 mm of deflection, maximum differential force exerted among brands [Nitinol superelastic (1.999N)—Sentalloy M (1.001 N)] was 0.998 N (102 gf). The Nitinol superelastic plateau slope (0.353 N/mm) was the only one that was statistically different at 2 mm of deflection, as compared with the other brands (0.129-0.155 N/ mm). Damon optimal force displayed the gentlest slope at 3 mm of deflection (0.230 N/mm) and one of the longest plateaus. Superelasticity of Nitinol superelastic was not observed, while Damon optimal force and Proclinic NiTi (G&H) showed the most superelastic curves. In all cases, heat treatment at 600°C produced precipitations in the matrix. The precipitates changed the chemical composition of the matrix and produced a loss of superelasticity. At 400°C these precipitates were not produced and the forces measured were very similar to untreated wires.
CONCLUSIONS: Exerted forces differ significantly among different brands. Heat treatment used in order to modify the original shape produced precipitates avoiding the superelastic properties.

309 COMPARISON OF THE THICKNESS OF THE ALVEOLAR WALL IN A MULTI-PLATFORM IMAGING STUDY

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AIM: Cone beam computed tomography (CBCT) has become a popular three-dimensional (3D) imaging technique in dentistry during the last decade. Various systems are commercially available at present. For orthodontics, the use of CBCT is mainly for diagnostics and treatment planning. For the latter, it is important to be able to judge to thickness of the alveolar wall around the teeth in order determine whether the bone is thick enough to allow for tooth movement without the risk of dehiscences or fenestrations. The aim of this study was to assess the accuracy and reliability of

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various CBCT systems in quantifying the thickness of the alveolar wall. This assessment was compared to the same quantification using conventional computed tomography (CT), magnetic resonance imaging (MRI) and microcomputed tomography (μ-CT).
MATERIALS AND METHOD: One human skull, obtained at autopsy, was used for different scanning procedures (CBCT, CT, MRI, μCT) with various systems installed in the northern Swiss and southern German region. Although the entire skull was scanned, for this study the buccal and lingual alveolar bone of the upper and lower central incisors and canines were selected as regions-of-interest. The volumes were measured twice by two examiners not knowing from which machine the images were obtained. For each tooth the alveolar wall thickness was measured on the lingual and buccal side at 33, 66 and 100 per cent of the root length. These measurements were compared among each other and to the gold standard measurements performed on the μCT data.
RESULTS: Considerable differences were observed when comparing measurements both performed on data-sets from the same system with different machine settings and from different systems. Variations for double measurements on the same system with the same settings were around 0.5 mm, while variations for the same measurement with different systems could go up to 2 mm.
CONCLUSIONS: Image quality differences exist between the many commercially available CBCT systems. Especially when visualizing a delicate structure such as the alveolar wall, image quality plays an important role when evaluating its thickness.

310 AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN THE MANDIBULAR FOSSA AND MANDIBULAR MORPHOLOGY IN MANDIBULAR PROGNATHISM WITH FACIAL ASYMMETRY

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AIM: Facial asymmetry is often accompanied by asymmetric morphology in the temporomandibular joint (TMJ) region or cranial base as well as mandibular asymmetry. The purposes of this study were to perform three-dimensional (3D) analysis of the maxillofacial area, especially the mandibular fossa, using 3D computed tomography in patients with facial asymmetry, and to examine the morphological relationship between the mandibular fossa and asymmetries of the mandible.
SUBJECTS AND METHOD: Fifty adult orthognathic patients with facial asymmetry and mandibular prognathism, excluding those with congenital abnormality and degenerative disease of the TMJ. Computed tomography data were reconstructed into 3D images and multiplanar reconstruction (MPR) images using 3D planning software for orthognathic surgery. Eleven landmarks were determined on the 3D surface model and MPR images, and their 3D coordinates were measured. Eight liner measurements pertaining to the mandibular fossa and the mandible were carried out (menton deviation, mandibular body length, mandibular ramus length, condylar process length and the distance between mandibular fossa and reference planes). Measurements were conducted for both the deviated side and non-deviated side. The statistical significant differences for the data were assessed using the paired Welch's *t*-test. Correlations between measurements relevant to the mandible and those regarding the mandibular fossa were investigated using Pearson's correlation coefficient.
RESULTS: Menton deviation was significantly correlated with mandibular body length, mandibular ramus length and condylar process length. Mandibular body length and ramus length were correlated with the vertical distance from the coronal plane to the mandibular fossa and with the horizontal distance from axial plane to mandibular fossa, respectively.
CONCLUSIONS: The present findings suggest that the asymmetry of the mandible might be compensated by the position of the TMJ.

311 EFFECTS OF LOADING, GENDER AND AGE ON RAT CONDYLAR CARTILAGE MORPHOLOGY

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AIM: The temporomandibular joint (TMJ) is able to adapt to changes caused by mandibular growth, masticatory loading and ageing. The aim of this study was to examine the effects of age, gender and dietary loading on rat mandibular condylar cartilage thickness and number of cells.
MATERIALS AND METHOD: TMJs collected from 80 rats. The rats were divided in eight groups by gender, diet hardness (normal/hard) and length of study period (1 year/2 years). To increase the diet hardness, the rats were fed using a dietboard feeding method, in which the rats have to gnaw wood to reach food which increased the work load. The control group were fed a pellet diet. Samples, 5 μm thick, were stained with toluidine blue for histomorphometric analysis and examined with a light microscope image analyzer (Leica Leitz DM RB/E). The thickness of the cellular layer was measured by drawing a line from top of the cartilage to the edge of the subchondral bone and measuring the length, and cells that touched the line were counted. Measuring was carried out using ImageJ-software. Statistical analysis of the total thickness of the cellular layer of the condylar cartilage and number of cells was undertaken using a two-level hierarchical ANOVA model.
RESULTS: The height of the cellular layer both in the female and male dietboard groups was significantly larger compared to the control groups in 1 year old rats. The height of the cellular layer in both genders was significantly larger in the 2 year old control rats than in the 1 year old control rats. The counted number of cartilage cells was higher in the 2 year old female rats than the male rats in both diet groups. In the control group rats the cell count was higher in 2 year old rats than in the 1 year old rats in both genders.
CONCLUSIONS: The condylar cartilage remains capable of adapting to changes also in older age and its morphology is sensitive to changes caused by loading, gender and age.

312 COMPENSATORY RESPONSES TO ADDED NASAL AIRWAY RESISTANCE WITH AGE

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AIM: To assess respiratory responses to increased upper airway resistance due to an obstructed nasal airway and to study possible changes with age.
SUBJECTS AND METHOD: Two different age groups, 40 11-20 year old and 40 59-82 year old subjects, were compared with each other. The pressure-flow technique (Microtronics Co., Chapel Hill, North Carolina, USA) was used to record inspiratory and expiratory phases during rest in a seated position. To create calibrated resistance loads, a device modified from precision iris diaphragm was used. Differences between inspiratory and expiratory resistance and airflow rate were assessed by paired *t*-test. Effect of age on respiratory values was analyzed by a linear regression model.
RESULTS: Resistance ($cmH_2O/L/s$) and airflow rate (mL/s) values were higher during inspiration compared to expiration at all conditions in 11-20 year olds but the difference was statistically significant only during rest breathing and at the unloaded condition ($P < 0.001$). In 59-82 year olds, nasal resistance was higher during inspiration at rest breathing and at the unloaded condition, but lower in all other conditions ($P < 0.05$ in all conditions). In the younger group, inspiratory airflow rate of 431 and expiratory airflow rate of 387 mL/s ($P < 0.001$) during rest breathing decreased to 302-303 mL/s just prior and at detecting increased respiratory load. Among older adults, during rest breathing airflow rate was almost equal during inspiration and expiration, 490 and 486 mL/s, respectively, and decreased to inspiratory airflow rate of 303 and expiratory airflow rate value of 318 mL/s By linear regression analysis, age affected airflow in the unloaded condition ($P = 0.044$) and differential resistance at detection ($P = 0.038$).
CONCLUSIONS: During rest breathing, higher values of nasal resistance and airflow rate during inspiration compared to expiration indicated a more passive nature of the expiratory phase in both age groups. The same was true in 11-20 year olds with increasing nasal obstruction while older adults changed the respiratory mode; expiratory phase requiring more effort than inspiration. However, compensatory response was the same in both age groups, resulting in the same decreased airflow rate value at the time of perception of the added respiratory load.

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313 EFFECTIVENESS OF DENTAL RETENTION AND ITS RELATIONSHIP WITH RELAPSE

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AIM: 1. To know the effectiveness of retainers, 2. to study undesirable factors associated with relapse in patients treated orthodontically who have retainers and 3. to identify treated malocclusions that are most frequently associated with the occurrence of relapse.
MATERIALS AND METHOD: A digital search was performed in PubMed, Science Direct and Cochrane with the keywords: retention, relapse, orthodontic treatment, associated factors, orthodontic retainers. Articles from high-impact scientific journals published from 2006 to 2016 were been included.
RESULTS: Nine hundred and thirty three articles were found in the initial search, of which 52 were included according to the inclusion and exclusion criteria.
CONCLUSIONS: There are many aetiological factors that can lead to recurrence, such as soft tissue pressure, the patient's own anatomical characteristics, retainer adhesion strength or wire thickness, among others. The adverse effects associated most frequently with retainers are crowding or opening spaces in the lower anterior sector, premolar protrusion, periodontal, problems or changes in dental torque. 2. Dental relapse is higher in cases of incisor diastema, orthodontic treatment with extractions or after modifying the intercanine distance. 3. No retention protocol showed better stability (vacuum formed retainer, fixed retainer, Hawley plate). The type of retention, time of use and protocol of appointments varied according to the professional and his/her own personal experience.

314 EFFECT OF ELECTRIC AND MANUAL TOOTHBRUSHES ON PLAQUE REMOVAL AND PERIODONTAL STATUS DURING ORTHODONTIC TREATMENT. A SYSTEMATIC LITERATURE REVIEW

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AIM: Orthodontic patients often show ineffective plaque control because fixed appliances shield dental plaque from the mechanical action of brushing and mastication. Undisturbed supragingival plaque initiates gingival inflammation and hyperplasia and may cause enamel white spots. Despite the use of mouthwashes and topical fluorides, mechanical removal of plaque remains the most important factor of oral hygiene during orthodontic treatment. The aim of this study was to review the effectiveness of electric and manual toothbrushes in removing plaque and in preventing the development of gingivitis in patients with fixed orthodontic appliances.
MATERIALS AND METHOD: Major electronic databases (PubMed, Scopus, EuropePMC, Google Scholar, MeSH) were searched for articles related to efficacy of electric and manual toothbrushes in orthodontic patients. Randomized controlled trials fulfilling the inclusion criteria were assessed by two evaluators independently and graded on the quality of the research and the presentation of the results. Plaque retention, gingivitis, gingival bleeding index and pocket depth were the main outcomes evaluated.
RESULTS: Fifty six papers were initially identified and, after evaluating the abstracts, 45 papers were removed as not fulfilling the inclusion criteria. Of the 11 studies reviewed, six concluded that electric toothbrushes offered statistically significant benefits in at least one area, four that there was no statistical difference between brushes, and one that manual toothbrushes were better at most outcomes assessed. In general, electric toothbrushes performed at an equal level with manual toothbrushes with regard to plaque index and gingival index but they were found to perform more superiorly in reducing the incidence of bleeding on probing and interdental bleeding. The investigation period ranged from a single evaluation time point to a maximum of 8 weeks. It was also found that among the electric brushes the one with the orthodontic head was more effective than the classic brush head.
CONCLUSIONS: Although electric toothbrushes may provide some improvements in orthodontic patients' oral health compared to manual toothbrushes, these improvements may not be strong enough to justify the greater cost of electric toothbrushes.

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315 A RANDOMIZED CLINICAL TRIAL PROTOCOL FOR EVALUATING THE EFFECTIVENESS OF ELECTRIC TOOTHBRUSHES IN ORTHODONTIC PATIENTS. THE SPIRIT STATEMENT

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AIM: The protocol of a clinical trial plays a key role in preparation, conduct, interpretation, and external review, by detailing the plans of each stage, from ethics approval to dissemination of results. This study describes the protocol of a clinical trial aiming to evaluate if electric toothbrushes with a three-dimensional action (rotation/oscillation and pulsation) are more effective than manual toothbrushes in removing plaque and reducing gingival inflammation in patients under orthodontic treatment with fixed appliances.

MATERIALS AND METHOD: The 33-item SPIRIT checklist was used. The checklist recommends a full description of what is planned; it does not prescribe how to design or conduct a trial. This trial was designed as a randomized, controlled, investigator blinded superiority trial, with two parallel groups and a 1:1 allocation ratio. Eighty patients with an equal number of males and females, will be allocated to each group. One group of orthodontic patients will receive an electric toothbrush with an orthodontic head and the other group will receive a manual orthodontic brush. Measurements of two plaque indices and two gingival indices will be taken at baseline and at 3 monthly intervals. The trial's inclusion criteria are: healthy patients between 12 and 16 years of age undergoing non-extraction orthodontic treatment, already placed fixed maxillary and mandibular labial orthodontic appliances on all teeth from central incisor to first molar (bands on first molars, conventional brackets) and plaque-induced gingivitis. Exclusion criteria are: active caries, periodontitis, tooth agenesis, syndromes and craniofacial deformities, current use of electric toothbrush, smoking, antibiotics, medication that results in gingival enlargement and participation in other trials.

RESULTS: The protocol has been approved by the Ethics Committee of the School of Dentistry, University of Athens and registered on ClinicalTrials.gov in March 2016 with identifier NCT02699931. Its current status is recruiting participants and completion date is estimated in December 2017. Data from the written records for every visit from baseline to 3 months will be analyzed using parametric tests.

CONCLUSIONS: Adherence to the SPIRIT guidelines enhances transparency and completeness of the trial and enables full appraisal of the methodology and results after trial completion.

316 COMPARISON OF ACCURACY OF MAXILLARY REPOSITIONING IN SINGLE PROCEDURE SURGERY (LE FORT 1) WITH CONVENTIONAL VERSUS VIRTUAL MODEL SURGERY

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AIM: In relation to orthognathic surgery a well-defined treatment plan and its transfer to the surgical procedure is crucial for a valid prediction of the treatment result. As a consequence of the development of three-dimensional (3D) technologies, virtual surgical planning is gradually replacing traditional model surgery. What has yet to be determined is whether the application of virtual model surgery is at a point where it can replace traditional model surgery. The first null-hypothesis tested in this study was that treatment planning based on plaster surgery did not deviate from that done virtually; secondly that the deviation from the planned and the real outcome obtained with the two methods did not differ.

MATERIALS AND METHOD: Pre- and post-operative clinical records from 22 patients who underwent maxillary orthognathic surgery, including articulator-mounted plaster models, cone beam computed tomography and virtual models were available. Two independent treatment plans were prepared for all patients using the following approaches: conventional plaster surgery and virtual surgery planning. Subsequently, two sets of surgical wafers were produced in order to transfer the designed movements to the operating theatre: a) traditional wafers made by a technician on the plaster casts

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and b) virtually designed splints, manufactured using computer-aided design and manufacturing techniques. The choice between the traditional and virtual wafer for use during the actual surgery was randomly determined. The movements planned with the two methods were compared with a non-parametric Mann-Whitney test for paired data. Following surgery the movements of the maxillary segments were assessed and compared to the planned displacements.
RESULTS: The first null-hypothesis could not be rejected as the differences between the movements achieved by conventional and virtual surgical planning were not statistically significant. The same applied to the second null hypothesis, although a tendency for larger planned movements was observed for the virtual approach. The differences between the planned and achieved movements for both planning approaches were not statistically significant.
CONCLUSIONS: Virtual surgery planning can replace plaster surgery, but does not lead to a significantly better correlation between the planned and actual result in relation to maxillary repositioning.

317 DIFFERENTIATION OF MESENCHYMAL STEM CELLS DERIVED FROM iPS CELLS INTO OSTEOBLAST-LIKE CELLS***

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AIM: Mesenchymal stem cells (MSCs) are useful for autologous therapy in tissue engineering, however, MSCs have a limited capacity to proliferate *in vitro*, making it difficult to acquire a sufficient cell numbers for implantation. As previously reported, MSC-like cells (MSLCs) from human gingival integration-free iPS cells have been derived. The objective of this study was to differentiate MSLCs into osteoblast-like cells.
MATERIALS AND METHOD: MSLCs were analyzed by flow cytometry for human mesenchymal markers. MSLCs were cultured in Dulbecco's modified Eagle's medium (DMEM) containing 10 per cent foetal bovine serum and an osteoblast differentiation factor (50 μM ascorbic acid-2-phosphate, 10 mM β-glycerophosphate, 100 nM dexamethasone, 100 ng/ml BMP-2) for 1, 2 or 3 weeks (experimental group). MSLCs were cultured in DMEM containing 10 per cent FBS without an osteoblast differentiation factor as a control group. Osteoblast differentiation was evaluated using real-time polymerase chain reaction (PCR), alkaline phosphatase activity (ALP), and osteocalcin (OCN) expression.
RESULTS: Expression of the MSC-specific markers CD105, 73 and 44 was detected by flow cytometry. PCR analysis indicated that ALP mRNA expression was higher in the experimental group than in the control group at all time points tested, and COL1-A1 expression was higher after 1 and 2 weeks of cultivation with the osteoblast differentiation factor. ALP and OCN protein expression after 1, 2 and 3 weeks, respectively, was higher in the experimental group than in the control group.
CONCLUSIONS: MSLCs expressing MSC-specific markers treated with osteoblast differentiation factor expressed osteoblast-specific mRNA and protein. MSLCs are likely to have higher proliferative capacity, hence, *in vitro* differentiated osteoblast-like cells can be used for bone tissue engineering.

318 STABILITY OF ANTERIOR MAXILLARY ADVANCEMENT USING TOOTH SUPPORTED DISTRACTION OSTEOGENESIS

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AIM: Distraction osteogenesis (DO) is a viable alternative in the treatment of midface deficiency associated with clefts in growing patients. An indication for this mode of treatment in growing patients is mid face retrusion requiring maxillary advancement. The main purpose of this retrospective longitudinal study was to evaluate the long-term changes in maxillary position after maxillary distraction and to measure the skeletal and dental relapse at end of 3 years following the procedure.

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SUBJECTS AND METHOD: Fifteen consecutive patients (7 girls, 8 boys) with non-syndromic repaired cleft lip and palate with an average age of 13 years (range 12-14 years) who underwent anterior maxillary DO using a tooth supported distraction device. Cone beam computed tomographic scans were used to measure the two-dimensional measurements of the maxillary position immediately after distraction and 3 years after distraction at points A and ANS, respectively. Arch length was measured on maxillary dental casts at different time intervals.
RESULTS: After maxillary distraction the maxilla (point A) on average moved forward by 6.3 mm and backwards by 1.5 mm 3-years post-operatively. Arch length increased significantly by 16.9 mm after distraction without significant relapse, indicating there was no dental relapse.
CONCLUSIONS: DO, using a tooth supported device, is an effective technique to treat growing patients with severe maxillary hypoplasia. There is a potential skeletal relapse rate of 20 per cent at the end of 3 years, but no dental relapse. This potential relapse needs to be compensated for by over correction during distraction.

319 EXTRACTION OF THE PRIMARY CANINE IN CHILDREN WITH PALATALLY DISPLACED CANINES: PREDICTIVE VARIABLES ON PANORAMIC RADIOGRAPHS

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AIM: To identify predictors for successful outcome of interceptive extraction of the primary canine in patients with palatally displaced canines (PDCs) and to find the cut-off point when interceptive treatment is not beneficial.
SUBJECTS AND METHOD: This randomized control trial involved 67 patients (10-13 years) with unilateral (45) and bilateral (22) PDCs. Patients were consecutively recruited and randomly allocated to extraction (EG) or non-extraction (CG) of the primary canine using the permuted block randomization method. There were no drop-outs. The patients had a clinical examination and dental pantogram taken at baseline and after 12 months. Predictive features such as: alpha angle (angle to the midline), distance to the occlusal plane, sector (closeness to the midline) and root development of the canine at baseline was tested. Measurements were done blinded and the observer was unaware of the outcome. Independent *t*-test, logistic regression and receiver-operating characteristic curve (ROC) analysis was calculated.
RESULTS: Extraction, alpha angle and sector were factors affecting the spontaneous eruption of the PDCs. ROC analysis revealed that PDCs located in sector 2 (PDC crown overlapping the distal half of the lateral), angulated < 20 degrees from the midline have good chances of erupting without prior extraction, while PDCs angulated >30 degrees from the midline may need surgical exposure despite of extraction of the primary canine. A cut-off point of the sector on when interceptive extraction would not be beneficial could not be determined. However, by extracting the primary canine, 76 per cent of the PDCs erupted in sector 2, 60 per cent in sector 3 (PDC crown overlapping the mesial half of the lateral) and 43 per cent in sector 4 (PDC crown overlapping the distal half of the central incisor).
CONCLUSIONS: If the alpha angle is < 20 degrees in patients at 10 years of age it is recommended to follow the eruption of the PDC every 6 months with periapical radiographs without previous interceptive extraction, while waiting for spontaneous eruption. However, if the alpha angle is >30 degrees one might consider exposure of the PDC immediately, without an interceptive extraction.

320 MECHANICAL STABILITY PROPERTIES OF ORTHODONTIC MINI-IMPLANTS. AN *IN VITRO* STUDY

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AIM: Orthodontic mini-implants with diameters in the range of 1.5-2 mm have been clinically established for anchorage control. During insertion and loading with active elements, such devices are subjected to high mechanical loads which may reach their stability limit. The aim of this study

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was to evaluate and compare the biomechanical properties of two commercially available mini-implants for skeletal anchorage in the maxilla and mandible.
MATERIALS AND METHOD: Two types of mini-implants (PSM Quattro® implants with a size of Ø 1.5 × 9 mm and Ø 2 × 9 mm) were mechanically tested using a universal testing machine (Zwick/Roell Zwicki Z2.5 TS). The following variables were determined: 1. maximal axial torque until implant fracture, 2. axial torque during insertion in a Cortex® artificial bone piece (20 × 20 × 12.7 mm) without a pilot hole and 3. maximum horizontal force (90° toward implant axis) and axial force applied at the implant head until the test specimens lost anchorage in the artificial bone. Ten specimens of each mini-implant type were tested.
RESULTS: The 1.5 mm and 2.0 mm diameter implants broke at axial loads of 30.54 ± 3.55 Ncm and 56.16 ± 7.53 Ncm, respectively. Maximal axial insertion torque values ranged from 8.61 ± 0.59 Ncm (1.5 × 9 mm implants) to 14.53 ± 1.13 Ncm (2 × 9 mm implants). The 1.5 × 9 mm implants showed mean axial and horizontal pullout forces of 345.89 ± 13.35 N and 382.1 ± 32.04, respectively, compared to 424.55 ± 13.86 N and 505.39 ± 8.89 N, respectively for the 2 × 9 mm implants.
CONCLUSIONS: The maximal axial torque during implant insertion was approximately four times lower than the maximal axial torque in the fraction tests. Therefore, the risk of implant breakage during insertion is very low. Vertical and horizontal pullout forces in artificial bone (i.e. primary stability of the implants) were much higher compared to forces applied during orthodontic therapy. Hence, both the mechanical stability of the tested implants as well as their primary stability are sufficient for clinical application.

PSM Medical Solutions (78532 Tuttlingen, Germany) sponsored this study.

321 EXPERIMENTAL FRICTIONAL FORCES PRODUCED BY DIFFERENT TYPES OF LIGATURES DURING SIMULATED INTRUSION-EXTRUSION IN A THREE-BRACKET MODEL

Konstantinos Naziris, Falko Schmidt, Bernd G. Lapatki, Department of Orthodontics, University Ulm, Germany

AIM: Since clinical monitoring of applied forces and moments during fixed appliance therapy are currently not possible, wire testing in a three-bracket model provides important information for orthodontic practitioners. So far, such tests have been mostly performed with continuous deflection of the middle bracket, which means that the measured loads are the sum of the wire deflection forces and the experimental frictional forces at the bracket-wire-ligature interface. The aim of the present study was to quantify the experimental friction for different ligature modes during dynamic measurements in the three-bracket model, and to determine the actual deflection properties of orthodontic levelling archwires without frictional forces.
MATERIALS AND METHOD: Four levelling wires (0.012, 0.014 and 0.016 inch Biolingual® and 0.016 × 0.016 inch Titanol®) were tested in a three-bracket set-up equipped with a three-dimensional force-moment sensor at each bracket. A first test included continuous deflection and return movement of the middle bracket (simulated intrusion/extrusion). This 'dynamic test' contained experimental friction and was performed using either elastic ligatures, or tight or loose steel ligatures. To determine the pure deflection characteristics of the wire without experimental friction, the same experimental movement was carried out in 0.1 mm steps with removal and reinsertion of the wire for each step (static approach). The results of dynamic and static tests were compared. Each test was repeated three times using new wires and new ligatures.
RESULTS: The mean unloading forces were significantly greater for the static tests when compared to the dynamic tests for all tested wires ($P < 0.01$, Kruskal-Wallis test). For instance, the mean plateau force for the 0.016 inch Biolingual® wire in the static test was at 2.85 N, while the corresponding force determined in the dynamic test was only 1.51 N (elastic ligatures), 0.52 N (tight steel ligatures) and 1.47 N (loose steel ligatures).
CONCLUSIONS: Clinically, in the initial phase after wire insertion friction is not yet present. Thus, a levelling wire exerts its pure deflection forces and moments. Dynamic tests in a three-bracket-model containing variable experimental friction lead to a considerable underestimation of initially occurring

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forces by up to 81 per cent. This aspect has to be considered during the selection of an appropriate levelling archwire.

322 THE INFLUENCE OF CORTICAL BONE THICKNESS ON MINISCREW MICRODAMAGE

Melissa Nguyen[1], John Codrington[1], Lloyd Fletcher[2], Craig Dreyer[1], Wayne Sampson[1], [1]The University of Adelaide, Australia and [2]University of Southampton, Hampshire, U.K.

AIMS: To investigate the influence of cortical bone thickness on the amount of surface microdamage produced following insertion of an orthodontic miniscrew (OM) in porcine tibia bone
MATERIALS AND METHOD: Aarhus OMs (diameter 1.5 mm; length 6 mm) were inserted into 1.0 mm (group A; n = 10), 1.5 mm (group B; n = 10) and 2.0 mm (group C; n = 10) porcine cortical bone using a torque-limiting hand screwdriver set at 18 Ncm. A sequential staining technique was used to identify microdamage under laser confocal microscopy. Virtual slices were stitched together using ImageJ software to form a compressed two-dimensional composition of the microdamage. The ImageJ software was used to quantify the total damage area, diffuse damage area, maximum crack length, maximum damage radius, and maximum diffuse damage radius. Kruskal-Wallis tests and Wilcoxon Rank-Sum tests were used to analyse the data.
RESULTS: All OMs in group A (1.0 mm) inserted completely; however, two OMs from group B (1.5 mm) and all OMs in group C (2.0 mm) failed to insert completely. The entry surface of group C (2.0 mm) exhibited a significantly higher amount of total damage, diffuse damage area, maximum crack length, and maximum crack damage radius compared with groups A (1.0 mm) and B (1.5 mm). The maximum crack length observed on the entry and exit surfaces ranged from 1.03 to 3.06 mm.
CONCLUSION: This study demonstrated a higher level of microdamage following insertion of OMs into 2.0 mm thick cortical bone compared with 1.0 mm thick cortical bone. Therefore, clinicians need to consider the thickness of the cortical bone at the insertion site, as mechanisms to reduce cortical bone thickness would likely reduce the amount of microdamage formed. A safety zone of 3.5 mm from the OM is also recommended for OMs inserted into 1.0-1.5 mm cortical bone thicknesses, to minimise any detrimental effects following targeted remodelling.

323 AGREEMENT BETWEEN PATIENTS WITH A CLEFT, THEIR PARENTS AND DOCTOR ON THE CLEFT HEARING, APPEARANCE AND SPEECH QUESTIONNAIRE IN TWO POPULATIONS

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AIM: To investigate agreement on the satisfaction of appearance, hearing, and speech between patients with a cleft, their parents, and clinician using the Cleft Hearing, Appearance and Speech Questionnaire (CHASQ) in two populations.
SUBJECTS AND METHOD: The CHASQ is a 15-item questionnaire, with each item having an interval rating scale of 0 to 10 where score 10 indicates the highest level of satisfaction. The CHASQ was translated into Vietnamese and Estonian. The sample included 29 Vietnamese patients (41.4% males; mean age = 12.6 years) and 27 Estonian patients (59.3% males; mean age = 11.9 years) with repaired non-syndromic cleft lip and/or palate. The questionnaire was completed independently by patients, their parents (mother or father), and one orthodontist. The orthodontist evaluated both Vietnamese and Estonian patients. An independent samples *t*-test and one-way ANOVA with *post hoc* Bonferroni test were used.
RESULTS: Vietnamese patients self-rated their appearance in 13 items significantly lower than Estonian patients. For example, the mean scores of satisfaction with the 'face' of Vietnamese and Estonian patients were 6.2 ± 3.1 and 8.3 ± 2.5, respectively ($P < 0.05$). Within the Vietnamese sample, patients self-rated their appearance lower than their parents and the clinician in six items. For example, the mean scores of satisfaction with the 'chin' of the patient, parents, and the clinician were 7.0 ± 2.4, 8.6 ± 1.3, 9.1 ± 0.6, respectively ($P < 0.05$). In the Estonian sample, there was no disagreement between patients, parents, and the orthodontist except in the items 'whole appearance' and 'teeth' which patients self-rated higher than their parents and the clinician significantly. The orthodontist scored eight items in appearance significantly lower in Vietnamese

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patients than in Estonian patients. There was no significant difference in hearing and speech satisfaction between the two countries from patients, parents, and the doctor's views.
CONCLUSIONS: Vietnamese patients with a cleft were less satisfied with their appearance than Estonian patients. The clinician was less satisfied with the appearance of Vietnamese patients. The difference could be because of cultural or treatment outcomes. No differences in the satisfaction with speech and hearing between the patients, parents, and the doctor were found.

324 SNORING AND DEVELOPMENT OF THE PRIMARY DENTITION AND SOFT TISSUE PROFILE

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AIM: To study the association between snoring and development of the primary and soft tissue profile. It was hypothesized that non-snoring children have more optimal development of the primary dentition and a straighter soft tissue profile than snoring children.
SUBJECTS AND METHOD: Thirty two snoring and 20 non-snoring children recruited as subsample from the Child Sleep Study on importance of sleep from social, cognitive and emotional perspectives studied from birth onwards. Children considered to snore were identified based on the caregiver's written report. A child was classified as a snorer if he/she snored >3 nights/week at age of 8 or 24 months. At the age of 24 months an otolaryngological examination included assessment of breathing habit (nose/mouth), palatine tonsils size (Friedman's tonsil classification) and adenoid size (nasofiberscopy). At 30 months a dental examination was undertaken including sagittal relationship of the second primary molars, overjet, overbite, crowding and lateral crossbite. An occlusal bite index was obtained to measure upper dental arch transverse dimensions and a profile photograph to define soft tissue morphology. Differences between breathing habit, tonsil size, occlusal characteristics and upper dental arch measurements in the two groups were tested with Fisher's exact test and soft tissue profile measurements with the Mann-Whitney test.
RESULTS: Mouth breathing was significantly (P = 0.035) more common among snorers. No significant difference was found when comparing palatine tonsil size between the groups. There was tendency for the adenoid size to be larger among snorers (P = 0.13). Although this was a non-snoring group there were fewer children with increased overjet, open bite and crowding, statistical analysis did not reveal significant differences between non-snorers and snorers in the occlusal characteristics (P > 0.05). A statistically significant difference was found between the groups for soft tissue profile; non-snorers had, on average, a straighter profile than snorers (P = 0.044).
CONCLUSIONS: Snoring in young children is abnormal and the early/first sign of sleep-disordered breathing. Within the limitations of the small sample size and short follow-up, the hypothesis is not fully supported. The present findings suggest that non-snorers did not have more optimal development of early primary dentition but may have a straighter soft tissue profile than children snoring >3 nights/week.

325 APPLICATION OF ORTHODONTIC FUNCTIONAL APPLIANCES IN FEMALE PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA

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AIM: To assess the outcome of orthodontic functional appliance in the treatment of obstructive sleep apnoea (OSA) in females, clinical findings and OSA symptoms confirmed by polysomnography in 10 patients were studied.
SUBJECTS AND METHOD: At baseline and after the trial, all patients underwent clinical assessments and standard polysomnography. Apnoea, habitual snoring and body movement were confirmed by a husband before and during the trial to identify the clinical findings.
RESULTS: In the 10 treated female subjects who completed the study and follow-up, polysomnography showed a significant decrease in the apnoea-hypopnoea index, lowest SpO_2 and

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mean SpO_2. Questionnaire responses before and after treatment showed a decrease in the severity of symptoms.
CONCLUSIONS: An orthodontic functional appliance can be an effective sleep splint treatment for female patients with OSA.

326 STABILITY OF A MINISCREW-SUPPORTED TOOTH AS INDIRECT ANCHORAGE

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AIM: To evaluate the stability of a miniscrew-supported tooth during adjunctive orthodontic treatment and to investigate factors that affect stability.
SUBJECTS AND METHOD: Twenty eight patients (15 males, 13 females) who received adjunctive orthodontic treatment using indirect anchorage with a miniscrew. The experimental group (n = 52) was composed of miniscrew-supported teeth connected to the miniscrew by a rigid wire. The control group (n = 55) was composed of the opposing first and second premolars in the same dental arch, which were not included in the treatment. Every study model was scanned digitally, and the scanned models before and after treatment were superimposed based on the anterior third palatal rugae. The amount and direction of tooth movement and possible affecting factors were analyzed.
RESULTS: In the experimental group, the amount of tooth movement was 0.9 mm on average, which was significantly larger than the amount of movement in the control group. The movement of the indirect anchored tooth was significantly larger than that of the untreated tooth in the transverse, sagittal and vertical planes. However, there was no significant difference among the three planes in either group. The location of the miniscrew-supported tooth was the only factor to affect stability; the movement of indirect anchored tooth was larger in the mandibular arch than in the maxillary arch.
CONCLUSIONS: Indirect anchorage can be used effectively during adjunctive orthodontic treatment. However, the occlusal plane may be affected by less than 1 mm which should be carefully monitored.

327 THE LEVEL OF SATISFACTION AFTER ORTHODONTIC TREATMENT AND ITS INFLUENCING FACTORS ON ADULT PATIENTS

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AIM: To investigate the level of satisfaction after orthodontic treatment and to evaluate possible influencing factors in adult orthodontic patients.
SUBJECTS AND METHOD: A questionnaire was developed to examine the level of treatment satisfaction and possible influencing factors. The questionnaire was designed to measure the level of satisfaction including overall satisfaction, treatment effects (tooth alignment, facial appearance, eating and chewing, self-confidence), retention state, treatment duration, treatment costs, intention to recommend orthodontic treatment to others, and relief of previous concerns using a five point Likert scale (1, very unsatisfied ~ 5, very satisfied). In addition, the possible influencing factors including the host factor (age and gender), pre-treatment psychological state (motivation and expected concerns), and discomfort during/after treatment were examined. The survey cohort consisted of 298 patients in the retention stage after orthodontic treatment in adulthood (>18 years). *t*-test, analysis of variance and multiple regression analysis were used to analyze the relationship between gender, age, and psychological state of treatment on satisfaction.
RESULTS: The overall satisfaction level (the % of very satisfied and satisfied) of adult patients was 84.9 per cent. The male patients were more satisfied than female patients ($P < 0.01$), and those over 50 years were more satisfied than those aged 40 years ($P < 0.05$). Patients whose motives for treatment were improvement of facial appearance showed higher levels of satisfaction compared to others ($P < 0.001$). Patients who had previous concerns of visiting hospitals regularly for orthodontic

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treatment showed a lower level of satisfaction compared to others ($P < 0.01$). Patients who expressed discomfort on assistance during administration showed a lower level of satisfaction compared to others ($P < 0.05$).
CONCLUSIONS: More than 84 per cent of adult patients were satisfied with the orthodontic treatment outcome. Host factors such as age, gender and motivation, expected concern before treatment, and discomfort during/after treatment may influence the level of satisfaction.

328 IMPLICATIONS OF DESIGNATING MAXILLARY EXPANSION ACTIVATION TO PARENTS ON THE ACTIVATION PROTOCOL

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AIM: Rapid maxillary expansion (RME) is a widely used orthodontic procedure and the most effective in correcting transverse deficiency by opening the mid palatal suture in prepubertal or pubertal subjects. Being the activation is applied with a daily rhythm, it is fundamental and mandatory to designate and instruct the parents on how to rotate the expansion screw and follow the activation protocol as planned by the orthodontist. Consequently, the importance of the maxillary expander activation protocol on the achievement of the desired dentoskeletal effect in maxillary arch gives to the parents' assiduousness and ability a crucial role on this orthodontic procedure. The aim of this study was to analyse the correspondence between the reported number of activations and the reality.
SUBJECTS AND METHOD: One hundred and fifteen patients for whom the RME procedure was indicated were included. The parents were instructed regarding the correct procedure and invited to record the number of activations made. After the end of palatal expansion, the number of quarter-turns were counted and related to the prescribed activations.
RESULTS: Of a total of 115 patients, in 47 cases an involuntary mistake during the activation procedure was presumably made (i.e. 40.86% of the sample). The errors committed were compared to the prescribed activations. In 63.3 per cent of cases (30 caregivers), the wrong activations concerned only one to three quarter-turns, totally. Caregivers who were prescribed two quarter-turns per day made errors more frequently than caregivers who had been prescribed only one quarter turn per day; they showed a relative risk of error of 1.96 greater than patients who were prescribed one quarter-turn per day (odds ratio 1.96; chi-square: 2.997; confidence interval: 0.91-4.22, $P = 0.0834$).
CONCLUSIONS: Although in most cases the entity is slight, it is not uncommon that there may be errors in following the RME protocol of activation. It is necessary, especially when many activations are prescribed, and a protocol with two activations per day is chosen, to pay close attention to the control of the activations by parents.

329 THE MHC-APP GIVES YOU THE OPPORTUNITY TO EASILY FIND INFORMATION ABOUT ORAL HEALTH, OROFACIAL FUNCTION AND CRANIOFACIAL MORPHOLOGY IN RARE DISEASES

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AIM: To spread information about oral health, orofacial function and craniofacial morphology in rare diseases
MATERIALS AND METHOD: The MHC-app is a non-profit app developed at the Mun-H-Center, which is a national orofacial resource centre for rare diseases and a specialist dental clinic belonging to the public dental service in Västra Götaland, Sweden. The information included in the app is mainly retrieved from the following sources: the database on rare diseases from The Swedish National Board of Health and Welfare, documentation from the Ågrenska centre for rare diseases, scientific publications and the MHC-database on rare diseases. Data for the MHC-database have been collected through the Mun-H-Center assessment forms.

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RESULTS: The MHC-app was released in 2012 in Swedish and in English. In May 2015 the app was supplemented with practical advice on how to introduce children to dental care and with some advice on oral care for children. At present the MHC-database contains data from more than 3330 individuals representing 260 different rare diseases and the MHC-app contains, so far, 74 of them. The MHC-app is extended every year with information on five new rare diseases. There is an increase in downloads; for example there is an increase of 4 per cent on Iphone during 2016 until November. The app has received a high score from the users.
CONCLUSIONS: The MHC-app gives the opportunity to simply and rapidly find information about rare diseases and how these conditions might have an impact on oral health, orofacial function and craniofacial morphology. Any advice given in the application is based on Swedish recommendations and checks will need to be made with dental healthcare advisors as to the recommendations in other countries.

330 NASAL OBSTRUCTION INDUCES MEMORY AND LEARNING IMPAIRMENT AND DECREASES THE NUMBER OF HIPPOCAMPAL NEURONS IN GROWING MICE

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AIM: Mouth breathing caused by nasal obstruction during the growth period (comprising preadolescence and adolescence) is a widely known aetiological factor for craniofacial and occlusal complications. In orthodontic practice, patients often present with maxillary protrusion and/or an anterior open bite, problems frequently related to mouth breathing and nasal obstruction. Moreover, recent studies report that children with nasal obstruction show decreased learning ability when compared to children without nasal obstruction. The hippocampus is an important brain region in memory and learning ability. In the hippocampus, brain-derived neurotrophic factor (BDNF) and tyrosine kinase receptor B (TrkB) play important roles in structural change and contribute to the development of neurons, synaptic functions, memory, and learning ability. In the present study, the aim was to investigate the mechanism of nasal obstruction during the growth period and relate nasal obstruction to impaired memory and learning ability using a combined behavioural, biochemical and histological approach.
MATERIALS AND METHOD: Male C57BL/6J mice (6-day-olds) were randomly divided into control (n = 8) and experimental (n = 8) groups. The experimental group underwent unilateral nasal obstruction by cauterization at postnatal day 8. At the age of 15 weeks, a passive avoidance task was performed. After the behavioural experiment, the mice were sacrificed and their brains were removed. Western blotting was performed on the right hippocampal tissue to measure expression levels of BDNF, TrkB, and β-actin. Haematoxylin and eosin staining was performed on the left hippocampi to determine the number of neural cells in CA1 and CA3 regions.
RESULTS: The passive avoidance test revealed a decline in memory and learning ability for the experimental relative to the control group. In line with the behavioural result, expression levels of both BDNF and TrkB were lower in the hippocampi of the experimental than the control group. Moreover, the number of neural cells in CA1 and CA3 regions of the hippocampus were significantly lower in the experimental than in the control group. Importantly, no significant difference in expression levels of hippocampal β-actin was observed between the two groups.
CONCLUSIONS: Nasal obstruction during the growth period caused neuronal loss in the hippocampus, resulting in memory and learning impairment.

331 VISUAL EVALUATION OF DIGITAL PANORAMIC RADIOGRAPHIC IMAGES VARIED BY EXPOSURE CONDITIONS

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AIM: To evaluate the effect of X-ray dose and beam quality on the visualization of diagnostic structures varied by exposure factors in digital panoramic radiography

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MATERIALS AND METHOD: Digital panoramic images were taken at various kV (60, 70 and 80 kV) and mAs (8, 16, 32, 48, 64, 96 and 160 mAs). Twelve diagnostic structures: pulp angle, tooth fracture line, enamel border, periodontal membrane, mental foramen, mandibular canal, trabecular bone, alveolar cortex, mandibular fossa, mandibular condyle, zygomatic arch and maxillary sinus, were evaluated by eight dental radiologists for their visualization.
RESULTS: For all structures, except the mandibular fossa and condyle, the dose effectiveness for the best visualization was 60 kV. For the mandibular fossa and condyle, it was 70 kV. In general, a radiation dose of 5.10 $cGycm^2$ was the lowest dose to achieve an effective diagnosis.
CONCLUSIONS: The mandibular fossa and condyle were the areas that gave different results for dose effectiveness from other structures in the jaw bone in digital panoramic image, and may need further research in this issue.

332 IMPACT OF ORTHODONTIC TREATMENT COMPLEXITY ON ORAL HEALTH RELATED QUALITY OF LIFE

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AIMS: To investigate the association between orthodontic treatment complexity and oral health-related quality of life (OHRQoL) in adults and adolescents who have undergone orthodontic treatment, and to compare quality of life according to age and gender.
SUBJECTS AND METHOD: One hundred and two patients who had registered for orthodontic treatment in the years between 2013-2015. The inclusion criteria were patients between 13-35 years of age, planning for comprehensive fixed orthodontic treatment. Patients with missing teeth except third molars, dental caries or periodontal problems, craniofacial anomalies or chronic medical problems, temporomandibular joint problems and those who had previously received any type of orthodontic treatment were excluded from the study. Before orthodontic treatment clinical evaluation was performed using the models and photographs of the patients and the Index of Complexity, Outcome and Need (ICON) was used to determine orthodontic treatment complexity. According to ICON scores, the subjects were divided into five groups as follows: 10.8 per cent were easy, 37.3 per cent were mild, 14.7 per cent were moderate, 10.8 per cent were difficult and 25.5 per cent were very difficult. The ICON was measured independently by two trained and calibrated examiners. To assess intra- and inter-examiner reliability, 20 subjects not included in the present study were randomly selected and reexamined 2 weeks after their initial examination. The kappa values were 0.85 for inter- and 0.95 and 0.99 for intrarater reliability. Surveys including OHIP-14 and sociodemographic datas were applied to the patients before and 1 month after orthodontic treatment.
RESULTS: There was no statistically significant difference between the groups of complexity in THE total Oral Health Impact Profile-14 scores, in both the pre- and post-treatment evaluation. The difficult group showed a statistically significant difference in subscale of pre-treatment psychological disability, compared to the moderate group ($P < 0.05$). According to pre-treatment scores, girls showed a significantly greater impact on the physical pain domain compared to boys and adults showed a significantly greater impact on the psychological discomfort and psychological disability domains compared to adolescents ($P < 0.05$).
CONCLUSION: Malocclusion has a significantly negative effect on OHRQoL and orthodontic treatment has a positive impact on patients' quality of life. There is no statistically significant relationship between orthodontic treatment complexity and OHRQoL.

333 ARE WE ASSESSING AND REPORTING RADIOGRAPHIC QUALITY AND FINDINGS?

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AIM: To assess compliance with Radiation (Medical Exposures) Regulations 2000, on reporting quality and radiographic findings in the records (either paper, electronic or both) of patients seen in

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new patient clinics in the orthodontic department at Guy's and St Thomas' Hospital over a 5 month period. For this initial audit a standard of 90 per cent reporting of radiographic quality and findings was set, with the view to aiming for 100 per cent in future cycles.
MATERIALS AND METHOD: A prospective audit assessing consecutive new/review patients seen at new patient clinics from July to November 2016. Those who had radiographs taken were included and their medical records (paper and electronic) reviewed to assess whether quality and findings were reported on. The reporting of copies of radiographs sent from outside practices and recording of quality undertaken by radiologists was also recorded.
RESULTS: In total 78 patients were included. Justification for the radiographs taken included; assessment of dental development (42.3%), impacted/unerupted teeth (30.8%), missing teeth (6.4%), other (7.7%) and unknown (11.5%). Of all radiographs included, radiographers graded on the radiographic viewing electronic system 69 per cent as grade 1 quality, 24 per cent grade 2, 0 per cent grade 3 and 5 per cent were ungraded. The radiographic findings were reported by clinicians in the electronic (47.4%), paper records (26.9%), both (7.7%) or unreported (17%). Only 19.2 per cent of clinicians reported on the quality of the radiographs taken. Twenty three per cent (18/78) of patients included in the audit had copies of previous radiographs attached to their referral letter; 20.5 per cent were paper, 1.3 per cent digital and 1.3 per cent film copies, yet only 14.1 per cent of these patient referral letters mentioned the radiograph attached. For these, only 3/18 and 7/18 had their quality and findings reported on.
CONCLUSIONS: The gold standard of 90 per cent reporting of quality was achieved by radiographer's reporting of these on the electronic viewing system (95% reported). However, this was only reported on by 19.2 per cent of clinicians in the clinical records. The radiographic findings were reported by clinicians in the medical records in 83 per cent of cases (with the majority of the reporting 47.4% occurring on the electronic records). Therefore, the 90 per cent gold standard was not achieved. Action points will be implemented and a re-audit undertaken.

334 PREVALENCE OF MALOCCLUSION AND ORTHODONTIC TREATMENT NEED IN INDIGENOUS SOUTH AMERICAN ADOLESCENTS
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AIM: Malocclusion is a common dental problem in adolescents. The aim of this study was to assess the prevalence of malocclusion and orthodontic treatment needs among indigenous adolescents living in the Titicaca lake, Peru.
SUBJECTS AND METHOD: This cross-sectional study was conducted among 286 school children living on the islands of Amantani and Taquile in the Titicaca Lake in Peru. The prevalence of malocclusion and orthodontic treatment need was assessed using the Index of Complexity, Outcome and Need (ICON). General information on demographic data was also recorded. Chi-square and Fisher's tests were employed for statistical analysis.
RESULTS: Malocclusion and orthodontic treatment need was reported among 55 per cent of the participants. Severe malocclusion affected almost 20 per cent of the population. The mean ICON score was of 47.81. Boys had a greater orthodontic treatment need (53.5%) than girls (46.5%) although not statistically significantly (P = 0.094). No student reported having orthodontic treatment or an orthodontic consultation.
CONCLUSIONS: Orthodontic treatment need among 55 per cent of adolescents living in these isolated islands calls for developing government supported programmes addressing prevention and early interceptive treatment of malocclusion.

335 A NEW EXPANSION APPLIANCE COMPARED WITH THE ROUTINE THREE-AXIS EXPANSION APPLIANCE IN TERMS OF DENTAL ARCH CHANGES AND PATIENT PROBLEMS DURING TREATMENT***
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AIM: To clinically compare a new expansion appliance with the routine three-axis expansion appliance in terms of dental arch changes and patient problems during treatment.
SUBJECTS AND METHOD: Thirty eight patients (8-14 years old) with bilateral posterior crossbite and skeletal growth potential were selected. They were randomly divided to two groups: 1) new expansion screw group. 2) three-axis expansion screw group. The measurements of dental arch dimensions on study models and reports of patient problems by questionnaires were accomplished every month. For comparison of the two groups, *t*- and Mann-Whitney *U*-test statistical analyses were used.
RESULTS: There were no significant differences between the two groups in terms of the mean increase in intermolar, interpremolar and intercanine widths ($P > 0.05$). The mean score of problems during use of the appliances in the two groups was not significantly different ($P > 0.05$).
CONCLUSIONS: Since the changes in dental arches and patient problems with the new expansion appliance were comparable to the three-axis expansion appliance and the new appliance requires less patient cooperation for activation of the screw, this new expansion screw can replace routine expansion screws.

336 CEPHALOMETRIC ANALYSIS IN THE DIAGNOSIS OF TONGUE DYSFUNCTION‡‡‡
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AIM: To determine whether the degree of inclination of the upper or lower incisors differentiates patients with a skeletal Class II malocclusion with or without tongue dysfunction diagnosed by other methods.
SUBJECTS AND METHOD: Sixty nine subjects aged 10 to 13 years with a diagnosis of skeletal Class II on the basis of cephalometric images. The patients, who were enrolled for orthodontic treatment and were in the process of orthodontic diagnostics, were divided into two groups according to the parameter ML-NSL using the cephalometric analysis of Hasund and Segner, and the presence of tongue dysfunction.
RESULTS: In patients with a known skeletal Class II, a statistically significant difference in the UL^NA parameter was observed between the treated and untreated group ($P < 0.01$). There was no statistically significant difference in the LI^NB parameter between the treated and untreated group, both with a skeletal Class II ($P > 0.05$). In the subgroup of the mesocephalic, there was no statistically significant difference in UL^NA or LI^NB parameters between the treated and untreated group, both with a skeletal Class II ($P > 0.05$). In the subgroup of the dolichocephalic, on the contrary, a statistically significant difference in the UL^NA parameter was observed between the treated and untreated groups, both with skeletal Class II ($P <0.05$) but not in the LI^NB parameter ($P > 0.05$).
CONCLUSIONS: Cephalometric imaging can be a helpful tool in the diagnosis of tongue dysfunction in patients with a skeletal Class II.

337 EVALUATION OF ORAL HYGIENE PRACTICES IN ORTHODONTICALLY TREATED CHILDREN WITH ASPERGER SYNDROME
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AIM: To evaluate oral hygienic practices in orthodontically treated children with Asperger Syndrome (AS) and a control group using questionnaires.
SUBJECTS AND METHOD: Questionnaires were collected from 30 children (from 8 to 12 years old) diagnosed with AS who were treated with orthodontic removable appliances (group A). The control group consisted of healthy children matched by age who were also using removable appliances (group B). Children answered the questionnaire, which included eight questions on oral hygiene practices, without parental participation.
RESULTS: The mean pain during tooth brushing in the group A was 2.84 (± 2.81) and in group B – 0.53 (± 0.83). The differences were statistically significant ($P < 0.001$). Group A children brushed their teeth less and less frequently than in the group B; the difference was statistically significant ($P = 0.047$). No statistically significant differences were seen in the application of tools supporting oral

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hygiene such as dental floss, mouthrinses, tongue brushes, water irrigators and interdental toothbrushes. Most of the children in the group A brushed their teeth for one minute, while most of the children in the group B brushed for two minutes or more (P = 0.002). Children with AS liked a taste of a toothpaste less (mean 4.67 ± 3.43) when compared to controls (average 2.62 ± 2.98). The difference was statistically significant (P = 0.008).
CONCLUSIONS: Orthodontically treated children with AS expressed less care for oral hygiene when compared to orthodontically treated healthy children. This may be related to differences in touch and smell perception in children with AS. More emphasis and supervision of oral hygiene in this group of patients during orthodontic treatment is recommended.

338 EFFECTS OF MANDIBULAR RETRUSIVE DEVIATION ON PREFRONTAL CORTEX ACTIVATION: A FUNCTIONAL NEAR-INFRARED SPECTROSCOPY STUDY

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AIM: Some studies have reported that occlusal dysfunction affects the stress response via changes in brain activity and leads to non-oral health problems. The objective of this study was to evaluate occlusal conditions by assessing brain activity in the prefrontal cortex, which is associated with emotion.
SUBJECTS AND METHOD: Functional near-infrared spectroscopy (fNIRS) was used to detect changes in cerebral blood flow in the prefrontal cortex of 12 healthy volunteers. The malocclusion model was a custom-made splint that forced the mandible into retrusion. A splint with no modification was used as a control. The cortical activation during clenching was compared between the retrusive position condition and the control condition. A visual analogue scale (VAS) score for discomfort was also obtained during clenching and used to evaluate the interaction between fNIRS data and psychiatric changes.
RESULTS: Activation of the prefrontal cortex was significantly greater during clenching in the mandibular retrusive condition than during clenching in the control condition. Furthermore, Spearman rank correlation coefficient revealed a parallel relationship between prefrontal cortex activation and VAS score for discomfort.
CONCLUSIONS: These results indicate that fNIRS can be used to objectively evaluate the occlusal condition by evaluating activity in the prefrontal cortex.

339 THE EFFECT OF TONGUE POSTURE ON JAW MORPHOLOGY IN PRE-PUBERTAL CLASS III CHILDREN: A THREE-DIMENSIONAL EVALUATION

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AIM: To assess the role of the tongue posture on jaw morphology in children with a Class III malocclusion in the pre-pubertal stage using non-invasive three-dimensional (3D) imaging.
SUBJECTS AND METHOD: Forty seven Class III children [14 children in the primary dentition (7 girls, 7 boys, aged 5.3 ± 0.7 years) and 33 children in the early mixed dentition (18 girls, 15 boys aged 7.4 ± 1.0 years) and 34 non-Class III children [9 with primary teeth (3 girls, 6 boys aged 5.2 ± 0.3 years) and 25 children in the early mixed dentition (10 girls, 15 boys aged 6.1 ± 0.5 years)]. Maxillary and mandibular morphology was assessed by measuring the gingival surface area, palatal/lingual surface area, and volume of the palatal vault and mouth floor on 3D digital models using Rapidform 2006 (INUS Technology Inc., South Korea). Tongue posture was assessed using a 3D ultrasound system (Voluson 730 Expert, RAB 2-5 MHz, General Electrics Healthcare, Austria) and 3D reconstructions were made using 4D View 5.0 (General Electrics Healthcare, USA). The groups were compared using a non-parametric test (Mann-Whitney U-test). The statistical significance level $P < 0.05$ was used.
RESULTS: Class III children had significantly greater values of the gingival surface area of the lower jaw in the early mixed dentition compared to non-Class III children (P = 0.038), while the mouth floor volume showed no difference ($P > 0.05$). Moreover, the ratio between palatal surface area and mouth floor area was statistically significantly lower in Class III children than in non-Class III children in early mixed dentition (P = 0.004), but no statistically significant differences were found in the

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primary dentition. Prevalence of tongue posture on the mouth floor was significantly higher in children with a Class III malocclusion ($P < 0.05$).
CONCLUSIONS: Tongue posture on the mouth floor is prevalent in children with a Class III malocclusion and is associated with the dentoalveolar characteristics of the maxilla and mandible in the early mixed dentition. Therefore, treatment of irregular tongue posture should be considered in the primary dentition to prevent adverse effects on jaw morphology.

340 EFFECTS OF SKELETALLY ANCHORED CLASS II ELASTICS: A PILOT STUDY AND A NEW APPROACH FOR THE TREATMENT OF CLASS II MALOCCLUSION

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AIM: To evaluate the skeletal, dentoalveolar, and soft tissue effects of skeletally anchored Class II elastics and to compare the findings with a well-matched control group treated with a monobloc appliance for the correction of a skeletal Class II malocclusion due to mandibular retrusion.
SUBJECTS AND METHOD: Twelve patients (6 girls, 6 boys) randomly divided into two groups. In group I, six patients (12.9 ± 1.5 years of age; 3 boys, 3 girls) were treated with skeletally anchored Class II elastics; two miniplates were placed bilaterally at the mandibular ramus and the other two miniplates at the maxillary aperture priformis area. In group II (3 boys, 3 girls, mean age 12.3 ± 1.6 years), a monobloc appliance was used. The changes observed in each phase of treatment were evaluated using Wilcoxon matched pairs sign test. Intergroup comparisons at the initial phase of treatment were analyzed using the Mann-Whitney *U* test.
RESULTS: There were statistically significant group differences in Co-Gn, B-VRL, U1-PP, U1-VRL, Ls-VRL, with significant increases of these parameters in the miniplate anchored Class II elastic group ($P < 0.05$). The mandibular incisors were protruded in the monobloc group (5.45 ± 1.23), whereas they were retruded in the miniplate anchored Class II elastic group (–3.01 ± 1.66; $P < 0.01$). Significant forward movement of the lower lip was found in the monobloc group ($P < 0.05$). No significant differences were observed between the groups concerning maxillary, maxillomandibular and vertical parameters ($P > 0.05$).
CONCLUSIONS: The undesirable dentoalveolar effects of the monobloc appliance were eliminated with utilization of miniplate anchorage. Favourable skeletal outcomes can be achieved by skeletal anchorage therapy which could be an alternative to treat skeletal Class II patients with mandibular deficiency.

341 IS THE TREADLOK BRACKET BASE MORE DURABLE THAN THE MESH BRACKET BASE?

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AIM: Treadlok bracket bases have deep channels which allow air bubbles to escape and create a strong bond strength. This treadlok base provides reinforced channels for multi-directional sheering protection. The aim of the study was to compare the shear bond strength (SBS) of two types of orthodontic bracket bases, treadlok and mesh.
MATERIALS AND METHOD: Forty two extracted human premolar teeth were divided into two groups and the roots of the teeth were embedded in self-cure acrylic in a vertical position. In each groups, the teeth were etched with 37 per cent phosphoric acid for 15 seconds and the same light cure adhesive primer applied for all teeth. All brackets were bonded by using Transbond XT adhesive (3M Unitek). American orthodontics mini-master bracket with a 80 gauge mesh base was used for 21 teeth in the first group and OrthoclassicH4 self-ligating bracket with a treadlok base in the second group. A computer aided universal testing machine (Instron Corp., Canton, Massachusetts, USA) was used for measurements of *in vitro* SBS. The brackets were stressed with a crosshead speed of 1 mm/minute. After the brackets were removed from the teeth were examined with a stereomicroscope and the adhesive remaining was assessed using the adhesive remnant index (ARI). SBS and ARI scores were considered. An independent *t*-test was used for statistical analysis.

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RESULTS: The mean SBS values of the treadlok base and mesh base groups were not statistically significant (P = 1). SBS for the first group was 153.102 ± 86.7 and for the second group 153.09 ± 71.3. ARI scores were not significantly different according to chi-square tests for each groups (P = 0.452).
CONCLUSIONS: The two types of bracket base tested in had similar SBS values. There were no significant differences in the ARI scores of the two groups.

342 INVESTIGATION OF INSULIN GROWTH FACTOR-1 GENE MUTATIONS AND POLYMORPHISMS IN NON-SYNDROMIC SUBJECTS WITH RETROGNATHIC MANDIBLES

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AIM: To determine whether there are insulin growth factor (IGF)-1 gene mutations and polymorphisms associated with mandibular retrognathism.
SUBJECTS AND METHOD: One hundred healthy subjects with a Class II skeletal pattern (ANB >4) due to a small sized mandible. To distinguish mandibular retrognathism caused by a distally positioned mandible from a small sized mandible, age-appropriate norms for maxillary length (CoA), mandibular length (CoGn), maxillo-mandibular difference, ramus length (CoGo), mandibular corpus length (GoGn) were used. Skeletal maturation was assessed from hand-wrist radiographs. Two cubic centilitres of peripheral blood was obtained from subjects and stored in 5 per cent Ethylenediaminetetraacetic acid tubes. All coding regions and flanking regions of the gene were sequenced with the next generation sequence analysis method to detect all mutations and polymorphisms of IGF-1 gene. In-house designed primers were used for this study. Data obtained from previous 200 exome sequencing studies and 1000 genome project data was used as the control data.
RESULTS: IGF-1 gene polymorphism was not detected in any of the patients. Only in one patient was a heterozygous p.C95C mutation on the third exon of IGF-1 found. This variant was classified as 'variant of unknown significance' due to in silico analysis data. Although p.C95C mutation detected in the IGF-1 gene is not included in the Human Genome Mutation Database, it is classified as a 'disease causing' according to mutation tester analysis. This classification implies that this mutation causes protein alterations but does not provide information about the extent and impact of this alteration as an aetiologic cause. Minor allele frequency was calculated as 0.005 in this study. When the values obtained in this study were compared with those obtained from different societies, it was found that this mutation has not previously been observed in African, American, East Asian, European or South Asian populations and its detection rate in ExAC data is 4/8596.
CONCLUSIONS: Mandibular deficiency is not associated with IGF-1 gene mutations and polymorphisms. Mandibular size seems like a spectrum varying widely in populations and exome sequencing data and complex statistical analysis will be needed to detect the exact effects on the mandibular size.

343 ENAMEL SURFACE QUALITY AFTER ADHESIVE REMNANT REMOVAL: A COMPARATIVE CONFOCAL MICROSCOPY STUDY

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AIM: To assess the effects of different removal variables, i.e. type of abrasive polisher, rotational speed and cooling conditions, on surface homogeneity.
MATERIALS AND METHOD: One hundred and twenty human incisors were polished with different carbide burs (Komet Torpedo H284, Komet H22ALGK and Reliance Renew 218) and the black 3M Sof-Lex disc attached to the pop-on mandrel to remove adhesive compomer remnants. Another four teeth were left untreated and served as the controls. After polishing the surfaces were scanned with a confocal microscope. The resultant surface quality was evaluated by computing the arithmetic

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area roughness (Sa), the root mean square of profile deviation (Sq), the average surface roughness (Sz), the average smoothing depth (Sp) and the mean drag line depth (Sv). Descriptive statistics were used for data analysis. Data significance was determined with the Mann-Whitney *U*-test.
RESULTS: The black 3M Sof-Lex disc showed the lowest variance of Sa. Decreasing the speed of the Komet H22ALGK bur from 120,000 to 40,000 rpm increased the variance of Sa. The distribution of the root mean square of Sq was similar to the Sa values for all abrasive instruments. Sz showed the widest variance for untreated teeth.
CONCLUSIONS: The black 3M Sof-Lex discs produced the most homogeneous and the Reliance Renew 218 the roughest enamel surfaces. Of two identical burs with different shanks (Komet H22ALKG), the one with the higher speed generated smoother surfaces.

344 MODERN METHODS OF IMAGING EVALUATION OF ALVEOLAR BONE MODIFICATIONS DURING ORTHODONTIC TREATMENT IN ADULTS

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AIM: To undertake an imaging study of the alveolar bone before and after orthodontic treatment because a great number of adult patients require orthodontic appliances. They also have a periodontal pathology, for which orthodontic biomechanics have to be applied after a careful clinical and radiological evaluation of the periodontal structures.
SUBJECTS AND METHOD: Seventeen adult patients, aged between 30-45 years, with different types of periodontal disease, orthodontically treated. To determine bone modifications, cone beam computed tomographic (CBCT) analysis was undertaken before the start of orthodontic treatment (T0) and 6 months after applying the fixed apparatus (T1). The following parameters were evaluated: the distance between the cementoenamel junction (CEJ) and the apex, the distance between the CEJ and the peak of the alveolar bone ridge and the middle thickness of the alveolar bone
RESULTS: Analyzing the three parameters of bone restructuring, no significant differences were found in the thickness of the alveolar bone between T0 and T1 for 15 patients (87%) indicating that orthodontic treatment does not negatively influence the width of the alveolar ridge. Modifications of the distance between CEJ and the apex were found in eight patients (41%) which indicates the appearance of a discreet degree of root resorption particularly for the lower anterior teeth.
CONCLUSIONS: CBCT imaging evaluation is a modern method which detects the values of the bone parameters, having a prognostic role in the degree of periodontal affectation in the adults undergoing fixed orthodontic treatment.

345 A QUESTIONNAIRE CONCERNING ORTHODONTIC RETENTION PROCEDURES IN THE NETHERLANDS AND NEW ZEALAND: A COMPARISON

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AIM: To investigate differences in orthodontic retention procedures between orthodontists from two contemporary countries in different continents.
MATERIALS AND METHOD: Identical questionnaires were sent to all registered orthodontists in the Netherlands and New Zealand. Questions were asked regarding orthodontic background, retention regimens, materials used for bonded retainers and acquaintance with active bonded retainers.
RESULTS: The response rates in the Netherlands and New Zealand were 98.0 per cent (N = 300) and 88.4 per cent (N = 81), respectively. Both populations showed similar characteristics. Males were more prevalent, older and spent more days on patient treatment. Large variations were observed in prescribed retention procedures within and between both countries. Dutch orthodontists used significantly more solitary bonded and significantly less solitary removable retention in the upper and lower arch. A retainer bonded to all anterior lower teeth was preferred by orthodontists in the Netherlands as opposed to a retainer bonded only to the canines in New Zealand. Permanent removable retainer wear was prescribed significantly more by orthodontists from New Zealand,

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versus temporary wear in the Netherlands. Dutch orthodontists preferred more often permanent – meaning life-long – fixed retention for both arches. The wire materials used for bonded retainers varied. Dutch orthodontists favoured stainless steel square multistrand and co-axial wires while orthodontists from New Zealand preferred the use of stainless steel single strand and twistflex multistrand wires. A significantly higher proportion of orthodontists in the Netherlands was aware of the phenomenon of active bonded retainers and had observed them more often. Both groups mentioned observing this phenomenon most often when round stainless steel twist-flex wires were applied.
CONCLUSIONS: Retention procedures varied largely within and between orthodontists from the two studied countries. The basis for these variations could be attributed to personal preference, differences in postgraduate training location, or insurance reimbursement policies. The difference in observing active retainers might be due to the difference in materials used for bonded retainers.

346 QUALITY OF LIFE OF ADOLESCENT ORTHODONTIC PATIENTS‡‡‡

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AIM: To assess oral health related quality of life (OHRQoL) related to relevant covariates in adolescents during orthodontic treatment.
SUBJECTS AND METHOD: Three hundred and seventy adolescent patients (6-18 years old; mean age: 14 years; 48.6% females, 51.4% males) who were under orthodontic treatment completed anonymously the German version of the Oral Health Impact Profile (OHIP-G14) to assess OHRQoL in addition to 23 items. Descriptive, explorative statistics and linear regression analysis were performed.
RESULTS: The mean score of OHIP-G14 was 8.4 (±7.1). The sub-scale 2 (pain) was the highest factor (2.3 ± 1.8). Sub-scales 3 (psychical indisposition; 1.5 ± 1.6) and 5 (psychical limitation; 1.3 ± 1.4) were also relevant factors. The linear regression model revealed that the presence of pain significantly influenced OHRQoL.
CONCLUSIONS: The findings showed that most of the 6-18 year old patients reported a good OHRQoL. In some cases, pain seems to be a relevant factor, which reduces it.

347 THE ROLE OF THE DENTAL HYGIENIST ON THE GINGIVAL HEALTH OF PATIENTS UNDERGOING ORTHODONTIC TREATMENT WITH MULTIBRACKET FIXED APPLIANCE AND CLEAR ALIGNERS

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AIM: To compare the effectiveness of oral hygiene motivation and professional oral hygiene on the gingival health of patients undergoing fixed orthodontic treatment and clear aligner therapy.
SUBJECTS AND METHOD: Thirty six ongoing orthodontic patients (24 females; 12 males, mean age 24.4 ± 7.6 years) with a full permanent dentition and free of periodontal problems. Seventeen subjects (mean age 21.9 ± 5.3 years) were undergoing a fixed orthodontic therapy [fixed group (F)], while 19 subjects (mean age 26.7 ± 8.7 years) were in treatment with clear aligners [clear aligner group (CA)]. At baseline (T0) the patients underwent an evaluation of full-mouth bleeding score and full-mouth plaque score. Subsequently, professional oral hygiene, along with periodontal scaling for removal of supra- and subgingival bacterial plaque/biofilm and calculus was undertaken. Finally, all patients were instructed in individualized tooth-brushing technique. Every two weeks, the subjects were re-called for reinforcement of the instructions of daily oral hygiene. After 2 months (T1), full-mouth bleeding score and full-mouth plaque score were re-evaluated. Intragroup comparisons (T1 versus T0) were calculated with a paired sample *t*-test. Comparisons between groups were performed with an independent sample *t*-test. The significance level was set at $P < 0.05$.
RESULTS: Intragroup comparisons showed statistically significant differences for all variables examined, except for the bleeding score of F ($P = 0.085$).The between-group comparisons revealed

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statistically significant differences for plaque score (F: –65.02 ± 15.4 versus CA: –46.37 ± 19.0; $P < 0.005$) and for bleeding score (F: –7.68 ± 16.0 versus CA –23.87 ± 13.7; $P < 0.005$).
CONCLUSIONS: The plaque and bleeding scores decreased during the study period in both groups. The current findings demonstrate that the implementation of motivational techniques and the intervention of a professional oral hygienist during orthodontic treatment are effective in the improvement of gingival health in patients with both fixed orthodontics and clear aligners, in a two month follow-up.

348 ELECTROMYOGRAPHIC ACTIVITY OF THE MASSETER MUSCLE IN PATIENTS WITH A CLASS III SKELETAL RELATIONSHIP***

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AIM: Evaluation of masticatory muscle activity with surface electromyography is a valuable tool for diagnosing dysfunction of the masticatory system. However, standardized data for Class III patients is not available. The purpose of this study was to use the standardized method to evaluate electromyographic activity of the masseter muscle in patients with a Class III skeletal relationship.
SUBJECTS AND METHOD: Thirty patients with a skeletal Class III relationship, aged 18-34 years (mean 22.3 years) and 30 subjects with a Class I skeletal relationship aged 18-35 years (mean 21.9 years). All had a normal vertical configuration, no temporomandibular disease and no previous orthodontic treatment. Standardized electromyographic activity was recorded from superficial masseter muscles in maximum clenching on cotton rolls and in maximum voluntary contraction (MVC). The highest data for maximum clenching on cotton rolls were used for standardizing and normalizing all MVC data. Then, the percentage overlapping coefficient (POC) index was calculated from standardized MVC data. The POC index can be used to analyze muscular asymmetry under varying patterns of muscular contraction. The POC indices from both groups were compared using the two-sample *t*-test.
RESULTS: The masseter POC in the patients with a Class III skeletal relationship was less than that in Class I skeletal relationships with statistical significance ($P < 0.01$).
CONCLUSIONS: Masseter muscle activity in Class III skeletal relationships was less symmetrical than that in Class I skeletal relationships.

349 CLINICAL OUTCOMES OF CLEAR ALIGNER THERAPY. A SYSTEMATIC REVIEW

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AIM: To systematically search the literature and assess the available evidence regarding the clinical effectiveness of the Invisalign® system.
MATERIALS AND METHOD: Electronic database searches of published and unpublished literature were performed in the following electronic databases without language and publication date restrictions: Medline (via Ovid and PubMed), Embase (via Ovid), the Cochrane Oral Health Group's Trials Register and Central, ClinicalTrials.gov, the National Research Register, and Pro-Quest Dissertation Abstracts and Thesis database. The reference lists of all eligible studies were checked for additional studies. Two review authors performed data extraction independently and in duplicate using data collection forms. Disagreements were resolved by discussion or the involvement of an arbiter. The risk of bias of randomised controlled trials (RCTs) was assessed using the Cochrane risk of bias tool. Prospective and retrospective studies were evaluated with ACROBAT-NRSI (A Cochrane Risk of Bias Assessment Tool for Non-Randomized Studies of Interventions).
RESULTS: Three RCTs, six prospective, and eight retrospective studies were considered eligible for inclusion in this review. The lack of standardized protocols and the high amount of heterogeneity precluded a valid interpretation of the actual results through pooled estimates. There was substantial consistency among studies, however, that the Invisalign® system is a viable alternative to conventional orthodontic therapy in the correction of mild to moderate malocclusions. Moreover,

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Invisalign® aligners can safely straighten dental arches in terms of levelling and derotating the teeth after cautious treatment planning. Finally, crown tipping can be easily performed. The level of evidence was found to be low given the high risk of bias in all included studies.
CONCLUSIONS: It is evident that more high-quality research of a prospective design with respect to the clinical outcomes of Invisalign® needs to be carried out in the future. A standardized methodology including control samples would be valuable in obtaining comparative results. Finally, the long-term effectiveness pertaining to retention outcomes also needs further investigation.

350 IMPLANT SITE DEVELOPMENT IN THE ANTERIOR MAXILLA AFTER TOOTH EXTRACTION WITH ORTHODONTIC FORCED ERUPTION. A CONE BEAM COMPUTED TOMOGRAPHY CLINICAL PILOT STUDY

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AIM: Orthodontic forced eruption (OFE) with the straightwire appliance has been proposed as a conservative method for alveolar socket preservation and implant site development. The aim of this study was to quantify the dimensional ridge alterations when OFE is used for the extraction of poor prognosis teeth and to determine if OFE can preserve or augment alveolar bone prior to immediate implant placement in the maxillary aesthetic zone.
MATERIALS AND METHOD: Cone beam computed tomographic (CBCT) scans of seven patients were obtained before and immediately after the application of OFE on 17 maxillary anterior teeth in total. Alveolar ridge dimensional changes were calculated with height and width measurements performed on the buccal and palatal cortical plates of the sockets and the interproximal areas in a co-ordinate system. Root length of all extracted teeth was also evaluated. All measurements were performed on the sagittal slices of the CBCT images. Paired *t*- and Wilcoxon tests were applied to evaluate osseous changes. Linear regression analysis was performed for calculating whether the differences were correlated to the root length of extracted teeth or the initial thickness of the cortical plates.
RESULTS: OFE resulted in a statistically significant reduction of the height of the buccal alveolar plate (1.95 ± 1.83 mm) and increase of the height of the palatal alveolar plate (1.31 ± 2.41 mm) in the tooth socket areas. In the interproximal areas an increase in both buccal and palatal alveolar plate was measured at 0.25 ± 0.98 mm and 0.63 ± 1.59 mm, respectively but it did not reach statistical significance. Alveolar height alterations were dependent and correlated to root length and initial width of the cortical plates in the socket areas. Immediate implant placement could not be performed in 30 per cent of the treated sockets due to inadequacy of buccal alveolar bone.
CONCLUSIONS: OFE with the straightwire appliance resulted in a favourable response in the heights of the palatal and interproximal alveolar bone but caused significant reduction of the buccal alveolar plate. Implant site development could not be accomplished in 30 per cent of the treated sockets.

351 CORTICOTOMIES AND ORTHODONTIC TOOTH MOVEMENT. A SYSTEMATIC REVIEW

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AIM: A systematic review was conducted to examine the evidence for the effectiveness and safety of corticotomy-facilitated orthodontics.
MATERIALS AND METHOD: Electronic databases (Ovid Medline, Embase, and Cochrane) were searched for articles that examined the rate of corticotomy-facilitated orthodontic tooth movement and its effects of the periodontium, root resorption and tooth vitality. Relevant orthodontic journals and reference lists were also checked for eligible studies. No language restrictions were applied in the search strategy. Randomised clinical trials (RCTs), controlled clinical trials (CCTs) and case series with four or more subjects were considered. Two article reviewers independently assessed the

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search results, screened the relevant articles, performed data extraction and evaluated the methodological quality of the studies.
RESULTS: Eighteen eligible articles were included in the review. This included six RCTs, seven CCTs and five case series. There was a statistically significant increase in the rate of tooth movement over controls for all of the different corticotomy techniques assessed. Some of the studies demonstrated that the acceleration in tooth movement was only temporary, lasting a few months. Corticotomy procedures did not seem to produce unwanted adverse effects on the periodontium, root resorption or tooth vitality. The quality of the body of evidence was regarded as low, due to the presence of multiple methodological issues, high risks of bias, and heterogeneity in the included articles.
CONCLUSIONS: Corticotomy procedures could produce statistically and clinically significant temporary increases in the rate of orthodontic tooth movement with minimal side effects. Additional high quality randomised clinical trials are needed to allow more definitive assessments on the rate and duration of accelerated tooth movement, comparisons of differing corticotomy procedures, and long-term follow-up.

352 CLINICAL OUTCOME OF ORTHODONTIC TREATMENT WITH FIXED APPLIANCES: AN EVIDENCE-BASED ASSESSMENT WITH THE AMERICAN BOARD OF ORTHODONTISTS GRADING SYSTEM

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AIM: To assess, in a systematic review, the occlusal outcome and duration of fixed orthodontic therapy from clinical trials in humans with the Objective Grading System (OGS) of the American Board of Orthodontics.
MATERIALS AND METHOD: Nine databases were searched up to October 2016 for prospective/ retrospective clinical trials assessing the outcome of orthodontic therapy with fixed appliances in human patients. After duplicate study selection, data extraction, and risk of bias assessment according to the Cochrane guidelines, random-effects meta-analyses of the mean OGS score and treatment duration or mean differences (MDs), including their 95 per cent confidence intervals (CIs) were calculated, followed by subgroup and sensitivity analyses.
RESULTS: A total of 34 clinical trials were identified that included 6207 patients (40% male, 60% female) with an average age of 18.4 years. The average OGS score after treatment was 27.8 points (95% CI: 26.1 to 30.1 OGS points), while the average treatment duration was 24.8 months (95% CI: 21.9 to 27.7 months), with no significant association between occlusal outcome and duration, with considerable heterogeneity identified. Additionally, orthodontic treatment with extraction of four premolars seemed to have an important effect on both outcome (MD: –4.9 OGS points; 95% CI: –10.7 to 0.9 OGS points; $P = 0.095$) and duration of treatment (MD: 6.5 months; 95% CI: 2.4 to 7.7 months; $P = 0.002$). Finally, only 10 (38%) of the identified studies matched compared groups by initial malocclusion severity, although meta-epidemiological evidence suggested that absence of baseline matching was statistically significantly associated with bias (difference in MDs: 5.9; 95% CI: 5.2 to 6.2; $P < 0.001$).
CONCLUSIONS: This systematic review indicated that the occlusal outcome of fixed appliance treatment varies considerably and no association between treatment outcome and duration could be found. Prospective matched clinical studies that use the OGS tool are needed to compare the effectiveness of orthodontic appliances.

Registration: PROSPERO (CRD42016049203)

353 DOES ORTHODONTIC TREATMENT INFLUENCE PERMANENTLY THE SUBGINGIVAL MICROFLORA: A SYSTEMATIC REVIEW AND META-ANALYSIS

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AIM: To assess the qualitative and quantitative changes in the subgingival microflora of human patients induced by orthodontic treatment.
MATERIALS AND METHOD: Seven databases were searched up to December 2016 for parallel or split-mouth randomized clinical trials and non-randomized cohort studies on human patients assessing the effect of any kind of orthodontic treatment on changes of the subgingival microflora. After duplicate study selection, data extraction, and risk of bias assessment according to the Cochrane guidelines, random-effects meta-analyses were conducted with relative risks (RRs) and 95 per cent confidence intervals (CIs), followed by subgroup and sensitivity analyses.
RESULTS: A total of 36 papers pertaining to 32 unique clinical studies (5 randomized and 27 non-randomized) were identified and included 1014 patients (39% male/61% female) with an average age of 12.9 years. The risk of bias of all included randomized and non-randomized studies was moderate to high. The evidence indicated that there was a shift in the subgingival microflora following the insertion of orthodontic appliances, with a variable response in quality and quantity of identified pathogens. The meta-analyses indicated an increase in the risk of finding *Aggregatibacter actinomycetemcomitans* (Aa) and a decrease in the risk of finding *Porphyromonas gingivalis* (Pg) in the gingival sulcus after appliance insertion (RR = 1.42; 95% CI = 0.83-2.42; *P* = 0.197 and RR = 0.85; 95% CI = 0.47-1.52; *P* = 0.580, respectively). The microflora of the gingival sulcus seemed to considerably partly revert back to a normal ecosystem within the first 3 months following appliance removal for both Aa (RR = 0.57; 95% CI = 0.29-1.11; *P* = 0.098) and Pg (RR = 0.52; 95% CI = 0.34-0.80; *P* = 0.002). However, the influence of orthodontic treatment could sometimes be seen even 2 years after appliance removal, although long-term evidence is very limited.
CONCLUSIONS: This systematic review indicated that the subgingival microflora experiences a shift towards anaerobic organisms following the insertion of orthodontic appliances with great clinical heterogeneity and a partial normalization after removal of the appliances. Additional long-term trials are needed to clarify if long-term changes to the subgingival microflora remain and have any clinical relevance.

Registration: PROSPERO (CRD42015029952)

354 SHAPE COVARIATION BETWEEN THE DENTAL ARCHES AND THE CRANIOFACIAL COMPLEX
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AIM: To evaluate the shape variance of the craniofacial complex in an orthodontic population, as well as the covariation patterns between the craniofacial complex and the upper and lower dental arches.
MATERIALS AND METHOD: Lateral cephalograms of 62 Caucasian subjects (30 males, 32 females) were scanned at 150 dpi, traced with 15 curves and 127 landmarks (10 fixed and 117 sliding semi-landmarks), so that the shape of the craniofacial complex could be comprehensively described. Dental casts of the upper and lower dental arches were scanned and digitized in three dimensions. Landmarks were placed on the incisal margins and on the cusps of the canines, premolars and molars. Geometric morphometric methods were applied [Procrustes superimposition and Principal Component (PC) Analysis]. Statistical significance was evaluated with permutation tests. Two block partial least squares analysis was used to assess shape covariation. Sexual dimorphism was also tested.
RESULTS: The first three PCs describing craniofacial complex variation represented shape patterns that can be easily recognized in clinical practice, accounting for 50 per cent of total shape variance. PC1 described changes in the vertical direction (long versus short facial pattern), PC2 described changes in the anteroposterior direction (Class II versus Class III skeletal relationship) and PC3 the inclination of the mandibular plane. No sexual dimorphism was observed (*P* = 0.72, 10000 permutations). The craniofacial complex covaried significantly with both the upper and lower dental arches (RV coefficient: 19.6 and 24.6%, respectively, 10000 permutations). The main covariation pattern (PLS1) between the craniofacial complex and the upper arch, as well as the craniofacial

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complex and the lower arch, accounting for 42 and 52 per cent of total covariance respectively, correlated a retrognathic mandible and a reduced lower face height to a long and narrow arch.
CONCLUSIONS: These results support previous findings regarding the major craniofacial shape variation patterns. Covariation with the dental arches was weak but consistent with clinical findings of constricted arches in Class II skeletal types. Arch shape within the orofacial matrix is a parameter to be addressed in future research.

355 ASTHMA AND ORTHODONTIC TREATMENT: LIMITATIONS AND CONSIDERATIONS

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AIM: Given the steady increase in the prevalence of asthma in the past two decades, the aim of this study was to review the existing literature on the correlation of the disease to orthodontic treatment and further identify the predisposing factors and limitations that may lead to modifications of the treatment plan as well as important considerations that need to be foreseen during orthodontic management of these patients.
MATERIALS AND METHOD: A computerized PubMed search was carried out. The following key words were used: asthma, asthma in orthodontic practice, management of medical compromised patients in dental practice, corticosteroids and bone alterations, asthma and root resorption. The search was limited to articles published within the last 10 years.
RESULTS: The review of the literature clearly demonstrated that specific features of the disease correlate with orthodontic treatment along with the presence of oral health changes and orofacial alterations. Furthermore the role of corticosteroids, as the main treatment of asthmatic patients, in affecting the oral environment and interfering with the tooth rate movement and normal apposition of the bone along with the higher susceptibility of these patients in root resorption was of great importance and underlined in many surveys. All these facts indicate the possible contemplations that need to be taken under consideration not only of treatment planning but also in treatment care of these patients in the orthodontic practice.
CONCLUSIONS: Orthodontic practice depends not only on knowledge of the physical mechanisms and characteristics of this medical condition but also on the ability of the orthodontist to offer the best possible treatment adjusted to these special features to treat asthmatic patients with minimum risk and maximum effectiveness.

356 EARLY TREATMENT OF CLASS III DENTOSKELETAL DISHARMONY: COMPARISON OF TWO PROTOCOLS

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AIM: To assess the short-term outcomes of splints, Class III elastics, and chincup (SEC III) and rapid maxillary expansion and facemask (RME/FM) protocols.
SUBJECTS AND METHOD: Twenty five patients with a Class III dentoskeletal disharmony (10 males, 15 females) treated with the SEC III protocol were evaluated at the beginning (T1, mean age 7.5 ± 1.4 years) and end (T2, mean age 8.7 ± 1.4 years) of treatment. The SEC III group was compared to a matched sample of 32 Class III patients (16 males, 16 females) treated with the RME/FM protocol and to a matched control group (CG) consisting of 23 subjects (12 males, 11 females) with an untreated Class III dentoskeletal disharmony. The statistical comparisons between the three groups were performed with analysis of variance with Tukey's *post hoc* tests.
RESULTS: With respect to the CG, the SECIII and the RME/FM groups showed significantly favourable effects in terms of maxillary advancement (SNA +1.2 and +1.4°, respectively), control of mandibular projection (SNB −1.3 and −1.4°, respectively), and intermaxillary relationships (ANB +2.6 and +2.9°,

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respectively; Wits +3.7 and +2.6 mm, respectively). The RME/FM group showed a significantly greater increase in intermaxillary divergence than the SEC III group (+1.8°) and the CG (+2.0°).
CONCLUSIONS: Early treatment of Class III dentoskeletal disharmony with both SEC III and RME/FM protocols produce favourable maxillary and mandibular skeletal changes. The SEC III protocol produces more control in intermaxillary vertical relationships than RME/FM therapy. A limitation of this study was its short-term nature.

357 COMPARATIVE EVALUATION OF REMINERALIZATION AGENTS AND ARTIFICIAL SALIVA ON TOOTH ENAMEL AFTER INTERPROXIMAL ENAMEL REDUCTION: *IN VITRO* STUDY

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AIM: To compare the remineralization effects of 1.23 per cent acidulated phosphate fluoride (APF) gel, casein phosphopeptide-amorphous calcium phosphate fluoride (CPP-ACPF) and artificial saliva through scanning electron microscopy (SEM) morphological evaluation, surface roughness test, Vickers microhardness test and energy dispersive spectroscopy (EDS) element analysis.
MATERIALS AND METHOD: Thirty five premolars (70 surfaces) divided into five groups: Sound enamel (controls); stripped and exposed to distilled water (S-DW); stripped and exposed to artificial saliva (S-AS group); stripped enamel treated with 1.23 per cent APF gel (S-APF); stripped enamel treated with CPP-ACPF (S-CPP). Interproximal enamel reduction was performed on each surface except on the surfaces of the control group, and the remineralizing effects were compared after 8 days.
RESULTS: SEM observations clearly showed deep furrows and scratches in the control group with distilled water; the smoothest surface was in the S-CPP group. Based on the Ra values, the surfaces of the S-CPP group were the smoothest ($P < 0.001$). In the Vickers microhardness test, the hardness of the control group was the highest, followed by the S-CPP group; the values for these two groups were significantly different from those for the other groups ($P < 0.001$). In the EDS analysis, the Ca and P (weight%) levels were slightly higher, while the Ca/P ratios (1.93~1.95) were slightly lower in the remineralization groups ($P < 0.05$ both) than in the other groups (1.99).
CONCLUSIONS: The remineralizing effect of CPP-ACPF is better than that of APF gel; additionally, there was no significant difference between the remineralizing effect of artificial saliva and APF gel. A larger remineralizing effect would be expected with multiple applications of low-concentrations of fluorides than a single high-concentration treatment after interproximal enamel reduction procedures.

358 EFFECTS OF TEMPOROMANDIBULAR JOINT DISK DISPLACEMENTS ON CHANGES IN MANDIBULAR CONDYLE DENSITY

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AIM: To assess differences in condylar bone density according to temporomandibular joint disc displacement (TMJ DD) status.
MATERIALS AND METHOD: One hundred and six condyles in 53 adult patients (females 39, males 14). TMJ DD status was divided into three groups based on TMJ magnetic resonance imaging: normal disc position (NR, n = 25), disc displacement with reduction (DDR, n = 30), and disc displacement without reduction (DDNR, n = 51). Total condylar bone density and its components (cortical and trabecular bone densities) were calculated from computed tomography images. As the upper articular part of the condyle would be more easily influenced by TMJ DD, bone densities were measured from both the whole condyle and the upper third part of the condyle. Condylar bone densities were calibrated with those of the first cervical vertebra to minimize individual variation. Differences in calibrated bone densities of the whole condyle and upper condyles with respect to TMJ DD status were tested with one-way ANOVA at a significance level of 0.05.

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RESULTS: Total bone densities of the whole condyle showed significant difference between NR and DDNR (NR < DDNR), while total bone densities of the upper condyle were significantly increased in the condyles with DD (NR < DDR, DDNR). Cortical bone densities of both the whole and upper condyles and trabecular bone of the whole condyles were not significantly influenced by TMJ DD status (NR = DDR = DDNR). However, trabecular bone densities of the upper condyles were significantly increased when DD progressed to DDNR (NR, DDR < DDNR).
CONCLUSIONS: The study suggests that condyles with TMJ DD were denser than those with NR, specifically in the upper articular part and these density changes mainly occur in inner trabecular bone rather than on outer cortical layer.

359 EVALUATION OF SOFT TISSUE CHANGES BEFORE AND AFTER ORTHOGNATHIC SURGERY IN CLASS III FACIAL ASYMMETRY ON FRONTAL FACIAL PHOTOGRAPHS

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AIM: Usually patients recognize their facial asymmetry in a mirror image or on facial photographs. This study aimed to determine the effect on the asymmetric soft tissue proportions together with hard tissue chin deviation and to evaluate the soft tissue change after orthognathic surgery using posteroanterior (PA) cephalograms and frontal facial photographs.
SUBJECTS AND METHOD: Twenty one Class III facial asymmetric subjects (>3.0 mm chin deviation on the PA cephalograms) who had undergone orthognathic surgery [maxillary Le Fort I osteotomy and mandibular bilateral sagittal split osteotomy (BSSRO) or only mandibular BSSRO]. The subjects consisted of eight females and 13 males (mean age 23.7 years). PA cephalograms and frontal facial photographs were obtained using a standardized method before and after surgery (T1, T2). Fourteen landmarks and 10 lines including the vertical reference line (Glabella~Subnasale, VRL) and horizontal reference line (perpendicular line to vertical reference line passing through the midpoint of both medial canthus) were digitized on each photograph, from which 12 linear and six angular variables were calculated. Chin deviation distances were measured on the radiographs (T1, T2). The relationship of the soft tissue changes together with the correction of chin deviation between T1 and T2 were analysed using corelationship analysis.
RESULTS: Significant differences were found between T1 and T2 in soft tissue changes by comparing linear and angular variables. The correction amounts of the deviated chin on the hard tissues were related significantly to the correction amounts (distance, degree) of soft tissue Menton, Cheilion (Ch) distance from VRL on the non-deviated side. Genioplasty influenced the change of VRL-Ch distance on the non-deviated side and gonial angle on the deviated side.
CONCLUSIONS: Use of frontal photographs in facial asymmetric patients is a clinically simple and easy method for clinicians and patients when predicting the facial soft tissue changes with surgery. This is more similar to the patient's perceptions of themselves in the mirror than the use of a three-dimensional computed tomography scan and can reduce additional radiation exposure.

360 WHAT ARE THE CONTRIBUTING FACTORS FOR POST-SURGICAL RELAPSE AFTER TWO-JAW SURGERY IN CLEFT PATIENTS?

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AIM: To investigate the amount and pattern of post-surgical relapse after two-jaw surgery in cleft lip and palate patients in terms of the sagittal and vertical aspects.
SUBJECTS AND METHOD: Twenty one adult patients who had a similar initial skeletodental pattern before surgery and underwent two-jaw surgery (Le Fort I advancement and posterior impaction of the maxilla/setback of the mandible with the same amount and direction of surgical movement). They were divided into high (n = 11) and low (n = 10) relapse groups (criteria, 30% forward relapse of the point B). After the cephalometric variables of cephalograms taken one month before, immediately after and at least 1 year after surgery were measured, the Wilcoxon, Mann-Whitney *U* and Pearson correlation tests were performed for statistical analysis.
RESULTS: When compared to the low relapse group, the high relapse group exhibited significant counterclockwise rotation of the distal segment of the mandible resulting in more forward

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movement of the mandible and significant labioversion of the maxillary incisors. Post-surgical relapse of the mandible had a positive relationship with the amount of setback and clockwise rotation of the mandible with surgery. In addition, the more reduction in overbite through surgery occurred, the more relapse (forward movement of the mandible) was produced.
CONCLUSIONS: In order to prevent significant post-surgical relapse of the mandible in cleft patients, methods that can reduce unnecessary clockwise and counterclockwise rotation of the mandible and increase the vertical stability of maxilla are required.

361 MANDIBULAR THIRD MOLARS TEETH AND THEIR INFLUENCE ON LATE MANDIBULAR INCISOR CROWDING: LONGITUDINAL STUDY

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AIM: To investigate the relationship between the presence and dynamics of mandibular third molar development and the occurrence and amount of late mandibular incisor crowding.
MATERIALS AND METHOD: Dental plaster casts and panoramic radiographs of 72 subjects (46% female) from the Nittedal growth study, Norway were analysed. The subjects were orthodontically untreated, and recalled for check-up at 12, 15, 18 and 21 years of age. The amount of mandibular incisor crowding was assessed at the ages of 12 and 21 years using the Little index. Dental maturation of the third molars was assessed by the Cameriere index (I3M) at 15, 18 and 21 years. Statistical analyses included a *t*-test, Pearson correlations, linear and logistic regression.
RESULTS: Sixty five subjects had a complete dentition and third molars teeth present until the age of 18. At 18 years 25 per cent of those subjects had their third molars teeth removed. However, there was no change in the amount of the amount of crowding at the age of 21. In 55 subjects, when those with extraction of the third molars were excluded, but those with hypodontia of the third molars were included, differences in the amount of crowding were observed. The amount of crowding was no different between subjects with missing third molars (13%) and those with third molars present. In 47 subjects with a complete dentition and third molars present at the age of 21 years the results demonstrated the change in Little's index [range –1.78-5.3 mm (mean 0.74 ± 1.41)]. The change in I3M was greater between 15-18 than 18-21 years in both genders ($P < 0.001$). No linear correlation was found between the amount of crowding and maturation dynamics of the third molars between 15-18, 18-21 and 15-21 years of age. The decelerated development of third molars was a significant predictor of late crowding, producing a ×5.2 higher odds ratio. (95% confidence interval 1.1-23.6; $P = 0.034$). Gender was not a significant predictor.
CONCLUSIONS: No linear relationship between the amount of late lower arch crowding and the dynamics of maturation of third molars was found although a decelerated maturation of the third molars seems to increase the occurrence of crowding.

362 GEOMETRIC MORPHOMETRIC ANALYSIS OF MAXILLARY MORPHOLOGY IN CHILDREN WITH IMPACTED INCISORS – A THREE-DIMENSIONAL EVALUATION

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AIM: To analyze variations in palatal morphology in subjects presenting with unilaterally impacted maxillary permanent central incisors (IIG) compared with a control group (CG) of subjects without eruption anomalies using three-dimensional (3D) analysis.
SUBJECTS AND METHOD: Twenty-six Caucasians (10 females, 16 males; mean age 9.5 ± 1.5 years) with IIG were compared with a CG of 26 subjects (14 females, 12 males, mean age 8.7 ± 1.6 years) presenting no eruption disorders. For each subject, dental casts were taken and the upper arch was scanned using a 3D laser scanner. To study the entirety of the shape of the palate at any point of the surface, 3D geometric morphometrics was applied.

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RESULTS: IIG showed skeletal adaptations of the maxilla. In the IIG, both superior palatal region and lateral palatal surface showed significantly different morphologies when compared with CG, with a narrower and higher palatal vault.
CONCLUSIONS: The absence of maxillary central incisors over the physiological age of eruption influenced the development of palatal morphology compared to subjects without eruption anomalies.

363 EFFECTS OF PREMOLAR EXTRACTIONS ON OVERALL BOLTON RATIO

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AIM: To investigate the effects of four premolar extractions, one in each quadrant, on overall Bolton ratio.
MATERIALS AND METHOD: The records of 102 patients were collected and measured before and after simulation of four premolar extractions. The extraction of four first premolars, the four second premolars, first upper premolars and second lower premolars, and second upper premolars and first lower premolars was simulated. The software R 3.2.3 (R Foundation for Statistical Computing) was used and statistical analyses, ANOVA, Bonferroni, Turkey and Kruskal-Wallis tests, were performed.
RESULTS: All combinations of four premolar extractions decreased the value of the overall Bolton ratio. This decrease in the ratio benefited patients starting from an increased situation and had an adverse effect on those starting from a decreased situation. Two-way ANOVA did not show any statistically significant relationship between Bolton ratio and facial pattern, gender or skeletal pattern.
CONCLUSIONS: The extraction of a premolar in each quadrant improves the discrepancy in patients with an increased Bolton ratio (superior defect) and having an adverse effect on those with a decreased ratio (upper excess).

364 PREVALENCE OF MALOCCLUSION AND TEMPOROMANDIBULAR DISORDERS IN ITALIAN SCHOOL CHILDREN

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AIM: To investigate the prevalence of malocclusion and temporomandibular disorder (TMD) signs in Italian school children, and to assess the association between occlusal traits and TMD in a children population.
SUBJECTS AND METHOD: Seven hundred children (341 females, 359 males) aged 9 to 11 years old, without a history of orthodontic treatment recruited from public schools in the Campania region of Italy. Molar relationship, overjet, overbite and crossbite were measured by means of clinical examination. Furthermore, all subjects were examined for TMJ clicking sounds and myofascial pain (MP), according to the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD). Descriptive statistics was used to report the distribution of the variables. The associations between occlusal traits and TMD were analysed with a Chi-square test. The significance level was set at $P < 0.05$.
RESULTS: Thirty three per cent of subjects showed a Class II molar relationship, 1 per cent a Class III and 19 per cent an asymmetric molar occlusion. The overjet was reduced (<1 mm) in 2 per cent of the population, increased (between 4 and 6 mm) in 7 per cent and highly increased in 17 per cent (>6 mm). The overbite was reduced in 6 per cent of the sample (<1 mm), increased in 28 per cent (between 4 and 6 mm) and highly increased in 7 per cent (>6 mm). Eight per cent of the population presented a unilateral posterior crossbite, while 5 per cent showed a bilateral posterior crossbite. Twelve per cent had a diagnosis of MP while the 6 per cent revealed a TMJ clicking sound. TMJ clicking was significantly associated with overjet ($P < 0.05$) and posterior crossbite ($P < 0.05$). MP was significantly associated with a posterior crossbite ($P < 0.05$), overbite ($P < 0.05$) and molar relationship ($P < 0.005$).

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CONCLUSIONS: A molar Class II relationship was the most frequent dental finding, followed by an increased overbite and highly increased overjet. The current findings support an association between some occlusal traits and TMD diagnosis in a population of school children. However, longitudinal studies are needed to assess the presence of potential risk factors.

365 DETERMINATION OF MECHANICAL PROPERTIES OF NICKEL-FREE ORTHODONTIC ARCHWIRES BY MEANS OF NANOINDENTATION

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AIM: A wide range of orthodontic archwires are used in contemporary orthodontic practice. The reports of patients with hypersensitivity to nickel (Ni) increase every year, resulting in the tendency for Ni-free materials to be used. With exception of composite wires, there are three metal Ni-free archwires: titanium molybdenum alloy (TMA), TiNb and TiMolium. The literature data concerning the mechanical properties of these materials are limited and their proper characterization is required, to predict their outcome when used clinically. Elastic modulus is a critical factor in determining the clinical performance of orthodontic archwires. Hardness is of secondary importance and relates to wire movement and strength. The aim of present work was to investigate mechanical properties of TMA, TiNb and TiMolium archwires.
MATERIALS AND METHOD: Nanoindentation was used to investigate the mechanical properties of as-received orthodontic archwires, made from three different materials: TMA (G&H Orthodontics, Franklin, Indiana, USA), TiNb (Ormco, Glendora, California, USA) and TiMolium (TP Labs, Indianapolis, Illinois, USA) with a size of 0.43 x 0.64 mm (0.017 x 0.025 inches). The tests were performed using a Nanoindenter G200 (Keysight Technologies) equipped with a Berkovich three-sided diamond pyramid with a centreline-to-face angle 65.3 degrees and a 20 nm radius at the tip of the indenter. The indentation method with load control and one loading-unloading cycle was used. The maximum load was 30 gf with a 10 second peak hold time at maximum load. All measurements were made at room temperature. Indentation hardness (HIT) and indentation modulus (EIT) were calculated using the approximation method of Oliver and Pharr.
RESULTS: TMA had the highest HIT (6 GPa), followed by TiMolium (4.6 GPa) and TiNb (2.18 GPa). On the other hand TiMolium had the highest EIT (137 GPa), followed by TMA (117 GPa) and TiNb (52.7 GPa).
CONCLUSIONS: TiMolium has higher EIT and smaller HIT than TMA, which makes it especially suitable for loop and cantilever mechanics and the final stage of orthodontic treatment. TiNb wire has higher plasticity and it is particularly useful in the final stage of orthodontic treatment when using vertical elastics.

366 INVESTIGATION OF THE CHANGES OF TITANIUM–NIOBIUM ARCHWIRES AFTER INTRAORAL APPLICATION

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AIM: In dental medicine, the most commonly used archwires are nickel (Ni), but these may cause unpleasant reactions during treatment. An alternative to Ni-contented archwires is an archwire, made from TiNb alloy. TiNb alloy is widely used in biomedicine, due to its good properties of high biocompatibility, low modulus of elasticity, high corrosion resistance and low toxicity. Sachdeva (1995) introduced TiNb archwire application in orthodontics. This archwire is an alternative to braided rectangular stainless steel archwire. Because of its mechanical properties TiNb archwire is suitable for the finishing stages of orthodontic treatment. This stage takes several weeks and the TiNb archwire is used simultaneously with vertical elastics. The aim of this study was to explore the

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changes of TiNb archwires, the microstructure, chemical composition and phase transition temperatures due to prolonged use.
MATERIALS AND METHOD: Retrieved TiNb archwires (used up to 4, 6 and 8 weeks) with dimensions of 0.017 × 0.025 inches were studied in the *in vivo* environment. The analyses were carried out using the following techniques: X-ray powder diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive X-ray microanalysis (EDX) and differential scanning calorimetry (DSC).
RESULTS: The registered diffractions demonstrated the presence of Ti and Nb. The composition of the wires after use (up to 6 weeks) were the same as received wires: Ti: 53,06wt%, Nb; 46,94wt% At 8 weeks, the chemical composition showed no change. From the SEM analyses a remarkable change could be observed on the surface of the used archwires after 6 weeks and the presence of microspores could be observed up to 8 weeks. DSC analyses showed no thermal transitions for all investigated TiNb archwires, in the temperature range from –500°C to +500°C.
CONCLUSIONS: Retrieved TiNb archwires used during orthodontic treatment in an *in vivo* environment demonstrated that the archwires kept their properties up to 6 weeks. Following 8 weeks of treatment, the archwires changed their morphology. This may cause some loss of their mechanical properties and can reduce their application.

367 ASSESSMENT OF THE MAGNITUDES OF FORCE FOR INTRUSION OF MAXILLARY FIRST MOLAR TEETH: A FINITE ELEMENT ANALYSIS

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AIM: To assess the greatest magnitude of force that can be applied to initiate intrusion of the maxillary first molar teeth without exceeding the periodontal capillary-vessel blood pressure of 0.0047 MPa.
MATERIALS AND METHOD: A three-dimensional finite element (FE) model, including the maxillary second premolar, the maxillary first and second molars, the periodontal ligament (PDL), the cancellous bone, and the cortical bone was constructed using SolidWorks software. The material behaviour of the PDL was hyperelastic. To simulate maxillary first molar intrusion, an intrusive force was applied at the middle of the occlusal surface of the maxillary first molar tooth. The force was transmitted through the centre of resistance, parallel to the long axis of the maxillary first molar tooth. The FE model was able to determine the greatest magnitude of force applied without exceeding the periodontal capillary-vessel blood pressure by simulation of various force magnitudes (5, 10, 15, 20, 25, 50, 100 g).The hydrostatic pressure distributions of the PDL were calculated using Abaqus software.
RESULTS: For intrusive forces of 5 and 10 g, there were no areas where the hydrostatic pressure exceeded the periodontal capillary-vessel blood pressure of 0.0047 MPa. When an intrusive force of 15 g was applied, a small area was found where the periodontal capillary-vessel blood pressure was exceeded. The location was in the furcation region of the PDL of the maxillary first molar tooth. Moreover, the results showed that the greater the force magnitude applied, the larger the area where the periodontal capillary-vessel blood pressure was exceeded.
CONCLUSIONS: The magnitude of force, that can be applied to initiate intrusion of the maxillary first molar teeth without exceeding the periodontal capillary-vessel blood pressure, is greater than 10 g but less than 15 g. Moreover, these results suggest that the furcation region of the maxillary first molar teeth should be prone to resorption before any other region during posterior intrusion treatment.

368 ASSOCIATIONS BETWEEN PATIENTS' SELF-REPORTED SYMPTOMS, ORTHOGNATHIC QUALITY OF LIFE AND SATISFACTION WITH OCCLUSAL FUNCTION

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AIM: To investigate the impact of orthognathic patients' self-reported symptoms in head and neck region on their orthognathic quality of life (OQoL) and satisfaction with occlusal function.
SUBJECTS AND METHOD: Fifty consecutive patients (13 males, 37 females, age range 18-61 years) referred for assessment of orthognathic-surgical treatment need and a control group of 29 voluntary first-year university students (28 females, 1 male, age range 19-49 years). All participants filled in the OQoL Questionnaire and a structured diary made compiled by the authors. The mean values of OQoL sum score and satisfaction with occlusal function were compared between patients and controls. Moreover, Spearman's correlations between the mean values of the OQoL sum and subscores (oral function, facial aesthetics, awareness of dentofacial aesthetics and social aspects of dentofacial deformity) and satisfaction with occlusal function were calculated.
RESULTS: Patients had higher OQoL sum scores (indicating a lower OQoL) than controls (mean 33.3 versus 17.9, respectively) and significantly more patients than controls reported symptoms (48% versus 17%, $P = 0.006$). The most commonly reported symptoms were pain in the head and/or neck region (38% of patients versus 3% of controls) followed by fatigue and/or stiffness in the jaws (32% versus 14%) and difficulties in chewing (26% versus 0%, respectively). Patients were significantly less satisfied with their occlusal function than controls (mean 3.40 versus 5.31, on a scale from 1 to 7, higher values indicating higher satisfaction ($P = 0.005$). Satisfaction was strongly correlated with the OQoL sum and subscores (r from -0.618 to -0.484), except the subscore of social aspects of dentofacial deformity, where the correlation was moderate (r= –0.300). Symptomatic patients were less satisfied with occlusal function than their asymptomatic counterparts ($P < 0.001$).
CONCLUSIONS: Experienced pain and discomfort have a great impact on orthognathic patients' quality of life.

369 INDICATIONS, APPLICATION AND ARMAMENTARIUM FOR INTERPROXIMAL ENAMEL REDUCTION IN CONTEMPORARY ORTHODONTICS

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AIM: Interproximal enamel reduction (IPR) has gained increasing prominence in recent years, being advocated to provide space for orthodontic alignment, to refine contact points and to potentially improve long-term stability. An array of techniques and products are available ranging from hand-held abrasive strips to handpiece mounted burs and discs. This research aimed to evaluate the various methods and armamentarium for IPR.
MATERIALS AND METHOD: A literature review was conducted around this topic area. The indications for IPR and the importance of formal space analysis, together with the various techniques and armamentarium which may be used to perform it safely in both the labial and buccal segments are outlined. A clinical case photographic series demonstrated its application.
RESULTS: While the use of IPR has become more widespread, clearly acceptable oral hygiene, absence of dental disease, and lack of previous proximal reduction are prerequisites. IPR is typically undertaken in adult patients rather than adolescents as the contact points tend to be more accessible and adequate gingival retraction and visualisation of contacts is more difficult in adolescents. Moreover, poorly performed IPR can produce irreversible enamel furrows, scratches and ledges, predisposing to plaque retention. There is also a risk of sensitivity if the underlying dentine is exposed. The production of a smooth enamel surface and sparing excessive removal of enamel are therefore imperatives. Long-term evidence, however, suggests that IPR is safe with no increased risk of caries or periodontal disease years after IPR with diamond disks. Similar findings have been reported following air-rotor stripping in the buccal segments up to 6 years later.
CONCLUSIONS: IPR is a valid treatment modality as part of comprehensive orthodontic treatment. It has gained popularity in view of the increasing trend towards non-extraction based treatment and the increasing popularity of adult orthodontics. As with any orthodontic procedure, case selection is paramount and the selection of IPR over and above other space-generating procedures should be informed by formal space planning and thorough planning in relation to the final occlusal and facial treatment objectives. A varied armamentarium is available to facilitate safe and precise IPR.

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370 MORPHOFUNCTIONAL CHANGES IN THE DENTOALVEOLAR COMPLEX, DUE TO THE EXISTENCE OF BITE PLATES ON THE LINGUAL BRACKETS SURFACE

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AIM: Comparative evaluation of morphofunctional changes in elements of the dentoalveolar complex, depending on the existence of the bite plates on the lingual brackets of patients with neutral and distal occlusions.
SUBJECTS AND METHOD: Fifty patients (38 female, 12 male, 20-50 years). Treatment was carried out using Incognito brackets with/without bite plates (20% of patients with neutral occlusion and overbite <2/3 without bite plates, 40% with distal occlusion and overbite <2/3 without bite plates and 40% with distal occlusion and overbite >2/3 with bite plates). All subjects underwent a clinical examination, anthropometric analysis, radiographic examination, T-scan analysis, electromyography and echo-density.
RESULTS: In the group with neutral occlusion without bite plates, with a stable occlusal load of the anterior teeth, proportional activity of the temporal muscles in relation to the masseter decreased 40 per cent. The index of deviation of the mandible and occlusal contacts and coefficient of symmetry of unilateral muscles did not exceed 5 per cent. In the distal occlusion without bite plates group the occlusal load on the anterior teeth decreased 24 per cent, the activity of the temporal muscles increased 20 per cent and echo density of lower alveolar bone decreased 10 per cent. Deviation of symmetry of occlusal contacts and muscle balance exceeded 10 per cent. For the distal occlusion group with bite plates the occlusal load on the anterior teeth decreased by 8 per cent. Echo-density of lower alveolar bone decreased 4 per cent and was accompanied by intrusion of the lower incisors on average by 2 mm. The total bioelectric potential of the masticatory muscles decreased 22 per cent; with hyperactivity of the temporal muscles it decreased 30 per cent. Bite plates during muscle relaxation led to elimination of the pathological occlusal block and contributed to formation of a new mandibular position, which was musculoskeletally stable. The index of deviation of the mandible and occlusal contacts (1%) and coefficient of symmetry of unilateral muscles (3%) demonstrated higher symmetry of occlusal-muscular balance.
CONCLUSIONS: Lingual braces with bite plates, do not cause pathological changes of elements of the dentoalveolar complex. The most effective formation of symmetry of occlusal balance and myodynamic equilibrium occurs in patients with a significant reduction in the bioelectric potential of masticatory muscles.

371 EARLY ORTHODONTIC TREATMENT AND SPEECH PERFORMANCE IN PATIENTS WITH A CLEFT LIP AND PALATE

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AIM: To investigate the effects of early orthodontic treatment on language and speech development in children with a cleft lip and palate (CLP).
SUBJECTS AND METHOD: Twenty-five consecutively treated patients with a CLP (18 boys, 7 girls). The orthodontic treatment protocol included maxillary expansion to increase the transverse dimension, incisor alignment and proclination to resolve crowding, rotations and anterior crossbites, and maxillary protraction to reduce maxillary retrusion. The patients were examined by two speech and language therapists before orthodontic treatment (T0; mean age of patients: 4.4 ± 1.1 years) and after a first phase of treatment (T1; mean age: 9.2 ± 1.9 years). The following speech parameters were investigated: consonant sound characteristics (presence, absence, distortion and substitution), resonance and intelligibility of speech. The presence or absence of any abnormality and its severity were scored for all consonant and vowel sounds as follows: 0, not present; 1, normal; 2, resonance;

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3 distortion; 4, substitution. Consonant sounds were classified, according to the place of articulation, in bilabial, labiodental, dental/alveolar, post-alveolar, palatal and velar and according to the manner of articulation (fricative, plosive, affricate). Chi-square tests were performed for statistical analysis. Statistical significance was set at $P < 0.05$.
RESULTS: Statistical comparison of T0 to T1 changes showed a significant difference for labiodental and velar consonant ($P < 0.05$), a highly significant difference for bilabial and palatal consonant ($P < 0.01$) and a very highly significant difference for dental, post-alveolar, plosive, fricative and affricate consonant ($P < 0.001$).
CONCLUSIONS: Orthodontic treatment of CLP patients during the primary and mixed dentition period has been recommended in order to create more favourable conditions for midfacial growth and development, to normalize the intermaxillary basal relationship and to prevent or eliminate functional disturbances. In the present investigation, an overall improvement of speech was observed during orthodontic therapy. Dental and skeletal modification may have an impact on speech and language management, given the relationship among articulation performance and various physiologic and anatomic factors. Therefore, a multidisciplinary approach is recommended to combine the development of proper occlusal conditions with speech treatment.

372 THERMOGRAPHY OF THE FACE BEFORE AND AFTER ORTHODONTIC TREATMENT OF CLASS III MALOCCLUSIONS USING THE POSTNIKOV DEVICES***

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AIM: To examine changes of facial skin temperature in children before and after orthodontic treatment of Class III malocclusions using the Postnikov devices.
SUBJECTS AND METHOD: Thermography of face was conducted in children aged 6-12 and 12-15 years before after orthodontic treatment of a Class III malocclusion using a removable double-jaw device in the first group (patent RU № 2307620, 10.10.2007) and a non-removable device for expansion and extension upper denture in the second group (patent RU № 2428951, 20.09.2011). A thermovisor IRTIS-2000 ME (Moscow, Russia) was used with the following characteristics: temperature resolution throughout the field of view 0.02°C; range of measured temperatures from –10°C to +170°C; temperature measurement accuracy ±0.05°C; a spatial ratio of 1.5 mrad; field of view (horizontal and vertical) 25 × 20 degrees; resolution of horizontal frame: 640 elements in a row; resolution of vertical frame: 480 lines. Statistical analysis of the data included computation of the following indicators: the average, standard error of the average and standard deviation. To assess the normality criterion of Shapiro-Wilk was used.
RESULTS: When conducting thermography of face in 6-12 year old children with premature loss of the deciduous molars, the temperature of the facial skin before treatment was lowered and averaged Mean ± Standard Deviation = 32.3 ± 0.4°C and after treatment 34.6 ± 0.8°C. The distribution of sample was normal (W = 0.97; 0.98); Femp.= 436,7 when $P < 0.01$ and Fkr.= 11.4. The average temperature in patients aged 12-15 years of age before treatment was M±S = 32.3 ± 0.63°C and after treatment 34.5 ± 0.7°C. The distribution of the sample was normal (W = 0.98; 0.96); Femp.= 323,8 when $P < 0.01$ and Fkr.= 11,4. After treatment symmetry of the skin temperature indicators was noted on the left and right using the new orthodontic devices in patients of two age groups.
CONCLUSIONS: Comparative characteristics of the thermography of patients with a Class III malocclusion allowed the difference of facial skin temperature to be distinguished before and after normalization of occlusion. 6-15 year patients the average temperature of the facial skin was lowered and during orthodontic treatment a statistically significant increase of temperature was found in both groups an average of 1.1 times (2.5°C more), which corresponds to its normal state.

373 ADVANTAGES AND DISADVANTAGES OF ORTHODONTIC TREATMENT WITH CLEAR ALIGNERS VERSUS FIXED ORTHODONTIC MULTIBRACKETS: A LITERATURE REVIEW

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AIM: To analyze the advantages and disadvantages of treating dental malocclusions with invisible aligners through a literature review.
MATERIALS AND METHOD: A literature search was made between January 2000 and June 2014 to identify all potentially relevant articles. The search was performed in the following databases: PubMed 'PubMed Central', National Library of Medline, Embase, Cochrane Central Register of Medicine Controlled Clinical Trials', Web of Knowledge, Scopus, Google Scholar and Lilacs. The search terms used were: 'Invisalign', 'Invisible aligners removable', 'Invisible aligners', 'Orthodontic clear removable aligner', 'Tooth movement' and 'Aligner efficiency'. Inclusion criteria: prospective and retrospective studies in human subjects in the permanent dentition; studies of treatment with transparent aligners; studies including a description of materials and applications of the technique; and studies with adequate statistical analysis. Exclusion criteria: studies in patients with syndromes or severe facial malformations; surgical case studies; animal studies; studies that were not in Spanish or English; abstracts. Three hundred and nine seven articles were identified. After eliminating duplicates and considering only those that fulfilled the inclusion criteria, 13 articles remained.
RESULTS: The greatest benefit was the aesthetic improvement provided during treatment. Other factors such as comfort, less pain or duration of treatment were also mentioned. Other advantages were oral hygiene, reducing the risk of decalcification, caries, gingivitis and periodontal disease, and the reduction of root resorption due to the application of light forces. The main drawbacks included dependence on patient cooperation, price and possible occurrence of a posterior open bite.
CONCLUSIONS: Invisible aligners offer a comfortable, hygienic and aesthetic orthodontic treatment alternative in spite of a higher cost and dependence on patient cooperation.

374 EFFECTS OF THE MODIFIED FRÄNKEL REGULATOR 3 ON MAXILLARY AND MANDIBULAR MORPHOLOGY AND TONGUE POSTURE – A CLINICAL CONTROLLED STUDY

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AIM: To assess the maxillary and mandibular morphological characteristics and tongue posture before and after treatment with a modified Fränkel regulator 3 (mFR-3).
SUBJECTS AND METHOD: A group of 28 subjects (9 females, 19 males, aged 5.7 ± 1.2 years), 14 with a Class III malocclusion (C3) and 14 matched controls without malocclusion (CG) were included. The C3 group was treated with a mFR-3 appliance, which had three additional parts: a palatal cup, a lingual shield and buccal composite instead of occlusal wire rests for appliance stabilization. The maxillary and mandibular morphological characteristics were assessed on digital study casts by measuring the maxillary and mandibular gingival surface areas, palatal surface and mouth floor areas as well as the palatal and mouth floor volumes. Furthermore, the ratios between the maxillary and mandibular parameters were calculated. Tongue posture was evaluated with a three-dimensional ultrasound system. Non parametric tests were used for within and between group comparisons at baseline and at the 1 year follow-up.
RESULTS: At baseline, the palatal surface area was significantly smaller in C3 than in the CG (707.2 ± 282.9 mm^2 and 828.2.2 ± 145.1 mm^2, respectively), while the mandibular gingival surface area (688.1 ± 202.7 mm^2 and 513.7 ± 63.1 mm^2, respectively), mouth floor surface area (731.8 ± 239.5 mm^2 and 274.4 ± 46.4 mm^2, respectively) and volume (3013.0 ± 1627.5 mm^3 and 1739.2 ± 286.2 mm^3, respectively) were larger. The ratios between all the maxillary and mandibular parameters were significantly smaller in C3 ($P < 0.05$). Incorrect tongue posture was significantly more prevalent in C3 than in the CG (85.7% and 28.4%, respectively; $P < 0.05$). After 1 year of treatment with the mFR3, all the maxillary parameters significantly increased ($P > 0.05$) to similar levels exhibited in the CG. The ratios between the maxillary and mandibular parameters also significantly improved in C3, while a correction of tongue posture was observed in 14.3 per cent of C3 subjects.
CONCLUSIONS: Treatment with the mFR3 improves mainly the maxillary morphological characteristics after 1 year of treatment, but has negligible effects on tongue posture. As tongue posture and function is very difficult to correct, a longer period of treatment and follow-up would be necessary in order to better evaluate the effectiveness of the mFR3.

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375 ANOMALIES IN TOOTH NUMBER OF THE PERMANENT DENTITION IN THREE ASIAN ETHNICITIES

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AIM: To determine the proportion and distribution of tooth number anomalies in the permanent dentition in a sample of Chinese, Indian and Malay orthodontic patients in Singapore.
MATERIALS AND METHOD: This cross-sectional study was carried out using radiographic and clinical data. Panoramic radiographs and clinical records of 1080 Chinese (n = 415), Indian (n = 317) and Malay (n = 348) orthodontic patients aged 12 to 16 years were examined for evidence of tooth number anomalies. Fisher's exact test was used to compare the occurrence of hypodontia and hyperdontia amongst the ethnicities and genders respectively.
RESULTS: Prevalence of hypodontia in Chinese, Indian and Malay orthodontic patients was 13.7 6.0 and 14.4 per cent, respectively. Prevalence of hyperdontia in Chinese, Indian and Malay orthodontic patients was 7.0, 3.8 and 7.8 per cent, respectively. Chinese orthodontic patients had A significantly higher prevalence of hypodontia compared to Indian orthodontic patients [odds ratio (OR) 2.50, 95% confidence interval (CI) 1.29-4.83, $P < 0.001$]. Malay orthodontic patients had a significantly higher prevalence of hypodontia compared to Indian orthodontic patients (OR 2.63, 95% CI 1.34-5.17, $P < 0.001$). Male orthodontic patients had a significantly higher prevalence of hyperdontia compared to female orthodontic patients (OR 1.87, 95% CI 1.14-3.07, $P = 0.015$). The most commonly missing tooth in Indian orthodontic patients was the upper lateral incisor (39.0%), whereas that of the Chinese and Malay orthodontic patients was the lower second premolar (26.1% and 26.2%, respectively).
CONCLUSIONS: There are significant differences in the presentation of anomalies in tooth number of the permanent dentition in Chinese, Indian and Malay orthodontic patients in Singapore.

376 ASSESSMENT OF THE NEED AND DEMAND FOR ORTHODONTIC TREATMENT IN 13- TO 14-YEAR-OLD STUDENTS IN KERMANSHAH, IRAN IN 2012

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AIM: Awareness of the need of society for orthodontic treatments is of importance for comprehensive health planning and dental insurance purposes. The objective of the present study was to determine the need and demand for orthodontic treatment in students in 2012
SUBJECTS AND METHOD: In this cross-sectional study, 600 13- to 14-year-old students of either gender of Kermanshah city were selected and included in the study using random cluster sampling method. The need for orthodontic treatment was assessed based on the Dental Health Component (DHC), Aesthetic Component (AC), and Index Orthodontic Treatment Need (IOTN). The demand for treatment was analyzed through a questionnaire. The gathered data were analyzed using SPSS software (version 16.0) by applying the Mann-Whitney *U* and Fisher exact tests.
RESULTS: Totally, 27.9 per cent of the students were in great or intense need of orthodontic treatment. There was no significant relationship between the need for orthodontic treatment and gender ($P > 0.05$). The demand rate for orthodontic treatment was 19.8 per cent. There was no significant difference between boys and girls in terms of variables of occlusion, satisfaction with dental appearance, difficulty with chewing or biting food, satisfaction with speaking and demand for orthodontic treatment ($P > 0.05$). While the absolute need for orthodontic treatment was 27.9 per cent, only 19.8 per cent of the sample was there a demand for receiving such treatment.
CONCLUSIONS: The studied samples had low awareness about their orthodontic problems and accordingly lower orthodontic treatment demand than they needed. Students could be clarified regarding dental aesthetics and malocclusion.

377 INDIVIDUAL AND SOCIAL MOTIVATION OF THE DECISION FOR ORTHODONTIC TREATMENT. COMPARISON BETWEEN POLISH AND CROATIAN PATIENTS

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AIM: To obtain information concerning patient's motivation for orthodontic treatment in Poland and Croatia, to compare factors making patients look for treatment in Poland and Croatia and to answer the question concerning individual and social motivations for this decision
SUBJECTS AND METHOD: Data was collected based on questionnaires completed by patients. The study group were 140 patients undergoing orthodontic treatment (80 Polish, 60 Croatian), treated with removable and fixed appliances, and at different stages of treatment.
RESULTS: For most respondents the major motivation for orthodontic treatment was aesthetic reasons. For some patients both aesthetic and functional reasons were important. The smallest group of represented patients who decided to undergo treatment had functional reasons. Motivation for treatment was also dependent on the patient's perception of himself/herself and his/her age. The examined patients associated treatment with many positive effects for themselves in various spheres of their life. Some patients with significant disorders of the masticatory system perceived in the treatment the possibility to avoid their social exclusion, marginalization. These patients noticed their chances for a positive perception by others
CONCLUSIONS: Many people are choosing orthodontic treatment to improve their image and self-esteem. Patients, who attend orthodontic practice obtain lot more information about their masticatory system condition, but if referred themselves, inner motivation, based on environmental factors is the most important.

378 OCCLUSAL CHARACTERISTICS REFLECTING PREVENTIVE AND INTERCEPTIVE ORTHODONTIC TREATMENT NEED IN CHILDREN AGED 8-9 YEARS IN A RURAL AREA OF THAILAND

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AIM: 1) To find the prevalence of preventive and interceptive orthodontic treatment (P&I Tx)need, and occlusal characteristics in children aged 8-9 years in a rural area of Thailand. 2) To investigate characteristics of malocclusion that indicated a P&I Tx need in these children.
SUBJECTS AND METHOD: One hundred and thirty four children randomly selected from five schools from the rural areas of Hatyai district, Songkhla, Thailand. Dental models, extra- and intra-oral photographs, as well as the results from the functional records of these children were examined using the Index for Preventive and Interceptive Orthodontic Needs (IPION) to determine the level of P&I Tx need (no need/moderate need/definite need). The Chi-square or Fisher's exact test was used to test the difference of each component of IPION between levels of P&I Tx need.
RESULTS: Almost all children (94.4%) in this study had caries or early loss of primary canines and molars with an average of 5.4 teeth per child. About 85.3 per cent had two or more teeth with caries and early loss of primary second molar. The prevalence of malocclusion was as follows: anterior crossbite (26.8%), posterior crossbite (7.0%), overjet >3 mm (41.9%), overbite >2/3 of the lower incisor (51.1%), open bite >0 mm (1.5%), rotation of the upper permanent molar (11.4%), and tipping of lower permanent molar (21.9%). The characteristics that were significantly different among the P&I Tx need group included anterior crossbite, tipping of the lower permanent molar, caries and early loss of the primary second molar (P <0.05).
CONCLUSIONS: The prevalence of P&I Tx need and caries in this group of children was extremely high. Anterior crossbite, tipping of lower permanent molar and caries, and early loss of the primary second molar were the dominant factors that indicated a P&I Tx need in this group of children.

379 CYTOTOXICITY AND OESTROGENICITY OF CLEAR RETAINERS

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AIM: To investigate the cytotoxicity and oestrogenicity of Vivera® retainers (Invisalign) by assessing its biological behavioural effect using them as-received and after retrieved from patients.
MATERIALS AND METHOD: Six sets (maxillary and mandibular), three as-received and three retrieved after 4 weeks of use, were immersed in a normal saline solution for 14 days following different modes of sterilization. The oestrogenicity assays involved two cell lines, namely the oestrogen-sensitive MCF-7 and the oestrogen-insensitive MDA-MB-231, in order to exclude the possibility that a decreased proliferation of cells induced by the retainer eluent would mask a potential induction of proliferation due to oestrogenicity. Cells were cultured in Dulbecco's Modified Eagle Medium (DMEM) supplemented with 10 per cent foetal bovine serum, at 37°C, in 5 per cent carbon dioxide, in a humidified incubator. The cells were regularly subcultured using a trypsin-citrate solution. To evaluate the oestrogenicity of the samples, the cells were plated in 48-well flat-bottomed microwells (10,000 cells per well) in DMEM and 10 per cent foetal calf serum. Twenty-four hours later, the medium was changed to phenol-free DMEM supplemented with 2 per cent foetal calf serum pre-treated with dextran-coated charcoal, along with the solutions to be tested, at concentrations varying from 5 to 20 per cent vol/vol. β-estradiol was used as the positive control, and a normal saline solution as the negative control. After six days of incubation, with medium renewal at day three, the cells were detached using trypsin-citrate solution and counted in a Z1 Beckman-Coulter counter. Assays were performed in triplicate, and the results were averaged. The statistical analysis of data was performed with two-way ANOVA with appliance and concentration as predictors. Differences were further investigated with the Tukey multiple comparison test at the 0.05 level of significance.
RESULTS: No significant MCF-7 proliferation was induced by the three samples compared either to the eluents from as-received retainers or to the negative control. As expected, β-estradiol induced a potent stimulation of MCF-7 cell proliferation, while no effect was observed on MDA-MB- 231 cells.
CONCLUSIONS: Under the conditions of this experiment as-received and retrieved Vivera® retainers did not seem to release substances with oestrogenic activity.

380 THE EFFECT OF SURGICAL EXPERIENCE ON MAXILLARY GROWTH AND OCCLUSION IN UNILATERAL CLEFT LIP AND PALATE PRIMARY SURGERY

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AIM: To compare the outcome of primary cleft surgery before and after centralization of primary surgery in the Cleft and Craniofacial Centre, University of Helsinki. The surgical team reorganized in 1991 and after that the guidance of the patient was undertaken by the cleft surgeon instead of the plastic surgeon.
MATERIALS AND METHOD: This long-term archive study of cleft treatment consisted retrospectively of patient charts, dental casts and lateral cephalograms from patients born from 1985 to 2006 with *a* unilateral cleft lip and palate (UCLP). The patients were divided into three groups according to the year of surgery and the clinical experience of the surgeon (1985-1990, 1991-1997 and 1998-2006). In group I the primary surgery was performed by large group of plastic surgeons, in group II by two young, quite recently qualified plastic cleft surgeons and in group III by the same two cleft surgeons, with now more training. At the age of 8 years the effect of surgical experience on maxillary growth was studied using lateral cephalometric variables and occlusion using the Goslon index. The facial and dental measurements were tested with a *t*-test and multifactorial variance analyse tests. Double blind measurements were performed to determine intraexaminer error.
RESULTS: SNA angle, as an indicator of maxillary sagittal growth of the cranial base, increased linearly from group I (SNA 77.2°) to group II (SNA 78.6°) and group III (SNA 80.4°). The difference was significant between groups I and III ($P < 0.000943$). As an indicator for correction of occlusion the Goslon index decreased, with the difference significant between groups I and III ($P < 0.00143$),.

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CONCLUSIONS: The clinical experience of the surgeon and the centralization of primary surgery for UCLP babies seem to correlate positively on the variables that measure the tendency of normal maxillary growth and dental occlusion.

381 GENETIC POLYMORPHISMS OF AXIN2 (SNP rs 7591 AND rs 7224837) GENE VARIANTS IN NON-SYNDROMIC CLEFT LIP/PALATE IN A LOCAL POPULATION

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AIM: To evaluate the association of Axis inhibition protein 2 (AXIN2) (a gene responsible for calvarial morphogenesis) gene variants rs 7591 and rs 7224837 with non-syndromic cleft lip and palate (NSCLP).
MATERIALS AND METHOD: Blood samples of 30 subjects with NSCLP and 30 unrelated controls were used for the study. The extracted DNA samples were subjected to polymerase chain reaction in which amplification of the selected gene segments was undertaken; later these amplified products were subjected to DNA sequencing.
RESULTS: The findings suggest that the likelihood of NSCLP is higher in subjects having TT ($P < 0.001$) and AT ($P = 0.03$) genotype for AXIN2 gene variant rs7591 and AG ($P = 0.01$) genotype for AXIN2 gene variant rs7224837.
CONCLUSIONS: The AXIN2 gene variants, rs7591 and rs7224837, can be considered as genetic markers for NSCLP in this local population.

382 BIOMECHANICAL ANALYSIS OF PERIODONTALLY REDUCED MOLARS IN ANCHORING UNITS USING CLINICAL DATA

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AIM: After periodontal therapy, orthodontic treatment of migrated anterior teeth is often carried out for functional and aesthetic reasons. The aim of this study was to investigate the biomechanical behaviour of the molars as an anchoring unit with typical bone defects for the treatment of different anterior tooth malocclusions.
MATERIALS AND METHOD: Existing three-dimensional finite element models of periodontally damaged maxilla with different variants of anterior tooth malocclusions. These models were completed around the molars and modelled with typical bone defects with and without furcation participation in the area of the molars. Similarly, segmented treatment elements adapted to the situation and with forces of 0.2 N per anterior tooth were modelled for gap closure and retraction of the fanned-out anterior dentition. The material parameters for bone (homogeneous, isotropic, E = 2 GPa), tooth (E = 20 GPa) and 'healed' periodontal ligament (PDL) were taken from previous investigations. Subsequently, initial tooth movement was simulated. The results were compared with those of a patient with reduced attachment but unchanged PDL and with a morphologically healthy patient.
RESULTS: The anchoring unit experienced up to four times less load than a morphologically healthy anterior dentition, due to bone deficiencies simulated in the anterior tooth area. Although the teeth were combined as an anchoring unit from the first premolar to the second molar, mesialising, rotating, and tipping forces resulted in these teeth in all directions in space. The rotating movement was particularly high at the molar, where a bone defect with furcation involvement was present. The molars with a periodontal defect show an elongation up to three times higher in the apical region than in the case of the molars without bone degradation.
CONCLUSIONS: Periodontally reduced lateral teeth in the anchoring unit lead more quickly to undesired tooth movements in the anchoring teeth or anchorage loss. Therefore, additional anchoring elements should be considered in therapy planning.

383 ORTHODONTIC BRACKETS AND ELASTICS AS A METHOD OF INTERMAXILLARY FIXATION IN SUITABLE MANDIBLE FRACTURES – A FINANCIAL CASE

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AIM: To establish how much cost-saving could be achieved by treating mandibular fractures that are suitable for intermaxillary fixation (IMF) with orthodontic brackets and elastics, rather than other commonly used IMF methods that require surgery under general anaesthesia (GA).
MATERIALS AND METHOD: A retrospective review was performed of mandibular fractures treated solely with IMF under GA at a regional trauma centre over 14 months between 2015 and 2016. Their length of admission, time to theatre and time in theatre were also identified. A cost analysis was performed and the potential amount saved if using orthodontic brackets and elastics instead of IMF was calculated. National data was used for estimation of cost of hospital admission stay (£400 per night) and operating theatre costs (£1,200 per hour).
RESULTS: Fifteen patients were identified who underwent treatment of a fractured mandible solely with IMF under GA. They spent a total of 41 days in hospital and a total of 24 hours in the operating theatre. The total cost of treating these 15 patients was £45,200 (£3,013 per patient).
CONCLUSIONS: Orthodontic brackets and elastics are an established safe and effective method of IMF in suitable cases of mandibular fractures, avoiding the need for hospital admission and GA. Not only would this provide significant cost savings for the hospital but also reduce morbidity for the patient as well as an earlier return to their normal activities.

384 AUDIT OF PATIENT SATISFACTION WITH SPACE CLOSURE OR SPACE OPENING IN MANAGING BILATERAL MISSING UPPER LATERAL INCISORS

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AIM: This audit aimed to assess patient satisfaction of both management options by completion of a questionnaire by hypodontia patients who had bilateral upper missing lateral incisors managed by either space closure or space opening and prosthetic replacement. This assessment of the acceptance of each method and the layperson's perception of aesthetics is useful to evaluate the impact of the burden of this care on the hypodontia service. In a publically funded healthcare system, there are implications of both options on long-term health service provision.
MATERIALS AND METHOD: Data was collected over 6 months at the Royal London Dental Hospital, U.K. An anonymous questionnaire was provided to a series of hypodontia patients with bilateral missing upper lateral incisors. The treatment method was recorded and participants were asked to use the five-point Likert scale to rate satisfaction with their smile aesthetics pre- and post-treatment. They were also asked to record any other treatment modalities that they were aware of and their perceptions of current prosthetic options.
RESULTS: There was an almost equal distribution in the number of cases managed with each treatment option within the dental hospital. With the space opening option, 90 per cent were fitted with resin bonded bridges and the remainder with dental implants. Overall, patients showed a good level of satisfaction with both treatment modalities. However, the space closure option resulted in a greater proportion of patients recording the maximum score for satisfaction (85%) compared to the space opening option (68%).
CONCLUSIONS: Both space closure and prosthetic replacement offer good aesthetic results and multidisciplinary assessment is essential for comprehensive decision making from the start. The lay person group showed greater satisfaction with the space closure option compared to the space opening option. This indicates that the space closing option can be just as successful and acceptable to patients as artificial replacement of teeth and has fewer long-term implications on patients and the health service.

385 SELF-PERCEPTION AND NORMATIVE ASSESSMENT OF MALOCCLUSION IN AN INDIGENOUS POPULATION

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AIM: To assess, in a cross-sectional study, the relationship of self-perception and normative measures of malocclusion in indigenous adolescents living in the Titicaca Lake in Peru
MATERIALS AND METHOD: Data were collected from the only two schools in the islands of Amantani and Taquile in the Titicaca Lake in Peru. Self-assessment of malocclusion severity was measured using the Index of Orthodontic Treatment Need (IOTN) Aesthetic Component that rates malocclusion from 1 (best) to 10 (worst). Malocclusion severity was measured by calibrated dental practitioners using the Index of Complexity, Outcome, and Need (ICON). Descriptive statistics were calculated to summarize the general characteristics of the sampled population. All statistical analysis was performed using SPSS for Windows, Version 22.0 (IBM Corp., Armonk, New York, USA).
RESULTS: A total of 286 students participated (47% female, 53% male). The mean age of the participants was 14.3 ± 1.8 years. The mean self-assessment score was of 2.3 (SD 1.8), whereas the mean normative assessment was 4.3 (SD 1.8). Participant (self-assessment) and practitioner (normative) did not correlate (Spearman P = 0.19, Pearson P = 0.26); participants tended to underestimate the severity of their malocclusion. Only 16 per cent of the participants assessed their malocclusion the same as the normative measurement. There was no significant difference in the way boys and girls rated their malocclusion (P = 0.24).
CONCLUSIONS: In this native isolated population, participants underestimated the severity of their malocclusion. It was hypothesized that lack of media influence may explain, in part, the observed results.

386 ASSESSMENT OF READINESS TO CHANGE ORAL HYGIENE BEHAVIOUR IN ADOLESCENTS WEARING FIXED APPLIANCES

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AIM: To evaluate the associations between the transtheoretical model stages of change and the level of oral hygiene in orthodontic patients. It was hypothesised that lower plaque index scores (≤ 1) would be prevalent in more advanced stages of change.
SUBJECTS AND METHOD: Thirty nine orthodontic patients, aged 12-16 years (mean age: 13 years) wearing fixed appliances in both arches, within the first 6 months of treatment from July to November 2016. Sociodemographic data was collected and participants received 15 minutes of oral hygiene conventional education. At the following orthodontic appointment, the plaque and gingival indices (Löe and Silness) and the stage of change as derived from the transtheoretical model (Prochaska and DiClemente, 1984) for oral hygiene behaviour were evaluated. This was assessed by asking the participants to choose one of five options: 1. I don't think I should change my oral hygiene (Pre-contemplation), 2. I don't brush my teeth very well but I'd like to do it better (Contemplation), 3. I've planned to brush my teeth better or more times (preparation), 4. I have good oral hygiene and I started in the last 6 months (action), 5. I've always brushed my teeth properly, and have been for longer than 6 months (maintenance). Study participants were characterized using descriptive statistics and ANOVA to evaluate the association between the transtheoretical model stages of change and the level of oral hygiene.
RESULTS: Fifty one per cent of the participants were in the preparation stage. Participants showed a plaque index of 1.18 and gingival index of 0.49. Subjects in the action and maintenance stages showed a lower plaque and gingival index (1.09/0.46) compared with those in the contemplation and preparation (1.21/0.51) stage, although the association was not significant (P = 0.54).
CONCLUSIONS: Conventional education is insufficient to achieve sustained behavioural changes as most of the participants reported being in the preparation stage. Motivational techniques would be useful to help participants move to the action stage.

387 POPULATION ANALYSIS OF CLEFT LIP AND/OR PALATE PATIENTS TREATED IN THE POSTGRADUATE ORTHODONTIC DEPARTMENT

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AIM: To analyze, in a population of cleft lip and/or palate (CLP) patients a number of anatomical and sociodemographic characteristics.
SUBJECTS AND METHOD: Sixty patients referred to the Postgraduate Orthodontic Department of the Faculty of Medicine of Coimbra by the Children's Hospital during 2015. All data related to the patients was obtained through a meticulous and thorough orthodontic examination (medical history, cast models, intra- and extraoral photographs and radiographic examinations).
RESULTS: Of the 60 patients included in the study 65 per cent were male. The most prevalent group was patients 11 years of age (5-22 years of range). The most common anomaly was a unilateral lip and palate cleft (63%). Maxillary endognathy was present in 75 per cent of the cases. Seventy four per cent of the patients presented at least one dental agenesis, with the upper lateral incisor being the more common.
CONCLUSIONS: A CLP is more frequent in males and seems to be associated with conditions such as maxillary endognathy and dental agenesis, with orthodontic treatment being required in these patients.

388 EFFECTS OF SURGICALLY ASSISTED RAPID PALATAL EXPANSION ON FACIAL SOFT TISSUES. A SYSTEMATIC REVIEW

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AIM: To systematically review the literature concerning the various effects of surgical transverse expansion of the maxilla on the soft tissues of the face.
MATERIALS AND METHOD: The search strategy included scanning of electronic databases (PubMed, Scopus, Proquest, Google Scholar, Cochrane Library) and hand searching of the reference lists of all included studies and any identified reviews. Two review authors independently screened the identified studies on the basis of title, abstract and full-text. Pre-specified inclusion and exclusion criteria were applied. Two review authors independently assessed the Risk of bias (RoB). The latter was assessed according to the design of each study followed by heterogeneity assessment within the framework of PICO. The RoB tools of the Cochrane Collaboration were applied.
RESULTS: From the 1184 articles initially identified, 11 were included in the qualitative synthesis. Among them were one randomized clinical trial, five non-randomized controlled studies and five before-after studies. RoB was generally high among the included studies. This finding along with the high clinical heterogeneity did not allow quantitative synthesis of the results.
CONCLUSIONS: A post-surgical increase in the dimensions of the alar width and the alar base width was commonly reported among the final studies. Yet, the above should be considered with caution due to the high risk of bias and the high clinical heterogeneity among the included studies. Additional high quality future research is needed in order to estimate the effect of surgically assisted rapid palatal expansion on the facial soft tissues.

389 A RETROSPECTIVE ANALYSIS OF TREATMENT DECISIONS RELATING TO THE MANAGEMENT OF UNERUPTED TEETH IN ADULTS

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AIM: To assess the treatment decisions of adult patients with unerupted teeth referred to a joint orthodontic restorative clinic.
MATERIALS AND METHOD: A retrospective analysis was undertaken. Patients (>18 years of age) were identified from the Joint Orthodontic-Restorative clinic lists at King's College Hospital between February 2015 and June 2016. Case notes were analysed and the following study variables collected: gender, age, skeletal pattern, number of unerupted teeth and malocclusion. In addition, the overall

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treatment decision was recorded: no treatment, orthodontic only, restorative only and combined orthodontic and restorative treatment.
RESULTS: Two hundred and ninety three patients attended the clinic during the study timeframe. Forty six (15.7%) patients (31 females, 15 males) presented with unerupted teeth. The mean age was 29.2 years (range 18-52 years). Most patients presented with a Class I malocclusion complicated by one unerupted tooth; UR3 (30%), UL3 (24%) and second premolar (6.5%). Eleven patients had bilaterally unerupted maxillary permanent canines and one multiple (>5) unerupted teeth. Twenty two patients (mean age 26.5 years) were recommended orthodontic treatment only and 15 patients (mean 32.8 years) a restorative only option. Treatment was commenced by 11 and eight patients, respectively, indicating an uptake of approximately 50 per cent for both treatment options. Nine patients were planned for a combination of orthodontic and restorative treatment (mean age 27.1 years) of which seven commenced treatment. The patient with multiple unerupted teeth (UR3, UL5, LL7, LL4, LL3, LR7) decided to have no treatment. Follow-up attendance at treatment clinics by adult patients was variable.
CONCLUSIONS: Orthodontic treatment alone or in combination with restorative treatment appears to be advocated for younger adult patients. Other factors that appear to influence treatment decisions include the position of unerupted teeth and adult patient's willingness to undergo prolonged orthodontic treatment and accept non-ideal restorations.

390 EFFECTS OF FACEMASK AND SKELETAL ANCHORAGE THERAPY FOR THE TREATMENT OF SKELETAL CLASS III MALOCCLUSIONS
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AIM: To evaluate and compare the effects of alternate rapid maxillary expansion and constriction (Alt-RAMEC) before facemask and skeletal anchorage therapy for the treatment of a skeletal Class III malocclusion in growing individuals.
SUBJECTS AND METHOD: A bonded type expander appliance was applied in 30 subjects. The Hyrax screw of the appliance was opened and closed alternately during 9 weeks. In 15 subjects a facemask (FM) was used and in the other 15 skeletal anchorage (SA) was applied. In the FM group the elastics produced a force of 400 g for each side and in SA group a force of 250-300 g from miniplates.
RESULTS: Forward displacement of the maxilla and clockwise rotation of the mandible occurred in both groups ($P > 0.05$). Overjet was increased in both treatment groups ($P > 0.05$).
CONCLUSIONS: The concave soft tissue profile was corrected in all subjects and Class I profile was achieved. Alt-RAMEC may be an alternative therapy.

391 MAGNITUDE OF FORCE FOR THE INTRUSION OF SIX MAXILLARY ANTERIOR TEETH USING TWO MINISCREW ANCHORAGE: A FINITE ELEMENT METHOD
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AIM: To evaluate the greatest magnitude of force for the intrusion of six maxillary anterior teeth without exceeding the capillary hydrostatic pressure of 0.0047 MPa, analyzed by the non-linear finite element (FE) method.
MATERIALS AND METHOD: A FE model of the six maxillary anterior teeth was reconstructed from three-dimensional scanning of a maxillary dental model (i21FE-400C; Nissin Dental Products, Kyoto, Japan). The maxillary alveolar bone was created, consisting of the cortical and cancellous bone with a periodontal ligament (PDL) thickness of 0.2 mm. Brackets with 0.022 × 0.028 inch slots and 0.017 × 0.025 inch archwire were created. Loads were applied on both sides to the archwire at the midpoint between the central and lateral incisors in an oblique direction to the miniscrew implant located between the roots of the lateral incisors and canines. Total force magnitudes of 10, 15, 20, 25, 30, 35, 40, 45, 50, 60 and 70 g were applied. The ABAQUS software (Dassault Systèmes Americas, Waltham, Massachusetts, USA) was used to generate the non-linear FE analysis.
RESULTS: The 45 g-force was the greatest intrusive force magnitude that did not exceed the capillary hydrostatic pressure in the PDL (0.0047 MPa). The greatest pressure area was observed at

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the root apex of the lateral incisor towards the palatal side, whereas the lowest was found at the canines. Higher force created a pressure in the PDL greater than 0.0047 MPa at the root apices of the lateral and central incisors. The central incisors were intruded with palatal displacement both crown and root, whereas the lateral incisors and canines were slightly proclined.
CONCLUSIONS: From the present study, the greatest force magnitude for the intrusion of the six maxillary anterior teeth using two miniscrew anchorage is 45 g. Force greater than this may be harmful to the root apices of incisors.

392 TREATMENT OUTCOMES OF IMPACTED MAXILLARY CANINES AFTER DIFFERENT SURGICAL EXPOSURES. A SYSTEMATIC REVIEW

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AIM: To compare the effectiveness of open and closed exposure techniques regarding periodontal outcomes, duration of surgical treatment, patient's inconvenience, aesthetics, and orthodontic treatment complications.
MATERIALS AND METHOD: Electronic database searches of published and unpublished literature were performed. The reference lists of eligible studies were hand searched for additional studies. Randomized clinical trials (RCTs), quasi-randomized clinical trials (Q-RCTs) and non-randomized trials of prospective and retrospective design with patients of any age that compared a group with palatally impacted canines treated by open exposure to a similar group treated by closed exposure technique were selected. There was no restriction on language or year of publication. Study selection, data extraction, and risk of bias assessment were performed individually and in duplicate.
RESULTS: The search strategy resulted in 159 articles, and nine were selected for final analysis. They were three non-randomized trials, one Q-RCT and two reports of another Q-RCT, and three reports of one RCT. The level of reported evidence was high for the RCT and one Q-RCT but poorer for the other trials. Four articles reported periodontal outcomes, three researched the duration of surgical procedure, two the duration of canine eruption, two investigated patient's inconvenience, two reported on failure rates and two addressed aesthetic outcomes. The results were inconsistent and there was considerable disagreement for most of the outcomes among studies.
CONCLUSIONS: According to the existing evidence it may be concluded that there is no difference between the two techniques regarding periodontal outcomes and aesthetic appearance. The surgical procedure was shorter in the open exposure group while the amount of post-operative pain during the first day was similar between the open and closed surgical exposure patients. However these conclusions are based on two single trials with high levels of evidence, while the rest of the studies present high risk of bias.

393 DENTAL ARCH DEVELOPMENT AFTER ADENOIDECTOMY AND TONSILLECTOMY IN PREPUBERAL CHILDREN: A SYSTEMATIC REVIEW

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AIM: Prepuberal children who have adenoids and/or tonsil enlargement require adenoidectomy and/or tonsillectomy. Thus, the aim was to review the literature on changes in the dental arch after these treatments.
MATERIALS AND METHOD: A systematic literature search was conducted in PubMed, Web of Science, and Cochrane for studies published up to October 2016. In each study, references were screened for useful publications. Articles in English or Spanish, studies performed in humans, non-syndromic patients and children up to the prepuberal age without orthodontic treatment were included. The year of publication was not taken into consideration. Case reports of less than five patients were excluded.
RESULTS: Eight publications were selected from a total of 112 search results. According to the articles reviewed, patients with mouth breathing showed a different facial appearance compared to

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those with nasal breathing. In several studies, adenoidectomy and/or tonsillectomy were associated with better development of the intercanine width, better bone remodelling in the palatal wall, and a more horizontal growth direction of the mandible.
CONCLUSIONS: When prepuberal patients have enlarged adenoids and/or tonsils obstructing respiratory airways, an adenoidectomy and/or tonsillectomy can favour correct development of dental arch and also relieve the respiratory airways.

394 LONG-TERM STABILITY ASSESSMENT OF DIFFERENT SIZES OF MINI-IMPLANTS PLACED IN THE POSTERIOR PART OF THE MANDIBULAR BODY

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AIM: Use of mini-implants permits different types of tooth movement, which are difficult to obtain. The aim of this study was to assess the stability of mini-implants with different diameters, placed in the alveolar part of the mandible and in the mandibular corpus.
SUBJECTS AND METHOD: Absoanchor® mini-implants (Dentos, South Korea) of different sizes (i.e. 2018-10-SH, 1514-08-SH or 1312-08-SH) were inserted bilaterally between the first and second molars of 99 generally healthy Caucasian patients aged 20-50 years. The surgical procedure and loading complied with the Wroclaw protocol. Skeletal anchorage was considered stable if it survived until achievement of the desired orthodontic movement. The results were statistically analysed using the Chi-square test, multiple comparison test, relative risk and odds ratio for each screw size. The level of significance was set at $P = 0.05$.
RESULTS: The success rates were as follows: 91.3 per cent for the 2018-10-SH mini-implants, 76.1 per cent for the 1514-1508-SH mini-implants, and 71.7 per cent for the 1312-1308-SH mini-implants. The 2018-10-SH mini-implants were significantly more stable than the 1312-1308-SH. No differences in stability were noted when comparing 2018-10-SH and 1514-08-SH mini-implants, as well as the 1514-08-SH and 1312-08-SH mini-implants.
CONCLUSIONS: Insertion of 2018-10-SH mini-implants in the mandibular corpus, in the area between the first and second molar, favours success of a treatment plan more than shorter mini-screws implanted in the alveolar part of the mandible.

395 SKELETAL, DENTAL AND SOFT TISSUE DIFFERENCES BETWEEN CHINESE AND CAUCASIAN ORTHODONTIC PATIENTS: A SYSTEMATIC REVIEW

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AIM: To prove validity of the standard cephalometric norms within the Chinese ethnic group.
MATERIALS AND METHOD: A systematic literature search was conducted in PubMed and Web of Science. The five selected articles included Chinese and Caucasian samples from 101 up to 245 children and young adults orthodontically untreated with normal occlusions and well-balanced faces. Furthermore, no craniofacial or dental abnormalities were noted. Each population was categorized into male and female groups. All lateral cephalograms were recorded in the natural head position.
RESULTS: Distinct facial differences were noted between the subgroups evaluated. Compare with Caucasians, Chinese females and males exhibited a shorter anterior cranial base, a shorter maxilla and mandible, greater anterior and posterior face heights, a posterior rotation of the maxillary plane, a greater vertical dimension, a larger distance between the projection of points A and B on the functional occlusal plane, a larger ANB (skeletal Class II tendency), a significant labial inclination of the upper and lower incisors (bimaxillary-alveolar protrusion), a decreased interincisal angle, more protrusive upper and lower lips, a more acute nasolabial angle and less prominent nose and chin. Chinese people have a flatter face, their nose is smaller, the dentition is more prognathic and the lips protrusive, so their profile is more convex than that of Caucasians.
CONCLUSIONS: A mean of each value was provided in every article after having analysed representative samples of Chinese and Caucasian individuals. Significant discrepancies among the

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given values were reported. Consequently, universal cephalometric norms are not suitable for Chinese patients. A successful orthodontic diagnosis will basically depend on accurate clinical and cephalometric analyses, to develop an individual treatment plan. Therefore, the dental and skeletal differences between the Chinese and Caucasian groups should be highly considered in treatment decision making.

396 PREDICTORS OF POST-RETENTION STABILITY OF MANDIBULAR DENTAL ARCH DIMENSIONS IN PATIENTS TREATED WITH A LIP BUMPER FOLLOWED BY FIXED APPLIANCES

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AIM: To identify which dental and/or cephalometric variables were predictors of post-retention mandibular dental arch stability in patients who underwent treatment with a transpalatal arch and lip bumper during the mixed dentition followed by full fixed appliances in the permanent dentition.
SUBJECTS AND METHOD: Thirty-one patients were divided into stable and relapse groups based on the post-retention presence or absence of relapse. Intercanine, interpremolar, and intermolar widths; arch length and perimeter; crowding; and lower incisor proclination were evaluated before treatment (T0), after lip bumper treatment (T1), after fixed appliance treatment (T2), and a minimum of 3 years after removal of the full fixed appliance (T3). Logistic regression analyses were performed to evaluate the effect of changes between T0 and T1, as predictive variables, on the occurrence of relapse at T3.
RESULTS: The model explained 53.5 per cent of the variance in treatment stability and correctly classified 80.6 per cent of the sample. Of the seven prediction variables, intermolar and interpremolar changes between T0 and T1 (P = 0.024 and P = 0.034, respectively) were statistically significant. For every millimetre of increase in intermolar and interpremolar widths there was a 1.52 and 2.70 times increase, respectively, in the odds of having stability. There was also weak evidence for the effect of gender (P = 0.047).
CONCLUSIONS: The best predictors of an average 4-year post-retention mandibular dental arch stability after treatment with a lip bumper followed by full fixed appliances were intermolar and interpremolar width increases during lip bumper therapy. The amount of relapse observed could be considered clinically irrelevant.

397 COMBINED ORTHODONTIC AND SURGICAL TREATMENT OF MANDIBULAR PROGNATHISM. THE PATIENTS' EVALUATION 10-15 YEARS AFTER TREATMENT

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AIM: To determine skeletal Class III patients' motivation for seeking orthodontic surgical treatment, the experience of treatment, and their degree of satisfaction with the result today, 10-15 years later.
SUBJECTS AND METHOD: A total of 36 of 84 potential participants returned a self-administered questionnaire and attended a clinical and radiological follow-up session 10-15 years after mandibular setback surgery. All patients had pre- and post-surgical orthodontic treatment, and the surgical procedure was only one jaw and exclusively the intraoral vertical ramus osteotomy procedure. The frequency of the oral impact on daily performance index was included in the questionnaire to measure patient reported oral health related quality of life (OHRQoL). Linear models (Pearson chi2, Fisher's exact test and logistic regression) were used to evaluate the results. Significance level was set to 5 per cent.
RESULTS: Participation rate was 42.9 per cent (25 females, 11 males). The mean mandibular setback was 8.2 mm and mean anterior skeletal relapse was 1.4 mm between eight weeks and 10-15 years after surgery. The main reasons for seeking treatment were to improve chewing (69.4%) and

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dissatisfaction with the facial appearance due to a prominent chin (38.9%). The orthodontic part of treatment was reported more frequently as the worst part compared to the healing and the six weeks of intermaxillary fixation after surgery. It was more than five times more likely that a patient reporting dissatisfaction with the facial appearance before treatment noticed a change in self-esteem after treatment [odds ratio (OR) = 5.5, *P* = 0.065]. All patients were either very (61.1%) or reasonably (38.9%) satisfied with the result, and only one patient would not have asked for the same treatment again. Females were more satisfied than males (OR = 1.48, *P* = 0.716). The patients that noticed a change in their self-esteem were also statistically significantly more satisfied with the treatment result (*P* = 0.019). The mean OIDP sum score was 8.49 (standard error: 0.18, range: 8-12, possible range: 8-40). Gender had no significant impact on OHRQoL (*P* = 0.393).
CONCLUSIONS: To improve masticatory function and appearance were the most frequent motives for seeking treatment. The patients were satisfied with the result, and the self-reported OHRQoL 10-15 years after surgery was good.

398 TRANSFER ACCURACY OF TWO INDIRECT BONDING TECHNIQUES – AN *IN VITRO* STUDY WITH THREE-DIMENSIONAL SCANNED MODELS †††

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AIM: Indirect bonding (IDB) has proven to be an effective method to establish an appropriate bracket positions in patients. There are several different methods and materials for the manufacture of transferring trays. The aim of this *in vitro* study was the measurement and comparison of the transfer accuracy of two different IDB methods.
MATERIALS AND METHOD: A total of 60 plaster models (15 different silicone moulds, each cast four times) were fabricated and then separated into two groups of 30 models each (15 working models, 15 patient models). After placing brackets on the working models, a total of 30 indirect bonding trays were built: 15 silicone and 15 double-vacuum forms. With these trays, the brackets were transferred to the patient models. The bracket positions were scanned before and after the IDB procedure using an intraoral scanner (TRIOS®, 3Shape Dental Systems, Copenhagen, Denmark). The linear and angular discrepancies were then digitally determined using the GOM Inspect Software V8 SR1 (GOM - Gesellschaft für Optische Messtechnik mbH, Braunschweig, Germany) by measuring six different dimensions: occluso-cervical, mesio-distal, bucco-lingual, tip, rotation and torque. Statistical differences between the methods were measured by using the Mann-Whitney-*U* test.
RESULTS: The silicone trays showed less transfer discrepancies, on average, for all measured dimensions. There were significant differences between the methods in the occluso-cervical (*P* < 0.001), mesio-distal (*P* = 0.001) and torque (*P* = 0.044) dimension. With both methods 100 per cent of the linear measurements were within a clinically acceptable range of 0.5 mm. For angular measurements 99.3 per cent in the silicone group and 97.5 per cent in the double-vacuum group were within a clinically acceptable range of 2 degrees.
CONCLUSIONS: Although both examined transfer methods showed a high precision, silicone trays had a higher accuracy than double-vacuum forms.

††† Winner of an EOS Scientific Poster Award

399 ACCURACY OF CONE BEAM COMPUTED TOMOGRAPHY IN PERIODONTAL BONE MEASUREMENTS FOR ORTHODONTIC TREATMENT PLANNING‡‡‡

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AIM: To evaluate the accuracy of a commercially available cone-beam computed tomograph (CBCT) and its impact on identifying periodontal intrabony defects. Focus was given to voxel resolution and bone thickness.

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MATERIALS AND METHOD: Sixty two artificial osseous defects (fenestration, dehiscence or parallel horizontal cuts) were created on the labial side of human formalin-fixed mandibles. CBCT scanning and linear measurements of height, width and depth of bony defects and length of the horizontal cuts were assessed at different voxel resolutions (0.125, 0.2, 0.25, 0.3 and 0.4 mm voxel data set). The results were compared to anatomic bony measurements under a stereomicroscope. Accuracy of the CBCT images was determined by Bland-Altman analysis and paired *t*-test. Method error was calculated by Dahlberg's formula and Houston's coefficient of reliability.
RESULTS: All bony defects were identifiable and measurable with CBCT. Voxel size and bone thickness affected the precision of the measurements significantly when compared to the microscopic data. Images with a 0.25 mm voxel size and bone thicknesses of 0.4 mm or more provided precise linear measurements with low rates of false-negative findings (<10%). Lower bone thicknesses could not be accurately detected. The mean difference of the radiographic measurements to the anatomical data ranged between 0.02 to 0.52 mm linearly, which can be considered as clinically irrelevant. The smallest discrepancy was observed for fenestration defects. Images with a resolution of 0.3 or 0.4 mm voxel size resulted in significantly more false-negative findings (40% fenestrations and dehiscences, 80% horizontal cuts). A clinically acceptable mean deviation ranging from 0.04 to 0.67 mm was detected; the smallest measurable bone thickness was 0.6 mm. The Bland-Altman analysis confirmed high agreement between the collected data.
CONCLUSIONS: CBCT imaging provides a reliable and accurate method for analyzing periodontal bony defects. Voxel resolution as well as bone thickness affected the precision of defect measurements. Bone thicknesses of 0.4 mm or more can be identified precisely by CBCT with voxel resolutions of 0.25, 0.2 and 0.125 mm. Measurements with lower voxel resolutions resulted in a substantial increase of false-negative findings, while showing only little influence on measurement accuracy.

400 CLOSING THE GAP FOR CHILDREN WITH PROMINENT ANTERIOR TEETH
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AIM: Quality healthcare services must be outcome focused and evidence based. Good governance is fundamentally linked to the quality, safety and accountability of the service to improve outcomes. Many growing Index of Orthodontic Treatment (IOTN) 5a patients have a 'window of opportunity' when treatment will be most efficient and most effective with a functional appliance. Long sequential waiting lists can obstruct timely access to treatment and encourage early referral, which can create bottlenecks. The aim of this organizational development project was to develop and implement a clinical protocol to improve access to functional appliance treatment for children with very prominent anterior teeth (IOTN Grade 5a).
MATERIALS AND METHOD: A retrospective review of 115 completed IOTN5a cases identified the bottlenecks in patient flow in the old system. The sequential waiting list was unbalanced and inefficient due to the wide variation of referral age and urgency. There was an *ad hoc* system of prioritization that was not equitable or robust. Using NCEC Guidance a clinical protocol was developed that was transparent, standardized and equitable. This was based on the best clinical evidence for the timing of treatment and the evidence for cost-effectiveness of treatment. Using the HSE Change Model, the new process was implemented, using the clinical protocol at assessment to record an indicative date for treatment to start. A key performance indicator was developed to measure compliance with the protocol and to measure the new quality standard.
RESULTS: This process change was successful in improving IOTN 5a patients' access to start treatment at the right time. Improved patient flow increased capacity. Standardised access to treatment can improve the quality and timing of referrals.
CONCLUSIONS: This quality improvement is patient-centred, but the balanced score card evaluation outlined had benefits for all stakeholders. There is a cost-benefit to the service by providing treatment at the most efficient and effective time. Further evaluation of outcome measures is required. This process change could be extended for other IOTN criteria.

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401 ORTHODONTIC TREATMENT PROVIDED BY GENERAL DENTAL CLINICS AND ORTHODONTIC SPECIALIST CLINICS IN THE SWEDISH COUNTY OF JÖNKÖPING AND KALMAR

Sandina Sehic[1], Anna Kratochwil[2], Monica Müller[3], Aleksandar Zoric[4], Rune Lindsten[1], Orthodontic Clinics of [1]Jönköping, Odontologiska Institutionen Jönköping, [2]Nässjö, [3]Värnamo and [4]Oskarshamn, Sweden

AIM: To evaluate the amount of orthodontic treatment provided by general practitioners and specialists within the subsidized Swedish system for orthodontic care.
SUBJECTS AND METHOD: Eight hundred patients, comprising 200 consecutive patients in each of four different general clinics, all born in 1995. Records of the patients were analyzed and assessed until 1 October 2016. Several variables were analyzed: number of patients receiving orthodontic treatment by general practitioners, number of patients receiving initial treatment by general practitioners and subsequently by orthodontists and also some occlusal and treatment related variables were registered. Descriptive statistical methods were used.
RESULTS: Thirty-nine per cent of patients received orthodontic treatment in general dental clinics (GDC); 61 per cent did not. Twenty-one per cent were referred to orthodontic clinics, 12 per cent of whom had received some treatment earlier in the GDC. Of the referred and treated patients at the orthodontic clinics 61 per cent had an Angle Class I, 34 per cent an Angle Class II and 4 per cent an Angle Class III malocclusion. Thirty per cent received fixed appliance solely in the upper jaw, 5 per cent solely in the lower jaw and 65 per cent both in the upper and lower jaws. Fifty-five per cent were treated non-extraction with fixed appliance, 44 per cent with extractions and fixed appliances and 1 per cent only with extraction. The treatment duration was 19 months on average. The most common retention in the upper jaw was a vacuum formed retainer and in the lower jaw a twist-flex retainer.
CONCLUSIONS: Thirty-nine per cent of the patients received some orthodontic intervention in the GDC after consultation with an orthodontic specialist. About 20 per cent were treated at the orthodontic clinics, some of whom had received orthodontic treatment in the GDC previously. It is desirable to minimize this group as far as possible.

402 ANALYSIS OF THE INFLUENCE OF MEANS FOR HYGIENE OF THE ORAL CAVITY OF ONCOLOGICAL ORTHODONTIC PATIENTS

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AIM: Improvement of methods of prophylaxis and hygiene the oral cavity mucosa of oncologic patients undergoing removable orthodontic treatment.
SUBJECTS AND METHOD: Eighteen patients aged from 7 to 12 years with an oncologic profile. Following voluntary consent, the patients were divided into two groups. The first group of patients undergoing removable orthodontic treatment received ‘a preventive and hygienic skin with leykovoriny’ while the second group received standard therapy used in treatment of a stomacace. In all patients, before insertion of the orthodontic appliance and after carrying out research, collection of stomatic liquid was made for microbiological and biochemical analysis and measurement of the quantity of Methotrexatum. A preventive and hygienic programme for the mucous membrane of the oral cavity was adapted for oncological patients. A liquid, by means of a nozzle, when sprayed on the surface of the teeth turns into foam. Such form of hygienic means on the structure is most effective for the mucous membrane of an oral cavity.
RESULTS: The quantity of a methotrexate with saliva has decreased to a research only in one group of the patients applying preventive hygienic means
CONCLUSIONS: This means is an effective remedy for prevention and hygiene for the oral cavity of orthodontic patients of an oncological profile.

403 IS THE SANDBLASTING PROCEDURE WITH ALUMINIUM DIOXIDE IN LINGUAL ORTHODONTICS AT THE EXPENSE OF PREVENTION?

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AIM: In lingual orthodontics, sandblasting with aluminium dioxide (Al_2O_3) is frequently recommended before the adhesive is applied on the tooth surface. The primary endpoints of existing studies are limited with investigations of the surface roughness of the enamel and the bond strength during shear stress. However, there is no data available about abrasion behaviour of enamel at present. The aims of this *in vitro* study were: i) to determine possible enamel loss after sandblasting using optical coherence tomography (OCT), a non-invasive method and ii) to put the manufacturers' recommendations into question for protecting the enamel structure during orthodontic treatment.
MATERIALS AND METHOD: Eighty extracted human teeth were prepared according to ISO 11405. The teeth were randomly assigned to four groups (n = 20), and in each group different enamel conditioning was performed on the lingual surfaces. In group 1, 37 per cent phosphoric acid (Ivoclar-Vivadent AG) was applied for 30 seconds, and the surfaces were then rinsed with water for 30 seconds. In groups 2, 3 and 4, the samples were treated with the MicroEtcher™ CD sand blasting device (Danville Engineering) at 3 bar air pressure for 3 seconds, with a distance of 5 mm with different grain sizes (27, 50 and 85 µm) of Al_2O_3 particles using various beam angles (45˚ and dynamic) by two experts. Enamel loss and change of enamel structure were analyzed using OCT. Analysis of three-dimensional scans before and after sandblasting derived from A-silicon precision impressions served as the gold standard.
RESULTS: On all sandblast treated surfaces enamel loss and change of the enamel structure could be detected using OCT. The OCT allowed non-invasive imaging with a resolution of ≈ 5 µm. It was found that the enamel loss values after sandblasting in all three treatment groups were between 118 and 279 µm.
CONCLUSIONS: Sandblasting with Al_2O_3 of the lingual surfaces can lead to enamel loss and changes of enamel structure. It is suggested that other parameters (low abrasive blasting agent, low propellant air pressure, flat beam angle, and enamel maturity) should be investigated in detail and the need for sandblasting should be re-evaluated.

404 COMPARISONS OF TWO PROTOCOLS FOR EARLY TREATMENT OF AN ANTERIOR OPEN BITE

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AIM: To compare the outcomes of treatment with the quadhelix/crib (Q-H/C) appliance with those of a combination of transpalatal arch, high-pull headgear, and lip bumper (TPA/HG/LB) in growing patients with an anterior open bite (AOB)malocclusion.
SUBJECTS AND METHOD: The TPA/HG/LB sample consisted of 22 subjects, 16 girls and 6 boys (mean age 7.5 ± 1.4 years at the start of treatment (T1) and 8.7 ± 1.5 years at the end of active treatment (T2). The Q-H/C sample consisted of 28 subjects, 17 girls and 11 boys (mean age 8.2 ± 1.3 years at T1, and 8.7 ± 1.6 years at T2). Both treated groups were compared with a control group of 20 untreated subjects matched for dentoskeletal disharmony and observation interval. The changes from T2 to T1 between the three groups were compared with the analysis of variance.
RESULTS: Both TPA/HG/LB and Q-H/C groups exhibited greater reduction of the palatal plane to mandibular plane angle (−1.7° and −1.9°, respectively) and a significantly greater increase in overbite (2.2 and 2.3 mm, respectively) with respect to controls.
CONCLUSIONS: Q-H/C and TPA/HG/LB protocols were equally effective in correcting the AOB.

405 ANALYSIS OF CHANGES IN HUMAN PERIODONTAL LIGAMENT STEAM CELLS AND DENTAL PULP STEM CELLS BY LOW LEVEL LASER THERAPY: A REVIEW AND NEW PERSPECTIVES

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AIM: To review the literature about the effects of low level laser therapy (LLLT) on human periodontal ligament steam cells (hPDLSCs) and human dental pulp stem cells (hDPSCs).
MATERIALS AND METHOD: The electronic search was performed collecting articles in the PubMed/Medline, Scopus and Google Scholar databases from January 1990 to June 2016. Suitable papers were characterized as experimental studies that evaluated the effects of LLLT on hPDLSCs and hDPSCs. Reference lists of the selected articles were hand-searched for additional relevant publications that may have been missed previously.
RESULTS: LLLT was able to significantly increase cell proliferation, collagen I and mRNA expression, and hPDLCs and hDPSCs osteogenic differentiation via cAMP regulation by stimulating oxidative phosphorylation and modulating inflammatory response.
CONCLUSIONS: LLLT showed a positive influence on hPDLSCs and hDPSCs proliferation rate suggesting that laser phototherapy may improve stem cells growth in tissue engineering and regenerative medicine. However, further clinical studies should be performed to determine the appropriate dose of irradiation because *in vitro* study cannot always mimic real clinical conditions.

406 THREE-YEAR UNITED KINGDOM AND SWEDISH ORTHODONTIC TRAINING PROGRAMMES, WHOM DID WE TREAT?

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AIM: To investigate the case mix of orthodontic specialist registrars in the United Kingdom (UK) and Sweden and compare them in terms of Index of Orthodontic Treatment Need Dental Health Component (IOTN DHC) grade, incisor classification, multidisciplinary care, and the use of functional appliances and headgear and to investigate compliance rates with the twin block functional appliance and extra-oral headgear.
SUBJECTS AND METHOD: Orthodontic specialist registrars from the East Midlands region (UK) and Uppsala County who had completed their training in the last five years were contacted by email inviting them to participate. Responders were asked to provide their logbook summary detailing the types of patients and their treatment categories. The lead author further investigated the treatment of Class II patients under his care. The compliance rate for functional appliances and headgear was assessed by reviewing the case notes and determining if the patient had worn their appliance successfully for a minimum of 6 months.
RESULTS: Complete data was obtained from three UK registrars and one Swedish registrar. The number of new cases ranged from 123 to 159. Nearly all cases were IOTN DHC 4 or 5 (range 97% to 100%). A similar proportion of extraction and non-extraction cases was observed amongst the trainees (extraction range 39% to 56%). UK trainees had a greater proportion of Class II cases (range 55% to 66%) compared to the Swedish trainee (29%). All trainees had multidisciplinary cases involving restorative, trauma, oral surgery and orthognathic treatment. All cases were treated with the pre-adjusted edgewise appliance except for approximately 2-4 upper removable appliances per trainee. The twin block compliance rate for the lead author was 84 per cent (26 out of 31 cases). The headgear compliance rate for the lead author was 82 per cent (9 out of 11 cases).
CONCLUSIONS: This sample of UK and Swedish registrars had similar numbers of patients, severity of IOTN and multidisciplinary cases. There were more Class I malocclusions in the Swedish sample and more Class II malocclusions in the UK sample. The compliance rate for functional appliance treatment using twin blocks was high at 84 per cent. The compliance rate for headgear was also high at 82 per cent.

407 AN AUDIT TO ASSESS THE APPROPRIATENESS OF ORTHODONTIC SECONDARY CARE REFERRALS WITH RESPECT TO THE COMMISSIONING GUIDELINES COMPLEXITY LEVELS

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AIM: The orthodontic department at the Eastman Dental Hospital (EDH) has approximately 25,000 patient episodes per year, including consultation, treatment and follow-up appointments. The estimated annual cost of orthodontic secondary care services across the London region is £12.6 million. As such, it is important that referrals accepted for treatment in secondary care are appropriate and timely. New commissioning arrangements have suggested tiers of complexity, with the patient treated in a setting suitable for their problem; level 1 (primary care general dentists), level 2 (primary care dentists with enhanced skills) and level 3a/3b (primary/secondary care specialists). This audit aimed to assess the complexity of current orthodontic referrals and whether this appropriately differentiates those patients who require hospital care.
SUBJECTS AND METHOD: All patients referred to the orthodontic department were identified from May-September 2016. The tier system was used to categorise the complexity of care as well as the Index of Orthodontic Treatment Need (IOTN) and appointment outcome. The data was prospectively collected and subsequently analysed.
RESULTS: One thousand two hundred and twenty six patient referrals were received by the department, of which 89 per cent were accepted for consultation. A total of 818 new patients were seen for consultation: 49 per cent were categorised as IOTN 4 or 5, 40 per cent did not have an IOTN score recorded. Two hundred and twenty nine patients were accepted for treatment, of which 87 per cent were complexity level 3b, 9 per cent level 3a and 2 per cent level 2; the level was not recorded for 2 per cent.
CONCLUSIONS: The majority of patients accepted for treatment were considered to have a malocclusion of level 3b complexity. This complies with the level of complexity that should be managed in a secondary care setting. Most level 3a or level 2 patients were accepted for interceptive treatment and perhaps the level selected did not accurately reflect the complexity of the case.

408 PREVALENCE OF TOOTH AGENESIS, SUPERNUMERARIES AND IMPACTION IN CHILDREN WITH VARIOUS TYPES OF CLEFTS

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AIM: To determine the prevalence of tooth agenesis, supernumeraries and impaction in different type of cleft patients.
SUBJECTS AND METHOD: Two hundred and one cleft patients including 131 male subjects with a mean age of 12.3 ± 4 years and 70 female subjects with a mean age of 12.6 ± 3.9 years. Charts, models, radiographs, and intraoral photographs were used for the study. *t*-, chi-square and binomial tests were used for assessment of the data.
RESULTS: Hypodontia was found in 129 subjects (64.1%). The chi-square test showed no statistically significant difference between the type of cleft and hypodontia ($P = 0.319$). The binomial test showed that the frequencies of subjects with hypodontia were significantly higher in both unilateral and bilateral cleft lip and palate patients ($P < 0.015$ and $P < 0.001$, respectively). Hyperdontia and impacted teeth were also found to occur mostly in the maxillary arch, with the maxillary canines the most commonly impacted teeth in both unilateral and bilateral cleft lip and palate patients.
CONCLUSIONS: In this study, no relationship was found between hypodontia and the type of cleft. No gender differences were found regarding the prevalence of hypodontia. This study also showed that both hyperdontia and impacted teeth occurred mostly in the maxillary arch, with the maxillary canines being the most frequently impacted teeth in all types of clefts

409 THE EFFECT OF THE TWIN BLOCK AND R-APPLIANCE IN THE TREATMENT OF MANDIBULAR DEFICIENCY

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AIM: To compare the effects of a differently designed functional appliance (the R-appliance) with a twin-block (TB) treated group.
SUBJECTS AND METHOD: Thirty patients (18 girls, 12 boys) with a mean age of 10.5 ± 0.7 years were treated with the R-appliance for 16.2 ± 0.3 months and 25 (11 boys, 14 girls) with a mean age of 11.2 ± 1.3 years with a TB for 16.1 ± 1.4 months (control). All had a Class II division 1 malocclusion due to mandibular deficiency. Lateral cephalograms obtained at the beginning (T1) and end (T2) of the study were analysed.
RESULTS: Paired *t*-tests showed that SNB significantly increased in both groups. The incisor mandibular plane angle (IMPA) was reduced in the R-appliance group by 1.9 ± 4.9 degrees ($P < 0.04$) but increased by 0.5 ± 5.1 degrees ($P < 0.6$) in the TB group. SNA in the R-appliance group showed an increase of 0.2 ± 1.8 degrees ($P < 0.5$), while it was decreased by 0.2 ± 1.3 degrees ($P < 0.3$) in the TB group.
CONCLUSIONS: Both treatment modalities were successful in moving the mandible forward. However, with the R-appliance, this was achieved without retroclination of the lower incisors; the difference between the two groups was not statistically significant

410 OPTIMAL TIMING OF EXTRACTION OF MANDIBULAR FIRST MOLARS

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AIM: It has been suggested that optimal time of extracting first molars is when the mandibular second molar (M2) is within bone, shows root cleft formation and the patient is 8-10 years of age. The aim of this study was to explore the age, root stage and eruption level of M2 at root cleft stage as well as the relationship between M2 and the mandibular second premolar (P2).
MATERIALS AND METHOD: This was a retrospective, cross-sectional study of archived panoramic radiographs (N = 2885, age range 2-23 years). A subset of this sample (N = 250) was used to assess P2 relative to M2 formation. The P2 and M2 were staged into Moorrees formation stages and eruption levels (unerupted or alveolar eruption). The average age of M2 root cleft stage was calculated. The proportion of individuals outside the age range 8-10 years was calculated. The percentage of the sample with M2 at root cleft and unerupted was calculated. The distribution of P2 stages at M2 root cleft stage was calculated. Reliability of tooth stage assessment was assessed using Cohen's Kappa (κ) after duplicate readings of 100 radiographs.
RESULTS: Reliability was excellent (κ = P2 0.87, M2 0.95). The mean age of M2 root cleft stage was 8.73 (SD 0.94) years and 20 per cent of individuals at M2 root cleft were outside the age range of 8-10 years. At M2 root cleft stage, 55 per cent of teeth were below the alveolar bone level. When M2 was at root cleft (N = 100), P2 ranged from initial root to root three quarters. These findings suggest that chronological age 8-10 years, within bone and M2 root cleft stage exclude some children and criteria should be based on tooth development rather than chronological age.
CONCLUSIONS: There is a need for an evidence based study to clarify the optimal timing of extraction of first molars.

411 BRAIN ACTIVATION DURING A WORKING MEMORY TEST WITH MOUTH BREATHING OR NASAL BREATHING

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AIM: Mouth breathing negatively affects facial growth, health, academics, and behaviour. The purpose of this study was to compare brain activation during a working memory test under the condition of mouth breathing and nasal breathing.

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SUBJECTS AND METHOD: Eighteen healthy volunteers participated in this study. Two-back task were used for the working memory tests. The subjects were asked to breathe through nose or mouth for 4 minutes 30 seconds. Subsequently, they performed working memory tests under the condition of nasal or mouth breathing. During the working memory tests, prefrontal brain activation was measured using functional near-infrared spectroscopy, which is an imaging modality measuring haemodynamic processes in the brain.
RESULTS: Brain activation was observed in the prefrontal cortex during working memory tests under both conditions of nasal and mouth breathing. When both conditions were compared, a greater increase of cerebral bold flow was observed under nasal than mouth breathing.
CONCLUSIONS: The prefrontal cortex is more activate during a working memory test under the condition of nasal breathing. This result indicates that to achieve nasal breathing by orthodontic treatment or myofunctional therapy may contribute not only for oral function but also to brain function.

412 THE EFFECTS OF A TONGUE PLATE VERSUS FACEMASK ON THE NASOMAXILLARY COMPLEX OF PATIENTS WITH A UNILATERAL CLEFT LIP AND PALATE

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AIM: Cleft lip and palate (CLP) patients suffer from maxillary deficiency. A facemask is a conventional appliance for treatment of maxillary deficiency in growing patients. Extraoral components and the bulky size of facemasks are the disadvantages of this appliance. A tongue plate appliance is a novel intraoral device for treatment of maxillary deficiency. To date, the effects of tongue plate therapy on patients with a CLP have not been evaluated. The aim of this study was to compare the effects of a tongue plate with a facemask on the nasomaxillary complex of growing patients with a CLP.
SUBJECTS AND METHOD: Thirty growing patients with a non-syndromic unilateral CLP (17 girls, 13 boys) between the ages of 6-12 years volunteered to participate in this study. Patients were randomly assigned to two groups: 16 patients with a mean age of 8 ± 1.2 years were treated with a tongue plate for 19 ± 3 months, whereas 14 patients with a mean age of 8 ± 0.9 years were treated with a facemask for 20 ± 4 months. All the patients had already undergone the preliminary stages of the lip and palate closure during infancy, but none of them had received bone grafts. Lateral cephalograms were obtained and analyzed at the start and end of treatment by means of paired *t*- and Mann-Whitney test.
RESULTS: The paired *t*-test showed that in the tongue plate group, SNA and ANB were both increased by 1.8° ± 1.8° and 1.6° ± 1.6° respectively ($P < 0.05$). Similar findings were observed in the facemask group, SNA and ANB were increased by 1.9° ±1.5° and 1.8° ± 1.4° respectively ($P < 0.05$). The Mann-Whitney test showed no statistically significant differences between the two groups ($P = 0.6$). However, a counterclockwise rotation of the palatal plane was observed in the tongue plate group (0.5° ± 0.5°) which was also considered to be insignificant ($P = 0.4$).
CONCLUSIONS: The tongue plate appliance shows comparable results with a facemask in improving the maxillary deficiency of growing patients with a CLP.

413 COMPARISON OF THE PERCEPTION OF METAL BRACKETS AND CLEAR ALIGNERS IN YOUNG ADULTS

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AIM: Smile aesthetics have been shown to influence an individual's social perception and self-esteem in adolescents and young adults (Hulsey, 1970; Henson, 2011). Orthodontics has played an important role in improving smile aesthetics by the correction of malocclusions and the overall improvement of the smile's appearance using fixed appliances. In the past two decades, more aesthetic modalities of treatment such as clear aligners have gained popularity. The purpose of this

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study was to compare the differences in appliance perceptions between fixed appliances (MB) and clear aligners (CA) in a young adult population.
MATERIALS AND METHOD: An electronic survey was administered to college students at the VCU Monroe Park Campus. The students were asked a series of questions about social acceptance, oral hygiene and comfort of fixed appliances, MB and CA. A Wilcoxon signed rank test was used to compare the univariate differences in subjects' perceptions.
RESULTS: Subjects preferred the CA over the MB for their appearance ($P < 0.0001$), social acceptability ($P = 0.0044$), comfort ($P < 0.0001$), and ability to eat food ($P = 0.0497$) and chew gum ($P < 0.0001$). They felt that the MB made it harder to brush and floss ($P < 0.0001$), took longer to brush ($P < 0.0001$), impacted the profile ($P = 0.0008$), and made individuals look younger ($P < 0.0001$). There was no difference between CA and MB regarding impeded speech, and retarding social interactions and friendships.
CONCLUSIONS: Young adults find CA to be a more aesthetic, and a more socially acceptable orthodontic treatment option than MB. It was also found that young adults felt that MB hindered their abilities to maintain proper oral hygiene, impacted their profile, and made them look more youthful. No differences were found for speech, social interactions and the ability to make friends.

414 ORTHOGNATHIC SURGERY AUDIT AND SERVICE EVALUATION

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AIM: To assess orthognathic procedures to improve future care for patients; to evaluate patient demographics and assess their reasons for having treatment including use of the Index of Orthognathic Functional Treatment Need (IOFTN) and to investigate peri-operative aspects of these procedures, post-operative complications and patient feedback regarding their experiences.
SUBJECTS AND METHOD: Data was collected and assessed retrospectively from the records of 55 patients who underwent orthognathic surgery between January 2015 and August 2016. This involved pre-, intra- and post-operative care and follow-up. The reason for surgery was assessed which included the use of the IOFTN scale using patient records and photographs. The peri-operative aspects of these procedures were assessed including surgery type, operation length, consent, administration of intravenous dexamethasone antibiotic prophylaxis and number of nights in hospital. Post-operative complications and patient satisfaction/dissatisfaction was recorded and assessed using a questionnaire.
RESULTS: Ninety three per cent scored 4 or 5 on the IOFTN having a great functional need for treatment while those that did not were undergoing surgery for psychosocial reasons. Intravenous antibiotic prophylaxis was administered to all patients. The hospital in-stay was on average one night (75%). Operation length was between 75 minutes and nine hours. The most common post-operative complication was infection (16%). Regarding patient outcome, 97 per cent of patients were satisfied with the result.
CONCLUSIONS: The IOFTN scale was very easy to use and reproducible in identifying patients need for treatment. For patients with post-operative infections most often there was another factor such as smoking (55%). Orthognathic surgery is invasive but many patients who undergo it are very satisfied.

415 SHEAR BOND STRENGTH OF METAL ORTHODONTIC BRACKETS TO DENTAL BASE ALLOY SURFACES: AN *IN VITRO* STUDY

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AIM: To compare the efficiency of different surface preparation methods on the shear bond strength (SBS) of metal orthodontic brackets to dental base alloy surfaces.
MATERIALS AND METHOD: Seventy-two non-precious base alloy discs were randomly and equally divided into two clusters; non-sandblasted and sandblasted. Sandblasting was performed using 50 µm aluminium oxide powders. The alloy surface was ultrasonically cleaned and dried. Each cluster

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was randomly subdivided into three groups of 12 based on the application of metal primers; no primer, Alloy primer and Reliance primer. Central incisor brackets were bonded to the alloy surface using Transbond XT light cure adhesive. All specimens were stored in distilled water at 37˚C for 24 hours and then thermocycled at 5-55˚C for 2,000 cycles. SBS was measured using an Instron® universal testing machine and the Adhesive Remnant Index (ARI) was recorded. Analysis of variance was performed to compare the bond strength among different groups and descriptive analysis was undertaken to assess the ARI. The results were considered significant at $P < 0.05$.
RESULTS: SBS was significantly greater in the sandblasted cluster when compared to the non-sandblasted cluster ($P < 0.05$). In sandblasted cluster, sandblasting alone, application of either Alloy primer or Reliance primer showed no statistically significant difference in SBS. Sandblasting the base metal alloy surface and Alloy primer application showed the highest bond strength. In the non-sandblasted group without application of metal primer, all brackets dislodged from the base metal alloy surface. No adhesive remained on the alloy surface in non-sandblasted group. The ARI increased in the sandblasted cluster, especially in combination with Alloy primer application.
CONCLUSIONS: Sandblasting with metal primer application, *in vitro*, improves the SBS for bonding metal orthodontic brackets onto a non-precious base alloy surface with conventional light-cure orthodontic adhesive.

416 EFFECT OF METAL PRIMERS AND SURFACE PREPARATION METHODS ON SHEAR BOND STRENGTH OF METAL ORTHODONTIC BRACKETS TO SILVER-PALLADIUM BASE ALLOY SURFACES***
Thanyabhorn Sittajarnpong, Supassara Sirabanchongkran, Department of Orthodontics and Pediatric Dentistry, Chiangmai University, Muang, Thailand

AIM: This *in vitro* study was designed to compare the efficiency of different thiol derivative metal primers and surface preparation methods on the shear bond strength (SBS) of stainless steel brackets to silver-palladium base alloy surfaces.
MATERIALS AND METHOD: Sixty disk-like specimens were made of silver-palladium base alloy and the disk surface was smoothed with silicon carbide papers. The specimens were randomly and evenly divided into two groups following surface preparation methods: (1) abrasion with 50 µm aluminium oxide particles, (2) grinding with a 125 µm rough flame shaped diamond bur. The following metal primers were applied on 10 disks of each surface roughening method group: Alloy primer®, Monobond plus®, and V primer®. Stainless steel orthodontic brackets were bonded to the specimen's surface with orthodontic resin adhesive (Transbond XT®) and were light-cured. According to ISO 104773, all specimens were stored in distilled water at 37°C for 24 hours and thermal cycled between 5°C and 55°C for 5,000 cycles. Tests in shear mode with an Instron® universal testing machine were performed. The mean SBS values were analyzed using two-way ANOVA followed by Tukey's multiple comparison tests ($P < 0.05$).
RESULTS: Two-way ANOVA did not significantly detect interaction between the types of metal primer and surface preparation methods. Furthermore, both main effect analyses were not significant at $P < 0.05$. Use of different metal primers and surface preparation methods showed no significant differences on the mean SBS. Surface preparation with the diamond bur in combination with V Primer® application provided the highest SBS (17.40 ± 4.67 MPa), whereas sandblasting together with Alloy Primer® application provided the lowest (14.82 ± 4.34 MPa).
CONCLUSIONS: From this *in vitro* study, surface preparation on silver-palladium base alloy surface with any thiol derivative metal primers in combination with any surface preparation methods prior to bonding with light-cured orthodontic adhesive provides similar SBS.

417 FEATURES OF ORTHODONTIC TREATMENT IN GIRLS WITH TEMPOROMANDIBULAR DYSFUNCTION AND DELAYED SEXUAL DEVELOPMENT AT PUBERTAL AGE
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AIM: Based on the definition of functional disorders of the masticatory muscles, to develop methods of correction

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SUBJECTS AND METHOD: Thirty two teenage girls with delayed sexual development. The average age of the girls was 14.66 ± 0.3 years. The control group consisted of 25 pubertal girls with a regular menstrual cycle chosen by random sampling. The average age of the girls was 14.48 ± 0.33 years.
RESULTS: Thirty (93.8%) patients of the study group were diagnosed with temporomandibular dysfunction according to the Research Diagnostic Criteria for Temporomandibular Dysfunction (group Ia, Ib of muscle disorders). They were treated by occlusal splint therapy. Surface electromyographic results before and after functional correction were significantly different. Thus, in all tests symmetrical EMG-activity of the temporal and masseter muscles was observed on the right and left sides. The maximum and average amplitude decreased significantly and was within the normal range.
CONCLUSIONS: The proposed method is effective and a necessary phase of orthodontic treatment.

418 WILLINGNESS TO PAY FOR ORTHODONTIC TREATMENT. DOES AN INCREASED OVERJET OR DENTAL CROWDING HAVE A GREATER INFLUENCE ON THE WILLINGNESS TO PAY VALUE?
Gillian Smith, Christopher Vernazza, School of Dental Sciences, Newcastle University, Newcastle-upon-Tyne, U.K.

AIM: To establish whether an increased overjet or dental crowding has the greatest influence on willingness to pay for correction of a malocclusion.
SUBJECTS AND METHOD: A questionnaire based was study carried out in three hospital orthodontic departments in the North of England. Four hundred and one parents of children attending hospital orthodontic appointments took part. The participants were asked to complete a questionnaire which gathered information on participant and child demographics, household income, educational level and previous experience of orthodontic treatment. The willingness to pay exercise consisted of seven sets of photographs representing different malocclusions as graded by the Index of Orthodontic Treatment Need (IOTN). Willingness to pay to correct the malocclusion in the photograph to the ideal occlusion was elicited using the payment card method.
RESULTS: On average participants were willing to pay significantly more (P = 0.00) to correct a crowded malocclusion (£844.55) than an increased overjet (£700.72). At the borderline treatment need level (IOTN dental health component 3a and 3d), participants were willing to pay significantly more (P = 0.00) to correct an increased overjet (£674.93) than a crowded case (£568). Willingness to pay was influenced by the participant's child being mid-treatment and the participant's child being treated in Middlesbrough. Low household income affected willingness to pay for correction of dental crowding but not willingness to pay for correction of an increased overjet.
CONCLUSIONS: Willingness to pay to correct a malocclusion with dental crowding was significantly greater than willingness to pay to correct an increased overjet.

419 ALAR BASE WIDTH CHANGES FOLLOWING LE FORT 1 OSTEOTOMIES
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AIM: To determine the increase in alar base width following Le Fort 1 osteotomies.
MATERIALS AND METHOD: A retrospective audit of orthognathic patients treated between January 2012 and December 2015 in the regional orthognathic surgery centre for South-East Scotland (St. John's Hospital, Livingston, West Lothian) was carried out. The gold standard was set as <10 per cent increase in alar width. The target to be achieved was less than a 10 per cent increase in alar base width and a mean reduction in alar width increase when a cinch suture was used. Data for patients with a Skeletal III malocclusion who had a maxillary advancement only was retrieved following an electronic search of patient records. Data included age, gender, race, orthognathic movements and cinch suture use. The distances between the nasofacial skinfold at the left alar base, the columella, and the right nasofacial skinfold were recorded before and six months after surgery using clinical photographs. The medial intercanthal distance was also recorded. A ratio was calculated between

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intercanthal width and alar base width for pre- and post-operative photographs. A ratio was then calculated to show the change in alar base width.
RESULTS: The subjects consisted of 42 patients (22 females, 20 males), mean age 26.1 years. Twenty seven patients were Caucasian, one Mongoloid and one Caucasian-Negroid mix. Thirteen patients were excluded as no post-operative photographs were available. The mean advancement was 5.6 mm (range 0.0-11.0 mm) and the mean increase in alar base width was 9 per cent (range 0-16%). There was no significant difference for increasing amounts of advancement. Two patients had nasal cinch sutures; increase of 9 and 10 per cent respectively.
CONCLUSIONS: This audit shows a mean increase in alar base width of 9 per cent following Le Fort 1 osteotomies (within the gold standard). There was no significant difference for increasing amounts of advancement. As only two patients had a nasal cinch suture carried out, no conclusions could be reached to say if it improves the outcome.

420 ASSESSMENT OF THE ROOT APEX POSITION OF IMPACTED MAXILLARY CANINES ON PANORAMIC FILMS

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AIM: To assess the root apex position of impacted maxillary canines on panoramic radiographs according to the labiopalatal position of the impacted canines and to propose a new predictor for impacted maxillary canines on panoramic radiographs.
SUBJECTS AND METHOD: One hundred and four subjects with unilateral impacted maxillary canines were selected. Each sample was classified according to the crown location of the impacted canine, specifically the labiopalatal relation and the mesiodistal position of the impacted maxillary canine root apex in relation to adjacent teeth was placed into a panoramic sector classification. The sector location of the impacted canine root apex on panoramic radiographs was compared with the labiopalatal position of impacted maxillary canines. Statistical correlation between the panoramic sector location of the impacted canine root apex and the labiopalatal position of the canines was examined using the chi-square test.
RESULTS: There was a statistically significant association between the mesiodistal sector location of the impacted canine root apex and the labiopalatal position of the canines ($P < 0.001$). The root apices of labially impacted canines were more frequent in sector 2 (corresponding to the lateral incisor position), those of palatally impacted canines were more frequent in sector 4 (corresponding to the first premolar position), and those of mid-alveolus impacted canines were more frequent in Sector 3 (corresponding to the canine position).
CONCLUSIONS: The root apex of palatally impacted canines tended towards the root apex of the maxillary first premolar and the root apex of labially impacted canines towards the root apex of the maxillary lateral incisor on panoramic films. Sector locations of impacted canine root apex on panoramic radiographs could be used in order to predict maxillary canine impaction early and the labiopalatal position of impacted canines.

421 COMPARISON OF THE ROOT APEX AND CROWN TIP ARCH-FORMS BETWEEN NON-CROWDED AND CROWDED CASES

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AIM: To demonstrate that the root apices of crowded teeth are not deviated even if a tooth crown shows severe displacement. To do this, the root apex and crown tip arch-forms were drawn in a crowded and non-crowded group and differences in the root apex and crown tip arch-forms between two groups was determined.
SUBJECTS AND METHOD: This study was a retrospective research. One hundred and two subjects in the non-crowded group and 98 in the crowded group were selected, based on the *X, Y, Z* coordinates of the root apices and crown tips using cone beam computed tomography (CBCT) data and Ondemand3D software. Most cases had a CBCT for evaluation of surgical conditions including facial

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asymmetry. Two-dimensional (2D) coordinates were converted from acquired three-dimensional coordinates via projection on the palatal plane, and the Procrustes method was employed to process the converted 2D coordinates. The mean shape of the root apex and crown tip arch-forms was derived, and the root apex and crown tip arch-forms between two groups were compared using statistical shape analysis.
RESULTS: There were statistically significant differences in the mean shapes of the crown tip and root apex arch-forms between the two groups ($P = 0.000$ for crown tip arch-forms; $P = 0.046$ for root apex arch-forms, $P < 0.05$). However, as the average difference of Euclidean distance in the root apex arch-form between two groups was not clinically large, ranging from 0.0113 to 0.3010 mm, the difference was judged to be clinically acceptable as it was minor compared to the degree of crowding.
CONCLUSIONS: The root apex arch-forms did not show a great degree of difference between the crowded group and non-crowded group, even though the crown tip arch-forms showed a large difference. Although there was a small difference between the mean shape of the root apex arch form of each group, that difference was clinically acceptable. Thus, even if a tooth crown shows severe displacement that results in crowding, the findings demonstrate that the root apices of crowded teeth are not deviated.

422 FACIAL DIVERGENCE AND ANTERIOR TOOTH SIZE: A TRANSVERSAL STUDY

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AIM: To evaluate the relationship between facial divergence and anterior tooth size.
MATERIALS AND METHOD: The size of the anterior teeth was measured on 60 digital impressions recorded for 13 to 70 year-old patients with Orthoanalyser software. Facial divergence was measured with the mandibular plane angle (SN/GnGo) recorded on lateral cephalographs. Univariate and multivariate regressions were calculated using SPPS v17.0 software. The power (1-β) of the study amounted to 0.90.
RESULTS: The sample encompassed 60 patients (71.2% females). The mean age was 23.8 years (±10.2) and the mean divergency angle 32 degrees (±5.8), ranging from 21 to 49 degrees. Univariate regressions highlighted no relationship between facial divergence and the height of the teeth (–0.009; $P = 0.91$), the width of the teeth (–0.141, $P = 0.34$), the ratio width/height (–6.464, $P = 0.53$) and the Bolton Index (–37.811, $P = 0.17$). Multivariate regressions, including age and gender, also showed no relationship.
CONCLUSIONS: Contrary to common belief, no statistically significant relationship was found between tooth size and proportions and facial divergence.

423 EVALUATION OF A FLUORESCENCE-AIDED IDENTIFICATION TECHNIQUE TO AID BRACKET DEBONDING

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AIM: To evaluate a fluorescence-aided identification technique (FIT) in comparison with a conventional light source (CLS) to aid visualization of composite remnants when debonding orthodontic brackets with respect to the time needed and the amount of tooth substance lost.
MATERIALS AND METHOD: Twelve maxillary models with 10 bovine teeth were fabricated. A pre-operative digital surface-scan was performed and metal brackets were bonded to each tooth using a primer and adhesive with fluorescent properties (Opal Seal™ and Opal Bond MV™). Models were randomly assigned to two groups (FIT and CLS). CLS group: bracket debonding under a conventional light source; FIT group: bracket debonding with the help of a 405 nm light-emitting headlamp (Karl Storz GmbH & Co. KG, Tuttlingen, Germany). Operators were an experienced orthodontist (A) and an undergraduate student (B). Operators had to remove all brackets and bonding composite residue. The time taken was recorded and a post-operative scan was superimposed on the pre-operative scan using OraCheck™ software to analyze the amount of enamel loss.

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RESULTS: There was a significant reduction in the time taken for orthodontic debonding using the FIT method for both operators: Operator A was 37 per cent and operator B 43 per cent faster with FIT compared with a conventional light source. Nevertheless, loss of enamel from all teeth was observed for both methods. Complete composite removal was only seen with the FIT method.
CONCLUSIONS: Orthodontic debonding with the aid of the FIT is superior to a conventional light source regarding both the time needed and in identifying the composite residue so that it can be completely removed.

424 AESTHETIC PERCEPTION OF THE VERTICAL POSITION OF THE INCISAL EDGES OF THE MAXILLARY LATERAL INCISORS IN THE SMILE ARC

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AIM: To assess the attractiveness, in the smile arc, of different vertical positions of the incisal edges of the maxillary lateral incisors.
MATERIALS AND METHOD: A frontal photograph of the smile of a Caucasian woman was digitally modified to obtain a first image with the incisal edges of the maxillary lateral incisors tangent symmetrically to the smile arc. These incisal edges were then moved vertically bilaterally in either an occlusal or gingival directions by 0.5 mm increments. The value was considered positive when the incisal edges were moved below the smile arc, and negative when above this reference line. Four other images were then generated by moving vertically the incisal edges of the maxillary lateral incisors from +0.5 mm to –1.5 mm. The five resulting images were rated on visual analogue scales by three groups of evaluators: 60 orthodontists, 60 dentists and 60 laypersons. Descriptive statistics were used to describe the data and inferential statistics were used to compare the data between the different groups.
RESULTS: Data were considered as relatively reproducible since the intraclass correlation coefficient was 0.74. There was no influence of gender, age or photographic layout on the scores obtained in the three groups and no influence of the rater's level of education on the scores given by laypersons. Laypersons preferred lateral incisors in the first place tangent to the smile arc, second with a 0.5 mm shift in the occlusal direction, and third with a 0.5 mm gingival shift. Orthodontists and dentists preferred a slight 0.5 mm gingival shift of the lateral incisors and enjoyed to a lesser extent the configuration found to be the most favourable by laypersons.
CONCLUSIONS: The aesthetic perception of the smile, as regard to the vertical relationships between the incisal edges of the anterior teeth, differs between groups of laypersons and professionals but remains homogenous between orthodontists and dentists. The most consensual aesthetic situation, from both the professionals and laypersons points of view, is the geometry where the incisal edges of the maxillary lateral incisors are tangent to the smile arc.

425 OBESITY IN ORTHOGNATHIC PATIENTS IN THE UNITED KINGDOM – IS A PROTOCOL REQUIRED?

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AIM: To identify the views of United Kingdom (UK) consultant oral maxillofacial surgeons (OMFS) and orthodontists involved in orthognathic surgery in relation to body mass index (BMI) and to determine how their perception matches the profile of patients scheduled for orthognathic care.
SUBJECTS AND METHOD: A questionnaire was sent to consultants in OMFS and orthodontists in the UK, who undertake orthognathic care within the National Health Service (NHS). This questionnaire assessed numerous parameters around BMI, local interventions and protocols. A cohort of 171 patients (126 female, 45 male) undergoing orthognathic care was used as a reference population. Data were analyzed using a spreadsheet (Excel, Microsoft, Redmond, California, USA) and a two-sample *t*-test ($P < 0.05$).

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RESULTS: One hundred consultants (65 orthodontic, 35 OMFS) completed the questionnaire. Variation in opinions, practice and protocol were evident. There was an overwhelming opinion that a BMI protocol for orthognathic patients is required. This is appropriate as the reference population had a mean BMI score of 25.88 (SD 4.86), which was above the World Health Organisation healthy BMI range (18.5-24.9). Females had a higher mean BMI (25.90, SD 4.56) than males (25.48, SD 4.51) (P = 0.59) whilst the mean BMI for patients under 30 years old (25.34, SD 4.88) was lower than for patients over 30 years old (27.37, SD 5.42) (P = 0.66) and the mean BMI for patients with a Class II malocclusion was higher (26.12, SD 5.21) than for those with a Class III malocclusion (25.77, SD 4.70) (P = 0.65).
CONCLUSIONS: A BMI protocol requires to be developed by the UK NHS in conjunction with the British Association for Oral and Maxillofacial Surgeons and British Orthodontic Society for orthognathic surgery.

426 HARD AND SOFT TISSUE CHANGES AFTER MANDIBULAR ADVANCEMENT SURGERY IN CLASS II PATIENTS: A RETROSPECTIVE CEPHALOMETRIC STUDY

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AIM: To describe hard and soft tissue changes after mandibular advancement surgery and to investigate the possible differences between Class II facial patterns.
MATERIALS AND METHOD: Lateral cephalograms of 109 patients who underwent combined orthodontic treatment and bilateral sagittal split osteotomy (BSSO) were studied. Radiographs were taken within 6 weeks before surgery and at least 6 months post-operatively. Patients were classified into three groups according to the pre-operative mandibular plane angle. Hard and soft tissue changes were analyzed with an *x-y* cranial base coordinate system. Measurements were evaluated statistically.
RESULTS: The soft and hard tissues of the chin moved forward and downward. The position of the upper lip remained unchanged, while the lower lip moved forward and upward and decreased in thickness. The soft tissue points of the chin follow their corresponding skeletal points almost completely, while the change of the lower lip was only 76 per cent of the movement of the underlying hard tissue. The increase of SNB was more evident in the low angle group, as well as improvement of the facial convexity. Stomium superius moved more forward in the low and medium angle cases. Ratios of hard and soft tissue changes showed no differences for different facial patterns.
CONCLUSIONS: The facial pattern of Class II patients seems to influence the outcome of mandibular advancement surgery and should be considered in treatment planning.

427 ANALYSIS OF TREATMENT EFFECTS OF PRE-SURGICAL INFANT ORTHOPAEDICS IN COMPLETE NON-SYNDROMIC UNILATERAL CLEFT LIP, ALVEOLUS AND PALATE

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AIM: In clinical practice it is difficult to evaluate treatment effects of pre-surgical infant orthopaedics (PSIO) in newborns with non-syndromic complete unilateral cleft lip, alveolus and palate (UCLAP). The aim of the investigation was to evaluate the usability of the method and the treatment effects by determining volumetric and metric changes within the alveolar cleft area.
SUBJECTS AND METHOD: A total of 13 newborns with non-syndromic UCLAP treated with PSIO, were included in this pilot study. Patient records were taken from the archives. PSIO was conducted in both groups for 6 months by using a passive modified Hotz plate continuously adapted to maxillary growth. Impressions of the upper jaws were taken immediately after birth (T1) and 6 months later before surgical lip closure (T2). The software Cleft Dynamic (Rostock, Germany) was developed to analyze volumetric changes in the alveolar cleft area from T1 to T2. Accuracy and reproducibility of three-dimensional model analysis were tested according to Wilcoxon rank sums as

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well as Bland and Altman randomly by determination of the method error for different scanning systems and by determining method error for calculation of volumetric changes in the alveolar cleft area from T1 to T2.
RESULTS: In terms of reproducibility the repetitive measurements showed no significant differences (P = 0.9637). The measurement error according to Bland and Altman was 12.78. Comparison of the measurements in the cleft area between T1 and T2 showed a decrease in the effective cleft volume of 40 per cent and a decrease between the alveolar segments in the metric distance analysis of 90 per cent while using PSIO.
CONCLUSIONS: There was good reproducibility of the introduced procedure for measuring volumetric changes in the alveolar cleft area in patients with a unilateral CLAP. Furthermore the results demonstrated an effective efficacy of the PSIO in terms of reducing the cleft volume and the gap between the alveolar segments. Thus treatment effects of PSIO can be analyzed more precisely. This also allows for better comparisons of treatment results within and between cleft centres with different treatment protocols.

428 TEMPORARY ANCHORAGE DEVICES IN CONTEMPORARY ORTHODONTICS – A LITERATURE REVIEW

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AIM: To highlight the indications and contraindications for treatment with miniscrew implants, clinical use and risks associated with miniscrew implant failure.
MATERIALS AND METHOD: Two independent reviewers conducted a literature search until August 2016 in five electronic databases (PubMed, Cochrane, Scopus, Web of Science, Embase). Search terms used were 'miniscrew implant', 'temporary anchorage device', 'orthodontic miniscrew'. Fifty seven studies were included in total. The inclusion criteria comprised observational clinical studies conducted on patients who received miniscrew implants for orthodontic anchorage, clinical trials, case reports and other reviews, all written in English.
RESULTS: Miniscrew implants offer many advantages as easy placement and removal, immediate loading, they provide no anchorage loss and can be used in a wide array of anatomical sites. Significantly higher success rates were revealed for miniscrew implants inserted in the maxilla, on young patients over 20 years of age and for longer implants, with a larger diameter.
CONCLUSIONS: Orthodontic miniscrew implants have a low failure rate, thus indicating usefulness in clinical practice. Obtaining a successful implant placement is extremely important. One has to take into account risk factors, bone quality and quantity, jaw of insertion, age, diameter and length of the miniscrew implant.

429 ARE THERE ANY ANTERIOR BOLTON TOOTH SIZE DISCREPANCIES IN CLASS III SURGICAL CASES?

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AIM: The purpose of orthognathic treatment is to obtain a favourable occlusion, an ideal overjet-overbite relationship and to improve smile aesthetics. Bolton analysis therefore becomes crucial while planning treatment. The aim of this study was to identify whether there is any mesiodistal tooth size discrepancies in the anterior region which can affect the smile aesthetics and final occlusion in Class III surgical cases.
MATERIALS AND METHOD: The archived pre-treatment dental casts and lateral cephalograms of 53 adults (27 females, 26 males) with dentoskeletal Class III malocclusion, who had undergone orthognathic treatment. Because of the presence of Class II restorations and/or missing teeth in most of the sample, Bolton anterior ratios were calculated. No patient had missing anterior teeth and no record of restoration in the anterior region. All teeth were measured at the largest mesio-distal dimension on the casts, using a digital calliper accurate to 0.01 mm. Bolton anterior ratios

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were calculated and cephalometric parameters were measured. For statistical evaluation, Minitab Statistical Package Software Version 7 was used.
RESULTS: Fifty two patients showed Bolton discrepancy in the anterior ratio. Of all patients 79.2 per cent had a greater lower anterior Bolton ratio (group 1) and 18.9 per cent greater upper anterior Bolton ratio (group 2). There was no difference between groups 1 and 2 in skeletal and dental parameters. On the other hand, it was observed that the SNB angle of 25 out of 42 individuals (59.5%) with greater lower anterior Bolton ratio was equal or greater than 82 per cent. Anterior Bolton ratio was not correlated with skeletal and dental parameters (SNA, SNB, ANB, GoGnSN, IMPA, U1-PP, overjet, overbite).
CONCLUSIONS: In this study, it was observed that there is high probability of Bolton anterior tooth size discrepancies in Class III orthognathic surgery patients. It was considered that better aesthetics and function can be obtained after surgery by performing necessary preperative treatment by evaluating the individuals in terms of Bolton discrepancies.

430 ASSESSMENT OF ROOT SURFACE AREAS OF MAXILLARY PERMANENT TEETH IN THAI PATIENTS EXHIBITING AN ANTERIOR OPEN BITE USING CONE-BEAM COMPUTED TOMOGRAPHY

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AIM: To assess the root surface areas of maxillary permanent teeth in Thai patients exhibiting an anterior open bite (AOB) with open vertical configuration using cone-beam computed tomography (CBCT).
MATERIALS AND METHOD: One hundred and forty images of maxillary permanent teeth (20 images for each tooth type except maxillary third molar) from 10 patients (age range from 15 to 30 years) who required pre-treatment cone-beam computed tomographs for miniscrew implant placement. Digital imaging and communications in medicine file was converted to stereolithography format using Mimics Research 17.0 software. Three-dimensional tooth models were constructed. The root surface area was calculated automatically by 3-Matic Research 9.0 software. Intraexaminer variation was assessed using intraclass correlation coefficient.
RESULTS: Means and standard deviations of root surface areas of the maxillary central incisor to the maxillary second molar were 178.36 ± 22.95, 163.42 ± 23.96, 243.79 ± 46.59, 227.45 ± 32.83, 242.39 ± 38.62, 433.23 ± 67.64 and 347.96 ± 72.34 mm^2, respectively.
CONCLUSIONS: The root surface areas of maxillary permanent teeth in patients exhibiting an AOB with open vertical configuration were measured using the CBCT measuring method, which was developed to determine the root surface area of vital or non-extracted teeth. The maxillary lateral incisor had the lowest root surface area and the maxillary first molar the greatest.

431 ASSESSMENT OF PALATAL BONE THICKNESS IN THAI PATIENTS WITH NORMAL SKELETAL RELATIONSHIP USING CONE-BEAM COMPUTED TOMOGRAPHY***

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AIM: To assess the palatal bone thickness in Thai patients exhibiting a Class I malocclusion with a normal skeletal relationship using cone-beam computed tomography
SUBJECTS AND METHOD: The study was approved by the Human Experimentation Committee of the Faculty of Dentistry, Chiang Mai University, Thailand. Fifteen Thai orthodontic patients (age range from 15.0 to 30.0 years) exhibiting a Class I malocclusion with a normal skeletal relationship who required pre-treatment cone-beam computed tomographs for miniscrew implant placement were recruited. The palatal bone thicknesses were measured at the antero-posterior (AP) and medio-lateral (ML) co-ordinates of AP intervals of 3.0 mm (3, 6, 9, 12, 15, 18, 21 and 24 mm sections) posteriorly to the middle of the distal bony margin of the incisive foramen, and of ML intervals of 3.0 mm (0, 3, 6, 9 and 12 mm sections) laterally from the midsagittal plane on both sides. The horizontal reference plane was orientated to pass through the middle of the distal bony margin of the incisive foramen and the posterior nasal spine. Intraexaminer variation was assessed using intraclass

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correlation. The palatal bone thickness measurements from the right and left sides were compared and pooled for statistical analysis.
RESULTS: The palatal bone thicknesses ranged from 2.16 ± 1.03 (at AP24/ML9 site) to 12.56 ± 4.11 mm (at AP3/ML12 site). Palatal bone thicknesses were equal to or greater than 5.0 mm at all AP sites along the ML0 and ML3 sections, from the AP3 to AP9 sites along the ML6, ML9 sections, and from the AP3 to AP15 sites along the ML12 section from the midsagittal plane.
CONCLUSIONS: Palatal bone thicknesses were variable, and only some palatal sites were appropriate for palatal miniscrew implant placement.

432 CURCUMIN INHIBITS TUMOUR NECROSIS FACTOR-A INDUCED CYCLOOXYGENASE-2 EXPRESSION AND PROSTAGLANDIN E_2 SYNTHESIS IN BONE MARROW STROMAL CELLS

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AIM: Orthodontic pain is a major concern of patients and parents both prior to and during orthodontic therapy. The application of orthodontic force causes release of several cytokines including tumour necrosis factor-α (TNF-α) leading to inflammatory cascades and tissue remodelling. Bone marrow stromal cells (BMSCs), the early regulators of inflammation, respond to TNF-α by secreting various cytokines and inflammatory mediators such as prostaglandin E_2 (PGE_2). The level of PGE_2 in the gingival crevicular fluid is associated with pain intensity and hyperalgesia during orthodontic tooth movement. Curcumin has an anti-inflammatory effect by downregulating key mediators of inflammation. This study examined the effect of curcumin on PGE_2 biosynthesis in TNF-α-stimulated BMSCs.
MATERIALS AND METHOD: To investigate curcumin cytotoxicity, ST2 BMSCs were treated with 1–50 μM curcumin and cell viability was determined by the MTT assay. BMSCs were then treated with TNF-α to determine the time- and dose-dependent cyclooxygenase (COX)-2 expression. Next, BMSCs were co-treated with curcumin and TNF-α. The level of PGE_2 in the culture media and the expression of COX-2 and microsomal prostaglandin E synthase (mPGES)-1 was measured using enzyme-linked immunosorbent assay (ELISA) and quantitative polymerase chain reaction, respectively. Statistical analysis was performed using ANOVA followed by the Tukey test. Differences were considered statistically significant at $P < 0.05$.
RESULTS: MTT assay showed that 1-10 μM curcumin promoted cell viability, whereas 30-50 μM curcumin was cytotoxic. TNF-α dose- and time-dependently upregulated COX-2 expression, with the highest increase shown by 20 ng/mL at 24 hours. Curcumin (10-20 μM) significantly reduced TNF-α-stimulated COX-2 expression. Curcumin (20 μM) almost completely inhibited the TNF-α-induced PGE_2 synthesis. Although mPGES-1 expression was also upregulated by TNF-α, it was not affected by curcumin treatment.
CONCLUSIONS: Taken together, the results demonstrated that curcumin enhanced cell viability and inhibited TNF-α-induced PGE_2 synthesis in ST2 BMSCs via the suppression of COX-2, but not mPGES-1, expression. These findings suggest that curcumin may have a therapeutic potential for tissue regeneration and pain control during orthodontic treatment.

433 THE MAXILLARY POSTERIOR ANATOMICAL LIMIT FOR MOLAR DISTALIZATION

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AIM: To quantitatively evaluate the influence of different antero-posterior (A-P) skeletal patterns in the length of the posterior anatomical limit of the maxilla, the maxillary tuberosity, and thus, determine the limits for maxillary molar distalization.
MATERIALS AND METHOD: Sixty-four sets of diagnostic (pre-treatment) lateral cephalometric and dental pantomogram images of adult patients (aged 23.2 ± 2.6 years) were selected. The subjects were divided into three groups according to their ANB angle as follows: skeletal Class I (n = 24), skeletal Class II (n = 22), and skeletal Class III (n = 22). The length of the posterior limit of a maxillary perpendicular line from a plane drawn from the distal surface of the maxillary second molars to the

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maxillary tuberosity was measured with the aid of i-Dixel 2.0 software. The maxillary third molar width and angulation was also measured. Each group was subdivided into impacted and erupted subgroups. Independent *t*-test, analysis of variance, and chi-square test were used for statistical analysis.
RESULTS: Posterior space length in the Class II subjects (24.9 ± 1.8 mm) was larger than in the Class I (22.5 ± 2.6 mm) and Class III (20.6 ± 1.6 mm) subjects ($P < 0.05$), while Class III subjects presented the smallest length of posterior space ($P < 0.05$). Maxillary third molars were recorded as impacted in 26, 18, and 41 per cent of the Class I, II, and III subjects, respectively ($P < 0.001$). The impacted groups had a reduced tuberosity space width, and reduced third molar angulation in all A-P skeletal patterns. Class III subjects showed increased maxillary third molar impaction with reduced tuberosity space width.
CONCLUSIONS: Substantial posterior maxillary limit is available and thus, conferring a potential site envelope for maxillary distalization. A-P skeletal patterns play an important role on the posterior maxillary limit, with Class II providing the largest amounts of maxillary posterior limits. Careful radiographic examination is recommended for patients who require significant maxillary molar distalization.

434 EVALUATION OF THE LATERALITY OF MASTICATORY MUSCLE TISSUE OXYGEN SATURATION IN SUBJECTS WITH FACIAL ASYMMETRY

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AIM: In subjects with facial asymmetry, both morphological and functional laterality are reported in the literature. For example, the electromyographic (EMG) activity of masticatory muscles is increased and temporomandibular joint symptoms are more frequently observed on the side of mandibular deviation. Although most reports on masticatory muscles were evaluated by EMG, no report to date has analyzed tissue oxygen saturation (StO_2) in subjects with facial asymmetry. The purpose of this study was to measure bilateral masticatory muscle StO_2 in subjects with facial asymmetry.
MATERIALS AND METHOD: Based on skeletal relationships and deviation of the menton from the cranial midline on postero-anterior cephalometric radiographs, the subjects were divided into three groups: group A (6 males, 1 female, 22.7 ± 5.4 years), mandibular protrusion with mandibular deviation of ≥3.0 mm; group B (5 males, 2 females, 25.9 ± 6.3 years), mandibular protrusion with mandibular deviation of <3.0 mm; and group C (5 males, 2 females, 27.7 ± 3.2 years), normal skeletal relationship and occlusion. Near-infrared spectroscopy was used to measure the bilateral masticatory muscle StO_2 in the resting position (i.e., baseline), immediately after maximum clenching for 10 seconds, and 30 seconds after 10 second maximum clenching. The rate of reduction in StO_2 after maximum clenching and its recovery rate after 30 seconds from the end of clenching were calculated, and both sides were statistically compared within each group ($P < 0.05$).
RESULTS: With regard to the rates of reduction and recovery of StO_2, there was no significant difference between sides in groups B and C. However, a significant difference was observed in group A; the rate of reduction was significantly higher and the rate of recovery was significantly lower on the side of mandibular deviation.
CONCLUSIONS: In subjects with facial asymmetry, laterality was demonstrated in the reduction and recovery of masticatory muscle StO_2 after clenching. Physiological laterality may be related to haemodynamic laterality between the deviated and non-deviated sides of the mandible.

435 COMPARISON OF TWO INTRAORAL MOLAR DISTALIZATION APPLIANCES

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AIM: To analyze three-dimensionally the effectiveness of molar distalization provided by the new developed indirect palatal miniscrew for distalization and anchorage (iPanda) and the Pendulum appliance.

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SUBJECTS AND METHOD: The treatment sample consisted of 50 adult patients with a Class II molar relationship, divided into two groups: The iPanda group consisted of 30 patients with a mean pre-treatment age of 23.5 years and the Pendulum group 20 patients with a mean pre-treatment age of 21.4 years. Lateral cephalograms and three-dimensional dental models were analyzed at three observation times: before treatment (T0), at the end of distalization (T1), and at the end of orthodontic fixed appliance therapy (T2). The amounts of distalization, anchorage loss, dental inclination, vertical and transverse changes were measured using the TRIOS® Ortho System. A Student's *t*-test was used to statistically assess the effects of treatment. Significance level was established at 0.05.
RESULTS: The maxillary first molars were successfully distalized into a Class I relationship in all patients. No significant differences were observed in the total durations of the distalization for the iPanda (9.1 ± 2.0 months) and Pendulum (10.8 ± 2.1 months) groups. The Pendulum produced a significantly larger amount of distalization (6.9 ± 1.4 mm) compared to the iPanda (4.5 ± 0.9 mm). However, the iPanda provided significantly more bodily movement (4.2 ± 1.0°) than the Pendulum (11.7 ± 2.8°). Vertical control was significantly more efficient with iPanda (0.6 ± 1.3 mm) than the Pendulum (–2.4 ± 0.7 mm). Moreover, the Pendulum produced a significantly undesirable anchorage loss of the premolars (2.2 ± 0.7 mm). Dental model analysis demonstrated that transverse width of the dental arch was maintained throughout treatment. No significant rotation of the first molars was observed. The overall treatment outcomes indicated that the distalization relapse with Pendulum (–73%) was four times higher than those observed with iPanda (+15%).
CONCLUSIONS: The iPanda is effective in producing bodily distalization of the maxillary molars with more stable results.

436 CORRELATION BETWEEN LOWER THIRD MOLARS AND MANDIBULAR INCISOR CROWDING

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AIM: Lower incisor crowding is often associated with the presence of lower third molars. Many researchers have tried to confirm or reject the correlation, but there is no strict evidence for any of the theories. The aim of this study was to verify if a relationship exists between the presence and stage of eruption of lower third molars and the presence of lower incisor crowding.
SUBJECTS AND METHOD: Two hundred and thirty one adults (145 females, 86 males between 18 and 68 years of age; mean 27.4 ± 9.7 years) were examined for the presence of lower incisor crowding, as well as for absence or eruption stage of the lower third molars. According to the status of both lower third molars, the patients were allocated to one of four groups (congenital absence, erupted, partially retained, and totally retained lower third molars). The data was analyzed with chi square tests (with =0.05).
RESULTS: Lower incisor crowding was observed in about 60 per cent of population. There was no difference in the frequency of crowding between females and males, nor in the whole population or any of the four groups. However, between all the groups a statistical significance (P = 0.035) was been observed; especially when comparing group of patients with partially retained lower third molars with those with a congenital lack, and erupted third molars (P = 0.031 and P = 0.014, respectively). The groups with congenital lack and erupted third molars were very similar (with a frequency of crowding about 47%; P = 0.862), as well as groups of partially and totally retained third molars (with a frequency of crowding about 69%; P = 0.841).
CONCLUSIONS: There may be a correlation between lower incisor crowding and the status of lower third molars. Patients with congenital lack or erupted third molars are less likely to present mandibular incisor crowding, whereas retention of third molars seems to increase the frequency of crowding. Gender seems not to have influence on the lack of space for mandibular incisors. The research needs to be continued on a larger group.

437 GENDER DISCREPANCIES BETWEEN OLIGODONTIC PATIENTS

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AIM: Oligodontia, also named partial anodontia, is a rare defect, which affects 0.13-0.25 per cent of the population. It may occur as an accompanying specific syndrome or as an isolated form (spontaneous or familial). To date, the main causal factor is not known. Many genes are being correlated to oligodontia (WNT10a, AXIN2, PAX9, EDA, MSX1, and others). It has been suggested that particular genes, as well as gender, may be responsible for a particular pattern of missing teeth. The aim of the study was to compare the prevalence of presence of particular permanent teeth in oligodontic patients according to gender.
SUBJECTS AND METHOD: Thirty patients (12 females, 18 males) between 3.64 and 17.1 years of age (mean 11 ± 4 years). All of them are undergoing orthodontic treatment. A dental diagram of the permanent dentition was made for each patient; the third molars were not taken into consideration. The prevalence of particular teeth were analysed in females and males (chi square test, with = 0.05).
RESULTS: Females were more likely to lack molars, whereas in males it was the premolars and upper incisors. A statistically significant difference was observed in the frequency of teeth: 37 and 47 (P = 0.002), then 26 (P = 0.015), next 27 (P = 0.033), and finally 16 and 36 (P = 0.046).
CONCLUSIONS: In patients with oligodontia, a different pattern of missing teeth according to gender has been observed. Females are more likely to lack molars.

438 STATISTICAL EVALUATION OF CEPHALOMETRIC NORMS IN CLASS III PATIENTS FROM WESTERN ROMANIAN

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AIM: To evaluate, by statistical analysis, the cephalometric characteristics of Class III orthodontic patients from the western Romanian area.
SUBJECTS AND METHOD: One hundred and twenty orthodontic patients with a Class III skeletal discrepancy were evaluated. All patients signed a written informed consent. The cephalometric analysis (Steiner, Tweed) was performed with CephX. The resulting data was statistically analysed with the non-parametric Wilcoxon-Mann-Whitney test (SPSS PC1 version 14.0, SPSS, Chicago, Ill). The significance level was set at $P < 0.05$. The mean standard deviation, minimal and maximal values were evaluated.
RESULTS: The mean value for Wits analysis was –4.20 mm, the mean SNA 77.88 degrees, IMPA 78.35 degrees and mean FMA 27.97 degrees.
CONCLUSIONS: The number of patients with a retrognathic maxilla was higher than those with a prognathic mandible, and a tendency for vertical excess was noticed.

439 TREATMENT EFFECT IN THE TRANSITIONAL DENTITION USING A PERSONAL ACTIVATOR FOR DISTAL OCCLUSION AND DEEP BITE

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AIM: To determine the effect of a personal activator in the treatment of sagittal and vertical occlusal problems in the developing dentition. The hypothesis was that sagittal and vertical jaw relationships and occlusion would be normalized during treatment with a personal activator in the transitional dentition.
SUBJECTS AND METHOD: The study approach was retrospective and consisted of 33 orthodontic patients. The longitudinal viewpoint included 14 children whose treatment had already been finished and cephalometric analyzes available from the beginning and end of treatment. According to incisal overjet, two study groups were constituted (0-4 mm and >4 mm). Another grouping was based on sagittal jaw relationship such as distal occlusion and normal occlusion. The comparisons were made by using the paired samples *t*-, Wilcoxon's and independent samples *t*-tests.
RESULTS: The mean age at the beginning of treatment by a personal activator was 12 years and the mean treatment time 2 years. The mean overjet was normalized (1-3 mm) being statistically significant both in the group of extreme overjet and minor overjet. However, the change in the

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extreme overjet group was larger and the difference was statistically significant in comparison to a minor overjet ($P < 0.015$). Changes in overbite were also significant in both study groups and the changes were about the same (1.5 mm). Cephalometric analysis showed that SNB normalized and ANB diminished significantly ($P < 0.011$) during treatment. ML-SN angle came close to normal values. Mandibular growth was directed towards anterior rotation. 1-ML angle decreased significantly ($P < 0.019$) and the interincisal angle increased close to normal values.
CONCLUSIONS: The study hypothesis was mainly accepted because the sagittal and vertical relationships of the jaws were normalized in most of the patients studied. These results were mainly in line with those of earlier publications, with one exception, the mandibular incisors were labially tilted at the beginning of treatment and at the end the position of the incisors moved into a more upright position in relation to the mandibular plane.

440 ASSESSMENT OF CHONDROITIN SULPHATE LEVELS AROUND MAXILLARY FIRST MOLARS BETWEEN TWO TREATMENT MODALITIES DURING POSTERIOR TOOTH INTRUSION

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AIM: To compare chondroitin sulphate (CS) levels around maxillary first molars between two different force magnitudes per unit of root surface area during posterior tooth intrusion.
SUBJECTS AND METHOD: Ninety teeth, from 30 patients exhibiting an anterior open bite and requiring maxillary posterior tooth intrusion, were recruited. Differences of CS levels during the unloaded and loaded periods were determined by Mann-Whitney *U* test.
RESULTS: The mean intrusive force magnitude was 0.094 g/mm^2 for group-of-two, or posterior tooth intrusion group, and 0.040 g/mm^2 for group-of-six, or segmental posterior tooth intrusion group. During the unloaded period, medians of CS levels in experimental group-of-two and group-of-six, control group-of-two and group-of-six were 0.258, 0.055, 0.652 and 0.012, respectively, and during the loaded period were 2.928, 5.738, 0.809 and 0.163 ng/μg of total protein respectively. The median of CS levels in both experimental groups were significantly raised during the loaded period.
CONCLUSIONS: Biochemical assessment using CS levels suggest that a force magnitude of 0.040 g/mm^2 was enough and effective for maxillary first molar intrusion.

441 SIGNS AND SYMPTOMS OF TEMPOROMANDIBULAR DISORDERS IN ITALIAN ADOLESCENTS

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AIM: To investigate the prevalence of the signs and symptoms of temporomandibular disorders (TMD) among Italian adolescents.
SUBJECTS AND METHOD: TMD signs and symptoms were recorded from a sample of 567 individuals (246 males, 321 females; age range 11-19 years; average: 15.8 ± 3.2) who attended their first visit for a consultation on the need for orthodontic treatment. TMD symptoms, presence of bruxism, temporomandibular joint (TMJ) sounds, presence of deviation during opening, existence of reduced opening/lateral/protrusive movements, and presence of myopain were recorded at patient level. The prevalence of signs and/or symptoms was established.
RESULTS: Of the total sample 41.5 per cent (41.7% females, 41.2% males) showed at least one sign or symptom of TMD. Data extracted from the whole sample show that females complained of a significantly higher prevalence of myopain than males [2 = 3.882; $P = 0.049$; 6.5% of males (16 over 246 males) and 10.35 per cent of females (40 over 321 females)] complained of myopain. Compared to males, myopain was about 1.92 times more frequent in females [chi-square: 5.5; 95% confidence interval (CI): 1.1-3.34; $P = 0.0185$). Individuals with Class II division 1 occlusion showed a significantly higher prevalence of the TMJ sounds [2 = 1.444; $P = 0.036$; 4.6% of Class I (9 over 193 individuals)] and 12 per cent of Class II division 1 (10 over 83 individuals) complained of TMJ sounds. Moreover,

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compared to Class I occlusion, TMD sounds were about 2.75 times more frequent (chi-square: 5.6; 95% CI: 1.16-6.51; *P* = 0.0173) in the presence of a Class II division 1 occlusion.
CONCLUSIONS: The prevalence of TMD signs and/or symptoms among urban Italian adolescents seems relatively high (41.5%), considering that the average age of the sample was 15.8 ± 3.2 years, which suggest that the disease appears even in a young population. The present findings favour the opinion of a poor association between type of occlusion and TMD signs and/or symptoms. Therefore, given the relatively high percentage of signs and symptoms observed, all adolescents, independent of their type of occlusion or gender, must be screened during their dental examination.

442 THE MANDIBULAR CONDYLE DURING GROWTH: A THREE-DIMENSIONAL VOLUMETRIC ANALYSIS OF 11, 17, 24 YEAR OLD SUBJECTS

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AIM: To determine condylar volume in subjects at different ages using cone-beam computed tomography (CBCT) and analysis software.
SUBJECTS AND METHOD: For 94 patients (46 females, 48 males; mean age 24.3 ± 6.5 years, range 11-26 years), resultant rendering reconstructions of the left and right temporal mandibular joints (TMJs) were obtained. The subjects were then classified on the base of age and the data were compared.
RESULTS: No significant difference was observed in the whole sample between the right and the left sides in condylar volume. Analysis of the mean volume among subjects with a low, normal and high mandibular plane angle revealed a significantly higher volume and surface from childhood to the young adulthood period, with a faster development for females which showed a mandibular condyle definitive morphology at just 15 years old.
CONCLUSIONS: Higher condylar volume was a common characteristic of adolescent female subjects compared to males. This could have implications in maxillofacial dimorphism concerning the age for maxillofacial surgery.

443 THE PREVALENCE OF DENTOALVEOLAR BONE DEHISCENCES IN CORRELATION WITH MALOCCLUSIONS

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AIM: To evaluate the quantitative influence of an Angle Class I and Angle Class II division 1 on bone dehiscence. Furthermore parameters such as age, gender, angulation of teeth and position of dehiscence in the jaw were evaluated.
MATERIALS AND METHOD: One hundred and forty nine pre-treatment cone beam computed tomographic (CBCT) scans (75 Angle Class I, 74 Angle Class II division 1) were examined using the three-dimensional imaging software InVivo 5 (Anatomage Inc., San Jose, California, USA). Adjusting the section of measurement alongside the tooth axis led to reproducible results. To quantify the tooth angulation, the occlusal plane was defined as a reference. The angles between the tooth axis and occlusal plane were measured. Statistical analysis mostly consisted of *t*-tests for independent samples. The Spearman correlation coefficient was used to investigate the coherence of tooth angulation and periodontal dehiscence. Additionally the Pearson correlation was used.
RESULTS: Patients with an Angle Class II division 1 presented statistically significant more (*P* = 0.003) and higher (*P* = 0.008) dehiscences than those with an Angle Class I (average value: Class I = 1.99 mm < Class II division 1 = 2.15 mm). The vestibular periodontium showed significantly higher dehiscence than the oral periodontium (average value: v = 2.20 mm > o = 2.05 mm; *P* < 0.008). Concerning tooth angulation, no statistically significant result was found. Positive correlations were found regarding age (*P* < 0.001) and female gender (*P* < 0.001). Higher defects were found in the posterior segments (average value: sta = 2.14 mm > fta = 2.10 mm; *P* = 0.008). In the upper jaw the buccal segment teeth showed larger dehiscence than the anterior tooth area (average value: sta = 2.22 mm > fta =

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2.04 mm; $P < 0.001$) in contrast to the lower jaw (average value: sta = 2.07 mm < fta = 2.15 mm; $P = 0.001$).
CONCLUSIONS: The findings verified the influence of orthodontic malocclusions such as Angle Class II division 1 on periodontal bone availability. An Angle Class II division 1 is correlated with a higher percentage and a larger amount of dehiscences. Pre-treatment orthodontic diagnostics employing mAs-reduced CBCT scans seems to be indicated.

444 BITE FORCE, OCCLUSAL CONTACTS, HEAD POSTURE, PAIN AND MUSCLE TENDERNESS IN ORTHODONTIC PATIENTS BEFORE, DURING AND AFTER FIXED APPLIANCE TREATMENT
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AIM: To investigate the change in bite force, occlusal contacts, head posture, pain and muscle tenderness in orthodontic patients with minor crowding before, during and after fixed appliance treatment.
SUBJECTS AND METHOD: Twenty seven orthodontic patients (21 females, 6 males, median age 15.3 years) with neutral occlusion and normal craniofacial morphology were treated non-extraction with fixed appliances due to minor crowding. Bite force, tooth and occlusal contact, pain and muscle tenderness were recorded at five time points: baseline [before treatment (T0), first appointment after bonding (T1), during treatment (T2), post-treatment (T3) and during retention (T4). Head posture was measured on lateral cephalograms at T0 and T3. Differences between the recordings were analysed with a mixed linear model with repeated measures.
RESULTS: A significant reduction in bite force, tooth and occlusal contacts was found between T0 and T1 ($P < 0.0001$; respectively) and between T0 and T2 ($P < 0.01$; respectively). A significant increase in bite force, tooth and occlusal contacts was found between T1 and T4 ($P < 0.05$, $P < 0.0001$, $P < 0.001$; respectively) and between T2 and T4 ($P < 0.05$, $P < 0.0001$, $P < 0.01$; respectively). No significant difference in pain and muscle tenderness was found between the five time points. The cervico-horizontal posture tends to decrease (OPT/HOR, $P = 0.0994$ and CVT/HOR, $P < 0.065$) after treatment.
CONCLUSIONS: The results indicate that there is significant fluctuation in bite force, tooth and occlusal contacts during treatment, which normalizes and reaches baseline level at the end of treatment in patients with normal craniofacial morphology and minor crowding. No significant differences in pain and muscle tenderness occurred, but head posture tends to be more forward after treatment. These new findings may prove valuable for the information given to orthodontic patients with minor malocclusion before and during treatment.

445 EFFECT OF ULTRASONIC IMMERSION ON FLEXURAL PROPERTIES OF A METHYL METHACRYLATE-BASED ORTHODONTIC BASE-PLATE MATERIAL
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AIM: To evaluate the effect of ultrasonic bath immersion with water, 10 and 40 per cent ethanol on flexural strength and flexural modulus of a self-cured methyl methacrylate (MMA)-based orthodontic base-plate material.
MATERIALS AND METHOD: Sixty rectangular specimens, 64 × 10 × 3.3 mm, of a MMA-based orthodontic base-plate material (Orthoplast, Vertex) were prepared according to the manufacturers' instruction and ISO 20795-2 (2013) and randomly divided into six groups (n = 10): group I, untreated controls; groups II and III, immersed in water at room temperature (25°C) for 24 and 72 hours respectively; groups IV-VI, immersed in an ultrasonic bath at 50°C for 10 minutes in water, 10 and 40 per cent ethanol, respectively. The flexural strength and flexural modulus were measured with a universal testing machine. Data were analyzed by a one-way ANOVA, followed by Tukey's honest significant difference *post hoc* test ($P < 0.05$).
RESULTS: The flexural strength of group II (69.70 ± 2.83), IV (69.05 ± 1.62), and VI (68.47 ± 1.87) were significantly higher than that of group I (65.60 ± 1.23), but those of group III (64.18 ± 1.87) and

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V (66.97 ± 2.63) were not. In the treatment groups, the flexural strength of group II, IV, V and VI were also significantly higher than that of group III. Comparing the flexural modulus, those of groups II (2,205.44 ± 19.84), IV (2,182.69 ± 34.52) and VI (2,197.75 ± 50.36) were significantly higher than that of group I (2,092.68 ± 27.06), but that of group V (2,138.66 ± 41.62) was not, and that of group III (2,025.22 ± 37.69) was lower.
CONCLUSIONS: Ultrasonic bath immersion with either warm water or ethanol, as post-polymerization treatment for reducing residual monomer, can improve flexural strength and flexural modulus of an MMA-based orthodontic base-plate material.

446 THE COURSE OF THE NASOPALATINE CANAL: A STUDY USING CONE BEAM COMPUTED TOMOGRAPHY

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AIM: To describe the course the nasopalatine canal, the adjacent vertical bone quantity, and whether it might differ among vertical facial types using cone beam computed tomography scans
MATERIALS AND METHOD: Out of a consecutive sample collected from April 2008 to August 2012, 398 patient data depicting both upper and lower jaw completely were evaluated retrospectively. The linear measurements were taken on the respective midsagittal view perpendicular to the palate at the level of first molar/second premolar (5/6), second premolar/first premolar (4/5) and first premolar/canine (3/4). Screen-prints were used to measure the inclination of the nasopalatine canal in relation to the maxillary jaw base. Maxillary and mandibular divergence was assessed on rendered lateral cephalograms.
RESULTS: Out of 3869 consecutive patients, the data of 398 patients met the inclusion criteria and could be extracted. The mean vertical bone was 4.09 mm at the 5/6 level, 5.22 mm at the 4/5 level and 3.14 mm at the 3/4 level, respectively. A statistically significant negative correlation existed between jaw divergence and canal angulation with regard to the maxillary base. A statistically significant negative correlation existed between the canal angulation and vertical bone measurements at the 4/5 and 3/4 level.
CONCLUSIONS: Vertical bone volume is sufficient at 4/5 level for temporary anchorage device (TAD) placement, and carries a small risk for permanent neuro-sensory impairment. However, the course of the nasopalatine canal is negatively correlated with the vertical skeletal facial pattern pointing to the fact that in hypodivergent patients a TAD might be placed in a more distal or paramedian region.

447 FACIAL ASYMMETRY IN ORTHOGNATHIC PATIENTS

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AIM: To detect facial asymmetry in orthognathic surgery patients before surgery.
SUBJECTS AND METHOD: One hundred and six patients divided into study groups by gender, Class and type of surgery: 28 skeletal Class II patients and 78 skeletal Class III patients. The average age was 27 years (SD ± 8.0 years, range 18-50 years). The study group consisted of 72 females (68%) and 34 males (32%). All patents had undergone combined orthodontic and orthognathic surgery treatment. Twenty-one facial soft tissue points were manually placed on each scanned patient's facial shell (Farkas, 1994). Each point was checked from different positions on the screen by rotating the head position. Three coordinate planes *X, Y* and *Z* were used to describe asymmetry (Djordjevic, 2011). Each patient was scanned with 3dMD scanner. Then the three-dimensional image data was processed by the program 3dMDvultus viewer. Statistical analysis was performed with SPSS Software (SPSS Inc., Version 23, USA).
RESULTS: Both male and female faces in this sample had a deviation to the left side (more the lower third of the face) but without a statistically significant difference. Pogonion point deviation to the left in males 0.8 ± 3.1 mm; females 0.7 ± 3.2 mm. Comparing the Class II and Class III groups, a minor deviation to the left side was observed not only in Pogonion point (Class II 0.9 ± 2.3, Class III 0.7 ± 3.4), but also in Pronasale (Class II 0.04 ± 0.9, Class III 0.19 ± 1,2) and Subnasale (Class II 0.08 ± 1.2,

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Class III 0.03 ± 1.2) points, but these were not statistically significant. Only Class II Pogonion point deviation was statistically significant (P = 0.044). Gender differences were also observed in the vertical dimension, males had slightly longer faces (122.2 ± 7.7 males, 117.5 ± 7.5 females); the results were statistically significant. The largest difference in vertical dimensions was between the skeletal Classes. Class II patients had shorter faces (114.3 ± 7.1) than Class III patients (119.9 ± 9.2). Length Glabella-Pogonion was longest in bimaxillary surgery patients (mean length 119.9 ± 9.7).
CONCLUSIONS: According to the measurements, facial deviation does not depend on gender. The faces of Class II and one jaw surgery patients are, on average, shorter than those of Class III patients.

448 EVALUATION OF AN AESTHETIC SMILE

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AIM: To analyse, describe and determine the different factors that make an aesthetic smile, through a complete analysis of the smile, and to evaluate the different perspectives of aesthetics among dentistry professionals and lay people
MATERIALS AND METHOD: Comparative studies of the parameters between subjects of different genders and ages were evaluated by two different groups: orthodontists and the general population, and judged by a minimum of 10 evaluators. Inclusion criteria were studies written in English and Spanish and published between 1970 and 2016 citing at least one of the following characteristics: aesthetic, smile, gingival exposure, midline, buccal corridor, and smile arch. The literature search for these terms was performed in the following electronic databases: PubMed, Web of Science, Embase (Elsevier, Science Direct) and Cochrane (The Cochrane Library). The exclusion criteria were all articles that did not compare: different genders, different ages and those who did not include several parameters.
RESULTS: Orthodontists are more critical as regards the deviations of the different parameters than laypeople: In dental visibility there is a variation of 2 mm in both groups; orthodontists accept a visibility of 4-5 mm while for laypeople it is 3-4 mm. Orthodontists accept a deviation from the midline of 2 mm and the population of up to 4 mm, but for both a higher deviation of the midline smile is perceived as less aesthetic. For a gingival smile the orthodontists accept up to 2 mm exposure along with the clinical crown, while for laypeople it was up to 4 mm. For an aesthetic lip smile, it should reach the gingival margin of the incisors and canines for orthodontists while the general population accept up to a 2-3 mm exposure. For both groups a consonant smile form was the most aesthetic.
CONCLUSIONS: There are different perceptions of smile aesthetics between orthodontists and the population in general. The most important parameters are the size and visibility of the teeth, the bow and the lines: smile, lip, middle and level of gingival show.

449 COMPARISON OF QUALITY OF LIFE IN PATIENTS WITH AND WITHOUT A DENTOFACIAL DEFORMITY

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AIM: Facial differences may have positive or negative impacts on social and psychological wellbeing, which are contributory to the quality of life (QoL). The purpose of this research was to determine if there is a difference in QoL between patients with and without a dentofacial deformity.
SUBJECTS AND METHOD: The case-study group of participants with dentofacial deformity were recruited from the National Dental Centre of Singapore (NDCS) Dentofacial Deformity Registry prior to the start of their combined orthodontic-orthognathic treatment; The control group without dentofacial deformity were recruited from patients who were attending appointments in NDCS for non-orthodontic treatment and were clinically assessed to have harmonious Class I skeletal profiles. QoL of the participants was assessed through three types of measures: (a) World Health Organization Quality of Life-BREF (WHOQoL-BREF), (b) 14-item short form Oral Health Impact Profile (OHIP-14) and (c) Orthognathic Quality of Life Questionnaire (OQLQ). The three questionnaires

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contain generic health, oral health-related and condition-specific measures, respectively. A total of 205 patients (99 and 106 patients in the case-study and control groups, respectively) were included in the final study. The participants were each given a set of four forms to be completed, comprising a patient-data form and the three QoL instruments. The results from the three questionnaires were compared for differences, if any, between the two groups of patients. Statistical analyses were performed using the IBM SPSS Statistics for Windows Version 23.0 (IBM Corp., Armonk, New York, USA).
RESULTS: Significant differences were found for the overall OHIP-14 scores ($P = 0.003$) and OQLQ scores ($P < 0.001$) between the case-study and control groups, while this difference was not significant to the statistical level in the overall WHOQoL-BREF scores ($P = 0.054$).
CONCLUSIONS: The generic oral health (OHIP-14) and condition-specific (OQLQ) measures employed detected a difference in QoL between patients with and without dentofacial deformities. This difference was, however, not significantly reflected in the results from the generic health measure (WHOQoL-BREF). The results reflect a poorer QoL in patients with dentofacial deformity compared to normal patients without dentofacial deformity, and this can be appropriately assessed through the application of generic oral health and condition-specific measures.

450 THE INFLUENCE OF HERITABILITY ON THE FORMATION OF THE THIRD MOLARS

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AIM: To evaluate the influence of genes on the formation of third molars
SUBJECTS AND METHOD: The same gender Caucasian twins with normal growth and development, older than 12 years and without tooth extractions were included in the study. Digital pre-treatment panoramic radiographs were evaluated for the mineralization stages of the upper and lower third molars using Demirjian's teeth mineralization assessment method. The zygosity of twins was established using 15 specific DNA markers
RESULTS: The study sample consisted of 296 twins (184 monozygotic, 112 dizygotic) with a mean age of 19.85 ± 4.45 years in the monozygotic group and 18.62 ± 4.93 years in the dizygotic group. The most popular mineralization stage in the dizygotic group was 5 and 6 in the upper jaw and 6 in the lower jaw. In the monozygotic twins the most common stage in the upper and lower jaw was 7 and 8. The differences in mineralization time between males and females were not statistically significant. Mineralization stages among siblings within each group did not differ significantly (P ranged from 0.164 to 0.986). However, Spearman correlation was strongest in the monozygotic group where it ranged from 0.80 to 0.89, while in the dizygotic group it fluctuated from 0.42 to 0.6. The heritability estimate h2 varied from 0.44 to 0.9 and showed a dominant influence of genetic factor on the formation of the third molars.
CONCLUSIONS: The formation of the third molars is strongly controlled by heritability.

451 THE TENSILE BOND STRENGTH CHANGES WITH METAL BRACKETS AFTER TOOTH BLEACHING

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AIM: To determine the effects of tooth bleaching on the tensile bond strength with metal brackets bonded with a light-curing adhesive system to human enamel.
MATERIALS AND METHOD: Forty recently extracted human permanent molars were used for the study. The mesial buccal surface of each tooth was used for the control group and the distal buccal surface for the experimental group. The surfaces of the experimental group were bleached with an in-office bleaching material containing 35 per cent hydrogen peroxide, while the surfaces in the control group were not submitted to the bleaching. Thirty days later, identical premolar metal brackets were bonded to the medial and distal buccal surfaces using a light-curing resin adhesive. Both groups were underwent a tension test.

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RESULTS: The tensile bond strength of brackets bonded to bleached enamel was 14.4 per cent lower than that of brackets bonded to unbleached enamel ($P < 0.05$). After debonding, more adhesive was left on the bracket base in the experimental group than in the control group.
CONCLUSIONS: Tooth bleaching with an in-office bleaching material containing 35 per cent hydrogen peroxide reduced the tensile bond strength of orthodontic bracket adhesive to the enamel surface.

452 CHANGES IN UPPER AIRWAY WIDTH IN PATIENTS WITH MILD OBSTRUCTIVE SLEEP APNOEA USING MAGNETIC MANDIBULAR ADVANCEMENT

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AIM: To determine changes in upper airway width in patients with mild obstructive sleep apnoea (OSA), treated with oral appliances [Magnetic Mandibular Advancement Appliances (2M2A)], by means of lateral cephalometric analysis.
SUBJECTS AND METHOD: Fifteen Thai subjects aged between 20 and 69 years of age with mild OSA were recruited. All lateral cephalograms were taken with the Kodak 9000 extraoral imaging system (Eastman Kodak, Rochester, New York, USA) in a standardized fashion. Lateral cephalometric radiographs were taken twice; prior to (baseline) and during 2M2A insertion. 2M2A are removable custom-made dental alloy frameworks, made of cobalt-chromium alloys (ADA specification No.14), with two pairs of neodymium-iron-boron magnets (4 × 1.5 mm) embedded in the acrylic, located in the anterior part of both the upper and lower frameworks. The oral appliances were designed to guide the mandible in the 50 per cent range of maximum protrusion in the present study. ImageJ 1.49v software (National Institutes of Health, USA) was used to determine changes of upper airway width. To determine intraexaminer repeatability, the radiographs were randomly re-measured by the same operator with a two week interval. The results of both readings were compared using a Student's *t*-test. The data were analyzed using the Wilcoxon signed rank test for between-groups comparison. The results were considered significant at $P < 0.05$.
RESULTS: When the 2M2A was worn, significant enlargement of the upper airway width was present when compared to baseline ($P < 0.05$).
CONCLUSIONS: Use of the 2M2A improves upper airway patency in patients with mild OSA. Further studies; however, should be conducted to monitor these changes in a long-term follow-up.

453 BUCCAL CORTICAL BONE THICKNESS AT THE INFRAZYGOMATIC CREST SITE IN THAI GROWING UNILATERAL CLEFT LIP AND PALATE PATIENTS

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AIM: To clarify bone thickness at the infrazygomatic crest site in Thai growing unilateral cleft lip and palate (UCLP) patients with a Class III skeletal pattern as an aid in planning temporary anchorage device (TAD) placement for bone-anchored protraction facemask treatment.
MATERIALS AND METHOD: Cone beam computed tomography (CBCT) images of 30 infrazygomatic crest sites obtained from 15 pre-treatment Thai UCLP patients (age range from 7 to 13 years) who required CBCT for alveolar bone grafting. Buccal cortical bone thickness at the mesiobuccal (MB) root, middle of the buccal furcation and distobuccal (DB) root of the maxillary first molar at seven vertical levels (4.8, 6, 7.2, 8.4, 9.6, 10.8 and 12 mm) from the buccal cementoenamel junction (CEJ) of the maxillary first molar were measured. Intraclass correlation was used to assess intraexaminer variation. Statistical analysis was performed for the buccal cortical bone thickness (means and standard deviations) at varying position. A paired *t*-test was used to assess the differences in bone thicknesses between the non-cleft and cleft sides.
RESULTS: The buccal cortical bone thickness on the non-cleft side was from 0.98 ± 0.26 to 2.72 ± 1.13 mm. The thinnest was found at the 4.8 mm vertical level of MB root while the thickest was at the 12 mm vertical level of middle of the buccal furcation. On cleft side, the measurements were from 1.15 ± 0.30 to 4.29 ± 3.20 mm. The thinnest was found at the 4.8 mm vertical level of the DB

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root while the thickest was at the 12 mm vertical level of DB root. Almost all measurements of non-cleft and cleft sides were significantly different at $P < 0.05$.
CONCLUSIONS: The thickness of buccal cortical bone at the infrazygomatic crest site in both non-cleft and cleft sides increased from the CEJ level towards the apical area. In addition, the buccal cortical bone on cleft side was significantly thicker than that on the non-cleft side for almost all measurements.

454 PREVALENCE OF IMPACTED THIRD MOLARS IN ADULTS

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AIM: To determine the prevalence of impacted mandibular and maxillary left and right third molars in adults.
MATERIALS AND METHOD: Five hundred and sixty one dental pantograms (DPTs) of patients were observed. From them 25 patients from 18 to 40-years-old (average 24.5 years) with no crowns, no extractions, no implants, no retainers, no previous orthodontic treatment were examined. Twenty five DPTs were studied using the Pell and Gregory classification.
RESULTS: 1. Seventy two per cent of the lower right third molars and 64 per cent of the lower left third molars were situated anterior to the anterior border of the ramus of the mandible (Class I). 2. Twenty per cent of the lower right third molars and 28 per cent of the lower left third molars had half of the crown covered by the anterior border of the ramus (Class II). 3. Eight per cent of both left and right lower third molars had the crown fully covered by the anterior border of the ramus (Class III). 4. Fifty six per cent of the upper right and 60 per cent of the upper left third molars had the occlusal plane at the same level as the adjacent tooth (Class A). 5. Twenty per cent of both left and right upper third molars had the occlusal plane apical to the cervical line of the adjacent tooth (Class C) which is more than twice that of the lower third molars. 6. Fifty two per cent of the lower right and 56 per cent of the lower left third molars had the occlusal plane between the occlusal plane and the cervical line of the adjacent tooth (Class B). 7. Only 36 per cent of both left and right lower third molars had the occlusal plane at the same level of the adjacent tooth (Class A).
CONCLUSIONS: The highest percentage of impacted third molars was observed on the right side of the mandible. Only 20 per cent of all patients had Class I A impaction and 8 per cent Class III C impaction.

455 ACCELERATED TOOTH MOVEMENT: CORTICOTOMIES VERSUS MICROOSTEOPERFORATIONS

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AIM: To investigate the effectiveness of corticotomies and microosteoperforations (MOPS) in reducing treatment time and side effects.
MATERIALS AND METHOD: A search was made in the medical literature between June 2000 and October 2016 in the following databases: PubMed, Central, Web of Knowledge, Medline, Cochrane and Scopus. with the keywords: 'accelerated dental movement', 'regional accelerating phenomenon', 'corticotomies', 'microosteoperforations'. Inclusion criteria: Randomized controlled trials (RCTs), controlled clinical trials (CCTs), and case series (CS) with sample sizes of five or more patients. There were no restrictions on language, gender, age, race or type of malocclusion. Eight hundred and forty three articles were identified; after eliminating duplicates and those that did not meet the inclusion criteria, 19 articles remained.
RESULTS: Fischer *et al*. and Shoreiba *et al*. showed a total treatment time reduction of 30 to 70 per cent in corticotomy treatment, respectively. Adverse effects on pulp vitality, periodontal insertion and root resorption were described. None of these side effects were significantly recorded in comparison with a control group; however these studies only provide a limited level of evidence. Teixeira *et al*. in treatment with MOPS showed 2.3 times more movement in canine retraction ($P < 0.05$), producing only local discomfort on the localization of MOPS.

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CONCLUSIONS: Corticotomies result in a greater increase of the speed of dental movement in comparison with MOPS. However, they require greater financial outlay. Due to the cost/benefit, MOPS would be more efficient in comparison with corticotomies. However, further high quality studies are required.

456 COMPARISON OF THE PATIENT PATHWAY BETWEEN SURGERY FIRST AND CONVENTIONAL ORTHOGNATHIC CASES

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AIM: To compare the patient pathway and experience between surgery first orthodontic-orthognathic cases and conventional orthodontic-orthognathic cases with focus on self-esteem, duration of treatment and overall treatment satisfaction.
MATERIALS AND METHOD: Data was collected from a hospital orthodontic department of five surgery first and five conventional orthognathic cases for Skeletal III correction using a questionnaire. The Likert scale was used to assess self-esteem at four time points (pre-treatment, pre-surgery, post-surgery and post-treatment) and the patient's overall treatment satisfaction at the end of treatment. Overall duration of treatment was also compared. The *t*-test was used to compare the data.
RESULTS: Self-esteem levels between both groups were similar at the pre-treatment, post-surgery and post-treatment stages. However all of the surgery first group reported higher scores for self-esteem in their pre-surgery phase with the mean score being 80 per cent greater than that of the conventional orthognathic group. The surgery first group also scored higher levels of patient satisfaction with overall treatment; however this was not statistically significant. On average, the total duration of treatment was shorter in the surgery first group by almost half the time compared to the conventional orthognathic group.
CONCLUSIONS: Surgery first is increasingly becoming a popular treatment modality in the United Kingdom for management of combined orthodontic-orthognathic cases. The main advantages appear to be shorter overall treatment duration and less negative effects on self-esteem compared with conventional orthognathic cases. This is of particular benefit considering many orthognathic patients have low self-esteem from the start and can have difficulty coping with worsening of their bite and dental appearance through conventional pre-surgical orthodontics before orthognathic surgery corrects the malocclusion later on in treatment. Appropriate case selection for surgery first is paramount and if managed well, surgery first would be a very useful treatment option in a clinician's armamentarium.

457 EVALUATION OF MANDIBULAR DENTAL ARCH FORMS FOR DIFFERENT CLASSES OF MALOCCLUSION IN TURKISH SUBJECTS: A PILOT STUDY

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AIM: To retrospectively evaluate the mandibular dental arch forms of Turkish subjects with Class I, II, and III malocclusions.
MATERIALS AND METHOD: The mandibular dental casts of 230 orthodontically untreated subjects (89 males, 141 females) in the permanent dentition with a normal tooth size and shape, a 3 mm or less arch length discrepancy, and without restorations extending to contact areas were collected. Patients were assigned into three groups according to their malocclusion by Angle's classification system; Class I, Class II and Class III. The lower dental arches were classified as ovoid, square and tapered shaped (OrthoForm, 3M Unitek, California, USA). The following four linear and two proportional measurements were also taken: intercanine width, intermolar width, canine depth, molar depth, canine width/depth ratio and molar width/depth ratio. A Chi square test was used to evaluate if there is a significant difference between different shapes of arch form in the different malocclusions.

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RESULTS: The most frequent arch form seen in Turkish subjects was ovoid (42.6%). The second most frequent arch form was square (38.7%) and the less frequent arch form was tapered (18.7%). For the total group, the most frequent arch forms seen were the ovoid arch form in Class I and II malocclusions, but for the Class III group the most frequent arch form was square (50%). However according to statistical analysis there was no significant difference in the pattern of distribution of arch types between Class I, II and III malocclusions.
CONCLUSIONS: Preservation of a patient's original dental arch form during orthodontic treatment is important for long-term stability. This study helps in understanding which archwires generally must be used for treating Turkish patients. This study will also guide us for making stock control protocols for different forms of archwires in our clinics.

458 EVALUATION OF CORTICOTOMY-ASSISTED POSTERIOR MAXILLARY INTRUSION WITH ZYGOMATIC ANCHORAGE: A FINITE ELEMENT STRESS ANALYSIS
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AIM: To evaluate the effects of different corticotomy techniques in posterior maxillary intrusion supported by zygomatic anchorage, by means of finite element stress analysis.
MATERIALS AND METHOD: Three different scenarios were established on the hypothesis that, subapical corticotomies could benefit tooth movement. The first scenario comprised no corticotomy, the second included buccal corticotomy, and the third involved both buccal and palatal corticotomies. An acrylic appliance covering all maxillary posterior teeth and two rigid transpalatal bars were built up, then an intrusive force of 200 g was applied from the appliance towards the miniplate located at the zygomatic buttress, and the stress levels were evaluated.
RESULTS: Posterior teeth and the inferior curvature of the zygomatic buttress had the highest stress values in all scenarios. Increased stress values were observed on the spongious bone mostly on the buccal surface, beneath the corticotomy regions. Dental structures showed increased stress values mainly at the apical region of the first molar mesiobuccal root, indicating no significant difference between scenarios.
CONCLUSIONS: Conclusively, corticotomies may enable clinicians to achieve accelerated bone-turnover, revealed by the increased stress values in the spongious bone. In this respect, performing a buccal corticotomy might be sufficient instead of buccal and palatal corticotomy due to less surgical procedures. Despite corticotomy assistance, appliance designs and force application should be considered during posterior maxillary intrusion.

459 ASSOCIATION BETWEEN CARABELLI CUSP AND SHOVEL INCISORS: PREVALENCE IN ORTHODONTICS PATIENTS AT SAN RAFAEL HOSPITAL IN MADRID
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AIM: To establish the prevalence of shovel incisors in a sample of orthodontic patients and to determine the relationship between the presence of shovel incisors and enlarged Carabelli cusp
SUBJECTS AND METHOD: A convenience sample of subjects of different ethnic origin who requested orthodontic treatment in the last 10 years was selected. The inclusion criteria were: male and female, fully erupted upper incisors, both central and lateral, present or not of shovel incisors and enlarged Carabelli cusp in the first permanent molar through photographs and dental casts. The exclusion criteria were patients with orofacial syndrome, palatal cleft, other morphological alterations and/or number alterations (microdontia, dental agenesis, supernumerary teeth) of the incisors or first permanent molars and dental trauma with loss of dental anatomy, dental restorations of the upper incisors or first permanent molars with Carabelli cusp affectation or not fully erupted.
RESULTS: In a sample of 300 orthodontic patients, 248 (82.66%) did not show shovel incisors or a Carabelli cusp. From the remaining 52 (17.33%), 37 (12.33%) showed an enlarged Carabelli cusp (35

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Caucasian, 2 Amerindians) and 15 (5%) showed a shovel incisor (9 Amerindian, 4 Caucasian, 1 Asian, 1 Black). No patients showed both features together.
CONCLUSIONS: In this sample of orthodontic patients, 12.33 per cent showed a Carabelli cusp and 5 per cent enlarged shovel incisors. Shovel incisors were more prevalent among Amerindians and enlarged Carabelli cusps among Caucasians.

460 EVALUATION OF SURFACE ROUGHNESS OF ORTHODONTIC METALLIC WIRES

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AIM: To compare the surface roughness of five different types of orthodontic archwires.
MATERIALS AND METHOD: The wires tested were: stainless steel (SS), conventional nickel-titanium (NiTi) alloy, superelastic NiTi-alloy [low-hysteresis wire (LH), heat-activated NiTi-alloy (NiTi HA) and beta titanium [titanium molybdenum alloy (TMA)]. The dimensions of all wires used were the same and they were tested under similar conditions, as received. Surface roughness was measured with a surface profilometer (Taly surf 50 profilometer, Tayler Habson, United Kingdom). The scanning distance was 5 mm along the length of the 0.64 mm side with a speed of 0.5 mm per second. Eight profilometric scans were performed for every sample. With specific software, Ra (the arithmetic mean of the absolute departures of the roughness profile from the mean line) and Rz (the maximum peak to valley height of the profile) were calculated.
RESULTS: The highest values were established for TMA (Ra = 0.23085 ± 0.066048 μm, Rz = 1.71181 ± 0.448155 μm). For Rz intermediate values were obtained for the three types of NiTi alloys. Statistical analysis showed that the values for both Rz and Ra had a normal distribution. Fisher's test results showed that surface roughness measurements (Rz and Ra) were highly significantly different between the five types of archwires. A Student's *t*-test showed that for Ra, there were no significant differences between NiTi and NiTi superelastic wires ($P = 0.942$), or between NiTi HA and TMA ($P = 0.175$). For Rz no significant differences were established for the following archwires: NiTi-NiTi SS ($P = 0.110$), NiTiSE-NiTiHA ($P = 0.628$), NiTiHA-NiTi ($P = 0.068$)
CONCLUSIONS: Surface roughness is an essential property of an archwire, which has influences sliding mechanics, corrosion behaviour as well as biocompatibility and aesthetics. The surface profilometry showed that SS was the smoothest wire. The highest values for roughness were possessed by the TMA archwire with NiTi alloy wires having intermediate values.

461 UNIVERSITY ORTHODONTIC CARE – CHANGES OF PATIENT CHARACTERISTICS, TREATMENT QUALITY AND TREATMENT COSTS OVER A PERIOD OF 20 YEARS

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AIM: To analyze whether or not there were changes in the severity of malocclusions of patients treated at the Department of Orthodontics, University of Giessen, Germany over a period of 20 years (1992-2012) and if the implementation of the KIG system (German index of treatment need) in 2001 had any effect on the patient cohort. Furthermore, the study aimed to analyze the influence of the severity of malocclusion on treatment quality and economic efficiency (relation payment per case/treatment effort).
MATERIALS AND METHOD: The files of all 5385 patients admitted to the orthodontic department between 1992 and 2012 were screened and the following information was recorded: patient characteristics, treatment duration, KIG, treatment outcome and costs.
RESULTS: In the KIG period patients were older, pre-treatment malocclusions were more severe, treatment took longer, required more appointments, and did not achieve the same degree of perfection as in the pre-KIG period. Patients with a higher pre-treatment KIG category had longer treatments and did not achieve the same degree of perfection as patients with lower KIG categories. Although total payment was slightly higher for the more severe cases, their cost-per-appointment-ratio was significantly lower.

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CONCLUSIONS: In the present university department a shift of the orthodontic care task towards more complex cases has occurred over the last twenty years. Generally the quality of orthodontic treatment was good, but it has been demonstrated that the higher KIG cases did not end up at the same level of excellence as the lower KIG cases. Furthermore, KIG 5 patients had a longer treatment duration, required more appointments and, thus, were not as profitable as low KIG cases. The implementation of the KIG system had a negative influence on the economic efficiency of the present university orthodontic department.

462 PRELIMINARY RESULTS OF THE SURVIVAL RATE OF MINIPLATES AND MINISCREWS USED AS ANCHORAGE IN ORTHODONTIC TREATMENTS

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AIM: To evaluate, in a register study, the stability of miniplates and miniscrews during orthodontic treatment.
MATERIALS AND METHOD: The data of subjects with miniplates and miniscrews were collected from the patient register of Turku University Hospital. During years 2010-2016, a total of 114 Bollard miniplates were inserted in 32 patients (20 females, 12 males, mean age 16.8 years) by oral surgeons. Sixty six miniplates were inserted on the infra-zygomatic crest in the maxilla and 48 miniplates in the mandibular canine region. A total of 109 VectorTAS miniscrews were inserted in 21 patients (14 females, 7 males, mean age 27.5 years) by oral surgeons (72%) and postgraduates in orthodontics (28%). In the maxilla, 54 screws were inserted on the buccal side and 46 on the palatal side; nine screws were inserted in the mandible. Loading of the miniplates was started approximately 52 days after surgery (range 13-308 days), while 85 per cent of the miniscrews were loaded immediately. Stability of the miniplates and miniscrews was evaluated by palpation during appointments.
RESULTS: In seven patients (22%), the placement of miniplates failed during the first operation while in three of them (9% of all patients), the miniplates were placed successfully in the second operation. A total of 11 plates (10 %) had to be removed during treatment. Moreover, in eight patients (25%), there were signs of mobility in the miniplates during active treatment. Of the screws, 57 per cent (n = 60 in upper and n = 2 in the lower jaw) were lost during active treatment. According to the practitioner, 42 of the 79 miniscrews (53%) inserted by oral surgeons and 20 of the 30 (67%) inserted by postgraduates had come loose. Of treatments with miniplates, 83 per cent and of those with miniscrews, 43 per cent were completed successfully with the anchorage device in place during the whole of active treatment.
CONCLUSIONS: During orthodontic treatments, miniplates seemed almost twice as stable as immediately loaded miniscrews.

463 EFFECTS OF RAPID MAXILLARY EXPANSION ON PALATALLY DISPLACED CANINES IN PATIENTS WITH A MAXILLARY TRANSVERSE DEFICIENCY

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AIM: Impacted maxillary canines are a common clinical problem. Interceptive treatment involves performing rapid maxillary expansion (RME). One of the most common malocclusions in the mixed dentition period is a maxillary transverse deficiency occurring with a frequency of 7.2 per cent (Litsas and Acar, 2011). McConnell *et al*. (1996) suggested transverse maxillary deficiency in the anterior portion of the dental arch as a potential cause of palatal canine displacement. The objective of this study was to define how RME could improve the displacement of palatal canines in patients with maxillary transverse deficiency.
SUBJECTS AND METHOD: One hundred and ninety three patients in the mixed dentition (103 girls, 90 boys). All subjects presented with either a unilateral or bilateral posterior crossbite and were treated with RME, performed with a banded Hyrax (two activations per day, where a 0.4 mm

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expansion was made). The mean age at the beginning of treatment was 8.5 years and 9 years when the Hyrax was banded. The study was based on the position of the cusp of the impacted canine, located on panoramic radiographs (Ericson and Kurol, 1987; Lindauer *et al*., 1992). Specifically, overlap of the canine with the homolateral lateral incisor is prognostic of canine impaction. Panoramic radiographs were used to determine the position of the canine before treatment and 6 months after intervention. Statistical analysis was performed with a Fisher's exact test using R2.14 software.
RESULTS: Eighty seven per cent of the canines had improved position (according to the score of Ericson and Kurol) after RME (P = 0.00063). The position did not change for 9.28 per cent of the left canine and 9.87 per cent of the right canine, despite interceptive treatment. No statistical differences were found either between genders or when comparing the right or left side.
CONCLUSIONS: When RME is performed in patients with a skeletal transverse deficiency, it is a successful therapeutic solution to effectively prevent canine inclusion in the maxilla.

464 AN ASSESSMENT OF THE RESULTS IN EARLY/LATE THERAPY OF CLASS III MALOCCLUSION‡‡‡
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AIM: To identify skeletal and dental differences between early and late Class III therapy.
MATERIALS AND METHOD: A retrospective analysis of 38 patients with an Angle Class III malocclusion was performed. Pre-therapeutic anamnesis, photographs, cephalometric radiographs and models were examined. The differences between early and late treated Class III patients were further analyzed by data collection at the end of treatment and a final analysis about 25 years after therapy.
RESULTS: The early treatment group (patients younger than 9 years) had about 74 per cent treatment success, the late treatment group (older than 9 years, but before the pubertal growth spurt) had a 67 per cent successful treatment. Boys had more failures. The skeletal values of the jaw size in the late treatment group showed significantly higher values compared to the early treatment group relative to Class I standard values. The skeletal discrepancy between the upper and lower jaws in the late treatment group was more pronounced. The mandibular length, Cond /Pog, ramus height, overjet, anteroposterior dysplasia indicator, anterior face height and Go angle were greater in the late treated group after therapy. The angle between the occlusal and mandibular plane and the angle between the AB-line and the mandibular plane were smaller in the late treated group. Camouflage of the mandibular anterior teeth was more pronounced in the late treatment group. The early treatment group showed a greater negative overjet at the beginning of treatment, but better correction at the end of treatment.
CONCLUSIONS: Early treatment of Class III results in better skeletal changes with less dental compensation.

465 THREE-DIMENSIONAL ANALYSIS OF THE EFFECTS OF SKELETALLY ANCHORED MESIALISATION IN THE MAXILLA
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AIM: Space closure by means of mesial tooth movement seems to be the most desirable option in subjects with congenitally missing lateral incisors or second premolars, extremely displaced canines, or severe trauma to the central incisors. The Mesialslider, attached to two mini-implants in the anterior palate, is used for mesialisation of the upper dentition either unilaterally or bilaterally. The aim of this study was to analyse the treatment effects three-dimensionally.
MATERIALS AND METHOD: In a retrospective study the effects of 48 consecutive treated patients (11-53 years) with the need for upper molar mesialisation were evaluated. For this purpose pre- and post-treatment models were digitalized using a model scanner (Dentaurum SmartOptics Activity

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300). The coordinates of the respective surfaces were processed with a commercial software program (Matlab R2014a, Mathworks, USA). Control points on the hard palate were placed manually and used to register the digital casts through a least squares approach. After this, the treatment effects were assessed as the differences between coordinates of corresponding molars from the registered digital casts.
RESULTS: The average upper molar mesialisation was 6.8 ± 2.6 mm, whereas the average duration of upper molar mesialisation was 11.8 ± 7.7 months. The average anchorage loss in terms of incisor movement was below 0.5 mm.
CONCLUSIONS: Mini-implants in the anterior palate facilitate upper molar mesialisation. Using three-dimensional scanning, accurate measurements of tooth displacements can be performed.

466 DENTOALVEOLAR CHANGES AFTER USING A NASOALVEOLAR MOULDING DEVICE IN UNILATERAL COMPLETE CLEFT LIP AND PALATE PATIENTS

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AIM: To determine the dimensional changes of alveolar bone cleft and arch form after using a Khon Kaen University intra-oral contraction-screw plate together with nasal elevator moulding and labial strapping prior to surgical lip repair.
MATERIALS AND METHOD: The maxillary study models of 17 infants with unilateral complete cleft lip and palate treated with the device were evaluated at the initiation of moulding therapy (T1) and 3 months after therapy before cheiloplasty (T2). Linear dimensions including cleft width, arch length, anterior arch width, posterior arch width, midline deviation, and arch circumference were recorded using a digital Vernier calliper. The data were analysed with a paired *t*-test.
RESULTS: Measurements at T1 were significantly decreased ($P > 0.05$) compared to T2 in the width of the alveolar cleft ($P = 0.000$), anterior arch width ($P = 0.006$), arch length ($P = 0.001$), midline deviation ($P = 0.000$), and arch circumference ($P = 0.018$). Posterior arch width showed minor differences.
CONCLUSIONS: The Khon Kaen University nasoalveolar moulding device was effective in reducing the severity of the alveolar cleft width and anterior portion of the arch. The arches were more symmetrical and the midline centralized which would facilitate surgical correction and result in better lip repair.

467 TRANSFECTION OF NUCLEAR FACTOR-KAPPA B DECOY INTO THE RODENT PERIODONTIUM USING ULTRASOUND-MICROBUBBLE TECHNIQUE PREVENTS PROGRESSION OF PERIODONTITIS

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AIM: Patients referred for orthodontic treatment often suffer from plaque-related gingivitis. Nuclear factor-kappa B decoy oligonucleotide (NF-κB decoy ODN) transfection is a pharmacological strategy to reduce inflammation by selectively blocking NF-κB activation. Despite the number of promising gene therapy approaches available, non-invasive administration has not been established for the periodontal tissues. Therefore, the objectives of this study were to develop the transcutaneous transfection of NF-κB decoy ODN into the rodent periodontium using a combination of ultrasound and microbubbles and to evaluate effects of NF-κB decoy ODN as the suppressor of gingival inflammation and aggravation of periodontal disease.
MATERIALS AND METHOD: A fluorescein-labelled scrambled decoy ODN was applied on the gingiva of the maxillary molars in healthy eight-week-old C57BL/6 mice to investigate the infiltrative efficiency of the ultrasound-microbubble technique. Two hours after transfection, the transfection efficiency was evaluated in the periodontal tissues by fluorescent intensity. At the same time, immunoblots were performed for the inflammatory cytokines and cell adhesion molecule in the gingival region. Then, NF-κB decoy ODN was continuously applied for two weeks into the ligature

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based periodontitis model six-week-old Wistar/ST rats, and microcomputed tomography (μCT) analysis and reverse transcription polymerase chain reaction (RT-PCR) were performed to reveal the effects of the NF-κB decoy ODN to the periodontitis condition. Intergroup comparisons were performed with a one-way analysis of variance (ANOVA) and Tukey's method ($P < 0.05$).
RESULTS: Fluorescein-labelled scrambled decoy ODNs were transfected into the gingival epithelium and connective tissues. Immunoblots showed NF-κB decoy ODN suppressed protein expressions of inflammatory cytokines and cell adhesion molecule in the healthy rodent periodontium. μCT analysis demonstrated a reduction of alveolar bone loss in the periodontitis model rats applied with NF-κB decoy ODN. RT-PCR showed that the expression of inflammatory cytokines significantly decreased in the group with NF-κB decoy ODN.
CONCLUSIONS: Transcutaneous transfection of NF-κB decoy ODN into the periodontal tissues was established using the ultrasound-microbubble technique. These findings suggest the effects of NF-κB decoy ODN as the suppresser of gingival inflammation and progression of the periodontal disease.

468 THE CORROSION BETWEEN METAL ORTHODONTIC BRACKETS AND DIFFERENT TYPES OF ARCHWIRES CAUSED BY FLUORIDE PRODUCTS

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AIM: To determine the metal ions released due to corrosion between orthodontic metal brackets and archwires after immersion in different fluoride products.
MATERIALS AND METHOD: Nine sets of 20 brackets were ligated to each of three types of archwires: stainless steel (SS), nickel-titanium (NiTi) and titanium molybdenum alloy (TMA). The archwire groups were randomly divided into three subgroups and immersed in solutions of fluoride toothpaste (TP), 1.23 per cent acidulated phosphate fluoride (APF), or artificial saliva without fluoride (control group). The immersion time was calculated from the recommended time of use for each fluoride product over 3 months. After immersion, each sample was rinsed with 100 ml deionized water and then immersed in artificial saliva without fluoride at 37°C for 7 days. The amount of nickel (Ni), chromium (Cr), and iron (Fe) ion release was measured using inductively coupled plasma mass spectroscopy.
RESULTS: Ni, Cr, and Fe ion levels significantly increased in the APF groups compared with the TP and control groups. The SS group showed the highest level of Cr and Fe ion release compared with the TMA and NiTi groups. However, the highest level of Ni release was found in the NiTi group.
CONCLUSIONS: APF gel significantly enhanced metal ion release from the brackets/archwires evaluated compared with the TP and control groups. Therefore, using APF gel during orthodontic treatment should be avoided.

469 COMPARISON OF ANCHORAGE LOSS BETWEEN THE 0.018- AND 0.022-INCH SLOT BRACKET SYSTEMS

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AIMS: To compare the amount of maxillary first molar anchorage loss (AL) between the 0.018- and 0.022-inch slot fixed appliance bracket systems.
SUBJECTS AND METHOD: Seventy-four orthodontic patients were selected from cases of a randomised clinical trial that compared the effectiveness of treatment with the 0.018- and 0.022-inch slot MBT bracket systems (3M-Unitek, Monrovia, California, USA). The cases selected had bilateral premolar extractions. Three-dimensional digital dental models were obtained pre- and post-treatment using a digital model scanner (R700, 3Shape, Copenhagen, Denmark) and OrthoAnalyzer software (3Shape) was used to identify the landmarks and calculate the measurements. In order to determine the anteroposterior position of the first molars, the distance from a line representing the mesial contact point of the first molar to the third medial ruga point was measured. AL represented the value of subtracting post-treatment distance from the pre-treatment distance for both right (ALR) and left (ALL) sides. These values were then compared

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between the 0.018- and 0.022-inch slot bracket groups using a two-way analysis of variance ($P < 0.05$).
RESULTS: The sample comprised 41 and 33 cases for the 0.018- and 0.022-inch brackets, respectively. The baseline characteristics did not differ between groups, except for the presence or absence of anchorage devices ($P = 0.050$). Therefore, the analysis was run twice, one for the total sample and the other following exclusion of cases with anchorage devices (the sample became 23 and 26 cases, respectively). For the total sample, ALR (0.018 inch): 3.86 mm, ALL (0.018 inch): 3.30 mm, ALR (0.022 inch): 3.73 mm, ALL (0.022 inch): 3.47 mm. After excluding cases with anchorage devices, the results were ALR (0.018 inch): 3.86 mm, ALL (0.018 inch): 3.26 mm, ALR (0.022 inch): 4.17 mm, ALL (0.022 inch): 3.76 mm. For both analyses, no significant differences were found between the two appliance groups ($P = 0.970$ and 0.383). There was also no significant difference for the interaction between group and side, nor for the effect of left-right sides ($P > 0.05$).
CONCLUSION: Bracket slot size has no significant influence on the amount of maxillary molar aAL during orthodontic treatment.

470 ASSESSMENT OF RELIABILITY OF AN ORTHODONTIC APPLICATION FOR CEPHALOMETRICS
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AIM: To evaluate the accuracy and reliability of angular and linear cephalometric measurements using an iPhone app (SmartCeph Pro, version 1.1). The measurements were then compared with those obtained with Dolphin computer software (version 11.7 Premium).
MATERIALS AND METHOD: Twenty digital cephalometric radiographs were randomly selected from the archive and traced with SmartCeph Pro and Dolphin computer software. Twenty one landmarks and 16 measurements were performed with both programs. Statistical analysis was undertaken using Bland Altman analysis at a significance level of <0.05.
RESULTS: There were only six measurements (SNA, Max Mand plane, Ant Cranial Base angle, U1/Max Plane, L1/Mand Plane and Lower lip/E line) that were in accordance with Dolphin software.
CONCLUSIONS: Although it is user-friendly and cheap, SmartCeph Pro app needs time to develop and to be more reliable.

471 CORRELATION BETWEEN IMPACTED UPPER SECOND PREMOLARS AND CANINES AND THEIR TREATMENT PROTOCOL
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AIM: One of the main factors for successful treatment of subjects with impacted teeth is the space in the dental arch. The aim of the survey was to analyze the correlation between impacted upper second premolars and canines and their treatment protocol: space gaining with tooth extraction, sagittal increase of the dental perimeter with the Pendulum appliance or conventional treatment with brackets.
SUBJECTS AND METHOD: The survey includes 1604 orthodontically treated patients. From them, 182 had impacted teeth without including the impacted third molars. For statistical analysis the specialized statistical package SPSS version 13.0 was used.
RESULTS: In the group of the patients with impacted teeth, 42 (23.1%) were treated with the Pendulum appliance and then with brackets. The rest of the patients with a lack of impacted teeth 1422, 235 (16.5%) were treated also with the Pendulum and then with brackets. This means that the relationship between impacted teeth and treatment with the Pendulum was statistically significant ($P = 0.028$). From all patients, 108 with impacted upper canines (unilateral, bilateral or in combination with other teeth) only 29 of them were treated with the Pendulum. In the case of $P = 0.144$ a significant relationship does not exist. The patients with impacted upper (unilateral, bilateral or in combination with other teeth), are 37. In 15 of them ($P = 0.005$) the Pendulum was used. A statistically significant relationship was found. In the group of patients with impacted teeth 20 (10.99%) were treated with extractions. This is close to the percentage treated with extractions

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without any impacted teeth (12.19%). The correlation was statistically significant (P = 0.035) between number of extractions and impacted teeth: extraction of two teeth 13 (7.1%) and four teeth 4 (2.2%) of all the cases with impacted teeth. In seven cases with impaction of the second premolars, extractions were carried out. No statistically significant difference was found. The average age of the patients treated with the two approaches was: Pendulum 13.4 years old, with extractions 15.8 years old. The difference was statistically significant t(58) = 2.64, P = 0.011.
CONCLUSIONS: Distalization of upper molars increases the dental arch and gives the opportunity to align impacted premolars.

472 FREQUENCY OF IMPACTION OF DIFFERENT TEETH GROUPS

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AIM: Treatment of impacted teeth in our practice during the last 10 years was 11.35 per cent from all orthodontic patients. The treatment approach in this group of patients was interdisciplinary and associated with orthodontic diagnostic. Knowledge of the problem and its prevalence gives the ability for predictability. The aim of this study is was to determine the frequency of impaction of different tooth groups and the age at which the problem most often appeared.
MATERIALS AND METHOD: The documentation of 182 treated patients with impacted teeth. The survey did not include patients with impacted third molars, supernumerary teeth or mesiodens. Statistical analysis was undertaken with the statistical package SPSS version 13.0.
RESULTS: One hundred and seventeen patients had impaction of only one tooth, 56 had two impacted teeth, five had three impacted teeth and four were with more than three impacted teeth. Of the teeth impacted, 137 (52.5%) were upper canines, 50 (9.16%) upper second premolars, 25 (9.58%) lower second premolars, 20 (7.66%) lower canines, 11 (4.21%) lower second molars and eight (3.06%) upper central incisors. When more than one impacted tooth was observed the highest frequency was a combination of two upper canines 24 (13.2%), two upper second premolars 11 (6.00%), two lower premolars 4 (2.2%), four canines 3 (1.6%) and three premolars 2 (1.1%). The impacted teeth were more often found in the maxilla 132 (72.5%) than in mandible 36 (19.8%) and in 14 (7.7%) of all patients with impacted teeth in both jaws. There was no significant difference between impaction of teeth in the right 55 (30.2%), left 72 (39.6%) or both sides 55 (30.2%). Most often the upper canines are affected, which is important for stability of the dentition and support of the soft tissues. The average age at which the problem appeared was 14.7 years, more often in permanent dentition, 163 (89.6%) than in the mixed 19 (10.4%).
CONCLUSIONS: The phenomenon of impacted teeth is frequent in orthodontic practice. Early diagnostic is an important condition for successful therapy.

473 INCREASED FRICTION FOLLOWING THE PROGRESS OF SPACE CLOSURE IN SLIDING MECHANICS: A TIME-DEPENDENT FINITE ELEMENT ANALYSIS FOR LONG-TERM TOOTH MOVEMENT***

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AIM: To evaluate changes in friction between the archwire and brackets or tubes on the posterior teeth during space closure in sliding mechanics by means of a time-dependent finite element (FE) analysis for long-term tooth movement.
MATERIALS AND METHOD: A FE model of a maxillary dentition simulating *en masse* retraction with sliding mechanics was constructed. Contact boundary conditions were prescribed on the surface of the archwire and brackets. As a first step, an orthodontic force was applied while the model was restrained at the outer surface of the periodontal ligament (PDL; initial displacement step). As a second step, the PDL was restored to its original configuration and width by displacing each node forming the outer surface (bone remodelling step). Then, these two steps, namely, the initial displacement and bone remodelling were iterated to simulate long-term tooth movement after the

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process of absorption and apposition of the alveolar bone. A retraction force of 1 N was applied to the hook on the archwire.
RESULTS: Normal contact forces generated at the interface between the archwire and brackets or tubes on the posterior teeth were quite small up to 0.5 mm of space closure. When the amount of space closure exceeded 0.5 mm, a normal contact force produced at the first molar was rapidly increased and reached 120, 180, 260 and 285 cN at 1, 2, 3 and 4 mm of space closure, respectively.
CONCLUSIONS: Changes in friction, namely, the force system during space closure in sliding mechanics could be determined using a time-dependent FE model. As the posterior teeth are tipped mesially due to anchorage loss, the archwire comes to contact the diagonal corners of the bracket, thereby generating normal contact force (binding force). Since the amount of friction is represented by the product of the normal contact force and the coefficient of friction, an increase in binding force in the posterior region is critical. The present study suggests that increased binding force could progressively impede sliding of the archwire, and therefore the velocity of tooth movement could decrease following the progress of space closure in sliding mechanics.

474 *IN VIVO* COLOUR EVALUATION OF CLEAR THERMOPLASTIC RETAINERS***

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AIM: To assess the *in vivo* colour alterations of two different clear thermoplastic retainers, Vivera® and Essix®.
SUBJECTS AND METHOD: Thirty patients were randomly allocated into two groups (n = 15) after orthodontic treatment completion. Group 1 received Vivera® retainers and group 2 Essix® C+ retainers. For each patient, two retainers were fabricated, one for oral use and the other as a control. The CIELAB colour parameters of each patient's upper central incisors were measured with a SpectroShade™ micro spectrophotometer immediately after retainer insertion in the mouth (T0) and after 15 days (T1), 1 month (T2) and 3 months (T3) of intraoral use. The measurements were also performed both with and without the control aligner in place (tooth-only). Colour differences (ΔE) were calculated.
RESULTS: ΔE changes from T0 to T1, T0 to T2 and T0 to T3 showed no statistically significant differences between teeth 11 and 21. No significant differences in ΔE changes were observed between Vivera® and Essix® C+ groups within any combination of used retainers, control or teeth-only measurements or teeth 11 or 21. ΔE changes between T3 and T0 for used retainers were 1.55 times higher than those of control retainers ($P = 0.002$) and 1.44 times higher than those of teeth-only ($P = 0.004$). In addition, for used retainers, colour changes between T3 and T0 were 1.56 times higher than those between T1 and T0 and 1.47 higher than those between T2 and T0 ($P < 0.001$).
CONCLUSIONS: The used retainers exhibited greater colour changes than control retainers or teeth without retainers and these changes became more pronounced with the duration of use. Vivera® and Essix® C+ retainers exhibited similar colour stability and there were no differences between teeth 11 and 21 measurements. All retainer colour differences observed during a 3 month post-treatment period were considered clinically acceptable (ΔE <3.7), although prolonged use of the retainers could cause clinically significant colour changes.

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475 ORTHODONTIC TREATMENT OF CHILDREN WITH A BILATERAL CLEFT LIP AND PALATE USING MICRO-IMPLANTS

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AIM: To increase the efficiency of surgical treatment using pre-orthodontic correction of the premaxilla position in children with a bilateral cleft lip and palate (BCLP).
SUBJECTS AND METHOD: During the period from 2011 to 2016 an orthodontist and maxillo-oral surgeon working in collaboration have developed an algorithm for treatment of children with a BCLP and have treated 24 patients aged from two months to one year. During a two week period, they had been performing premaxillary traction to an attached appliance. At the unit itself the movement had been directed towards the side of the upper jaw fragments by unwinding the screw. After two weeks, the orthodontic appliance was removed together with the microimplants from the premaxilla. In this way, the whole assembly has been removed. This was followed by primary-stage bilateral cheiloplasty.
RESULTS: Clinical and biometric research was performed on study models of 24 children with a BCLP both in the pre- and post-operative periods. Normalization of the relationship between the intermaxillary bone and the lateral fragments was observed in all patients.
CONCLUSIONS: The use of modern appliance design with modifications and of micro implants allows a reduction in the time required for orthodontic preparation of surgery for infants (under one year). The described approach allows introduction of active elements into the orthodontic appliance, to normalize the position of the intermaxillary bone and the shape of the upper jaw, and to perform subsequent primary cheiloplasty. For successful early orthodontic preparation, it is necessary to ensure reliable fixation of the orthodontic appliance. This reduces the treatment time, creates favourable conditions for primary cheiloplasty, improves the patient's condition during the post-operative period, prevents the development of secondary deformities of the maxillofacial region, and significantly reduces the time required for rehabilitation of patients with a BCLP with good aesthetic results.

476 INFLUENCE OF REAL BUCCOLINGUAL INCLINATION OF FIRST AND SECOND PREMOLARS ON PANORAMIC MESIODISTAL ANGULATION MEASUREMENT

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AIM: Clinicians need to assess mesiodistal angulation of teeth before, during and after orthodontic treatment to obtain correct root positioning. Panoramic imaging is routinely used for this evaluation, especially in guiding bracket repositioning to correct roots before the bracket replacement phase in the straightwire technique. Nevertheless panoramic radiography presents several distortion limits. Cone-beam computed tomography (CBCT) might overcome this by real three-dimensional visualization of the root position and comparison with traditional two-dimensional images. The aim of the present study was to compare mesiodistal angulation of pre-treatment panoramic images with mesiodistal and buccolingual angulation obtained by CBCT scans.
SUBJECTS AND METHOD: Fifty five orthodontic patients who had panoramic radiograph and CBCT scan before treatment due to impacted canines were selected. Mesiodistal root angulations from panoramic images were measured using the occlusal plane as the reference line. Then CBCT scans were used to measure the mesiodistal and buccolingual inclination of the same teeth for every patient by one trained operator. Pearson rho correlation coefficient was employed to determine the correlation between panoramic mesiodistal angulation and CBCT mesiodistal angulation and buccolingual inclination respectively for the upper first and second premolars right and left.
RESULTS: Correlation analysis indicated that panoramic mesiodistal angulation of the first premolars was more correlated with CBCT buccolingual inclination than mesiodistal angulation. Furthermore panoramic mesiodistal angulation of the second premolars showed very low correlation coefficient when compared to both CBCT mesiodistal angulation and buccolingual inclination.
CONCLUSIONS: The assessment of mesiodistal angulation of the first and second premolars with panoramic radiography should be approached with caution and reinforced by a thorough clinical examination of the dentition. First premolar mesiodistal angulation on panoramic radiographs might change significantly according to the buccolingual inclination of the tooth.

477 BONE SAFE ORTHODONTIC SET-UP

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AIM: Orthodontic set-ups could simulate correct teeth and arch relationships as they are intended to be at the end of orthodontic treatment. Normally an orthodontic set-up takes into consideration only the crown position and not the root position inside the bone: our three-dimensional (3D) virtual setup allows movement of the teeth keeping contact with the inner bone. The aim of this study was to perform a 3D virtual set-up which takes into account the patient's morphology and their relationship with roots, crowns and facial patterns in order to be as close as possible to the ideal treatment.
MATERIALS AND METHOD: Cone beam computed tomography (CBCT) scans were obtained for 23 orthodontic patients and 3D models of the dental arches and each tooth were digitized. Inclusion criteria consisted of a complete permanent dentition, absence of previous orthodontic treatment, absence of craniofacial syndromes and good oral hygiene. 3D virtual segmentation was performed in order to obtain 3D model of each tooth with the roots and crown. Furthermore 3D virtual dental casts were obtained from plaster using a 3D laser scanner and were then registered and superimposed, performing best fit alignment on the tooth crowns. Dental crown 3D models were acquired with two different methods with the purpose of increasing image accuracy, which could be affected by artefacts and scattering with the solely CBCT acquisition. The orthodontic set-up was performed by a trained operator using 3D editing software. The teeth were moved virtually according to retention and stability criteria.
RESULTS: The virtual orthodontic set-up was easily performed using the 3D modelling software and the individual position for each tooth was calculated. 3D models showed graphical quality which allowed recognition and manipulation of every single tooth.
CONCLUSIONS: Development of virtual set-up according to retention and stability criteria could be a great aid in diagnosis and treatment planning in order to evaluate biomechanics and to perform a tailored treatment, enhancing post-treatment result and stability in time. This improvement arises from the fact that the set-up evaluates root position, which is a common concern for orthodontists at the beginning and during treatment, which traditional and 3D virtual set-ups obtained only by a laser scanner could not take it into account.

478 GALVANIC COUPLING OF LINGUAL BRACKETS MADE OF STAINLESS STEEL AND GOLD ALLOYS WITH ARCHWIRES

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AIM: To compare the galvanic coupling of lingual brackets made of stainless steel (SS) and gold alloys with orthodontic archwires.
MATERIALS AND METHOD: Two SS brackets (In-Ovation, L, Dentsply GAC, STb Light Lingual System, Ormco) and one made of Au alloy (Incognito, 3M Unitek) were included in this study along with a SS orthodontic wire (Steel archwire, Forestadent). Two couples from each bracket wire combination were immersed in 0.1 M lactic acid and 0.1 M NaCl (pH: 2.3) and the potential was recorded continuously up to the point that the potential remained steady for 6 hours.
RESULTS: The initial difference in Incognito couple was –100 mV but after 8 hours was stabilized at –30 mV. The STb couple started at –350 mV and reached a plateau after 27 hours at –52 mV while the Innovation couple started from –257 mV and obtained a constant value after approximately 3 hours at –34 mV. All couples showed potential differences below the threshold of 200 mV which is considered a threshold for the triggering of galvanic corrosion.
CONCLUSIONS: Under the limitations of this study all lingual brackets tested showed potential differences lower than the threshold for galvanic corrosion and thus SS archwire is considered as an appropriate choice from this standpoint.

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479 COMPARATIVE ASSESSMENT OF AS RECEIVED AND INTRAORAL AGED MULTISTRANDED ORTHODONTIC WIRE USED IN FIXED RETENTION

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AIM: To evaluate the elemental alterations of stainless steel (SS) multistranded orthodontic wires used in fixed retention after intraoral ageing.

MATERIALS AND METHOD: Twenty fixed retainers made with the same orthodontic multistrand wire (RMO, Denver, Co) were retrieved after the end of therapy and preserved in sealed plastic boxes. The median intraoral time was 9.3 years with 7.6 and 15.6 years indicating the 25 and 75 per cent percentiles respectively. Ten composition and cross-section matched archwires were used as reference. All wires were subjected to scanning electron microscopy and energy-dispersive X-ray microanalysis (SEM/EDX). Three spectra were taken from the surface of each wire and the mean values of elemental contents were used to characterize the wire itself. The metal content between unused and retrieved wires were statistically compared employing Mann-Whitney rank sum test at a = 0.05.

RESULTS: EDX analysis revealed that orthodontic wire comprised of wt(%): Fe: 69.7, Cr: 18.1, Ni: 8.1, Cu: 2.1, Si: 0.5 and Al: 0.1 a composition similar to that of precipitation hardening PH 17-4 SS alloy. Statistical analysis illustrated no significant differences in all these elements implying that elemental composition remained unaffected by intraoral ageing.

CONCLUSIONS: Under the limitation of this study it may concluded that the surface elemental composition of multistranded orthodontic wire tested is not affected by *in vivo* ageing.

480 ORTHODONTIC TREATMENT IN BISPHOSPHONATE PATIENTS: A SYSTEMATIC REVIEW

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AIM: To assess various characteristics of orthodontic treatment in patients receiving bisphosphonates for bone-related diseases.

MATERIALS AND METHOD: Search methods: Unrestricted electronic search of 18 databases, complemented by additional manual searches was performed up to August 2015. Selection criteria: Only studies on human subjects of any age or gender, reporting on patients receiving bisphosphonates for bone-related diseases, before or during orthodontic treatment were included. Data collection: Data regarding the patients' characteristics (age, gender, medical condition), the exact bisphosphonate treatment protocol (specific drug used, route of administration, dosage) and the orthodontic treatment procedures were extracted in piloted and pre-determined forms. The primary outcomes were classified as clinical, radiographic or patient-reported.

RESULTS: Six articles were included in the qualitative analysis of the present review (5 case reports and 1 retrospective cohort study), reporting in total on 28 patients (1 male, 27 females). Patients were receiving bisphosphonates in the form of oral alendronate (n = 23), oral ibandronate (n = 3) and intravenous zoledronate (n = 2) for osteoporosis or cancer-related bone pathology. Orthodontic treatment in bisphosphonate patients was clinically associated with slower rates of tooth movement, incomplete finishing and long treatment duration. With regard to the radiographic findings, the observed results on the periodontal spaces, root resorption and the alveolar bone seem to be controversial. No patient-reported outcomes were provided in any of the included papers.

CONCLUSIONS: According to existing (low quality) evidence, orthodontic treatment appears to be viable in bisphosphonate patients, yet its effectiveness is limited, it progresses at a slow pace and often leads to compromised treatment outcomes.

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