*Original Article*

# Three-dimensional tooth crown size symmetry in cleft lip and cleft palate

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**ABSTRACT**

**Objective:** To evaluate and compare three-dimensional tooth size symmetry in the right and left sides of upper and lower dental arches in cleft lip and palate (CLP) patients and to compare it with an Angle Class I normal occlusion control group.

**Materials and Methods:** Dental casts of 72 individuals with CLP (20 bilateral [BCLP], 34 unilateral left [ULCLP], and 18 unilateral right [URCLP]) and 53 individuals with Class I occlusion, all with permanent dentition, were randomly selected. Mesiodistal (MD), labiolingual (LL), and occlusogingival (OG) measurements of upper and lower teeth were recorded with a digital caliper. Descriptive statistics and paired *t*-test were used for statistical analysis.

**Results:** Significant asymmetries were found between the right and left sides of the dental arches in CLP as follows: MD dimension: mandibular first premolar (ULCLP, $P < .01$); LL dimension: mandibular first premolar (URCLP, $P < .05$); OG dimension: maxillary central incisor and first premolar (ULCLP, $P < .05$ and $P < .01$, respectively), central incisor (BLCLP, $P < .01$), mandibular canine and first premolar (ULCLP, $P < .01$), and first molar (ULCLP, $P < .05$). Tooth crown size asymmetries were also recorded in the Class I group.

**Conclusions:** Significant three-dimensional tooth size asymmetries were found in CLP subjects; however, such asymmetries were also present on the Class I control group. (*Angle Orthod.* 2014;84:623–627.)

**KEY WORDS:** Tooth size; Symmetry; Cleft lip and palate

## INTRODUCTION

Cleft lip and palate (CLP) is one of the most common congenital craniofacial anomalies with multifactorial etiology. CLP affects not only craniofacial growth, but also the dentition. Abnormal tooth size and morphology are the most prevalent dental abnormalities in CLP.[1] Dental abnormalities, such as disturbances in number, size, and shape, are more frequent in subjects with CLP than in the general population.[1–9]

In CLP patients, teeth in the region of an alveolar cleft, particularly the lateral incisors, are commonly malformed, pegged, microformed, or congenitally absent.[1,10–12] Moreover, tooth size discrepancies can be seen in both affected and nonaffected sides[1,2,13,14] and even in the lower dentition.[2]

Various studies have evaluated tooth crown size in CLP patients; however, there are marked variations in the published results.[5] The studies commonly evaluated crown size discrepancies in the mesiodistal (MD) dimension only.[14–18] Markovic and Djordjevic[19] found that the canines, premolars, and molars were smaller on the cleft side, but not to a statistically significant degree. Rawashdeh and Bakir[20] found that the central and lateral incisors were smaller on the cleft side, but only the lateral incisor was statistically significantly smaller. Werner and Harris[2] also demonstrated significant levels of asymmetry between the cleft and noncleft sides.

With a remarkable asymmetry in tooth crown sizes, symmetric alignment of the teeth along a smoothly curving line of occlusion with a correct midline may not be possible. Few studies have evaluated tooth crown size in the MD, labiolingual (LL), and occlusogingival (OG) dimensions,[8] and asymmetry in three dimensions has not been evaluated in unilateral (UCLP), bilateral (BCLP), and Class I groups. The current study

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**Table 1.** Sex and Number Distribution and Mean Age of Patients According to Groups

| Groups | Female | Male | n | Mean age (y) (± SD[a]) |
|---|---|---|---|---|
| ULCLP[a] | 18 | 16 | 34 | 17.5 ± 4.1 |
| URCLP[a] | 10 | 8 | 18 | 16.9 ± 4.4 |
| BCLP[a] | 11 | 9 | 20 | 18.3 ± 4.6 |
| Class I | 27 | 26 | 53 | 15.9 ± 4.0 |

[a] ULCLP indicates unilateral left cleft lip and palate; URCLP, unilateral right cleft lip and palate; BCLP, bilateral cleft lip and palate; SD, standard deviation.

therefore aimed to assess and compare tooth size symmetry on the right and left sides of the maxilla and mandible in UCLP and BCLP cases and in a Class I group.

## MATERIALS AND METHODS

This retrospective study was done on dental casts from the department archives according to the Ethics Committee of Ankara University. The pretreatment orthodontic dental casts of CLP patients and controls were selected from the archives of Ankara University Faculty of Dentistry Department of Orthodontics. Dental casts from 125 patients were divided into four groups: group 1, 20 BCLP patients; group 2, 34 unilateral left (ULCLP) patients; group 3, 18 unilateral right (URCLP) patients; group 4, 53 Class I subjects (Table 1). Group 4 consisted of patients with Class I occlusion, ideal overjet and overbite, well-aligned dental arches, and a normal dentoskeletal pattern with minor or no crowding. All subjects were in the permanent dentition stage. Only nonsyndromic subjects with good quality dental casts were included. Casts with missing, ectopic, pegged, microform, absent, deformed, unerupted, or partially erupted teeth, or with teeth with large restorations or crowns were excluded.

Measurements were recorded with a digital caliper that was accurate to within 0.01 mm (Mitutoyo Corp, Kanazawa, Japan) (Figure 1). The MD, LL, and OG (vertical) dimensions of the teeth were measured according to the method of Hunter and Priest.[21] The MD dimension was measured as the greatest distance between the anatomic mesial and distal contact points, the LL dimension was measured perpendicular to the MD axis of the tooth, and the OG dimension was measured on the labiobuccal side to the gingival border parallel to the axis of the tooth.

### Reliability

The MD, LL, and OG dimensions of teeth were measured twice by the same investigator, and the mean values of the measurements were recorded to eliminate errors in the measurements. The measurements were repeated on 20 randomly selected dental casts. The first and second measurements were compared and correlation coefficients ($r^2$) were obtained.

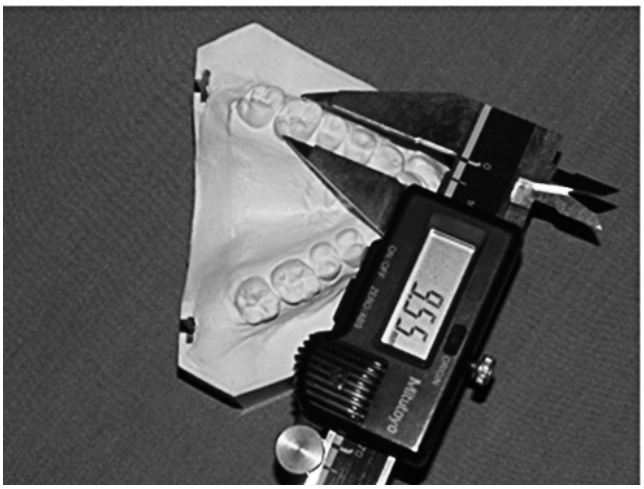



**Figure 1.** Measurements with a digital caliper.

### Statistical Analysis

Descriptive statistics (means and standard deviations) were calculated. Paired *t*-tests were performed to analyze asymmetry between the right and left dental arches in each group.

## RESULTS

The reliability of the measurements was high, with the correlation coefficients ranging between 0.9916 and 0.9985. Asymmetry values were calculated as the mean difference of the right and left MD, LL, and OG measurements for the maxilla and mandible in each group. Asymmetry values for the maxilla and mandible are shown in Tables 2 and 3, respectively.

There was no statistically significant difference in the maxillary MD dimension for each group. In the ULCLP group, the mandibular left first premolar was significantly greater in the MD dimension and significantly smaller in the OG dimension.

There was no statistically significant difference in the maxillary arches in the CLP groups when the LL dimension was evaluated. However, in the mandible, the right first premolar was bigger in the URCLP group.

In the Class I group, the maxillary right second premolar and the maxillary and mandibular right lateral incisors and canines were significantly bigger in the LL dimension. When the OG dimensions were evaluated, the maxillary left premolar, mandibular right second premolar, and mandibular right second molar teeth were significantly bigger.



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**Table 2.** Paired *T*-Test Results Showing Right-Left (R-L) Side Asymmetry in Maxilla[a]

| | | ULCLP *P* | URCLP *P* | BCLP *P* | Class I *P* |
|---|---|---|---|---|---|
| MD | R1 - L1 | 0.18 ± 0.480 | −0.10 ± 0.589 | 0.13 ± 0.356 | −0.03 ± 0.204 |
| | R2 - L2 | 2.05 ± 3.225 | −2.01 ± 3.110 | 0.07 ± 0.877 | 0.05 ± 0.287 |
| | R3 - L3 | 0.01 ± 0.446 | 0.05 ± 0.345 | −0.15 ± 0.299 | 0.01 ± 0.258 |
| | R4 - L4 | 0.03 ± 0.273 | −0.10 ± 0.326 | −0.03 ± 0.524 | −0.06 ± 0.364 |
| | R5 - L5 | 0.16 ± 0.379 | 0.13 ± 0.346 | 0.07 ± 0.456 | −0.08 ± 0.372 |
| | R6 - L6 | 0.47 ± 1.932 | −0.18 ± 0.464 | −0.08 ± 0.495 | 0.16 ± 0.671 |
| | R7 - L7 | 0.24 ± 0.447 | 0.09 ± 0.465 | 0.17 ± 0.447 | −0.10 ± 0.925 |
| LL | R1 - L1 | 0.15 ± 0.814 | −0.12 ± 0.651 | 0.00 ± 0.596 | 0.01 ± 0.230 |
| | R2 - L2 | 2.54 ± 3.875 | −2.08 ± 3.080 | 0.05 ± 0.113 | 0.16 ± 0.375*** |
| | R3 - L3 | 0.50 ± 0.382 | 0.15 ± 0.200 | −0.26 ± 1.351 | 0.14 ± 0.371** |
| | R4 - L4 | 0.28 ± 0.802 | 0.14 ± 0.310 | 0.07 ± 0.382 | −0.08 ± 1.359 |
| | R5 - L5 | 0.21 ± 0.564 | −0.21 ± 1.344 | 0.04 ± 0.483 | 0.10 ± 0.343* |
| | R6 - L6 | 0.53 ± 2.215 | −0.08 ± 0.410 | 0.00 ± 0.410 | 0.05 ± 0.291 |
| | R7 - L7 | −0.09 ± 0.506 | −0.31 ± 0.572 | −0.03 ± 0.480 | 0.33 ± 1.525 |
| OG | R1 - L1 | −0.50 ± 1.137* | 0.81 ± 1.600 | −0.80 ± 0.872** | −0.07 ± 0.404 |
| | R2 - L2 | 0.11 ± 4.022 | −0.09 ± 3.170 | 0.48 ± 0.431 | −0.14 ± 0.542 |
| | R3 - L3 | 0.56 ± 0.961 | 0.59 ± 1.151 | −0.22 ± 1.315 | 0.02 ± 0.634 |
| | R4 - L4 | 0.72 ± 1.104** | 0.09 ± 0.568 | −0.29 ± 1.013 | −0.14 ± 0.495* |
| | R5 - L5 | 0.20 ± 0.938 | 0.30 ± 0.595 | −0.33 ± 1.176 | 0.05 ± 0.442 |
| | R6 - L6 | 0.28 ± 1.428 | −0.08 ± 0.597 | −0.08 ± 0.715 | −0.09 ± 1.283 |
| | R7 - L7 | 0.46 ± 0.870 | 0.17 ± 1.100 | −0.14 ± 0.630 | −0.01 ± 0.821 |

* $P < .05$, ** $P < .01$, *** $P < .001$.

[a] MD indicates mesiodistal; LL, labiolingual; OG, occlusogingival; 1, central incisor; 2, lateral incisor; 3, canine; 4, first premolar; 5, second premolar; 6, first molar; 7, second molar.

In the ULCLP group, the maxillary left central incisor and right first premolar and the mandibular right canine, first premolar, and first molar were significantly larger in the OG dimension. In the BCLP group, the maxillary left central incisor was larger in the OG dimension.

## DISCUSSION

A digital caliper was used for three-dimensional measurements in the current study. It has been reported that measurements with digital calipers on dental casts showed the highest accuracy and reproducibility when compared to computerized models assessed with the Ortho-CAD measurement tool; digital calipers were shown to be a more suitable tool for scientific work.[22] Moreover, it was reported that measurements involving Vernier calipers or needle-pointed dividers on photocopies, photographs, and holograms of digitization of points from the dental casts showed errors.[22]

The study sample consisted of exclusively adolescent patients with a complete permanent dentition to eliminate the possibility of attritional size reduction or delayed eruption. Maxillary lateral incisors with abnormal morphology have been reported in up to 94% of patients with CLP on the cleft side.[1] Also, abnormal morphology of the central incisor on the cleft side has been reported.[23] CLP patients with missing, ectopic, pegged, microform, absent, deformed, unerupted, or partially erupted teeth were excluded from the study to eliminate tooth size abnormalities and evaluate asymmetries objectively with a Class I control group.

Rawashdeh and Bakir[20] found a remarkable gender difference when asymmetries in the upper and lower arches were evaluated in CLP patients. According to their study, in men, almost all mandibular teeth on the cleft side were larger than on the noncleft side. However, in women, most teeth on the cleft side were smaller than on the noncleft side. To avoid a reduction in the number of subjects per group, we could not evaluate the genders independently. However, the numbers of male and female patients in our study were almost equal.

We found that the maxillary central and lateral incisors and first molars were significantly larger on the noncleft side in the MD dimension compared with the cleft side in unilateral CLP patients.[5,7,24,25] In our study, we found no significant difference in the MD dimension in the maxilla. However, the lateral incisors were larger in the MD and LL dimensions on the noncleft side, although this difference was not significant.

According to a meta-analysis of Antonarakis et al.,[24] in the mandibular dentition, the central and lateral incisors and first and second premolars are larger on the cleft side. Rawashdeh and Bakir[20] also found that the mandibular lateral incisors and premolars were larger on the cleft side. In our study, in the ULCLP group, the mandibular first premolars were larger in the MD dimension on the cleft side, whereas the mandibular first premolars were significantly larger on the noncleft side in the LL dimension.



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**Table 3.** Paired *T*-Test Results Showing Right-Left (R-L) Side Asymmetry in Mandible[a]

| | | ULCLP *P* | URCLP *P* | BCLP *P* | Class I *P* |
|---|---|---|---|---|---|
| MD | R1 - L1 | −0.04 ± 0.188 | 0.01 ± 0.182 | −0.04 ± 0.157 | −0.07 ± 0.448 |
| | R2 - L2 | −0.10 ± 0.335 | −0.08 ± 0.324 | −0.31 ± 1.248 | 0.05 ± 0.535 |
| | R3 - L3 | 0.12 ± 0.689 | 0.11 ± 0.391 | −0.12 ± 0.310 | 0.06 ± 0.578 |
| | R4 - L4 | −0.21 ± 0.337** | 0.19 ± 0.420 | 0.03 ± 0.370 | −0.01 ± 0.318 |
| | R5 - L5 | −0.17 ± 0.706 | 0.14 ± 0.434 | −0.03 ± 0.331 | 0.06 ± 0.343 |
| | R6 - L6 | 0.02 ± 0.437 | 0.08 ± 0.167 | 0.07 ± 0.371 | 0.04 ± 0.636 |
| | R7 - L7 | −0.05 ± 0.697 | 0.11 ± 0.512 | 0.08 ± 0.486 | 0.14 ± 0.505 |
| LL | R1 - L1 | 0.06 ± 0.301 | 0.06 ± 0.129 | −0.01 ± 0.177 | 0.02 ± 0.212 |
| | R2 - L2 | 0.06 ± 0.311 | 0.11 ± 0.364 | 0.10 ± 0.317 | 0.15 ± 0.259*** |
| | R3 - L3 | 0.15 ± 0.469 | 0.06 ± 0.281 | −0.05 ± 0.505 | 0.15 ± 0.552* |
| | R4 - L4 | 0.15 ± 0.498 | 0.03 ± 0.355* | 0.02 ± 0.192 | 0.06 ± 0.341 |
| | R5 - L5 | 0.29 ± 0.613 | 0.20 ± 0.213 | 0.05 ± 0.197 | 0.00 ± 0.453 |
| | R6 - L6 | 0.16 ± 0.565 | 0.13 ± 0.356 | 0.19 ± 0.473 | 0.04 ± 0.414 |
| | R7 - L7 | 0.28 ± 0.927 | 0.69 ± 1.540 | 0.12 ± 0.468 | 0.15 ± 0.536 |
| OG | R1 - L1 | 0.12 ± 0.538 | −0.21 ± 0.441 | 0.05 ± 0.220 | 0.04 ± 0.316 |
| | R2 - L2 | 0.15 ± 0.643 | 0.13 ± 0.832 | −0.15 ± 0.429 | 0.01 ± 0.401 |
| | R3 - L3 | 0.47 ± 0.787** | −0.02 ± 1.044 | −0.15 ± 0.678 | 0.10 ± 0.712 |
| | R4 - L4 | 0.35 ± 0.559** | −0.07 ± 0.884 | −0.05 ± 0.547 | −0.04 ± 0.595 |
| | R5 - L5 | 0.20 ± 0.567 | −0.11 ± 0.726 | 0.04 ± 0.453 | 0.17 ± 0.495** |
| | R6 - L6 | 0.27 ± 0.643* | −0.01 ± 0.536 | 0.03 ± 0.636 | 0.07 ± 0.646 |
| | R7 - L7 | 0.26 ± 0.483 | 0.10 ± 1.078 | −0.11 ± 0.546 | 0.27 ± 0.657*** |

* $P < .05$, ** $P < .01$, *** $P < .001$.

[a] MD indicates mesiodistal; LL, labiolingual; OG, occlusogingival; 1, central incisor; 2, lateral incisor; 3, canine; 4, first premolar; 5, second premolar; 6, first molar; 7, second molar.

In the ULCLP group, the maxillary first premolar and the mandibular canine, mandibular first premolar, and mandibular first molar were bigger in the OG dimension on the noncleft side. However, we could not detect those asymmetries in the URCLP group. Considering all tooth types in the incisor and molar field, maxillary teeth are not inherently more asymmetric than their mandibular counterparts, even when the cleft is limited to the upper arch.

We found no significant asymmetry except in the OG dimension of the maxillary central incisor in the BCLP group. However, in the Class I group, we observed much more asymmetry in the dental arches (Tables 2 and 3). Sofaer[26] and Werner and Harris[2] reported high levels of tooth asymmetry between the cleft and noncleft sides in 77 patients and 63 noncleft controls. According to Sofaer,[26] this generalized developmental instability is controlled genetically because patients with a positive family history showed some signs of greater asymmetry.

Since clefting is an isolating phenomenon occurring in early fetal development, permanent teeth should not be affected. However, environmental factors such as surgery in the cleft area can affect the teeth in the cleft region and in the entire dentition because of the systemic effects of surgical treatment and feeding problems.[27]

## CONCLUSIONS

- Dental asymmetries can occur in nonsyndromic CLP patients in the permanent dentition without missing, ectopic, pegged, microform, absent, deformed, unerupted, or partially erupted teeth.
- Three-dimensional asymmetries can also be found in Angle Class I normal occlusion subjects.
- There was no statistically significant relationship between clefting and tooth asymmetry in this comparison of cleft and Class I subjects.
- Tooth size symmetry should be considered during treatment planning in individuals with a cleft.

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