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Long-term effects of chin-cap therapy on the temporomandibular joints

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SUMMARY It is commonly believed that upward/backward forces applied to the condyle by a chin-cap cause temporomandibular dysfunction (TMD). In the current study the long-term follow-up (2–11 years) of patients treated with a chin-cap was investigated regarding signs and symptoms of TMD. The treatment group consisted of 32 individuals who had a skeletal Class III malocclusion treated using chin-cap therapy (mean age 18.4 years). The two control groups contained 39 untreated subjects with skeletal Class III malocclusions (mean age 15.5 years) and 53 dental students (mean age 19.2 years) with acceptable normal occlusions. Functional examination of the subjects was carried out and those with at least one sign/symptom (clicking, pain, or deviation) were identified as the 'symptomatic' subgroup. The distribution of symptomatic individuals was 25 per cent in the treatment group, 23 per cent in the Class III malocclusion group, and 41.5 per cent in the normal group (dental students). In addition, the frequency of signs and symptoms of TMD in the symptomatic individuals was also investigated. There were no signs of crepitus in any subject, clicking was found in 50 per cent of the treatment group and pain in 54.5 per cent of the normal group.

The results of this long-term follow-up indicate that chin-cap treatment is neither a risk factor nor a prevention for TMD. Age and stress factors should always be considered in the evaluation of TMD.

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Introduction

The association between orthodontic treatment and temporomandibular joint dysfunctions (TMD) has been discussed widely in the literature. Chin-cap therapy has been one of the procedures most frequently cited as a cause of TMD (Wyatt, 1988; Tanne *et al*., 1996). However, studies by Dibbets and van der Weele (1987, 1991, 1992) relieved the concerns of clinicians who use chin-cap in the treatment of subjects with skeletal Class III malocclusions. It has also been suggested that the chin-cap does not have a detrimental effect on the temporomandibular joints (TMJ) (Gavakos and Witt, 1991; Deguchi *et al*., 1998; Gökalp *et al*., 2000). Gökalp *et al.* (2000) investigated the condyle–disc relationship in patients treated with chin-cap using magnetic resonance imaging (MRI) and concluded that 'if the chin-cap is used at an early age and with appropriate forces, there will be no adverse effect on the condyle–disc relationship'. As there are only a few follow-up studies examining the long-term effects of chin-cap on TMD in the orthodontic literature, the aim of the present investigation was to evaluate the long-term effects of chin-cap therapy in terms of TMD symptoms.

Subjects and method

The three study groups were as follows:

Treatment group. 32 individuals (14 male, 18 female) with a mean age of 18.4 years (range 13.9–22.5 years) who previously had a skeletal Class III malocclusion and were treated by chin-cap therapy. (Pre-treatment mean: ANB –1.8°; overjet –1.7 mm; GoGn/SN 30.5°; mean age 11.2 years; range 8.3–14 years. Post-treatment age: 13.4 years; range 9.7–16.8 years.) The mean post-retention follow-up period was 5.6 years (range 2–11 years) and the average treatment time was 1.8 years. A chin-cap with 500 g force was used for 14 hours/day.

Skeletal Class III group. 39 untreated individuals (20 male, 14 female) with a skeletal Class III malocclusion (ANB mean ± SD –2.8° ± 2.4; overjet –1.8 mm ± 2.4). The mean age of this group was 15.5 years (range 12.5–31.1 years).

Normal occlusion group. 53 first and second year dental students (24 male, 29 female) with harmonious profiles and acceptable normal occlusions. The mean age of this group was 19.2 years (range 18–21.4 years).

All subjects underwent a functional examination by the same investigator (HG), according to the following criteria (Graber *et al*., 1997; Okeson, 1998):

1. Clicking: defined as a short hard sound, which was osculated by a paediatric stethoscope bilaterally when the mandible opened and/or closed.
2. Pain: was determined by palpation of the joints and masticatory muscles with the mandible stationary and during function.
3. Deviation: any shift of the jaw midline during opening, which disappeared by continued opening with a return to midline.

Table 1 Grouping of the subjects.

Study groups	Treatment ($N = 32$) (18 females, 14 males)	Class III ($N = 39$) (14 females, 20 males)	Normal ($N = 53$) (29 females, 24 males)
Subgroups			
Symptomatic	25% ($N = 8$)	23% ($N = 9$)	41.5% ($N = 22$)
Asymptomatic	75% ($N = 24$)	76% ($N = 30$)	58.5% ($N = 31$)

The subjects were subsequently grouped as 'symptomatic' or 'asymptomatic'. The symptomatic group consisted of individuals having at least one sign/symptom.

Statistical method

The distribution of symptomatic and asymptomatic subjects in the study groups and the occurrence rate of TMD signs/symptoms in symptomatic subjects were examined. Intergroup differences in the distribution of symptomatic and asymptomatic subjects and the occurrence rate of TMD signs/symptoms in symptomatic subjects were compared by a Z-test.

Results

Distributions of symptomatic and asymptomatic subjects are shown in Table 1. The distribution of symptomatic subjects was 25, 23, and 41.5 per cent in the treatment, Class III malocclusion, and normal occlusion groups, respectively. Intergroup differences in the distribution of symptomatic subjects are shown in Table 2. The distribution of symptomatic subjects in the treatment and Class III malocclusion groups was found to be statistically similar ($Z = 0.19$) (Table 2). This finding indicates that chin-cap therapy neither created a negative effect nor played a role in preventing TMD. The distribution of symptomatic individuals was statistically different ($Z = -1.93$) ($P < 0.05$) between the Class III malocclusion and normal occlusion groups. Hence, the distribution of symptomatic individuals was at a higher rate in the normal group (41.5%) when compared with the Class III malocclusion group (23%). The distribution of symptomatic subjects was found to be statistically similar between the treatment and normal groups ($Z = 1.54$).

The occurrence rate of TMD signs and symptoms in the symptomatic subjects and the differences in distribution among the groups are given in Figure 1 and Table 3. The occurrence of pain, which is regarded as a subjective sign, was different between the treatment (37.5%) and normal occlusion groups (54.5%) ($P < 0.01$). The occurrence rate of pain was higher in the normal occlusion group than in the skeletal Class III malocclusion group (33%); however, it was not statistically significant. The occurrence rate of clicking and deviation did not differ among the groups.

Table 2 The difference in the distribution of symptomatic individuals in the groups was compared by Z-test.

Groups	Z-test	
Treatment/Class III	$Z = 0.19$	NS
Treatment/normal	$Z = 1.54$	NS
Normal/Class III	$Z = -1.93$	*

NS, not significant; *$P < 0.05$.

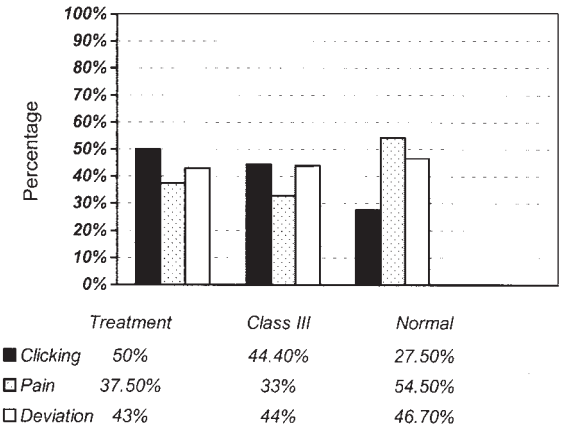


Figure 1 Occurrence rate of TMD signs and symptoms in the symptomatic subjects.

Discussion

The results of the current study reveal that chin-cap treatment has no risk or advantage in terms of TMD. Similar results were reported in a comprehensive review by Reynders (1990) and Tallents *et al.* (1991).

Upward/backward forces applied to the mandible have long been assumed to be the reason for TMD (Riolo *et al.*, 1987; Tanne *et al.*, 1996; Wyatt, 1998). Unfortunately, some components of the TMJ, such as the temporomandibular ligament (TML), have always

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Table 3 The difference in the occurrence rate of TMD signs and symptoms among the study groups was compared by *Z*-test.

Sign/symptom	Treatment/Class III		Treatment/normal		Normal/Class III	
Clicking	$Z = 0.23$	NS	$Z = 1.34$	NS	$Z = -0.90$	NS
Pain	$Z = 0.18$	NS	$Z = 3.1$	**	$Z = 1.12$	NS
Deviation	$Z = -0.29$	NS	$Z = 0.39$	NS	$Z = 0.05$	NS

NS, not significant; $^{**}P < 0.01$.

been ignored in these evaluations (Okeson, 1998). In fact, when a force is applied to the mandible in a postero-superior direction, the expected upward and backward movement of the condyle is opposed by the horizontal portion of the TML, such that the TML acts as a 'safety belt' mechanism. Moreover, in a recent study, Gökalp *et al.* (2000) reported a significant decrease in the angle between the condyle and collum axis in individuals treated with a chin-cap, which can be regarded as a biological defence mechanism.

Considering the aforementioned opinions, it is not surprising to encounter similar distributions of TMD in the chin-cap and control groups. Gavakos and Witt (1991) stated that the functional status of individuals treated with chin-cap was improved in comparison with untreated prognathic patients. Those authors also reported that the functional status of the chin-cap group was weaker when compared with dental school students. However, Keß *et al*. (1991) found that individuals with malocclusions have a more harmonious functional status than dental students. In the present study the chin-cap group was more 'comfortable' than the dental students (normal group) and the dental students group was less comfortable than the untreated skeletal Class III malocclusion group in terms of TMD. It should, however, be borne in mind that the normal group was the oldest and also the most stressed group. This implies that age is a risk factor for TMD. There is common agreement on this view in the literature (Egemark-Eriksson *et al*., 1981, 1990; Dibbets *et al.*, 1985; Riolo *et al*., 1987; Dibbets and van der Weele, 1989; Runge *et al*., 1989; Sadowsky *et al*., 1991; Katzberg *et al*., 1996; Magnusson *et al*., 2000).

Recently there has been an increase in the number of studies involving psychological factors. It is suggested that stress plays a role in the frequency of TMD (Stockstill and Callahan, 1991; Shiau and Chang, 1992; Jones *et al.*, 1997; Sipilä *et al*., 2001; Steed and Wexler, 2001). There appears to be a common peak in the age distribution of patients with TMD, predominantly females, between 20 and 45 years of age (Mohlin, 1983; Athanasiou, 2001; Vollaro *et al*., 2001). According to Athanasiou (2001) 'possible explanations for this finding may relate to the emotional aspects and stressful lifestyle that characterize this age period'. In the current study, the normal group consisted of first and second grade dental students who were at the beginning of a difficult education with increasing responsibilities and stress. Unfortunately this was not taken into consideration in the design of the investigation. A question now arises as to what would have been the result if the normal group had consisted of arts students. However, it is emphasized that clinicians should be cautious in the recognition of psychological factors (Dahlström, 1993; Rugh *et al*., 1993) since the effects of initial psychological symptoms on the results of TMD treatment are not yet clarified (Steed, 1997; Wexler and Steed, 1998).

In the current study, the rate of TMD signs and symptoms (clicking, pain, deviation) was also examined. Clicking is the most common sign of TMD (Mohlin, 1983; Athanasiou, 2001) and it is frequently accompanied by deviation (Graber *et al*., 1997). The distribution of clicking and deviation was similar for all groups. However, the rate of clicking was higher in the chin-cap treatment group (50%) than in the controls. It has been suggested that joint noise (clicking and/or crepitation) is found significantly more often in subjects with a Class II molar relationship (18%) and negative overjet (37%), although molar relationships were not associated with pain (Riolo *et al*., 1987). It has also been demonstrated that physchological factors play a significant role in the ocurrence of pain (Glaros, 2000; Alamoudi, 2001; Athanasiou, 2001; Auerbach *et al*., 2001). TMD symptoms show a high population prevalence (Glass *et al*., 1993; Conti *et al*., 1996; Ciancaglini and Radaelli, 2001; Pow *et al*., 2001). However, the frequency of severe disorders that require treatment is reported to be 5 per cent in adolescents and 5–12 per cent in adults (Magnusson *et al*., 2000; Athanasiou, 2001), and this should be taken into consideration.

There may be other factors that should be taken into consideration regarding the results of the current study. The question 'To what extent do TMD symptoms reflect internal derangement (ID)?' and the existence of ID risk even in asymptomatic individuals make it more complicated (Nebbe and Major, 2000; Trpkova *et al*., 2000). In the present study, the aim was not to focus on the aetiology of TMD. However, when the effects of chin-cap therapy were evaluated it was sometimes mentioned briefly. The authors believe that TMD may depend on individual responses rather than external factors, such as occlusion, orthodontic treatment, parafunctions, etc.

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Conclusions

1. Chin-cap therapy is neither a risk factor for nor a prevention of TMD.
2. The skeletal Class III group seems in a more advantageous position in terms of comfort when compared with dental students regarding TMD signs and symptoms.

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