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Original Article

# A study of the incidence of overeruption, rotation, tipping in unopposed molars and temporomandibular disorders

# *Kapanışı olmayan dişlerde; uzama, dönme, devrilme sıklığı ve temporomandibular düzensizlikler ile ilgili çalışma*

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## ABSTRACT

**Aim:** The purpose of this study was to determine the incidence of overeruption, rotation and tipping in unopposed posterior teeth and study the association among temporomandibular disorders (TMD).

**Material and Method:** The study group consisted of 191 patients with posterior tooth loss. These teeth (462 molars) overeruption, rotation and tipping records were reviewed. Tooth loss and TMD symptoms were detected. In order to compare the variables Chi-square tests and Fisher's exact probability test were used. For TMD, Pearson correlation prevalence parameters were used.

**Results:** 291 molars showed no signs of overeruption. 119 molars showed slight, 52 molars had erupted moderate to severe eruption. 184 molars had no signs of rotation, 203 were rotated less than 15°, while 75 molars were rotated more than 15°. 274 molars showed no signs of tipping whereas, 108 had tipping less than 15°, and 80 molars had tipping of greater than 15°. Younger age group and female gender were found to be statistically significant regarding mean scores of TMDs (Age: $P < 0.05$, Gender: $P < 0.001$)

**Conclusions:** Molar rotation was more frequent in the maxilla; whereas overeruption and tipping were more common in the mandible Significant associations between the signs of TMD and tooth loss were found, but the current results does not support the concept that loss of molar support is an etiologic factor in TMDs.

**Keywords:** Overeruption, rotation and tipping of molars, temporomandibular joint, temporomandibular disorders

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## ÖZ

**Amaç:** Bu çalışmanın amacı, kapanışı olmayan dişlerde uzama, dönme ve devrilme sıklığı ile oklüzal girişimler ve molar dişlerin uzaması ile temporomandibuler düzensizlikler (TMD) arasındaki ilişkinin belirlenmesidir.

**Gereç ve Yöntem:** Çalışma grubu posterior diş kaybı ile başvuran191 hastadan oluşmuştur. Bu dişlerin (462 molar diş) uzama, dönme ve devrilme kayıtları incelendi. Diş kaybı ve TMD belirtileri saptandı. Bağımsız değişkenler karşılaştırılması için Ki-kare testi ve Fisher kesin olasılık testi kullanılmıştır. TMD için Pearson korelasyon yaygınlık parametreleri kullanıldı.

**Bulgular:** 291 azı dişinde, uzama belirtisi gözlemlenmedi. 119 azı dişinde, hafif uzama, 52 azı dişinde, orta ve şiddetli uzama görüldü. 184 azı dişinde, dönme belirtisi görülmedi, 203 molar dişte, 150den daha az, 75 dişte ise 150 den fazla dönme tespit edildi. 274 dişte devrilme gözlenmezken, 108 dişte 150 den az devrilme ve 80 dişte ise 150 den fazla devrilme gözlemlendi. TMD ortalama skorları ile genç yaş grubu ve cinsiyet (kadın) istatistiksel olarak anlamlı olarak bulundu (Yaş: $P < 0.05$. Cinsiyet: $P < 0.001$).

**Sonuç:** Azı dişlerinde dönme bulgusu daha çok maksillada iken, uzama ve devrilme bulgusu daha çok mandibulada saptanmıştır. TMD ve diş kaybı belirtileri arasında anlamlı sonuçlar bulunmuştur, ancak bu sonuçlar molar destek kaybının, TMD hazırlayıcı faktörleri arasında olduğunu desteklemektedir.


**Anahtar Kelimeler:** Molar dişlerde dönme, uzama ve devrilme, temporomandibular eklem, temporomandibular düzensizlikler

## Introduction

Prosthetic dentistry has traditionally held that missing teeth should be replaced as soon as possible, as a failure to replace a missing tooth could result in the loss of tooth function and damage specifically, unaesthetic appearance, dental caries, periodontal disease, possible food impaction and a reduction or complete cessation of local function [1]. Cultural norm of the population, financial status and socio-demographic factors are important determinants in tooth loss patterns [2]. The location of missing teeth is important in a person's subjective need for replacing them [2]. Over time, a number of posterior teeth may be lost, leaving antagonists unopposed. [3]. Failure to replace a missing posterior tooth has been believed to result in several adverse consequences. These consequences include; overeruption of the opposing tooth or teeth, tilting or drifting of adjacent teeth, and loss of proximal contacts, which negatively impact occlusion and the health of the supporting structures [4]. Tipping and overeruption of teeth as well as altered muscular function are some other factors resulting from tooth loss and ultimately leading to dysfunction [5]. Loss of occlusal support may cause impairment of masticatory performance and changes in the neuromuscular pattern of jaw activity. These, in turn, can result in structural changes both in the TMJ (Temporomandibular Joint) and jaw musculature due to an altered distribution of functional and parafunctional loads [6].

Overeruption describes the vertical migration of a tooth after the loss of an antagonist contact. The effect of this eruptive process is unpredictable in adults. It has been suggested that teeth erupt until they reach a functional position in the oral cavity [7]. Compagnon and Woda [8] demonstrated that the majority of overeruption occurred in the early years after the loss of an opposing tooth loss. In healthy individuals, the gingival margin remains at its original level during this occlusal movement. After ten years no opposition, this periodontal migration reversed and the tooth experiences a "passive eruption" [8]. From these findings, overeruption may have several components, including periodontal growth, passive eruption and active eruption [3].

TMDs (Temporomandibular Disorders) are acknowledged to originate from many sources [9]. Loss of molar support has been implicated with TMJ modeling, with the tendency for a progression toward locking and joint degeneration and with increases in clicking [10].

A number of studies have connected tooth loss with TMDs [5,6]. Loss of molar support has long been considered an important etiological factor for TMDs [11]. It has been repeatedly reported that there is either no association, or only a weak association, observed between the loss of posterior molars and TMDs symptoms in the non-patient population [5,6]. Some studies described the fact that the loss of a molar tooth was associated with more pain and dysfunction in the TMJ [5]. In some reviews, the effect of the loss of posterior molar support on TMJ pathology has been discussed. Maintenance of most molars and premolars will ensure occlusal stability, adequate muscle support and joint function and masticatory ability [12]. Tallents et al [13] suggested that a positive association between missing mandible posterior teeth and the presence of disk displacement existed. Tooth losses is usually considered to be a predisposing factor to TMDs. Tipping and over-eruption of teeth; as well as altered muscular function, are some of factors resulting from tooth loss; ultimately leading to TMDs. Additionally, the number of remaining teeth or occluding pairs of teeth is correlated with the presence of TMDS [14-16].

The purposes of this study are to:

1. Determine the incidence of overeruption in unopposed posterior teeth.

2. Determine the incidence of occlusal interferences associated with unopposed posterior teeth.

3. Detect an association among occlusal interference and overeruption of unopposed posterior teeth with TMDs.

## Material and Method

The project was approved by the Ethical Committee our University Faculty of Dentistry. Written informed consent was obtained from all subjects following a verbal explanation of the purpose of the study and methods to be used in the study. An explanatory leaflet was provided for each patient. For the purposes of this study "posterior" was defined as an upper or lower first or second molar. Third molars were not counted as missing teeth [4,7]. Unopposed occlusion was defined as 20% or less of the occlusal surface in contact with an opposing tooth when examined in the intercuspal position. When more than one tooth in the same quadrant was unopposed the tooth nearest to an antagonist was observed. Where this was judged to be equal, both teeth were included in the study [3]. Exclusion criteria; patients for whom documentary evidence showing that the tooth under investigation had been unopposed for the minimum period of 5 years was unavailable. Patients with unopposed teeth that were prevented from independent movement by involvement in the support or retention for fixed or removable prostheses were excluded.

The study group consisted of 191 patients [102 women (35 to 85 years; SD 67.95 ± 10.99) and 89 men (35 to 84 years; SD 68.66 ± 12.56)] with posterior tooth loss. These patients were stratified by gender and age (younger: ≥35 and ≤60 years; older: >61 years).

The first section of the questionnaire enquired about socio-demographic data, including age, gender, duration of years without antagonist, TMD (TMJ sounds, feeling of stiffness or fatigue of the jaw, difficulty in widely opening the mouth or locking the jaw, luxation, pain on movement and facial and jaw pain [16,17]. The second section; while also including the following symptoms: bruxism, difficulty or pain on mastication and tremors of the jaw in opening the mouth. Each subject underwent a comprehensive dental examination by one of the examiners. All patients answered a questionnaire including questions about TMD, TMJ sounds, pain on movement, facial and jaw pain occurring in the prior 6 months. A clinical examination was administered including palpation and auscultation of the TMJ, palpation of masticatory muscles and determining if there was pain on movement of mandible, or a deviation at mouth opening.

462 first and second molars were recorded, 230 were in the maxilla and 232 were in the mandible. Among these molars, 310 had neither an antagonist nor a mesially adjacent tooth (171 in the maxillae and 139 in the mandible; Table 1).

**Table 1.** Distribution of molars with and without adjacent teeth

| Documented years without antagonists | Maxilla (n=230) | | Mandible (n=232) | |
|---|---|---|---|---|
| | Adjacent Teeth | No Adjacent Teeth | Adjacent Teeth | No Adjacent Teeth |
| 1-5 | 25 | 71 | 35 | 61 |
| 6-10 | 18 | 59 | 29 | 50 |
| 11-+ | 16 | 41 | 29 | 28 |
| Total | 59 | 171 | 93 | 139 |

### *Materials Used*

Impressions for study models were made using Kromopan alginate impression material (Lascod, Italy) with the Fix tray adhesive: (Fix, De trey, Weybridge, England). The models were subsequently cast in Moldano model stone (Heraeus Kulzer, Germany).

### *Position Evaluation of Unopposed Molars*

The vertical and mesiodistal/ buccolingual position of the molars with regard to overeruption, rotation, and tipping, were evaluated on dental casts by one examiner and the radiographic evaluation of overeruption on dental panoramic radiographs was made by one examiner.

Overeruption was determined by the vertical position of the

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unopposed molar in relation with the following landmarks: The individual's occlusal plane and the marginal ridges of adjacent teeth with antagonists. The unopposed molars were scored as:

0 = no sign of overeruption;

1 = slight overeruption, just detectable elongation up to 2 mm; or

2 = moderate to severe overeruption, indicating elongation of 2 mm or more.

Rotation was determined in the horizontal plane using a protractor, by estimating the angular deviation of a line drawn through the contact points of the unop¬posed molar and the direction of the alveolar process in the area of interest. Rotation was scored as:

0 = no sign of rotation;

1 = slight rotation (less than 15 degrees); or

2 = definite rotation (15 de¬grees or more).

Tipping was determined using a protractor, by judging the angle formed by the estimated long axis of the unopposed molar and a line perpendicular to the occlusal plane. Tipping was scored as:

0= no sign of tipping;

1 = slight tipping (less than 15 degrees); or

2 = definite tipping (15 degrees or more).

***Radiographic evaluation of overeruption***

A single examiner evaluated teeth by using panoramic radiographs (Planmeca praline EC pan/ceph, Helsinki, Finland) taken in the standard position and processed by automatic development (Velopex Extra-X). Overeruption of the mandibular molar was noted when the occlusal surface was above the occlusal plane of the adjacent molar/premolar. The degree of overeruption was measured as a fraction of the crown height.

## Statistical Analysis

Chi-square tests and Fisher's exact probability test were used for comparison of Independent variables. Pearson correlation was used to study the prevalence of the parameters on TMD signs and symptoms.

## Results

***Overeruption***

291 molars (62.9%) showed no signs of overeruption. 119 molars ( 25.8%) showed slight overeruption (< 2mm), 52 molars (11.3%) had erupted ≥2 mm (moderate to severe eruption) (Table 2). In the entire moderate to severe samples, the antagonist was lost in adulthood (the minimum age 20 years). Slight, moderate and severe overeruption showed more in mandible molars than maxillary molars. The distribution of overeruption did not differ significantly (P > 0.05) between the maxillary and mandible unopposed molar (Figure 1).

**Table 2.** Overeruption, rotation and tipping of unopposed molars with regard to documented years without antagonists

| Document-ed years without antagonists | N (462) | Overeruption | | | | | | Rotation | | | | | | Tipping | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Maxilla (n=230) | | | Mandible (n=232) | | | Maxilla (n=230) | | | Mandible (n=232) | | | Maxilla (n=230) | | | Mandible (n=232) | | |
| | | 0 | <2mm | ≥2mm | 0 | <2mm | ≥2mm | 0 | <150 | ≥150 | 0 | <150 | ≥150 | 0 | <150 | ≥150 | 0 | <150 | ≥150 |
| 1-5 | 187 | 64 | 22 | 7 | 56 | 30 | 8 | 29 | 49 | 14 | 45 | 41 | 9 | 59 | 23 | 12 | 48 | 29 | 16 |
| 6-10 | 162 | 49 | 25 | 7 | 57 | 18 | 6 | 32 | 35 | 14 | 36 | 29 | 16 | 53 | 12 | 14 | 53 | 19 | 11 |
| 11-+ | 113 | 36 | 9 | 11 | 29 | 15 | 13 | 22 | 24 | 11 | 20 | 25 | 11 | 29 | 11 | 13 | 31 | 14 | 15 |

*0= no eruption, <2mm= slight overeruption, ≥2mm= definite overeruption*

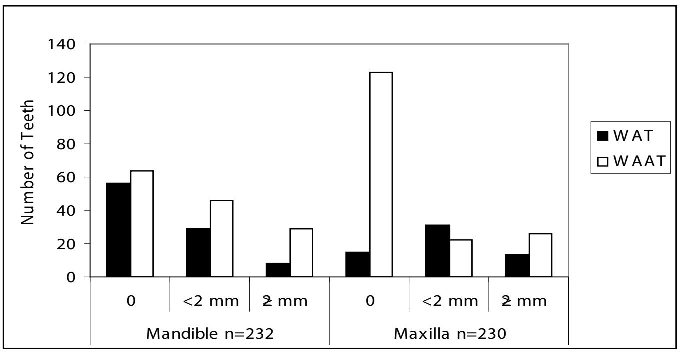


**Figure 1.** Overeruption: Distribution of teeth in each jaw without antagonist teeth (WAT), without antagonist and adjacent teeth (WAAT) (n=462 unopposed molars). 0: no overeruption; <2mm: slight overeruption; ≥2mm: moderate or severe overeruption.

### *Rotation*

184 molars (39.8%) had no signs of rotation 203 (43.9%) were rotated less than 15 degrees, while 75 (16.3%) molars were rotated more than 15 degrees. Of the 278 rotated teeth, 147 molars were in the maxilla (50.2%) and 131 molars were (49.8%) in the mandible.

In the cases of rotation, the molars showed a different degree of rotation when the antagonist had been lost for either 5-10 years, 11-20 years or 21 or more years without antagonist (Table 2). The distribution of rotation did not differ significantly (P > 0.05) between the rotated maxillary and mandible molars, but there was a tendency for slight, but definite, rotation in maxilla (Figure 2).

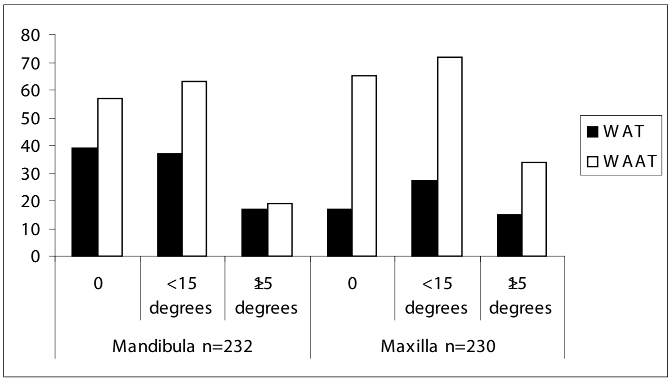


**Figure 2.** Rotation: Distribution of teeth in each jaw without antagonist teeth (WAT), without antagonist and adjacent teeth (WAAT), (n=462 unopposed molars). 0: no rotation; <15 degrees: slight rotation; ≥15 degrees: definite rotation.

### *Tipping*

274 (59.3%) teeth had no signs of tipping either in a mesiodistal or in a buccolingual direction; however, most of the unopposed teeth that showed no sign of tipping had contact with adjacent teeth. 108 (23.4%) had tipping less than 15 degrees, and 80 (17.3%) molars had tipping of greater than 15 degrees. There were 99 molars in the maxilla and 89 molars in the mandible that exhibited tipping (Figure 3).

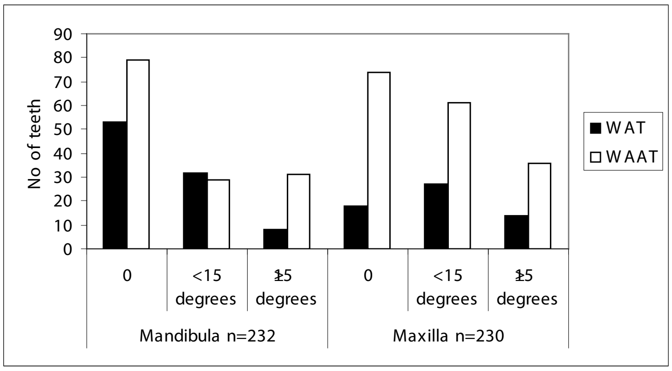


**Figure 3.** Tipping: Distribution of teeth in each jaw without antagonist teeth (WAT), without antagonist and adjacent teeth (WAAT), (n=462 unopposed molars). 0: no tipping; <15 degrees: slight tipping; ≥15 degrees: definite tipping.

In the cases of tipping, the molars that showed moderate or severe overeruption occurred more frequently in mandible molars than maxillary molars. Significant overeruption, rotation and tipping occurred more often in patients who had lost their antagonist molars between the ages of 20-41 years old than for patients who had lost antagonist molars between the ages of 42-75 years old (P < 0.05) (Table 3).

**Table 3.** Overeruption, rotation and tipping of unopposed molars with regard to age

| Age at loss of antagonist | Overeruption | | | | | | Rotation | | | | | | Tipping | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Maxilla (n=230) | | | Mandible (n=232) | | | Maxilla (n=230) | | | Mandible (n=232) | | | Maxilla (n=230) | | | Mandible (n=232) | | |
| | 0 | <2mm | ≥2mm | 0 | <2mm | ≥2mm | 0 | <150 | ≥150 | 0 | <150 | ≥150 | 0 | <150 | ≥150 | 0 | <150 | ≥150 |
| 20-41 | 124 | 40 | 21 | 106 | 54 | 18 | 65 | 91 | 29 | 81 | 70 | 27 | 115 | 36 | 34 | 99 | 51 | 28 |
| 42-75 | 24 | 15 | 6 | 35 | 11 | 8 | 19 | 17 | 9 | 18 | 26 | 10 | 26 | 12 | 7 | 26 | 11 | 17 |

*0= no eruption, <2mm= slight overeruption, ≥2mm= definite overeruption*

The prevalence of TMDs may be seen in Table 4. Of the patients who had lost molars, the younger age group (35-64 y.) had significantly higher mean TMD scores (P < 0.05) than did the older age group (65>). For the entire sample, a there was no statistical significance between young and older groups for difficulty in widely opening the mouth or in locking of the mouth or pain on movement.

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| **Table 4.** Pearson correlation coefficients (r) between symptoms of functional disturbances of TMJ | | | | | |
|---|---|---|---|---|---|
| | Age | Sex | Overeruption | Rotation | Tipping |
| TMJ Disorder | r=0.015, p<0.05* | R=0.403, p<0.001** | r=-0.31, p>0.05 | r=0.057, p>0.05 | r=0.110, p<0.05* |
| TMJ Sounds | r=-0.111, p>0.05 | R=0.038, p<0.01** | r=-0.060, p>0.05 | r=0.037, p>0.05 | r=0.079, p>0.05 |
| Feeling of stiffness or fatigue of the jaws | r=-0.050, p>0.05 | R=0.028, p<0.01** | r=-0.024, p>0.05 | r=0.034, p>0.05 | r=0.058, p>0.05 |
| Difficulty in opening the mouth wide or in locking the mouth | r=-0.076, p>0.05 | R=0.034, p>0.05 | r=-0.062, p>0.05 | r=0.040, p>0.05 | r=0.036, p>0.05 |
| Luxation | r=-0.079, p>0.05 | R=0.121, p>0.05 | r=-0.023, p>0.05 | r=-0.051, p>0.05 | r=0.005, p>0.05 |
| Pain on movement | r=0.103, p>0.05 | R=-0.014, p>0.05 | r=-0.052, p>0.05 | r=0.068, p>0.05 | r=0.188, p<0.01** |
| Facial and jaw pain | r=0.040, p>0.05 | R=0.178, p<0.05* | r=-0.052, p>0.05 | r=0.046, p>0.05 | r=0.041, p>0.05 |
| Bruxizm | r=0.068, p>0.05 | R=0.066, p>0.05 | r=-0.019, p>0.05 | r=0.017, p>0.05 | r=0.064, p>0.05 |
| Difficulty or pain on mastication | r=0.037, p>0.05 | R=0.205, p<0.01** | r=0.025, p>0.05 | r=0.053, p>0.05 | r=-0.013, p>0.05 |
| Tremors of the jaws in opening the mouth | r=-0.016, p>0.05 | R=0.044, p>0.05 | r=-0.020, p>0.05 | r=0.014, p>0.05 | r=0.071, p>0.05 |

*p: Chi-square or Fisher's exact test, *statistical significance level 0.05, ** statistical significance level 0.01*

Gender had a significant influence when associated with loss of molars and TMDs. Females had a statistically significant occurrence of TMDs ($P < 0.01$). Female subjects with lost molar support had a statistically significant occurrence of TMJ sounds ($P < 0.01$). No significant associations were found between some subjective symptoms (pain on movement, facial and jaw pain, bruxism, tremors of the jaw in opening the mouth) and gender.

Female subjects with loss of molar support reported difficulty in opening the mouth wide or in locking of the mouth and luxation symptoms more frequently than male subjects. The difference, however, was not statistically significant ($P > 0.05$).

Subjects with overeruption and rotation with loss of molar support did not significantly differ with all subjects with TMDs. Although TMDs and tipping were frequently found in the subjects that had a loss of molar support ($P < 0.05$), subjects that exhibited tipping statistically had more frequent subjective symptoms (pain on movement) ($P < 0.01$).

## Discussion

Failure to replace a missing posterior tooth has been believed to result in several adverse consequences. These consequences include the supra eruption of the opposing tooth, tilting or drifting of the adjacent teeth and loss of proximal contacts. These consequences negatively impact the supporting structures and occlusion [18]. They may ultimately result in the loss of one or more of the teeth adjacent to the edentulous space.

The present study included molars that had been unopposed for different periods (5-10, 11-20, 21 and over years). An interesting finding was that not all unopposed molars had overerupted. The studies by Lindskog-Stokland et al. [19] and Kiliaridis et al. [20] showed that molar rotation was more frequent in the maxilla, whereas tipping was more common in the mandible. In the present study, overeruption and tipping were more frequent in mandible molars, whereas rotation was more common in maxilla molars. Compagnon and Woda [8] found that all unopposed maxillary molars showed overeruption after a period of time; however, 62.7% of the molars that had been without antagonist contact in the current study did not exhibit signs of overeruption. In their 2000 study, Kiliaridis et al [7] identified that 18% of teeth with no antagonist support have no demonstrable overeruption at all, leaving 82% of unopposed teeth with some overeruption which could have a clinical significance in terms of restoring the lost teeth. Kaplan's [21] found that not all of the movement in supraerupted teeth was in a vertical direction and that there was often also a horizontal or rotational component to the movement. Kaplan deduced that this horizontal component may have been due to guidance by partial tooth contact with an antagonist. The studies by Kiliardis et al. [7] and Kaplan [21] indicate that leaving a tooth partially opposed may not prevent undesirable vertical rotations. The unopposed upper first molar, in both healthy mouths and those with some periodontal pathology, was studied by Compagnon and Woda [8]. They showed that the majority of overeruption occurred in the early years following the loss of an opposing tooth. Clinically, overeruption of posterior teeth may often complicate the restoration of an edentulous space with either fixed or removable prostheses. In severe cases, most or all of the interocclusal space may be taken up by the vertical movement of the unopposed tooth, prohibiting restoration of the space without extraction of the overerupted tooth. The extent of overeruption determines to what extent the overerupted tooth can be reduced, or the occlusal plane modified. This change in tooth position could result in the development of an occlusal interference or contact position, which may be of relevance in the restoration of the teeth involved.

Age is another important factor. The range of the age in the study by Compagnon and Woda [8] was 18 to 45 years, meaning that there were subjects examined for supraeruption who had lost the antagonist contact during the active growth period. The subjects included in the current study ranged in age from 50 to 85 years. Overeruption, rotation and tipping in the current study occurred more frequently in the younger group (5-64 years) than in the older group (65> years). The presence of occlusal interferences in the mouth was noted as having an incidence of between 75–89% in Agerberg and Sandstrom's study [22]. This study's subject group consisted of adults. Unilateral tooth contacts in a returned position were found in 75% of both subject groups. Non-working side contacts were found in 6-13% of the teenagers and 9-25% of adults.

The presence of occlusal interferences, while not proven to be associated with any pathology, can certainly complicate the restoration of the teeth involved. The current investigation attempted to provide a guide to determine the extent of overeruption that the clinician is likely to encounter and indicate whether an associated occlusal interference is likely to be present. In this context, it can also be mentioned that the loss of molar support-shortened dental arches does not generally lead to impairment of the health of the masticatory system [23].

A stable position of teeth, or the absence of gross migration, is a result of a balance of forces. In addition to occlusion, other factors, such as cheeks, lips, and tongue, are recognized. Changes in the tooth position may be induced by a loss of teeth. Tooth loss is usually considered to be a predisposing factor to dysfunction. This study has several strengths: the tooth loss sample covered overeruption, rotation and tipping: numerous covariates, such as age, gender and TMDs were included in the statistical analyses; and significant associations between TMD signs and tooth loss were found, in agreement with various clinical and epidemiologic studies [11-13]. Experimental and autopsy studies indicate degenerative changes of the articular tissue because of tooth loss [15].

De Boever [14] signaled the role of molar support in preventing TMD. Kirveskari & Alanen [5] found a significant association between the loss of the first maxillary premolar and TMD. Pullinger et al. [12] found an increased risk of TMD in subjects with more than five or six missing posterior teeth. On the other hand, other authors did not confirm that correlation [6]. In current study, subjects with overeruption and rotation, associated with a loss of molar support, did not significantly differ all subjects with TMDs. However, TMDs and tipping were frequently found in the subjects with loss of molar support ($p<0.05$). Additionally, subjects that experienced tipping frequently exhibited more subjective symptoms (pain on movement) ($p<0.01$) (Table 4). The loss of occlusal support and tipping may cause an impairment of masticatory performances and changes in the neuromuscular pattern of jaw masticatory activity.

This study showed in the subjects with the loss of molars, the younger age group (20-41 y) had significantly higher mean scores ($p<0.05$) for TMDs than did the older age group (42-75 y). Subjects aged 45 to 54 years had significantly less muscle tenderness or pain in relation to the younger group [24]. These findings agree with a report that found muscle disorders to be more frequent in younger patients [14].

The higher prevalence of TMD for women in the present study is confirmed by numerous epidemiologic studies [11,25,26]. Therefore, women and men were analyzed separately because gender seems to have a great influence on the development of functional disturbances. In this study, TMDs were significantly reported more frequently by female subjects ($p<0.01$) and female subjects with the loss of molar support reported difficulty in widely opening the mouth or in locking the mouth and luxation symptoms more frequently than male subjects. The higher number of TMD signs in females may be due to a higher biologic sensitivity to stimuli [25-27]. Women may detect signals that men might not notice [28]. In terms of the biologic background, the higher number of estrogen receptors in the female TMJ itself has been suggested to be important in gender differences [29,30]. Recent reports have shown a significant influence of the menstrual cycle on musculoskeletal pain [31,32]

## Conclusions

Molar rotation was more frequent in the maxilla; whereas overeruption and tipping were more common in the mandible. Significant associations between the signs of TMD and tooth loss were found, but the current results do not support the concept that loss of molar support is an etiologic factor in TMDs. Subjects with the loss of molars, the younger age group had significantly higher mean scores for TMDs than did the older age group. The sex discrepancy between epidemiologic and clinical examinations is likely to be explained by a higher propensity of women to seek treatment among women than men. If prosthetic treatment is considered necessary for patients with the loss of molar support, that treatment should be based on predetermined goals and should only be started after careful planning and when initial reversible therapy has proven to be effective.

## Declaration of conflicting interests

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