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Review

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# ORTHODONTIC THERAPY AND TEMPOROMANDIBULAR DISORDERS

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## Summary

Orthodontic treatment has been variously cited both as a protective and harmful factor in temporomandibular disorders (TMD) etiology. Therefore, it is important to understand associations between different malocclusions, orthodontic treatment, and signs and symptoms of temporomandibular disorders (TMD). From the presented literature the suggestion that orthodontic treatment leads to TMD appears to be ill-founded. Clinical studies suggest that orthodontic treatment has little role to play in worsening or precipitating TMD when treated patients are compared with untreated individuals, with or without malocclusion, or when different types of orthodontic treatment are compared. A considerable reduction in signs and symptoms of TMD between the teenage period and young adulthood has been shown in some recent longitudinal studies.

**Key words:** orthodontic treatment; malocclusion; temporomandibular disorders.

## INTRODUCTION

The question of whether a relationship exists between orthodontic treatment, abnormal condyle and disc position, and temporomandibular disorders (TMD) has been investigated for many years. Despite the abundance of studies, the question continues to trouble orthodontic community over the last decade. The relationship between orthodontic treatment and temporomandibular disorders (TMDs) has long been of interest to the practicing orthodontist, but only during the past decade a significant number of clinical studies have been conducted that have investigated this association. This interest in orthodontics and TMD in part was prompted in the late 1980s after litigation that alleged that orthodontic treatment was the proximal cause of TMD in orthodontic patients. This litigious climate resulted in an increased understanding of the need for risk management as well as for methodologically sound clinical studies.

TMD is a common condition, although the prevalence of symptoms and signs varies according to the criteria used and the methods of data collection. Longitudinal studies are probably the most useful. They tend to show that the prevalence of signs and symptoms increases with age and that the prevalence of signs is greater than the prevalence of symptoms.

Symptoms and signs of temporomandibular disorders (TMD) are relatively common in children and adolescents and about 30 per cent of this population receive orthodontic treatment in most western European countries during this period. This led to opinion that appeared in the literature that orthodontic treatment is a risk factor for the development of TMD [1,2]. But in recent literature reviews these claims have been questioned and discussed. Because of the high prevalence of symptoms and signs of TMD in children and adolescents, it is likely that patients receiving orthodontic treatment could experience TMD before, during, or after their orthodontic treatment. It is generally agreed that signs and symptoms are mostly mild in childhood and that they increase slightly with age up to adolescence, both in prevalence and severity [2,3].

Two main questions about temporomandibular disorders (TMD) in relation to malocclusion/orthodontic treatment seem to be of interest. The first concerns correlations between TMD and different kinds of functional or morphologic malocclusions. The other seeks to determine whether the severity and prevalence of TMD are influenced or even caused by orthodontic treatment.

Temporomandibular dysfunction is a collective term embracing a number of subjective symptoms and clinical signs that involve the temporomandibular joint and surrounding structures, and is considered a mayor cause of nondental pain in the orofacial region. The main signs and symptoms are: pain from the temporomandibular joints or jaw muscles, pain on mandibular movement, joint sounds, and locking/luxation of joints, as well as restricted mandibular movement.

The etiology of TMD is considered to be multifactorial. Unstable occlusion, untreated malocclusions, stress and other psychological factors, trauma, genetic predisposition, and structural conditions have been suggested as possible etiologic factors. Symptoms and signs are also affected by ethnicity, social class and psychological status.

Studies of the prevalence of mandibular dysfunction in children and adolescents have also shown that subjective symptoms and clinical signs are rather common and increase with age. Clinical symptoms of TMJ disorders have been reported to affect as many as 75% of a young adult population [4-6].

TMD is difficult to define and measure; therefore, numerous problems exist when clinical studies are undertaken. For, example, it has been shown that TMD

increase with age. Egemark-Ericson, Carlson and Ingervall noted that the prevalence of symptoms increased from 30% to 60% between 7 and 15 years and symptoms tend to be more prevalent in females than in males [7]. The study of Thilander et al has shown that the prevalence of functional disturbances of the masticatory system in Colombian sample, recorded as clinical signs is 25% which is lower than in most previous publications. Girls were in general more affected than boys, but most of the disturbances were mild in character. The explanation of the differences in the TMD may be due a real difference that exist between various ethnic populations, or may depend on methodological registration criteria [8].

### **MALOCCLUSION AND TMD**

The role of morphological and functional occlusion as contributing factors in the development of TMD has been discussed during the last decades, but there are still different opinions about the relative importance of occlusion to other contributing factors. Even if much controversy has been reported regarding the role of occlusion on TMD, there is, however, no doubt that occlusal variables influence natural masticatory muscle function [8].

The view of the influence of occlusion on the development of TMD has varied from none to considerable. Mohlin et al in their systematic review from the literature that was searched in the Medline and Cochrane Library databases from 1966 to 2005 found that the differences in TMD between those with and without malocclusion were small. Subjects with untreated cross-bite, crowding of teeth or large overjet showed a higher prevalence of signs and symptoms of TMD, but other studies failed to identify associations between malocclusion and TMD. Because of that, no conclusions could be drawn about associations between specific types of malocclusion and TMD. In some studies that compared treated malocclusions with untreated controls, a slightly lower prevalence of TMD was found, but the differences were small, while other studies found no differences [9].

Egemark, Magnusson and Carlsson in their investigation analyzes the influence of orthodontic treatment on signs and symptoms of temporomandibular disorders and different malocclusions during a 20-year period on 402 subjects [3]. This study supports the opinion that no single occlusal factor is of major importance for the development of TMD, but a lateral forced bite between retruded contact position (RCP) and intercuspal position (ICP), as well as unilateral cross-bite, may be a potential risk factor in this respect. The finding that four of

six subjects with severe clinical signs and/or frequent subjective symptoms of TMD at both the 10- and 20-year follow-ups had a lateral forced bite between RCP and ICP and/or unilateral cross-bite supports the findings by Mohlin et al, who found that cross-bite was more common in TMD patients compared with controls [9].

In the same study performed by Mohlin et al that included subjects who were examined at the age of 11, 15, 19 and 30 years, anamnestic and clinical recordings of temporomandibular disorder (TMD) were made. They concluded that orthodontic treatment seems to be neither a major preventive nor a significant cause of TMD [9].

Subjects with malocclusion over a long period of time tended to report more symptoms of TMD and to show a higher dysfunction index, compared with subjects with no malocclusion at all. Thilander et al. in their study found that TMD was significantly associated with posterior cross-bite, anterior open bite, angle Class III malocclusion, and extreme maxillary overjet. They also suggest that these morphological malocclusions should be treated orthodontically at an early age to eliminate the traits of the anomaly [8].

Henrikson and Nilner [2] carried out a prospective study of symptoms and signs of TMD and occlusal changes in girls with Class II malocclusion receiving orthodontic treatment with fixed straight-wire appliance in comparison with untreated Class II malocclusions and subjects with normal occlusion. Anamnestic and clinical registrations were made at the start and after 2 years in all three groups, while in the orthodontic group, additional registrations were made after 1 and 3 years. Clinical signs of TMD was numerically lower in the normal group than in the other two groups. Symptoms and signs of TMD showed considerable fluctuations over the 3-year period within the individuals, but the general tendency was a decreased prevalence of symptoms and signs of TMD over the 3 years. It seems that subjects with Class II malocclusion and muscular signs of TMD benefit from orthodontic treatment. The decreased prevalence of tenderness to palpation of the musculature in the orthodontic group whether this is a muscular response due to altered use of the masticatory muscles or due to occlusal changes has been difficult to say. Egermart-Eriksson and Rönnerman suggested that the decrease in muscle tenderness was due to a reduced activity of masticatory muscles during orthodontic tooth movement because of tender teeth [10]. All three groups in this study showed a similar increase in the prevalence of TMJ clicking over the 2 years, but this was in agreement with earlier studies, reporting that TMJ clicking increased from childhood to adolescence and to a even higher prevalence in adults [11-13].

In the recent systematic literature review by Mohlin et al. the associations between certain malocclusions and TMD were found in some studies, whereas the majority of the reviewed articles failed to identify significant and clinically important associations. TMD could not be correlated to any specific type of malocclusion, and there was no support for the belief that orthodontic treatment may cause TMD [14]. Obvious individual variations in signs and symptoms of TMD over time according to some longitudinal studies further emphasized the difficulty in establishing malocclusion as a significant risk factor for TMD. A considerable reduction in signs and symptoms of TMD between the teenage period and young adulthood has been shown in some recent longitudinal studies. They conclude that the associations between specific types of malocclusions and development of significant signs and symptoms of TMD could not be verified but there is still a need for longitudinal studies.

## **ORTHODONTIC THERAPY AND TMD**

Studies on the consequences of orthodontic treatment on TMD have shown that such treatment neither increases nor decreases the risk of developing TMD later in life, and some recent studies have found less prevalent TMD signs and symptoms in subjects who have received orthodontic treatment, compared with orthodontically untreated subjects [15].

The first authors that have undertaken an investigation with the main purpose to answer the question does the orthodontic treatment with fixed or removable appliances increase the risk for TMD were Sadovsky and Be Gola. They couldn't find statistically significant difference between treated and untreated subjects and they concluded that orthodontic treatment with fixed appliances in adolescence doesn't increase the risk of TMD [16].

The situation prior to 1988 was summed up by Gianelly, who suggested that the evidence indicating that orthodontics had caused long-term sequel of TMD was based largely on anecdotal reports, but recently because of more severe criteria and better evidence the results become reliable [17].

Sadowsky et al. found less reciprocal clicking after orthodontic treatment than before on a group basis, but reported individual fluctuation, while Lundh et al. found an unchanged status in 71 per cento of 70 adult patients with reciprocal clicking during a 3-year period, and in 29 per cent it disappeared [18,19].

Smith and Freer examined 87 patients who received full fixed appliances during adolescence with an untreated control group. There were no statistically significant differences between investigated groups; the one exception was the

finding of a higher rate of soft clicks in postorthodontic group. Their results rejected the hypothesis of association between orthodontic treatment and TMD [20].

Orthodontic treatment involving retraction of the maxillary incisors toward the mandible is said to lead to a posteriorly positioned condyle and TMD: However, few clinical studies have examined this directly. Luecke and Johnston used cephalometric radiographs to assess not only changes in condylar position but also changes in mandibular basal bone position. They investigated 42 Class II Division 1 patients, treated with two maxillary premolar extractions and fixed edgewise appliances. Treatment time ranged from 11 to 33 months, and there were 20 male and 22 female subjects. They reported that 70% of the sample showed a net forward displacement of mandibular basal bone, but that changes in condylar position were not correlated with incisor retraction [21].

Furthermore, Dibbets and van der Weele concluded in their comparison of two different orthodontic treatment types (involving nonextraction or premolar extraction treatments) that it was the original growth pattern that caused the teeth to be selected for extraction, rather than the extraction itself [22].

Egemark and Thilander conducted a longitudinal study of 293 children aged 7, 11 and 15. After a ten-year period subjects that were orthodontically treated show less subjective symptoms, and Helkimo clinical dysfunction index were significantly lower in these group. Joint sounds also do not appear so often in orthodontically treated subjects [4].

Olsson and Lindqvist conducted a longitudinal study of 210 patients that were orthodontically treated with fixed appliance. Before the orthodontic treatment, symptoms of TMD were found in 17% and after the treatment in 7% of the patients. In this study it was found that orthodontic treatment in many patients prevented further development of and/or cured TMD [23].

Egemark, Magnusson and Carlsson in their 20-year follow-up study found no statistically significant differences in the prevalence of TMD signs and symptoms between subjects with or without previous experience of orthodontic treatment [3].

Studies of TMD in relation to orthodontic treatment did not show an association, but longitudinal studies from adolescence to adulthood are lacking. That was the reason why Macfarlane et al. investigate the relationship between orthodontic treatment and TMD with a prospective cohort longitudinal study design. The baseline investigation was carried out in 1981 and involved children aged 11 to 12 years (n = 1018). Follow-up investigations were done in 1984, 1989, and 2000. Overall TMD prevalence increased from the baseline (3.2%) to age 19 to 20 (17.6%)

and decreased by age 30 to 31 (9.9%). Overall, incidences of TMD were 11.9%, 11.5%, and 6.0% at the first, second, and last follow-ups, respectively. Females were more likely to develop TMD than males and those with high self-esteem were less likely to develop TMD. There was no association between orthodontic treatment and new TMD onset as well as persistent TMD. The authors conclude that orthodontic treatment neither causes nor prevents TMD. Female sex and TMD in adolescence were the only predictors of TMD in young adulthood [24].

A systematic review of 31 studies also drew no definitive conclusion about the relationship, and found that data “do not indicate that traditional orthodontic treatment increased the prevalence of TMD”. The authors commented that they were hampered by variations in study design and the lack of consistent, reliable and valid diagnostic criteria for TMD among all reviewed studies [25].

The study of Tecco et al. evaluated the use of a fixed orthodontic appliance in treatment of temporomandibular disorder (TMD) compared to the use of an intra-oral splint. Fifty (50) adult patients, with confirmed anterior disk displacement with reduction in at least one temporomandibular joint (TMJ), were divided into three groups: 20 patients treated with AR splint; 20 patients treated with a fixed orthodontic appliance and 10 patients who underwent no treatment. Joint pain, joint noise, muscle pain, and subjective relief were evaluated monthly before the treatment began and for six months thereafter. The use of a fixed orthodontic appliance seems to be as efficacious as the use of an AR maxillary splint in the treatment of joint pain and muscle pain, but not in the treatment of joint noise [26].

Occasionally, during the active orthodontic treatment phase, TMD symptoms occur to the point that TMD therapy is needed. Depending on severity of the symptoms, orthodontic treatment may need to be slowed or temporarily discontinued as TMD therapy is provided (medications, adjunctive therapies, occlusal appliance therapy etc.). Orthodontist should warn orthodontic patients that TMD symptoms could develop or worsen and to be prepared to deal with their onset or exacerbation. Because of the potential for TMD signs and symptoms during orthodontic treatment, it is imperative that a TMD screening examination be performed prior to orthodontic therapy.

The orthodontist must determine if any TMD symptoms are present as part of the overall diagnostic process. However, many so-called symptoms are either insignificant (such as painless clicking) or just normal variations (such as a crooked opening pattern). Significant jaw pain and dysfunction does require treatment before orthodontic therapy is initiated, and hopefully an enlightened orthodontist can provide that basic TMD treatment. If patients develop symp-

toms during treatment the first rule in such cases is to stop active orthodontic mechanics immediately; this is both a medic-legal and a practical matter at that point. The question to be resolved is: Did the patient develop TMD symptoms because of the orthodontic treatment, or merely during that treatment period? Once again, basic pain management and support should be provided to reduce the symptoms, and then the orthodontic treatment process can be resumed. If the symptoms keep recurring as treatment resumes, the orthodontist may be dealing with a person who cannot accommodate to the forces and mechanics of conventional orthodontic therapy, and it is time to consider a compromise treatment plan.

## CONCLUSIONS

The relation of orthodontic treatment and TMD can be summarized as follows:

1. Signs and symptoms of TMD increase with age, particularly during adolescence, until menopause, and therefore TMDs that originate during orthodontic treatment may not be related to the treatment
2. Subjects who have received orthodontic treatment in childhood do not run an increased risk of developing signs or symptoms of TMD later in life.
3. Orthodontic treatment with fixed appliance either with or without tooth extractions did not increase the prevalence of symptoms and signs, or worsen preexisting symptoms and signs of TMD.
4. Associations between specific types of malocclusions and development of significant signs and symptoms of TMD could not be verified.
5. There is no increased risk of TMD associated with any particular type of orthodontic mechanics
6. Although a stable occlusion is a reasonable orthodontic treatment goal, not achieving a specific gnathologic ideal occlusion does not result in signs and symptoms of TMD
7. There is little evidence that orthodontic treatment prevents TMD, although the role of unilateral posterior cross-bite correction in children may warrant further investigation.

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## Sažetak

### **Ortodontska terapija i temporomandibularni poremećaji**

Ortodontska terapija često se navodi kao protektivni ili pak otežavajući čimbenik u etiologiji temporomandibularnih poremećaja. Zbog toga je vrlo važno razumjeti vezu između različitih ortodontskih anomalija i ortodontske terapije te znakova i simptoma temporomandibularnih poremećaja. Iz prezentirane literature proizlazi da je pretpostavka po kojoj ortodontska terapija dovodi do TMD-a neutemeljena. Klinička istraživanja pokazuju da ortodontska terapija igra malu ulogu u pogoršanju TMD-a kada se uspoređuju tretirani i netretirani ispitanici, oni s malokluzijama i bez njih ili kada se uspoređuju različite vrste ortodontske terapije. U nedavno objavljenim longitudinalnim istraživanjima navodi se znatno smanjenje simptoma i znakova TMD-a između tinejdžerske i rane odrasle dobi.

**Ključne riječi:** ortodontska terapija; malokluzija; temporomandibularni poremećaji.

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