Review

Orthodontics and Temporomandibular Disorders. Are They Related?

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ABSTRACT
The aim of this review was to evaluate associations between different orthodontic treatment techniques, the role of malocclusion types, and signs and symptoms of temporomandibular disorders (TMDs). Associations between different orthodontic treatment techniques and TMD were found in some studies, whereas most of the reviewed articles failed to identify significant associations. Based on the presently available research, because it has not been demonstrated that malocclusions cause TMDs, it is incorrect to claim that orthodontic approaches can treat or prevent TMDs. Moreover, there is no evidence that any orthodontic treatment causes TMD signs or symptoms. Longitudinal studies are still needed. (*Turkish J Orthod* 2015;28:71–76)

KEY WORDS: orthodontic treatment, temporomandibular disorders

INTRODUCTION

Temporomandibular disorders (TMDs) are conditions involving the masticatory muscles, teeth, and stomatognathic system.[1] They include temporomandibular joint (TMJ) pain that increases with function, limitations or deviations of mandibular movement, and TMJ sounds associated with mandibular function. Head, neck, and ear pain are common symptoms.[1]

More than 90–95% of patients with TMD present with musculoskeletal pain, TMJ dysfunction, or unidentified problems. Thus, diagnosis should be specific to the patient and should highlight the underlying cause of the condition.[2] For a proper diagnosis, masticatory muscles, articular disks, soft tissues of the TMJ, type of pain, and mandibular functional movements should be examined, and a patient behavioral analysis should also be considered.[3] During examination of the patient, many disorders may be diagnosed concomitantly, such as rheumatoid arthritis with synovitis or behavioral disorders, chronic pain, and internal disk derangement.[3]

In the general population, the incidence of TMD symptoms is higher for persons 20–40 years old compared with children and persons older 60 years.[4–6] It has been reported that 75% of the population shows at least one TMD sign and that 33% of the population shows at least one TMD symptom.[7,8]

Although signs and symptoms are common, only 3–11% require treatment.[9–11] Magnusson *et al*.[10] reported that TMJ sounds rarely progress to severe clinical problems. Additionally, some researchers have suggested that TMJ sounds may be a normal condition, rather than a disease, and that unnecessary treatment of TMJ sounds should be avoided.[11]

There is a consensus that the cause of TMD is multifactorial.[1,12] The many factors that increase the risk of developing TMDs are referred to as predisposing factors, those that lead to the onset of TMDs are initiating factors, and those that cause progression of TMD are perpetuating factors. Although such factors as trauma are considered predisposing factors, parafunctions, malocclusions, psychologi-

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cal, and psychosocial factors are considered initiating and perpetuating factors.[13,14]

Until the mid-1980s, orthodontists tended not to be involved in the diagnosis of TMDs or therapy. After a lawsuit in which it was argued that "orthodontic treatment causes TMD" that resulted in an unfavorable judgment against an orthodontist, the American Orthodontic Society led the way in clinical research into the TMD-orthodontic treatment relationship.[15] Although the research showed that orthodontic treatments were not a primary factor in TMDs, controversy remains regarding whether orthodontic treatment can prevent future development of TMDs or causes TMDs.

ROLE OF MALOCCLUSION IN TMDs

The relationship between occlusal factors and TMDs is debated within the dental profession.[16–18] TMDs and malocclusions, such as differences in the centric relation with centric occlusion, crossbite, overjet, and overbite, have been the subject of many studies; however, the role of malocclusion has not been clarified.[19,20]

Some research has emphasized that crossbite may cause TMDs, as a result of asymmetrical muscle function.[19,21] Thilander *et al*.[19] noted a significant relationship between posterior crossbite and muscle and TMJ pain. Lui and Tsai[20] determined that 31.2% of 508 patients with posterior crossbite showed TMD; however, no significant relationship between TMD and posterior crossbite was observed.

Other than crossbite, the relationships between TMD and openbite, increased overjet, and reverse overjet have also been analyzed; in some studies, these malocclusions have been related to TMDs.[22–24] Anterior openbite has been reported to be a risk factor that could prevent the normal functioning of a regular joint.[23,25] It was also claimed that anterior openbite aggravated myofascial pain.[26] However, other studies showed that anterior openbite was not a risk factor for TMD.[9] Tanne *et al*.[23] examined the relationship between malocclusions and TMDs in 305 patients and stated that TMD was observed in almost 50% of the openbite group. In another study, the relationship between malocclusions, such as openbite, overjet, and negative overjet, and TMJ and the associated muscles was evaluated; increased overjet and negative overjet were positively related to joint sensitivity rather than muscles.[22] Pullinger *et al*.[27] investigated the effects of 11 malocclusions on TMDs; none of the malocclusions alone could cause TMD. Pullinger and Seligman[28] compared patients with and without TMD and reported no difference between the 2 groups in terms of overjet or overbite. Although openbite was common among patients with osteoarthritis, this was attributed to intracapsular changes. Thus, it was concluded that openbite could be the result of osteoarthritis[28] rather than an initiating factor for TMD.

Another malocclusion related to TMD is deepbite.[24,29,30] In the presence of minimal overjet with deepbite, at the beginning of mouth opening, translation of the condyle is inhibited and, because of its pure rotation, the superior lateral pterygoid muscle stretches, causing it to be ineffective in stabilizing the disk. Thus, movement of the disk to a lateral position may occur, causing a click sound.[29,30]

In another study, subjects with TMD and non-TMD symptoms were evaluated according to their degree of overjet and overbite; within the symptomatic group, the percentage of patients with overjet and overbite of 5 mm or more was higher than in the asymptomatic group[24] Pullinger *et al*.[31] compared occlusal variables and TMD and stated that persons with Class II Div 2 malocclusion had greater TMJ sensitivity than those with Class I malocclusion. In contrast to previous research, in a study of TMD symptoms in patients with clinically normal overbite and deepbite, there was no difference in terms of TMD symptoms.[32].John *et al*.[33] reported that overbite and overjet did not damage the masticatory muscles and TMJ function was normal. They suggested that changes to overjet or overbite in an attempt to prevent TMD should be avoided. Thus, there is debate regarding whether increased overjet or deepbite may cause TMD; however, there is at present no evidence of an association.[33,34]

Some researchers have claimed that malocclusion is an etiologic factor for TMD, and the slide in centric and balance side contacts has been proposed to cause TMJ dysfunction. Functional occlusion in the presence of canine-guided occlusion and anterior guidance may eliminate TMD symptoms. Thus, occlusal equilibration should be performed to obtain functional occlusion.[35,36] Seligman and Pullinger[37] showed that in asymptomatic patients there was no relationship between TMD and the balancing side contact, occlusal guidance, the centric relation, or centric occlusion slide during lateral movements. Indeed, Conti *et al*.[38] also reported no association

between TMD signs and balancing side contacts during anterolateral movement.

Selaimen *et al*.[39] stated that in patients with Class II malocclusion, the lack of canine-guided occlusion during lateral movement could be a risk factor for TMD. Although studies have reported that different occlusal guidance may alter muscle activity, there is no evidence that this causes TMD symptoms.[37,40] Mohlin *et al*.[18] reviewed studies of the malocclusion-TMD relationship from 1966 to 2000 and concluded that no association could be established between malocclusion and TMD. However, longitudinal studies are needed.

Thus, at present there is no evidence that malocclusion causes TMD, so occlusal equilibration should be avoided during treatment of TMD.

ROLE OF ORTHODONTIC TREATMENT IN TMDs

The possible negative effects of orthodontic treatments on TMDs has been investigated extensively.[41–46] Although some researchers claim that orthodontic treatments, such as extraoral appliances, functional appliances, and tooth extraction, can cause TMDs,[47–50] others disagree.[41–46]

Extraoral Appliances

Because the use of a chin cup and face mask may cause distal forces on the mandible, those appliances have been considered to cause pressure on the TMJ.[47] Deguchi *et al*.[51] reported TMD symptoms, such as click sounds, during the retention period with a chin cup in 28 of 160 patients and indicated a weak relationship between TMD and orthodontic treatment. Gavakos and Witt[52] compared patients with Class III malocclusion treated with and without a chin cup. They pointed out that 67% of patients treated with a chin cup showed moderate dysfunction, whereas of those treated without a chin cup, 73% showed moderate dysfunction. Thus, the study failed to show any significant difference between the two groups. Dibbets and Van der Weele[42] indicated that removable appliances, including chin cups, would not cause TMDs. Based on the available research, it can be concluded that there is no association between extraoral appliances and TMD signs or symptoms.[42,51,52]

Functional Appliance Treatment

Herbst appliances can cause temporary subclinical capsulitis because of the continuous load generation at its posterior attachment.[53] Chronic loading can cause posterior attachment lengthening and disk displacement.[48,49] Pancherz and Anehus-Pancherz[54] reported minor muscle disorders in patients using Herbst appliances. However, this was temporary and occurred only during the initial stages of treatment. Keeling *et al*.[55] found that click sounds were increased at the end of Bionator treatment compared with the beginning. They suggested that use of a Bionator in patients who had TMD symptoms could be risky. Ruf and Pancherz[53] compared magnetic resonance imaging (MRI) images of patients with Herbst treatment (before, during, and 1 year later) and evaluated them clinically. The disk reverted to its primary position in persons with partial disk displacement after Herbst treatment, and the disk position was unchanged at the 1-year follow-up. Furthermore, it was stressed that no muscle disorder occurred and that the Herbst apparatus was not a risk factor for developing TMD. In a similar study, Aidar *et al*.[56] stated that the Herbst appliance did not cause articular disk damage during a short-term treatment. Ruf *et al*.[57] assessed the relationship between activator treatment and disk-condyle integrity. They concluded that activator treatment did not affect the physiological disk-condyle relationship. Similarly, Arat *et al*.[58] and Cacho and Martin[59] also stated that the activator appliance was not a risk factor for TMJ dysfunction.

The disk is considered to be in a normal position when the posterior band is superior to the condyle, in the so-called twelve o'clock position. However variations have been reported in asymptomatic persons.[60] There is a consensus that such variation is physiological.[60–63] Franco *et al*.[64] analyzed MRI images of patients treated with Frankel appliances. They found that although disk morphology varied, there was no significant difference among the patients and that the variation observed could be accepted as physiological. Chintakanon *et al*.[62] compared MRI images of patients treated with Twin Block appliances and pointed out that the disk was positioned posteriorly. Over time, however, Twin Block treatment had no effect on disk position, positively or negatively. Thus, these reports[53,54,62,64] suggest that no relationship exists between functional appliances and TMD. Although TMJ click sounds have been considered a first symptom of TMD, clinically this is suspect. Unless some other sign or symptom accompanies the click sound, the condition is not progressive and cannot be considered to be a TMD.[10,65,66]

Treatment With and Without Tooth Extraction

Another orthodontic treatment believed to cause TMD is planned tooth extraction. Witzig and Spahl[50] determined that extraction of premolars reduced the vertical dimension; moreover, the retraction caused TMJ problems and the retracted anterior teeth showed premature contact. They also stated that the condyle shifted posteriorly, which aggravated the risk of joint dysfunction. Furthermore, it has been suggested that extracting the second molar instead of a premolar is a better treatment choice.[50] Janson and Hasund[67] examined 60 patients with 2 plans, with and without premolar extraction, and found no increased risk of TMD after treatment. McLaughlin and Bennett[68] evaluated treatment plans with and without extraction and stressed that the rate of TMD in patients who underwent tooth extraction was not higher than in the others.

Dibbet and Van der Weele[43] evaluated patients treated with alternative orthodontic approaches, such as extraoral appliances, functional appliances, and treatment with or without tooth extraction in a 20-year follow-up study. Although they found an increase in TMD signs and symptoms with age, they found no association between orthodontic treatments and TMDs.

Koh and Robinson[17] indicated in their review that the studies in which the argument that occlusal equilibration prevented TMD was made were either designed with no control group or were compared with placebo. Moreover, they emphasized that in 9 studies that were accepted as well designed, occlusal equilibration neither prevented nor treated TMDs. MacFarlane *et al*.[69] carried out a 20-year cohort study and concluded that orthodontic treatments neither caused nor prevented TMDs. Mohlin *et al*.[70] observed patients after orthodontic treatment, beginning at age 11 and continuing to age 30, and pointed out that orthodontic treatment neither caused nor had any protective effect against TMDs. Another study using the Cochrane database concluded that data were insufficient sufficient to conclude that orthodontic treatment prevented the development of TMD.[71]

Consequently, based on the presently available research, because it has not been demonstrated that malocclusions cause TMDs, it is incorrect to claim that orthodontic approaches can treat or prevent TMDs. Moreover, there is no evidence that any orthodontic treatment causes TMD signs or symptoms.

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