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Influence of occlusal features and orthodontic treatment on temporomandibular disorders: a systematic review

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Abstract

Temporomandibular disorder (TMD) is a common diseases of the craniofacial region characterized by functional disturbances of the masticatory system. The etiology of TMJ is multifactorial, involving a large number of direct and indirect etiological factors, with occlusion playing only a minor part (only 10-20%), without a cause-and-effect relationship. TMD was associated with posterior crossbite, anterior open bite, Angle class III malocclusion, and extreme maxillary overjet. The aim of this systematic literature review was to analyze the relationship between TMD and malocclusion and orthodontic treatment. The systematic review of literature has been performed on the principal medical databases: PubMed (Medline), Embase and Scopus. To identify all articles reporting on the topic untill October 2016. No restrictions of time and languages have been fixed. The possible relationship between orthodontics and TMD command great interest in literature, but the mechanism through the orthodontic treatment can influence the etiology of TMD is still unknown.

Introduction

Temporomandibular disorder (TMD) is one of the most common diseases of the craniofacial region and is characterized by functional disturbances of the masticatory system, which leads to pain and dysfunction in the temporomandibular joint, masticatory muscles, and associated structures [1].

TMD patients frequently experience the following: painful symptoms such as headaches, facial pain, pain in the jaw joints or on jaw movement, ear pain, and neck pain; dysfunctional signs such as limited jaw movement, jaw deviations, clicking, jaw locks, and dislocation; dental destruction, traumatic occlusion, and wear of the dentition; and parafunctional habits such as clenching and grinding [2].

The etiology of TMD has received a great deal of attention in recent years. The etiology of TMJ disorders is poorly understood, but it is generally accepted that it is multifactorial, involving a large number of direct and indirect etiological factors, with occlusion playing only a minor part. McNamara et al[3] estimated the contribution of occlusal factors to the characterization of TMD as approximately 10% to 20%, based on a review of relevant literature. This, however, does not imply a cause-and-effect relationship. Other potential etiological factors include trauma, systemic diseases, habits, posture, psychosocial factors, stress, and bruxism.

Little is known about the precise etiology and mechanisms of action of the condition, and, since disagreement is still evident about the diagnosis and classification of the various subtypes of TMD, this inevitably impacts on research in this field.

Thilander et al. [4] investigated the prevalence of temporomandibular dysfunction and its association with malocclusion in children and adolescents; their results suggested that TMD was associated with posterior crossbite, anterior open bite, Angle class III malocclusion, and extreme maxillary overjet. Marklund et al.[5,6] also implied that crossbite and asymmetry of occlusal contacts increased the incidence and duration of TMD. Some articles reported that oral parafunctions, such as bruxism, might play a role in the development of TMD. Moreover, psychologic status has been suggested to be involved in the presence of TMD [7,8].

There are still controversies concerning canine protection, lack of non–working side interferences on lateral mandibular movements, and the importance of establishing an ideal occlusion via orthodontic treatment.

The importance of occlusion and its role in perpetuating or causing TMD, compared with other factors, has been studied and is still debated nowadays [9,10].

Subjects with malocclusions have been suggested to have a significantly higher prevalence of signs and symptoms of TMD than subjects without malocclusions [11].

Endogenous and exogenous factors may disrupt the dynamic equilibrium (adaptive capacity) of the masticatory system, leading to the development and/or maintenance of TMD signs and symptoms [12].

Temporomandibular disorder, meaning the aberrant articular motion of the TMJ, can be induced by occlusion or malocclusion, untreated malocclusions, unstable occlusion, facial deformity, bruxism, estrogen level, anatomy, stress, nutrition, trauma, gender, parafunction, sleep disorders, posture, stress and other psychological factors [13,14]. The aim of this systematic literature review was to answer the following question: Are signs and symptoms of TMD related to malocclusion or orthodontic treatment?

Materials and Methods

Several orthodontic works have been published on international literature about the incidence of TDM and its relationships with malocclusion and orthodontic treatment. So the systematic review of literature has been performed on the principal medical databases: PubMed (Medline), Embase and Scopus. The keywords used were: *malocclusion, occlusal features, temporomandibular disorder* and *orthodontic treatment;* to identify all articles reporting on the topic untill October 2016. No restrictions of time and languages have been fixed. The results have been filtered and valued following our eligibility criteria and then organized following the PRISMA method. The search identified 9,642 abstracts, which were reviewed manually and each article of interest was marked for further review. The full text of the marked studies was retrieved and studies that satisfied our eligibility criteria were included in this review. At the end only 48 full articles have been selected.

Review

The possible relationship between orthodontics and TMD command great interest in literature. The mechanism through the orthodontic treatment can influence the etiology of TMD is still unknown. The evaluation and analysis of numerous articles about the negative effects of orthodontics on stomatognathic system became difficult because of the heterogeneity of the variables and the methodology used to record results.The diagnostic criteria that define the disease so far have not been standardized. The multifactorial nature of TMD (occlusion, trauma, emotional stress, intense pain and parafunctional activities [15,16]) and their great diversity of events makes it difficult to prove that orthodontics solve or improve a TMD. The suggestion that orthodontic treatment leads to TMD, causing the displacement of the distal condyle appears to be unfounded. 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 whe different types of orthodontic treatment are compared; indie, longitudinal studies tend to show a reduction in the DTM signs in patients treated orthodontically. Some occlusal factors, such as class II malocclusion and the absence of canine guidance lateral excursions, can be considered indicators of risk for TMD, even controlling for sociodemographic confounding variables (occupation, age, cigarette and alcohol consumption) .Longitudinal studies [17,18] have shown an increased prevalence of signs and symptoms of TMD with age, with a higher prevalence of signs of symptoms, so it is important to include a complete physical examination, as part of the diagnostic process, in regardless of the type of orthodontic treatment to be performed. Machen et al. [19,20] in their studies of 1990 and 1991 already stressed the need to record any impairment diagnosed on clinical examination of the temporomandibular joint (TMJ) for medical-legal reasons. They also recommended the control of the ATM situation every six months during orthodontic treatment and the sign of a patient informed consent. Since Costen [21] occlusal factors first associated with TMD symptoms in 1930, different types of treatment have been proposed, including orthodontics and occlusal adjustments to correct malocclusions and improve signs and symptoms of TMD. Achieving a perfect occlusion through orthodontic treatment and / or occlusal adjustments may decrease signs and symptoms of TMD. In the case of sagittal malocclusions, Henrikson and Nilner [22], reported lower prevalence of signs and symptoms of TMD in patients with Class I malocclusion than those with Class II, although this influence has been difficult to quantify and predict. They also find a number significantly less functional occlusal interferences in the Class II group treated with orthodontics compared to the untreated group with malocclusion and the group with normal occlusion, which may explain the decreased muscle signs observed in this group of patients. These findings underscore the importance of correct and stable occlusion to the proper functioning of the stomatognathic system. A stable occlusion is important to keep the physiologic relationship between joint structures. However, it is not possible to define predictable, clinically relevant models for TMDs that are based on the analysis of dental occlusion alonE [23,23]. It is likely that the few malocclusion features that were seen to be associated with TMDs, even if weakly, represent a small portion of the complex picture of factors that should be entered in a multifactorial model for disease. Egemark et al. [19] analysed the influence of

multiple variables on TMDs in three samples of children of 7, 11 and 15 years, reporting morphological criteria such as class II, class III, anterior open bites and posterior crossbites as potential factors of predisposition to TMDs associated with functional malocclusions. Moreover, in a previous research, they described an improvement in muscular signs after orthodontics in class II malocclusions [26], which could be explained by the improved occlusal stability observed by reduction of interferences and increase in occlusal contacts in treated patients. This improved muscular discomfort may already be noted during orthodontic treatment, probably owing to the diminished activity of the chewing muscles during treatment brought on by the increased dental sensitivity associated with orthodontic movement. Likewise, Vanderas and Papagiannoulis [27], in their multiple logistic regression study, analysed a sample of 314 children aged 6-8 assessing clinical signs of TMDs and also morphological or functional malocclusions. Prognathism was basically associated with TMJ noises, whereas posterior crossbites had a significant impact on joint pain. They concluded that parafunctional habits and certain structural and physiological factors may increase the probability of developing signs and symptoms of a TMD in children. Other studies, however, could not demonstrate a correlation between prognathism and TMD [28,29]. Among different malocclusions, posterior crossbite are considered to have a strong impact on the functioning of the stomatognatic system. Several studies have associated unilateral posterior crossbite in children with an increased probability of developing signs and symptoms of TMD [30,31]. The mandibular deviation that is frequently associated with this posterior crossbites, interferes with the development and growth of the stomatognathic system [32].Twenty-seven articles evaluate the association between posterior crossbite and TMJ disc displacement. The existing relationship between posterior crossbite and TMJ disc displacement is still an unsolved question because several studies obtained different results [33]. According to the most part of studies available at today, the altered morphological relationship between the upper and lower dentition seems to result in alterations of the disc–condyle relationship, which in turn are possibly responsible for disc displacement and TMJ clicking [3,9,17,34]. Indeed, positive associations between unilateral posterior crossbite and TMJ clicking are supported by several studies, suggesting that the crossbite increases the risk of disc displacement by a factor of up to 3 [3,4,9,17,35,36]. It must be stressed that, according to our findings, among the studies based on adolescent samples two out of eight (25%) reported a significant association, whereas, among the studies based on adult samples, four out of five (80%) reported significant association between posterior crossbite and disc displacement. The higher association between crossbite and disc displacement in adults than in adolescents could be explained by the adaptive of the stomatognathic system in adolescents. Consequently, the persisting exposition to the risk factor (i.e. posterior crossbite) could determine the development of disk displacement in the adult age. Nevertheless, considering that the 80% of studies on adults and 25% of studies on adolescents reported significant association between posterior crossbite and disc displacement, the orthodontic correction of a posterior crossbite could be suggested to reduce the adaptation demands of the stomatognathic system in growing subjects [37], whereas it is not warranted in adults to prevent TMJ derangement because skeletal adaptation has already taken place. Twenty articles evaluate the association between posterior crossbite and TMD. According to some studies [38,39] posterior crossbite is one of the most important occlusal features significantly associated to TMDs suggestingthe importance of an early orthodontic intervention to prevent the development of TMDs. Conversely, according to some other studies [30,40], no significant association was found between posterior crossbite and TMDs, suggesting caution when it is a matter of altering the existing occlusion to prevent or totreat temporomandibular dysfunction. Lippold et al. [41] studied the discrepancies in the condyle position between the centric relation and maximum intercuspation in a sample of 65 children with posterior crossbite in mixed dentition. A comparison of patients who had received orthodontic treatment and others who had not, revealed no statistically significant differences between the groups at the beginning of treatment, being the condyle deviation less than 2mm in the transverse, frontal and sagittal planes on both sides. The treated group showed a statistically significant decreased in condyle deviation. Regarding the possible consideration of orthodontic treatment as a TMD risk factor, several authors [30,42] consider that certain dental interventions, including orthodontics itself could cause TMD. However, the prospective cohort study by MacFarlane and co-workers [31] concluded, after a follow-up period of 20 years, that orthodontics is not linked with the appearance of TMDs or their persistence. Only female gender and the presence of signs and symptoms of TMD during adolescence were the unique predicting factors. Orthodontists should screen their patients for pretreatment TMD signs and symptoms—but in doing so they need to have a realistic understanding of the

difference between TMJ trivia and meaningful symptoms. They should be more careful when dealing with patients who have a significant TMD history, because they might be more vulnerable to recurrences and symptom flareups during orthodontic treatment than normal subjects. If TMD symptoms arise for the first time during your orthodontic treatment, you should be prepared to recognize and manage those symptoms while discontinuing active orthodontic therapy. The continuous monitoring of TMJ is essential to detect the onset of a TMD as early as possible. In these cases it is recommended to temporarily stop orthodontic treatment in order to avoid possible aggravating factors until signs and symptoms, especially pain, improve. Otherwise, if TMD is diagnosed in the first evaluation of the patient, the orthodontic treatment should not be initiated, according to Michelotti et al.[43] as long as the patient suffers from a facial pain. In both cases, the priority should be the differential diagnosis between musculoskeletal condition and another diseases, and the management of the TMD would include the use of occlusal splints to evaluate the interference-free position of the mandible, pharmacotherapy, behavioural therapy, and/or physical therapy. Historically, dental occlusion was assigned a central role in the etiology and management of TMDs because dental professionals had achieved a better know-how and had seen more TMD patients than other professionals. Over the years, however, a growing body of evidence has been gathered in support of a diminished role of occlusal abnormalities and misalignments in the etiology of TMDs. In particular, findings from studies adopting multifactorial models of disease suggested that dental occlusion features are poorly associated with muscle and TMJ pain [9,44,45], thus confirming that other factors (ie, bruxism activities, psychosocial factors) are fundamental for pain symptoms to occur.[46].On the other hand, there is some orthodontic and maxillofacial surgery literature suggesting the existence of a possible skeletal predisposition to TMJ disc displacement due to peculiar features of facial morphology [47,48].

Conclusions

According to the authors studied, there would appear to be no evidence for a direct or obvious cause-effect relationship between orthodontic treatment and TMD. Definitive conclusions cannot be drawn, and the possible association should be addressed by future researches, with rigorous scientific methodology.

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