

Relationship between Orthodontics and Temporomandibular Disorders

SUMMARY

Since the end of the 20th century, the problems of the temporomandibular disorders (TMDs) have aroused interest to the orthodontists. The aim of this literature review is to present the contemporary evidence concerning the association between the presence of malocclusions and the occurrence of signs and symptoms of the TMJ. In addition, additional variables, which may affect the TMJs of a patient during the orthodontic treatment are pointed out. It is evident that there is an increased number of patients who are seeking for orthodontic treatment, not only in order to enhance their facial aesthetics and the function of mastication system, but also to relieve the symptoms of the temporomandibular joint (TMJ). There are multiple etiological factors that have been associated with the TMDs and they may be manifested by pain and/or sounds of TMJ. In addition, during the clinical examination it can be detected a deviation from the normal function of the mandible.

Key words: Orthodontic Treatment, Temporomandibular Disorders, Temporomandibular Joint

**Aikaterini Tagkli, Polytimi Paschalidi,
Alexis Katsadouris, Apostolos I. Tsolakis**

School of Dentistry,
National and Kapodistrian University of Athens
Greece

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Introduction

The temporomandibular disorders (TMDs), according to the American Academy of Orofacial Pain, is a collective term for a group of musculoskeletal and neuromuscular conditions which include several clinical signs and symptoms involving the muscles of mastication, TMJ and associated structures¹. Also, the American Academy of Pediatric Dentistry (AAPD) recognizes that these disorders of the temporomandibular joint (TMJ), masticatory muscles and associated structures occasionally occur, besides in adults, in infants, children, and adolescents². These situations are often associated with the pain, sounds originating from the TMJs and a noticeable deviation from the normal movements of the mandible³. The most common clinical sign is considered to be the clicking of the TMJ⁴, which often appears with a deviation of the mandible during its movements⁵. Also, in the literature we can detect the limited movement of the mandible as a consequence of the reduced mouth opening, headaches and pervasive pain in the orofacial area during the function⁶. The most frequent symptom is

pain originating from the TMJ, masticatory muscles and the supporting soft tissues⁷. It is noteworthy that the TMDs are considered as the main cause of pain of non-dental origin in the craniofacial region^{7,8}.

Nowadays, it is evident that there is an increased number of patients who are seeking for orthodontic treatment, not only in order to enhance their facial aesthetics and the function of their mastication system, but also to relieve their symptoms and clinical signs of the temporomandibular joint (TMJ) and thus, since the end of the 20th century, the problems of the TMDs have aroused interest to the orthodontists.

Multiple etiological factors have been associated with the appearance of the TMDs and it is of great interest to detect the way the TMJ disorders cause problems to patients and if the orthodontic treatment is able to prevent the symptoms and signs of the TMDs. The development of the contemporary diagnostic tools like the magnetic tomography and numerous *in vitro* and *in vivo* research papers, in the past years, did not give the final answers to the questions if the orthodontic treatment does cause any

disorder to the TMJ and/or if the orthodontic treatment can heal the symptoms of the TMJ.

The aim of this literature review is to gather the contemporary references regarding the malocclusions, the orthodontic therapy and the occurrence of signs and symptoms of the TMJ during and after the orthodontic treatment. In addition we will point out additional variables, which are possible to affect the TMJ of a patient during the orthodontic therapy.

Epidemiology of the Temporomandibular Disorders

The prevalence of the TMDs has been reported in many studies and it has been found that patients of all ages can display signs and symptoms of TMDs⁹. There is a correlation between the age of the patient and the occurrence of TMDs meaning that the prevalence of TMDs increases with age⁹⁻¹⁶. This finding may be due to the fact that younger patients face less severe symptoms that is more difficult to detect contrary to older patients¹⁷.

As far as it concerns the genders, many researchers point out that women have a predisposition for TMDs^{11,14,16,19-23}. Recent surveys have showed a significantly higher prevalence of TMDs and greater need for treatment respecting the girls²⁴ especially during the puberty^{25,26}. Multiple factors have been associated with TMDs, such as the high stress, the occurrence of specific pain receptors and the bigger elasticity of the TMJ in women¹⁵. Nevertheless, the orthodontists have to be careful, because generally women may show a greater sensitivity during the painful palpation than the men⁶.

Statistical significant correlation between signs and symptoms of the TMJ with the psychological condition of the patients such as anxiety, depression and with their social condition was shown^{4,6,10,11}. As far as genetic predisposition is concerned, no correlation between members of families investigated has been found⁶.

Finally, many researchers support that specific malocclusions such as excessive curve of Spee, crossbite, Angle Class II division 2, premature contacts and many others are able to contribute to the TMDs^{8,9,28}. In addition, it has been found that there is correlation between the flat curve of Spee and the appearance of sounds originating from the TMJ²⁹. Also, regarding the association between the crossbite and the symptoms of TMDs, the unilateral functional crossbite is relevant to the strong appearance of clinical symptoms of TMDs³⁰. This is due to the asymmetric development and function of the masseter muscles, as well as the erroneous position of the condyle into the temporomandibular joint between the side presenting the crossbite and the opposite one, both in maximum intercuspation, and in rest position. However,

further researches are needed in order to detect the exact position of the condyles into the temporomandibular joint in the cases of crossbites, concerning the controversial results shown in the literature³¹. Moreover, in a recent research, correlation between the deviation of the mandible in maximum intercuspation and in centric relation and the appearance of symptoms of TMDs was registered³².

According to a survey, sounds originating from the TMJ and headaches are the most common described symptoms with percentages 15,5% and 13% respectively¹⁴. In a survey, the sound of clicking was seen in 2,7 % of children in the primary dentition and 10,1 % in late mixed dentition, and further increased to 16,6 % in patients with permanent dentition³³. Thus, the prevalence of TMJ sounds seems to increase from primary to permanent dentition, due to the longer duration of muscle tension among older age groups, causing intracapsular changes and consequently TMJ sounds⁶. It is not easy to differentiate the primary headache and the headache as a symptom of the TMDs because the two situations refer to the same neural pathway of the central nervous system, the trigeminal nerve, therefore further investigations to identify the source of the pain are required. There is a great variety of sensitivities rates concerning the palpation of the TMJ, from 5,3 %¹⁹ to 22,5 %¹⁴. These variations are due to the differently used technique of palpation and exercised pressure of the examiner¹⁴.

Etiology of TMD

The temporomandibular disorders have a multifactorial etiology. In the literature, we can see that the occurrence of trauma, genetic diseases, anatomical, psychological and pathophysiological factors are implicated as contributing factors of the TMDs¹⁰. The occlusion is also one of the main factors for the occurrence of TMDs^{7,10} and different types of malocclusion are associated with the clinical signs and symptoms of the TMDs^{8,27,29}, with the increased overjet, the anterior open bite, the posterior crossbite and the occurrence of Angle Class II or Class III dental relationship as the most reported types of malocclusions^{27,29}.

Nowadays, also there is a special clinical and research interest in finding any correlation between the orthodontic therapy and the dysfunctions of the TMJ.

The orthodontic treatment of TMDs

There are many clinical researches which investigated the possible relationship between orthodontic therapy and TMDs from the mid of the last century, with

the first reference to correlate the occlusion with the symptoms of the TMJ carried out by Costen in 1934. In the late 1980s, the attention of the orthodontic community was heightened on litigation involving allegations that orthodontic treatment was the proximal cause of the TMDs in orthodontic patients, with substantial monetary judgments awarded to several plaintiffs³⁰. The outcome of these court cases resulted in a burst of research activity investigating the correlation between orthodontic treatment and TMDs.

Frequently, a very common question is if extractions of permanent teeth during the orthodontic treatment influence the frequency of TMDs, as the developmental growth pattern of the craniofacial complex may lead to the need of extractions and not the extractions of teeth themselves^{7,10,27}. In addition, patients who had not been treated orthodontically during puberty, did not present any statistical differences in the signs and symptoms originating from the TMJ later in their life, when compared to patients who had not received any orthodontic treatment^{8,10}.

Different studies have been carried out in order to examine treated patients with a background of Angle Class I or Angle Class II malocclusions, compared to patients with the same problem who were not treated, but no difference was found among them so it could be concluded that the use of extra-oral devices did not influence the existence of the TMDs¹⁴. However, Manfredini in a recent systematic review supports the existence of TMDs in the skeletal pattern (Angle Class II malocclusions) with increased anterior lower height due to displacement of the articular disc³⁴. Henrikton⁴⁰ also refers that patients with untreated Angle Class II malocclusions who suffer from muscular signs of TMJ experience decrease in symptoms after the orthodontic treatment.

In the perspective of the treatment of Angle Class III malocclusions, studies have showed that the usage of extra-oral devices did not have any negative influence on the TMDs, but also did not help in the prevention of their appearance¹⁵. Moreover, the impacts of a Delaire-type facemask or a modified Jasper Jumper (JJ) used in the treatment of children with Class III malocclusions, on the TMJ were investigated in a recent clinical research, but without the evidence of correlation³⁵. In a recent literature review carried out by Zurfluh et al., assessing the effect of the use of the chin cup, does not cause nor prevent the occurrence of TMDs, although it appears to cause significant changes in craniofacial complex³⁶. Also, Hakan El et al., comparing the use of the Delaire-type facemask and the Grummons-type in the treating patients with Class III malocclusions, demonstrated an improvement between the position of the mandible in centric relation and maximum intercuspation, but these authors accentuate that the patients should be evaluated equally in both cases for the display of TMJ symptoms³⁷.

Another question that derives is how much orthodontic therapy can influence the position of the condyle in the glenoid fossa and more specifically in its posterior movement, as this position seems to be predisposing for the occurrence of TMDs¹⁰. Many surveys deny this claim using tomographic slices, in which condyle is in a central position in the glenoid fossa with minor deviations in its position¹⁰. In literature, the anterior open bite is the most common occlusion disorder in patients with TMDs and it is attributed to biomechanical imbalance of the TMJ that induce abnormality of the articular disk³⁸. On the other hand, the incorrect position of articular disc has been accused of causing changes in the skeletal morphology of the patients, but without a relevant occurrence of symptoms of the TMJ region³⁹.

It is worth mentioning that patients with Angle Class II malocclusions who have been treated orthodontically had a reduction in the frequency of tooth grinding (23 % in the beginning, 11% after the therapy), but the same results had been marked also in patients who had not been treated (23 % in the beginning, 11 % after treatment)⁴⁰. Moreover, a reduction in the frequency of headaches had been observed (22 % from 26 %) in patients who had been treated orthodontically, and an increase in prevalence (40 % from 31 %) of the untreated Angle Class II group⁴⁰. In another survey, it was shown that orthodontic treatment can inhibit the progress or even treat the TMDs, as before the beginning of the therapy the percentage of patients without signs and symptoms of TMDs was 27 %, while after the therapy increased to 46 %^{10,41}.

According to Hirsch, patients who had worn facets on the front teeth and also had bruxism, presented reduced orofacial functional disorders during orthodontic treatment (8,4 % from 12 %). This study accentuated that even if parafunctional activities do not disappear 2-3 years following orthodontic treatment, usually orthodontic therapy is beneficial for the patient's musculoskeletal system¹⁶. The mechanism, which leads to these results, through the usage of orthodontic appliances, is similar to the one used to treat the TMDs by splints⁴².

According to a recent clinical research carried out by Manfredini et al., no statistically significant correlation between patients with a history of orthodontic treatment and the presence of specific symptoms of the TMJ was found, thus the researchers conclude that the orthodontic treatment cannot cause or play a decisive role in the prevention of the TMDs⁴³. The same conclusion is detected by several other recent reviews^{23,44-48}. Nevertheless, the correct occlusion and the muscle equilibration, which are achieved with the orthodontic treatment, may prevent or reduce the risk factors of the TMDs⁴⁹⁻⁵².

The conservative treatment of TMD with occlusal devices in combination with orthodontic fixed Edgewise appliances has statistically significant results in the reduction of pain of the TMJ (60 %) and thus the authors

suggest the splint therapy during orthodontic treatment in patients with a history of restriction of TMJ movement³⁸. In a recent clinical research, Chen et al. suggest the use of fixed orthodontic appliances combined with TMJ splint for equilibration of the occlusion throughout the treatment of crossbite combined with significant deviation of the mandible from the rest position to the maximum intercuspation, when the patients present symptoms of TMJ⁵³. Moreover, after the splint therapy, the reduced movement of the mandible has been improved (100 % of patients), while only the 9,1 % of patients who continued the orthodontic therapy have reshown reduced movement of the mandible³⁸. The mechanisms of improvement of clinical symptoms during the orthodontic treatment are not clear but are attributed mostly to the therapeutic effects of the splint in the elimination of occlusal interferences caused by orthodontic tooth movement³⁸.

Takayoshi Ishida et al. suggested as an appropriate treatment for patients who exhibit signs of the TMDs (sound clicking and pain) with a skeletal Class II malocclusion division 1, the use of orthodontic temporary anchorage devices (TADs) and increased resiliency nickel-titanium wires, due to their successful use in correcting the specific malocclusion and the absence of clinical symptoms of the TMJ after the end of the treatment⁵⁴. Also, the use of orthodontic mini implants as temporary anchorage devices for the intrusion of the upper molars is suggested by Kaku et al. for the treatment of Angle Class II malocclusion, as the patients at the end of treatment and three years of follow-up period did not have any symptoms of the TMDs⁵⁵. Also, after one year of the treatment, more appropriate centric position of the condyle into the temporomandibular glenoid fossa was observed, compared to the pre-treatment rear position of the condyle.

There are many disturbances in untreated Angle Class II and Angle Class III malocclusions which may include the orthognathic surgery as treatment. The orthognathic surgery in combination with orthodontic treatment have shown amelioration and favorable effects on TMJ and the masticatory functions⁵⁶⁻⁵⁸, as a significant reduction of myofascial pain, as well as an important resolution of the signs and symptoms of the TMJ⁵⁹⁻⁶¹. However, a significant elimination of previous sounds from the TMJ, has not been observed⁶².

In the everyday clinical practice, orthodontists frequently have to deal with patients presenting, besides the various orthodontic malocclusions, with clinical signs and symptoms of the TMDs^{63,64}. A comprehensive medical and dental history and a thorough physical examination of these patients in combination with the appropriate radiographic examinations of the TMJ, constitute the most comprehensive diagnostic evaluation of the TMDs^{23,44,64,65}, especially in the case of adult patients⁶⁶.

Conclusions

Signs and symptoms of TMDs increase with age, particularly during adolescence.

The symptoms of the TMDs are less predominant in patients with normal occlusion than in patients with any malocclusion, either treated or untreated.

There is little evidence that orthodontic treatment is a predisposing factor for TMDs, although the role of unilateral posterior cross-bite correction in children may warrant further investigation.

The orthodontic treatment does not appear to be a notable resource for treating or preventing the onset of signs and symptoms of TMDs.

Orthodontic therapy is not suggested as the initial and only treatment for patients suffering from TMDs.

Orthodontic treatment does not provide the risk for development of signs and symptoms of TMDs, regardless of the used treatment technique.

Orthodontic treatment diminishes the occurrence of parafunctional activities and restricts the possibility of destroying the dental tissues through bruxism.

Orthodontic treatment combined with orthognathic surgery affects positively on patients who show TMDs pre-operatively.

Establishing a stable relationship between the occlusal position of the teeth and the joint position is significant for proper masticatory function and must be orthodontists' treatment goal.

Every comprehensive dental history and examination should include TMJ evaluation.

More clinical and laboratory researches are required to find out definite answers to the question if orthodontic treatment can cause or treat the TMDs.

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Correspondence:

Apostolos Tsolakis
Kapodistrian University of Athens
School of Dentistry, Greece
Email: atsolaki@dent.uoa.gr