

Does Orthodontic Treatment have Therapeutic Effect on Temporomandibular Joint Disorders?

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ABSTRACT: Temporomandibular joint disorders (TMDs) are common conditions affecting the temporomandibular joint, masticatory muscles, and related structures. They often cause orofacial pain, joint sounds, and limitations in mandibular movement. For many years, the relationship between malocclusion, orthodontic treatment, and TMD has been widely discussed. In the past, it was suggested that orthodontic treatment could improve TMD symptoms by correcting occlusal relationships and reducing mechanical stress on the joint. However, current scientific evidence does not support a direct or causal link between specific malocclusion types and TMD. Recent studies indicate that TMD has a multifactorial etiology, in which psychosocial factors, parafunctional habits, trauma, and individual adaptation play a more important role than occlusion alone. Systematic reviews and long-term prospective studies show that orthodontic treatment is not a primary treatment option for TMD and does not increase the risk of developing these disorders. Improvements in TMD symptoms reported during or after orthodontic treatment are often related to the natural course of the condition, psychosocial adaptation, or nonspecific treatment effects rather than to direct biomechanical changes. This review aims to evaluate the relationship between orthodontic treatment and temporomandibular joint disorders based on current evidence and to provide clinicians with a clear and evidence-based perspective for clinical practice.

KEYWORDS: Temporomandibular disorders; Orthodontic treatment; Temporomandibular joint; Malocclusion; Biopsychosocial model

INTRODUCTION

Temporomandibular joint (TMJ) disorders are multifactorial conditions encompassing functional disturbances of the stomatognathic system, including the temporomandibular joint and the masticatory muscles [1, 2]. TMJ disorders are characterized by orofacial pain, joint sounds,

limitation of mandibular movements, and functional impairments, and they may negatively affect individuals' quality of life [3]. Epidemiological studies indicate that the prevalence of TMJ symptoms in the general population ranges between 5% and 12%; however, clinically significant cases requiring treatment occur at a lower rate [4]. TMJ disorders are reported to be more common particularly among young adults and females, which may be associated with hormonal and psychosocial factors [2, 5].

The etiology of TMJ disorders is multifactorial and cannot be explained by a single causative factor [6]. Current literature acknowledges that psychological stress, anxiety, depression, parafunctional habits, trauma, and muscular hyperactivity play significant roles in the development of TMJ disorders [7, 8]. In contrast, the influence of occlusion and dental relationships on TMJ disorders has remained a controversial topic for many years [9].

Historically, malocclusion was proposed to contribute to the development of TMJ disorders, and orthodontic treatment was suggested to have beneficial effects on joint health by reducing functional trauma [10]. However, subsequent clinical and epidemiological studies have demonstrated that no specific type of malocclusion has a strong or direct association with TMJ disorders [9, 11]. These findings suggest that occlusion may play only a limited and secondary role in the etiology of TMJ disorders [12].

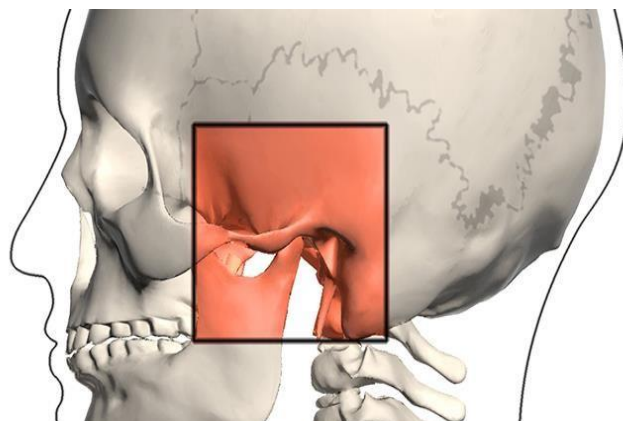
Orthodontic treatment is a therapeutic approach that alters the position of the teeth and jaws, thereby reorganizing occlusal relationships, and is therefore assumed to potentially influence temporomandibular joint function [8]. While some studies have suggested that orthodontic treatment may reduce TMJ symptoms by improving occlusal stability, it has been argued that this effect does not reflect a direct causal relationship [13]. Moreover, it has been reported that the reduction of TMJ symptoms over time in individuals undergoing orthodontic treatment may be related to the natural course of TMJ disorders rather than the effect of the treatment itself [14].

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Systematic reviews and long-term follow-up studies in the literature indicate that orthodontic treatment is not a risk factor for the development of TMJ disorders [15]. Similarly, it has been reported that extraction and non-extraction orthodontic treatment approaches do not result in significant differences with respect to TMJ disorders [16]. These findings demonstrate that orthodontic treatment should not be considered as a method that either triggers or directly treats TMJ disorders [9].

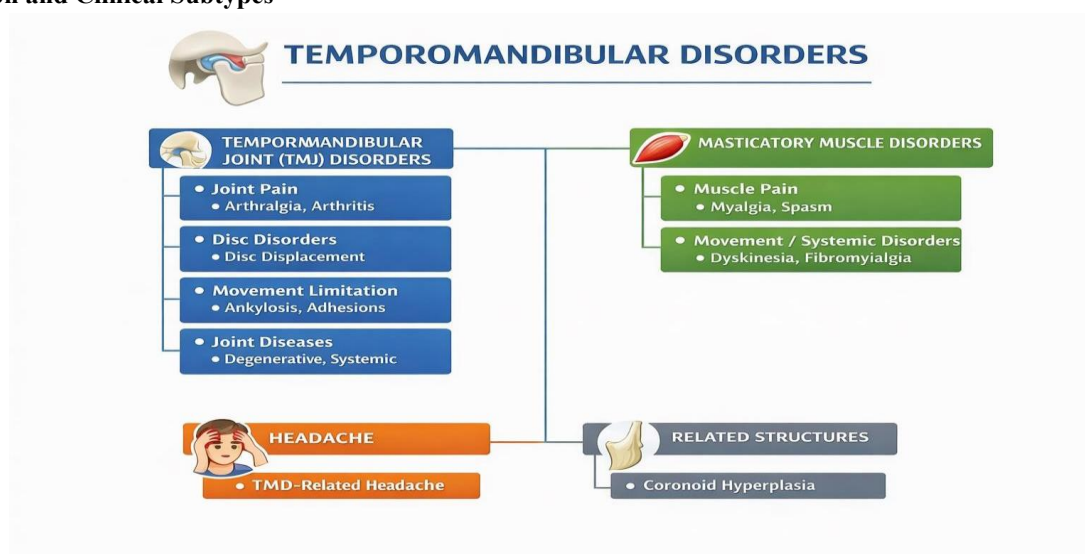
The currently accepted view emphasizes that a multidisciplinary approach should be adopted in the management of TMJ disorders and that orthodontic treatment should be planned solely based on occlusal and functional requirements [17]. In this context, it is important to critically evaluate the effects of orthodontic treatment on temporomandibular joint disorders in light of the existing scientific evidence [18].

The aim of this review is to examine the effects of orthodontic treatment on temporomandibular joint disorders in the general population in accordance with the current literature, to discuss conflicting findings, and to provide orthodontists with an evidence-based perspective for clinical practice.



2. TEMPOROMANDIBULAR JOINT DISORDERS

2.1. Definition and Clinical Subtypes



Temporomandibular joint disorders refer to musculoskeletal conditions that affect the temporomandibular joint, the masticatory muscles, and the craniofacial tissues that are functionally related to these structures, and they present with a variety of clinical manifestations [1]. Although these disorders may exhibit similar symptoms, they demonstrate a heterogeneous profile in terms of their underlying pathophysiological mechanisms [19]. According to current diagnostic and classification systems, temporomandibular joint disorders are fundamentally categorized into three main clinical subgroups: muscle-related disorders, intra-articular disorders, and degenerative joint diseases [19].

Muscle-related temporomandibular joint disorders constitute the most prevalent subgroup and are characterized by myofascial pain, muscle tenderness, and functional fatigue [20]. Intraarticular disorders primarily arise from disruption of the disc–condyle relationship and clinically manifest as joint sounds, a sensation of locking, and irregularities in mandibular movements [1]. Disc displacement is one of the most commonly described pathologies within this group and, particularly in the early stages, may not be accompanied by pain [19].

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Degenerative joint diseases represent clinical conditions in which structural changes of the temporomandibular joint are prominent and are generally observed in older age groups. Osteoarthritis and osteoarthrosis fall within this category and are associated with crepitation, joint stiffness, and progressive loss of function [21]. In this subtype, inflammatory processes and mechanical loading are thought to play significant roles in disease progression [21].

This classification underscores that a uniform approach is insufficient for the diagnosis and management of temporomandibular joint disorders and that clinical decision-making should be tailored according to the specific type of the underlying disorder [19].

2.2. Etiology



It is widely accepted that no single factor is solely responsible for the development of temporomandibular joint disorders; rather, these conditions arise from the interaction of multiple biological and psychosocial factors [19]. Recent studies indicate that, in addition to mechanical loading on the musculoskeletal system, pain mechanisms originating from the central nervous system play a significant role in the development and persistence of temporomandibular joint disorders [22].

Psychological stress and emotional factors have been reported to be closely associated with the onset and exacerbation of symptoms, particularly in muscle-related temporomandibular joint disorders [5, 11]. Furthermore, parafunctional habits—especially clenching and bruxism—may lead to excessive activity of the masticatory muscles, thereby predisposing individuals to muscle fatigue and pain [23].

Traumatic events or repetitive microtrauma may disrupt the biomechanics of intra-articular temporomandibular joint structures, contributing to the development of disc displacement and degenerative changes [24]. In light of these findings, it is emphasized that temporomandibular joint disorders should be evaluated not only in terms of local structural alterations but also in conjunction with the individual's biopsychosocial characteristics [25].

2.3. The role of occlusion in TMJ disorders

In the past, occlusion was regarded as one of the primary determining factors in the etiology of temporomandibular disorders; however, current scientific evidence has demonstrated that this relationship is far more limited than previously assumed [22]. Large-scale epidemiological, prospective, and systematic review studies have failed to establish a strong and causal association between specific occlusal characteristics and the development of temporomandibular joint disorders [2, 22]. Although certain morphological malocclusions, such as anterior open bite, deep bite, and posterior crossbite, have been reported to show weak associations with temporomandibular disorders, these relationships are emphasized to have low clinical significance and do not constitute an independent etiological role [26, 27].

Furthermore, it has been demonstrated that the discriminative power of mechanical factors, including occlusion and bruxism, in explaining temporomandibular joint pain is quite limited, with logistic regression models showing that these variables account for only a small proportion of the total variance [27]. In light of these findings, contemporary approaches acknowledge that the etiology of temporomandibular joint disorders cannot be explained by a single mechanical factor; rather, occlusion may play a secondary or modulatory role only when evaluated in conjunction with biological, neuromuscular, and psychosocial factors [11, 28].

3. THE RELATIONSHIP BETWEEN ORTHODONTIC TREATMENT AND TMJ

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3.1. The relationship between malocclusion and TMJ disorders



The relationship between malocclusion and temporomandibular joint disorders has been a subject of debate for many years, with particular emphasis placed on the hypothesis that occlusal irregularities may play a determining role in the development of temporomandibular joint disorders. However, current

literature indicates that no specific type of malocclusion demonstrates a strong and consistent association with temporomandibular joint disorders [11, 29]. Epidemiological studies report that various occlusal characteristics exhibit only weak or inconsistent relationships with temporomandibular joint symptoms [26].

Systematic reviews further demonstrate that considering malocclusion as a primary etiological factor for temporomandibular joint disorders is not scientifically supported, and that occlusal factors may act only as predisposing or contributing factors in certain individuals [30]. Consequently, the consideration of occlusion as a sole determining criterion in the evaluation of temporomandibular joint disorders is no longer regarded as valid in contemporary clinical practice [15].

3.2. Theoretical implications of orthodontic treatment



Orthodontic treatment can influence occlusal contacts and mandibular movement patterns by altering the position of the teeth and jaws [31]. Theoretically, it has been proposed that mechanical loading on the temporomandibular joint may be reduced through improved occlusal harmony and the establishment of functional balance [31]. In this context, orthodontic treatment is thought to positively affect the balance of activity among the masticatory muscles [9]. However, the high adaptive capacity of the temporomandibular joint explains why occlusal changes do not lead to clinically significant temporomandibular joint symptoms in most individuals [32]. Current evidence indicates that orthodontic treatment is not a modality that directly improves temporomandibular joint disorders; rather, it may exert indirect and limited effects on joint function when appropriate patient selection and correct indications are present [15].

4. LITERATURE FINDINGS

4.1 Studies have reported that orthodontic treatment reduces symptoms of TMJ disorders

Some studies in the literature suggest that orthodontic treatment may improve occlusal relationships, thereby reducing abnormal loading on the temporomandibular joint (TMJ) and consequently leading to an improvement in temporomandibular disorder (TMD) symptoms. Particularly in the presence of pronounced malocclusion, it has been proposed that the reestablishment of functional occlusion may induce adaptive changes within the musculoskeletal system.

Proffit et al. reported that properly planned orthodontic treatment may reduce TMD-related pain and functional limitations in certain patients by balancing masticatory muscle activity [33]. Similarly, the correction of specific malocclusion types—especially severe

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crossbites and skeletal discrepancies—has been suggested to exert favorable effects on TMJ biomechanics. However, in the majority of these studies, it has not been clearly established whether the observed improvement in symptoms is attributable directly to orthodontic treatment or to the natural course of the disorder [30].

4.2. Studies have reported that orthodontic treatment is ineffective on TMD

A substantial body of literature reports that orthodontic treatment does not have a significant effect in terms of the prevention or treatment of temporomandibular disorders (TMD). Longterm prospective and retrospective studies have demonstrated that the prevalence of TMD among individuals who have undergone orthodontic treatment is comparable to that observed in untreated individuals.

In a comprehensive review conducted by McNamara et al., it was emphasized that there is insufficient evidence to establish a causal relationship between orthodontic treatment and either the development of TMD or the reduction of its symptoms [29]. Similarly, systematic reviews and meta-analyses have revealed that orthodontic treatment does not exert a clinically meaningful or consistent effect on TMD symptoms [29].

4.3. Studies have reported that orthodontic treatment does not pose a risk for TMD

The current consensus indicates that orthodontic treatment alone is not a risk factor for the development of temporomandibular disorders (TMD). Multicenter epidemiological studies and systematic reviews have demonstrated that orthodontic treatment does not increase the incidence of TMD and that pre-existing TMD symptoms present before treatment generally remain stable or may even regress spontaneously during the course of treatment.

Okeson emphasized the multifactorial etiology of TMD, highlighting that genetic predisposition, psychosocial factors, parafunctional habits, and trauma play a more decisive role than occlusal factors [21]. In this context, orthodontic treatment is currently regarded as neither a protective nor a triggering factor with respect to TMD [34].

Based on the available literature, there is no strong or consistent evidence indicating that orthodontic treatment plays a determining role in the etiology of temporomandibular disorders. When planned with appropriate indications and with consideration of individual risk factors, orthodontic treatment is considered a safe therapeutic approach in terms of TMD.

5. DISCUSSION

5.1. Why are the results in the literature contradictory?

The conflicting results reported in studies examining the relationship between orthodontic treatment and temporomandibular disorders (TMD) are largely attributable to methodological differences. There is considerable heterogeneity among studies with respect to patient populations, diagnostic criteria, follow-up durations, and assessment methods. In particular, the reliance on non-standardized clinical criteria for the diagnosis of TMD in earlier studies has limited the comparability of their findings.

Moreover, the multifactorial nature of TMD complicates the isolation of the effects of orthodontic treatment. The simultaneous influence of multiple factors—including genetic predisposition, parafunctional habits, history of trauma, and psychosocial stress—makes it difficult to establish a causal role for orthodontic treatment alone [21, 29].

5.2 The impact of patient selection on outcomes

Patient selection is one of the key factors that directly influences the outcomes of studies evaluating the relationship between orthodontic treatment and temporomandibular disorders (TMD). Variables such as the presence of TMD symptoms prior to treatment, the severity and type of symptoms (muscle-related, intra-articular, or combined), as well as patients' age group and sex, have not been adequately controlled in many studies.

In particular, the fact that a substantial proportion of TMD symptoms observed in adolescents are transient and self-limiting may lead to the erroneous attribution of post-orthodontic improvement to the treatment itself. Similarly, in studies that include individuals without preexisting TMD, findings indicating that orthodontic treatment does not trigger TMD are likely to predominate [30, 35].

5.3. The role of psychosocial factors

Current literature demonstrates that temporomandibular disorders (TMD) are not solely biomechanical in nature but also have a strong psychosocial component. Factors such as anxiety, depression, stress levels, and a tendency toward somatization have been shown to play a decisive role in both the onset and the perceived severity of TMD symptoms [19].

The orthodontic treatment process, particularly in long-term treatments and in patients with high aesthetic expectations, may influence psychological status. This suggests that increases or decreases in TMD symptoms during orthodontic treatment may be more closely related to psychosocial adaptation processes rather than to orthodontic mechanics per se [11].

5.4. Evaluating the placebo effect

The placebo effect should also be considered an important factor when interpreting the relationship between orthodontic treatment and temporomandibular disorder (TMD) symptoms. In patients undergoing treatment, clinician–patient interaction, regular follow-up visits, and expectations regarding therapy may lead to a reduction in perceived pain. This phenomenon may result in an overestimation of true biological effects, particularly in studies relying on subjective symptom reporting [6].

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Considering that similar placebo effects have been reported in the literature for splints and other conservative approaches used in the management of TMD, it is evident that symptom improvements reported after orthodontic treatment should be interpreted with caution. The limited number of controlled and randomized studies further complicates the quantitative assessment of this effect [36]. Overall, the evaluation of the relationship between orthodontic treatment and temporomandibular disorders indicates that conflicting findings largely stem from factors such as methodological differences, patient selection, psychosocial variables, and the placebo effect. Therefore, when assessing the effects of orthodontic treatment on TMD, a biopsychosocial model should be adopted rather than a unidimensional occlusal approach.

6. CONCLUSION

A comprehensive evaluation of the existing literature indicates that there is no strong evidence supporting a direct or causal relationship between orthodontic treatment and temporomandibular disorders (TMD). There is a general consensus that orthodontic treatment, when planned with appropriate indications and with consideration of individual risk factors, is not an independent risk factor for the development of TMD; nor should it be regarded as a primary treatment modality for TMD. In this context, the effects of orthodontic treatment on TMD symptoms should be assessed within the framework of multifactorial etiology and biopsychosocial adaptation processes rather than solely through biomechanical adjustments.

6.1. Clinical recommendations

In clinical practice, it is of great importance that patients undergo a comprehensive evaluation of the temporomandibular joint and masticatory muscles prior to orthodontic treatment planning. Before treatment, the presence, type, and severity of existing TMD symptoms should be documented according to objective criteria, with particular attention given to findings such as pain, joint sounds, and functional limitations.

In patients presenting with TMD symptoms, conservative and reversible approaches—including patient education, behavioral modifications, physiotherapy, or splint therapy—are recommended as first-line options before initiating orthodontic treatment. During the orthodontic treatment process, regular monitoring of symptoms and early identification of any changes are critical for ensuring patient safety.

6.2. The role of the orthodontist

The role of the orthodontist is not limited solely to the correction of occlusal relationships but requires the adoption of a comprehensive approach that takes into account the multifactorial nature of temporomandibular disorders (TMD). Orthodontists should be aware that psychosocial factors, parafunctional habits, and individual adaptive capacity play significant roles in the etiology of TMD, and patients should be informed accordingly with realistic expectations.

Furthermore, promises that orthodontic treatment will definitively eliminate TMD symptoms should be avoided. When necessary, multidisciplinary collaboration with clinicians specializing in oral and maxillofacial surgery, physical therapy, or pain management should be established. This approach not only enhances treatment outcomes but also contributes to the prevention of potential medicolegal issues.

In conclusion, the relationship between orthodontic treatment and temporomandibular disorders is too complex to be explained by a simple cause–effect model. Orthodontic treatment, when implemented with appropriate patient selection and thorough clinical evaluation, is considered a safe intervention with respect to TMD; however, it is not routinely recommended for the prevention or treatment of TMD. Future well-designed prospective and randomized controlled studies will help to further clarify this relationship.

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