SVOA Dentistry
e-ISSN 2753-9172
ScienceVolks Open Access
Literature Review

Effects of Orthodontic Treatment with Clear Aligners on Temporomandibular Disorders: Articular and Muscular Components: A Review of the Current Scientific Evidence

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https://doi.org/10.58624/SVOADE.2026.07.037

Received: August 20, 2026

Published: September 21, 2026

Citation: Fernandez J, Rotman M. Effects of Orthodontic Treatment with Clear Aligners on Temporomandibular Disorders: Articular and Muscular Components: A Review of the Current Scientific Evidence. *SVOA Dentistry* 2026, 7:5, 296-305. doi: 10.58624/SVOADE.2026.07.037

Abstract

Given the recent widespread use of clear aligners as an orthodontic alternative to fixed appliances, scientific interest has been renewed in determining whether this treatment option differentially affects one or both components of temporomandibular disorders (TMD). TMD constitute a heterogeneous group of musculoskeletal conditions that compromise the temporomandibular joint (TMJ) in its articular component—including arthralgia, disc displacements, and osteoarthrosis—and the masticatory musculature in its muscular component—including local myalgia and myofascial pain, with or without referral. The scientific evidence available on the effects of clear aligner treatment on the articular and muscular components of TMD was analyzed through a narrative literature review. Results showed that, at the articular level, the evidence indicates discrete changes in condylar position and joint spaces, of comparable or lesser magnitude than those induced by fixed appliances. At the muscular level, electromyographic evidence describes a transient and self-limiting alteration of masticatory muscle activity upon insertion of each new aligner, with no consistent evidence that aligners induce objective tooth clenching or produce a sustained modification of the sleep bruxism index. Cohort studies with clinical follow-up show an incidence of articular and muscular TMD signs and symptoms in aligner-treated patients that is equal to or lower than the baseline prevalence expected in the general population, and systematically lower than in patients treated with fixed appliances. In summary, clear aligners do not appear to constitute, per se, a relevant causal factor for either articular or muscular TMD, although their own occlusal coverage generates a transient neuromuscular effect analogous, on a smaller scale, to that of an occlusal splint. The current evidence is of low to moderate quality, and prospective, standardized studies with long-term follow-up are required to establish definitive conclusions regarding both components.

Keywords: *clear aligners; temporomandibular disorders; bruxism; literature review.*

Introduction

Temporomandibular disorders (TMD) are the most frequent group of musculoskeletal conditions in the orofacial territory, and they affect—jointly or independently—two anatomically distinct components: the temporomandibular joint (TMJ) and the masticatory musculature. According to the Diagnostic Criteria for TMD (DC/TMD), the articular component includes entities such as arthralgia, disc displacement disorders (with or without reduction), osteoarthrosis, and subluxation, whereas the muscular component includes local myalgia, myofascial pain with or without referral, and other forms of masticatory muscle pain.

In some cases both components may be affected and coexist in the same patient. Additionally, both components share common risk factors, although their pathophysiology, clinical behavior, and response to different interventions—including orthodontics—are not necessarily equivalent.

For decades, it was held, from a classic gnathological perspective, that dental occlusion exerted a determining influence on both components of TMD, which led to considering orthodontic treatment both as a possible etiological factor and as a potential therapeutic tool. The evidence accumulated over recent decades has substantially attenuated this direct causal relationship, shifting the current consensus toward a biopsychosocial and multifactorial model, in which occlusion is only one of several contributing factors, such as articular, muscular, psychosocial, and parafunctional factors.

The widespread incorporation of clear aligners into orthodontic practice has renewed this scientific interest from a particular angle: whereas metal brackets and archwires exert continuous forces through discrete anchorage points, aligners exert forces of an intermittent and sequential nature, distributed across the entire tooth surface covered by the tray, while also fully covering the occlusal surfaces. This dual particularity of aligners—a distinct force system together with a transient occlusal coverage similar to that of an occlusal splint—raises the hypothesis that aligners could have a differentiated effect on the articular and muscular components of TMDs, which justifies addressing both in a differentiated manner, rather than as a single clinical entity, in the present review.

Objectives

General objective

To analyze the scientific evidence available on the effects of orthodontic treatment with clear aligners on temporomandibular disorders, considering separately its articular component and its muscular component.

Specific objectives

- To describe the changes in condylar position and TMJ joint spaces reported after treatment with clear aligners, as an expression of the articular component of TMD.
- To analyze the force system of aligners compared with fixed appliances and the biomechanical pathways through which this system could influence the TMJ.
- To describe the effects of aligner treatment on masticatory muscle activity, bruxism, and tooth clenching, as an expression of the muscular component of TMD.
- To identify the prevalence and clinical behavior of articular and muscular TMD signs and symptoms in patients treated with aligners.

Methodology

This work corresponds to a narrative literature review, the purpose of which is to critically synthesize the current state of scientific knowledge on the relationship between clear aligner treatment and TMD, integrating systematic reviews, meta-analyses, and cohort studies published in indexed journals.

For this purpose, an electronic search was conducted in PubMed/MEDLINE, Scopus, Web of Science, Embase, LILACS, ProQuest Theses and Dissertations, and The Cochrane Library, complemented by literature available in institutional repositories and official publications of scientific societies, such as the American Association of Orthodontists (AAO) [1].

The search terms used included: “clear aligners,” “Invisalign,” “orthodontic treatment,” “temporomandibular joint,” “temporomandibular disorders,” “condylar position,” “joint space,” “masticatory muscle activity,” “electromyography,” “bruxism,” “myofascial pain,” “myalgia,” “finite element analysis,” “TMJ,” “TMD,” and their Spanish-language equivalents.

Inclusion criteria

- Systematic reviews, meta-analyses, and scoping reviews on clear aligners and TMD, addressing both the articular and muscular components.
- Clinical studies evaluating positional or morphological TMJ parameters through imaging (CBCT) before and after aligner treatment.
- Surface electromyographic studies evaluating masticatory muscle activity during aligner treatment.
- Studies evaluating articular or muscular TMD clinical signs and symptoms associated with aligner use, including cohort studies with clinical follow-up and validated diagnostic criteria (RDC/TMD, DC/TMD).
- Biomechanical studies (finite element analysis, direct force measurement) comparing aligners and fixed appliances.
- Publications in English or Spanish, preferably from the last three to five years, in peer-reviewed journals.

Exclusion criteria

- Letters to the editor, and expert opinions without primary data support, except when used strictly for illustrative purposes.
- Studies focused exclusively on muscular or articular disorders unrelated to orthodontics, or on populations with no record of aligner treatment.

Development

Aligners are removable thermoplastic devices, manufactured through 3D printing and thermoforming, used in a sequential manner to move teeth toward predetermined positions through light, controlled forces. Unlike fixed appliances, in which forces are generated continuously through brackets and archwires, aligners exert forces of an intermittent and sequential type, distributed over the entire tooth surface covered by the tray. These intraoral devices require periodic replacement and a recommended use of at least 22 hours per day. This distinct biomechanical pattern, together with the complete occlusal coverage that the device itself generates while worn, constitutes the basis for understanding its differentiated behavior with respect to the articular and muscular components of TMD.

For the purposes of this review, it is essential to distinguish two TMD subgroups. On one hand, there is the articular component, which groups the conditions that directly affect TMJ structures: arthralgia (joint pain elicited by palpation or mandibular movement), disc displacement disorders with or without reduction (manifesting as clicking or locking), and degenerative joint disease. On the other hand, there is the muscular component, which groups the conditions affecting the masticatory musculature: local myalgia (pain elicited by muscle palpation, without spreading), and myofascial pain, with or without referral. Both components share a multifactorial etiology and frequently coexist in the same patient, but their pathophysiology and their response to orthodontic interventions are not necessarily identical, which is why they are addressed separately in the following sections.

The relationship between occlusal characteristics and TMD, in both components, has been the subject of extensive scientific debate. Literature reviews have concluded that there is no clear and consistent association between specific occlusal traits and the presence of TMD [2], which has shifted professional consensus toward a multifactorial etiological model. Furthermore, professional perception surveys have shown that most orthodontists do not consider orthodontic treatment capable of preventing or curing TMD [3,4], although a relevant proportion of clinicians still believe that such treatment could, under certain circumstances, contribute to triggering articular or muscular symptoms.

Articular Component: Changes in Condylar Position and Joint Spaces

Several three-dimensional imaging studies (CBCT) have evaluated changes in condylar position within the glenoid fossa and in joint spaces before and after aligner treatment [5-10]. The most specific systematic review on this topic, registered in PROSPERO, started from 1490 identified references, of which only 5 studies met the eligibility criteria [5].

In these studies, aligner treatment was associated with dimensional alterations in condylar volume and surface area, an increase in the superior joint space and fossa depth, accompanied by a decrease in condylar bone density, but without significant changes in condylar inclination or position within the fossa.

A retrospective cohort study on molar distalization involving a total of 70 individuals, 35 patients per group, who underwent CBCT before and after treatment [8], showed that the centered condylar position within the glenoid fossa changed from 45.7% to 51.4% in the aligner group, and from 40% to 31.4% in the fixed appliance group. In addition, the change in condylar position in the mediolateral plane was significantly greater (more inward) in the bracket group than in the aligner group, positioning fixed appliances as the system with the greatest measurable positional displacement for this specific parameter.

In the comparative study of skeletal Class I malocclusion, in which 120 patients were evaluated with and without extraction indications [9], significant increases in anteroposterior condylar position and mediolateral condylar inclination were observed in the non-extraction fixed appliance group. In the extraction group, by contrast, both devices showed changes in joint spaces (increase in the anterior space and decrease in the posterior space), suggesting that part of the effect comes from the mechanics of closing the spaces themselves, and not exclusively from the type of appliance used.

Taken together, these quantitative findings are consistent with one another: the condylar changes of greater magnitude, such as those observed in anteroposterior position and mediolateral inclination, appear systematically associated with fixed appliances, whereas aligners are associated with dimensional alterations—volume, bone density, and joint spaces—of lesser positional significance. This distinction between “dimensional changes,” more closely linked to aligners, and “positional/inclinational changes,” more closely linked to brackets, is revisited and mechanistically explained below, where the biomechanical pathways that could account for this difference are analyzed.

From the Force System to the TMJ: Biomechanical Pathways of Articular Influence

Aligners exert forces of an intermittent and sequential type, distributed over the entire tooth surface covered by the tray, in contrast to fixed appliances, which exert continuous forces through brackets and archwires. This difference translates into at least two distinct mechanical pathways of potential influence on the TMJ [15-17]:

“Direct Condylar Loading” Pathway

A force of lower magnitude, distributed, and of an intermittent nature translates into a lower overload transmitted toward the condyle-disc-fossa complex. In contrast, the metal archwire, by maintaining a continuous force across the entire dentoalveolar system—including the posterior anchorage units—induces more pronounced positional condylar micro-adjustments than the light, intermittent load of the aligner, which is consistent with the CBCT findings noted in the previous section, “Articular Component: Changes in Condylar Position and Joint Spaces.”

“Splint Effect” Pathway

The aligner has a thickness of approximately 0.5–0.75 mm [17] that covers the occlusal surfaces of both arches while worn, transiently generating a slight increase in vertical dimension, a relative disclusion of posterior tooth contacts, and a change in the proprioceptive feedback from the periodontal ligament. This makes the aligner mechanically analogous—although with much lower rigidity and structural coverage—to a full-coverage occlusal splint, without this effect constituting a planned therapeutic intervention. Finite element analysis (FEA) studies from 2024–2026 quantify this difference [11-17].

A comparative anteroposterior retraction model, in which both devices were evaluated, found that fixed appliances generate a reciprocal distal displacement of the molars and premolars, resulting from the friction of the continuous archwire—a pattern absent in the aligner model, where stress remained comparable among the teeth covered by the tray, and the molars tended to mesialize [11,12].

Direct measurement studies, in which 90 aligners of two different materials—PET (polyethylene terephthalate) and PETg (glycol-modified polyethylene terephthalate)—were fabricated, showed that aligner force decays significantly between day 3 and day 14 of use due to material relaxation, whereas the force of the metal archwire remains more stable [16].

It is important to note that no available study has directly measured, in vivo, the actual force transmitted to the condyle, so this mechanical pathway remains indirect, although consistent across studies.

Muscular Component: Electromyographic and Clinical Evidence

Research from recent years provides direct evidence on the behavior of the masticatory musculature during aligner treatment, mainly through surface electromyography (sEMG).

A PRISMA systematic review of six studies [18] on the effect of aligners on the masticatory musculature across different functional states found a significant alteration of muscle activity and discomfort in the initial days following the placement of each new aligner, of a transient nature and without significant changes at later follow-up. In the same vein, an sEMG study in 16 adults [19] documented a significant reduction in masseter activity at mandibular rest one month into treatment, with no differences in muscle pain on palpation at any evaluated time point. In addition, a larger and more recent study [20] found that aligners tend to distribute occlusal forces more evenly among the different masticatory muscles, which could reduce localized overload, suggesting that clinicians should anticipate an adaptation period during which the musculature responds to the altered occlusion.

Now, a study evaluating the use of passive aligners in adults with different levels of pre-existing oral parafunction prior to orthodontic treatment [21] found that the muscular response to aligners varies according to the patient's baseline level of parafunctional habits, suggesting that the neuromuscular effect of aligners is not uniform across the population but rather depends, in part, on the individual patient's prior characteristics—a finding consistent with what was subsequently reported by cohort studies using cluster analysis, discussed further below.

Effect on Sleep and Awake Bruxism

A systematic review published in 2026, involving 818 patients [22], evaluated the relationship between aligners and bruxism, both during sleep and while awake. Among its primary studies, it identified findings of reduced sleep bruxism episodes at one month of aligner use, with a return to baseline values by the third month—unlike occlusal splints, which do produce a sustained reduction in the sleep bruxism index. The review concludes that the overall evidence suggests a neutral effect on bruxism, without sufficient robustness for definitive conclusions, and highlights the need for standardized diagnostic protocols.

An experimental study with 21 participants [23] compared passive aligners worn during an induced stress task versus not wearing them. This study found no significant differences in masticatory muscle activity measured by electromyography, nor in perceived clenching, although it did find a significant association with somatization scores. This finding challenges the widespread clinical belief that aligners directly induce clenching.

Another study [24] notes that, during bruxism episodes, the aligner material itself may cushion the teeth against excessive occlusal load, although the authors caution that the material is not as durable as a rigid acrylic splint and may be damaged by clenching or grinding, and therefore should not be indicated as a substitute for a therapeutic splint in patients with active muscular TMD.

In summary, the electromyographic evidence converges on a consistent pattern, reflecting that aligners modify masticatory muscle activity in a transient and self-limiting manner during the first days of each new aligner, analogous to the adaptation observed with occlusal splints, with no solid evidence that they generate objective tooth clenching, sustained myalgia, or a prolonged therapeutic effect on bruxism.

Prevalence and Clinical Behavior of TMD Signs and Symptoms (Articular and Muscular)

Beyond structural and electromyographic findings, the outcome of greatest clinical relevance is the behavior of TMD signs and symptoms—articular or muscular pain, joint sounds, and limited mouth opening—in patients undergoing active treatment with aligners.

A prospective cohort study [25] included 200 adolescents, divided into fixed appliances (n=150) and aligners (n=50), evaluating TMD using the RDC/TMD criteria at 0, 6, and 12 months. At baseline, 10% of the cohort presented mild TMD symptoms. At 12 months, the fixed appliance group showed an increase in TMD symptoms to 25%, compared with only 15% in the aligner group. Only the duration of fixed appliance treatment was statistically significantly associated with TMD development (OR = 2.5; 95% CI 1.2–5.1; p = 0.02); aligner treatment showed no significant association (OR = 1.1; 95% CI 0.5–2.3; p = 0.67).

A more recent cohort study [26] evaluated TMD and bruxism signs and symptoms in aligner users through a virtual questionnaire in which 87 individuals participated, along with a three-month clinical follow-up of a subgroup of 40 participants (20 aligner users and 20 controls). Cluster analysis identified three patient profiles, differentiated by age, pain level, and parafunctional habits, but no association was found between aligner use and the occurrence of TMD or self-reported bruxism.

A longitudinal pilot study [27] followed 42 patients undergoing active aligner treatment, evaluating masticatory function and TMD symptoms with DC/TMD at three time points: before treatment, at completion, and three months later with nighttime-only use. During the active phase, the authors documented a significant and transient reduction in occlusal contact area, which partially recovered at follow-up. This finding is interpreted as a possible “bite-block effect.” In aligners, this effect is neither sought nor planned, but rather an incidental consequence of the material; nevertheless, it produces the same underlying mechanical phenomenon: reduced direct tooth-to-tooth contact and a tendency, with sustained use, toward intrusion of or resistance to eruption of the posterior teeth. Despite detecting this measurable mechanical change, the authors found no articular or muscular TMD clinical sign or symptom at any point in the DC/TMD evaluation, suggesting that, in this small sample, the bite-block effect was measurable at the occlusal level but without detectable functional translation.

The most recent global meta-analysis on TMD prevalence, which included 27 studies and 20,971 subjects [28], estimated that 29.5% of the general population presents some form of TMD, with myalgia in 37.2% of diagnosed cases, joint sounds in 29.8%, arthralgia in 16.8%, and limited opening in 8.1%. The 10% to 15% incidence observed in the aligner-treated groups in the reviewed cohort studies is, in fact, below this baseline prevalence expected in the general population. This finding reinforces the evidence presented above, indicating that aligners do not appear to increase the risk of TMD relative to the general population, whether or not orthodontic treatment is undertaken.

The narrative review by Bucci et al [24] concludes that there are no absolute contraindications to treating patients with TMD or bruxism using aligners, but that aligners neither stop bruxism nor cure TMD in either of its two components. The authors recommend managing active TMD pain before initiating orthodontic treatment, as well as educating the patient about possible transient occlusal and muscular changes, and adopting a comprehensive biopsychosocial approach to treatment.

A case report by Sharab et al [29] describes a 56-year-old woman, with a history of tooth clenching but no prior history of TMD, who developed acute pain in the masseter and preauricular region a few weeks after starting full-time daytime aligner treatment. Initial conservative management focused on exercises, a soft diet, and anti-inflammatory medication; however, this did not resolve the condition. Instead, temporarily discontinuing aligner use, switching to exclusively nighttime wear, and behavioral education allowed treatment to be completed. The authors themselves attribute the condition to the occlusal coverage of the aligner, rather than to the force of tooth movement, in a patient with poor neuromuscular adaptation to occlusal changes—direct clinical evidence of the “splint effect” mechanism described above, with symptomatic translation into both muscular (masseter myalgia) and potentially articular (preauricular pain) manifestations.

On the other hand, unlike the muscular component, evidence on the reactivation of acute joint inflammation (synovitis, effusion) and on TMJ osteoarthrosis in relation to the type of orthodontic appliance is practically nonexistent. The reference systematic review on aligners and the TMJ did not evaluate clinical outcomes of this type, and only one study [30] compared condylar bone density between aligners and conventional brackets, finding a reduction in density in the aligner group and an increase in the bracket group—a finding of very low certainty, with no established clinical translation.

A scoping review on degenerative TMJ changes in orthodontics [31] identifies Class II malocclusion with mandibular retrognathism and a hypodivergent pattern as risk factors for degenerative changes; however, this study does not compare types of appliances. Therefore, its results cannot be considered conclusive for the present investigation.

A cross-cutting finding regarding the available information on both the articular and muscular components is the low overall level of evidence. The main limitations include: a small number of eligible primary studies; a predominance of retrospective or observational designs, with a scarcity of randomized clinical trials; heterogeneity in the imaging, electromyographic, and diagnostic protocols employed; moderate sample sizes; variable follow-up periods; and the absence of adequate control groups in several studies.

Discussion

This review confirms that the effects of aligner treatment on TMD must be analyzed in a differentiated manner according to the affected component. In the articular component, the evidence converges on discrete structural changes of lesser magnitude than with fixed appliances, explainable by two complementary biomechanical pathways: a direct condylar loading of lower intensity, and a transient splint effect derived from the device's own occlusal coverage.

In the muscular component, electromyographic evidence describes a pattern of transient and self-limiting neuromuscular adaptation upon insertion of each new aligner, with no consistent support for the belief that aligners induce tooth clenching, sustained myalgia, or de novo bruxism.

Both components converge, however, on the same underlying mechanism: the occlusal coverage of the aligner—the same feature that explains the splint effect on the TMJ—is also the most plausible explanation for the observed transient neuromuscular modulation. This suggests that, rather than two independent phenomena, the articular and muscular components of TMD may share a common mechanical pathway in response to aligners, distinct from the predominant pathway in fixed appliances, which is of a more reciprocal and sustained nature through the continuous archwire.

The clinical case reported by Sharab et al [29] illustrates that, in patients with poor neuromuscular adaptation or pre-existing parafunction, this shared mechanism can have relevant symptomatic translation in both components simultaneously, as presented in the case report with masseter pain and preauricular pain, reinforcing the need for individualized prior evaluation rather than a blanket contraindication. The incidence data from the cohort studies, with TMD figures in aligner users equal to or lower than the baseline population prevalence, together constitute an argument against a relevant causal effect of aligners on the development of TMD, both articular and muscular, although the limited methodological quality of the available evidence suggests that these results should be interpreted with caution.

Furthermore, a notable evidence gap persists regarding the relationship between aligners and inflammatory or degenerative articular phenomena (acute synovitis, osteoarthrosis), which contrasts with the growing body of evidence on the positional-condylar and neuromuscular components, suggesting that future research should further explore this topic.

Conclusions

- The articular component of TMD is affected by aligners through discrete changes in condylar position and joint spaces, of lesser magnitude than those induced by fixed appliances, explainable by a lower direct condylar loading and by a transient splint effect inherent to the device's occlusal coverage.
- The muscular component of TMD is affected by aligners through a transient and self-limiting modulation of masticatory muscle activity during the first days of use of each new aligner, with no consistent evidence of objective tooth clenching, sustained myalgia, or a prolonged therapeutic effect on bruxism.
- There is no conclusive evidence supporting a direct causal relationship between aligner use and the development of articular or muscular TMD; the available cohort studies show an incidence equal to or lower than the baseline prevalence expected in the general population, and systematically lower than with fixed appliances.
- Likewise, there is no solid evidence to support recommending aligner treatment as a primary or curative therapy for already established TMD, in either of its two components.
- A relevant evidence gap persists regarding acute inflammatory and degenerative phenomena (osteoarthrosis) of the TMJ in relation to the type of orthodontic appliance used.
- The overall quality of the evidence is low to moderate for both components, due to the predominance of retrospective or observational studies, methodological heterogeneity, and the scarcity of randomized clinical trials.

Clinical Recommendations

- Perform a thorough clinical evaluation of the TMJ and masticatory musculature, including a directed history and functional examination, before initiating any treatment with clear aligners.
- In patients with active TMD (articular or muscular) or relevant parafunction, consider prior stabilization before initiating active tooth movement, regardless of the treatment system chosen [32].
- Inform patients, as part of informed consent, that the current evidence does not allow guaranteeing that aligner treatment will predictably prevent, cure, or cause TMD in either of its two components.

- Anticipate and explain to the patient the possibility of a transient muscular adaptation period upon insertion of each new aligner, especially in patients with parafunction or prior poor neuromuscular adaptation.
- Longitudinally monitor articular and muscular function during active treatment, and consider protocol adjustments (nighttime-only use, pauses, behavioral management) if symptoms arise, as illustrated by the clinical case reviewed.
- Promote the development of prospective, standardized clinical research, particularly on inflammatory and degenerative articular phenomena, which constitute the main evidence gap identified.

Declarations

Conflict of Interest: The authors declare no conflict of interest. Neither author has any financial or non-financial relationship with any manufacturer or distributor of clear aligner systems, orthodontic appliances, or related products, and no commercial entity had any role in the conception, preparation, or review of this manuscript.

Funding: No external funding was received for the preparation of this review.

Acknowledgment: The authors received no assistance from third parties in the preparation of this manuscript. No administrative, technical, statistical, language-editing, or writing support was provided by any person or organization other than the named authors, and no individual meeting less than full authorship criteria contributed to the work.

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