

RELATIONSHIP BETWEEN ORTHODONTICS AND TEMPOROMANDIBULAR DISORDERS

Dr. Prateeksha Bora

Department of Orthodontics & Dentofacial Orthopedics, School of Dental Sciences, Sharda University,
Knowledge Park III, Greater Noida, Uttar Pradesh

Dr. Poonam Agrawal

Professor, Department of Orthodontics & Dentofacial Orthopedics, School of Dental Sciences, Sharda
University, Knowledge Park III, Greater Noida, Uttar Pradesh

Dr. Dinesh Kumar Bagga

Professor and HOD, Department of Orthodontics & Dentofacial Orthopedics, School of Dental Sciences,
Sharda University, Knowledge Park III, Greater Noida, Uttar Pradesh

Abstract - According to the American Academy of Orofacial Pain, the term TMD refers to a set of clinical problems that involve the masticatory musculature, the TMJ and associated structures, or both, being identified as the leading cause of non-dental pain in the orofacial region and is considered a subclass of musculoskeletal disorders. This condition can be known by a variety of terms including craniomandibular disorders (CMD) and is a frequent cause of facial pain problems. The interest of the orthodontic speciality and of other disciplines of dentistry and medicine concerning the association, or lack of association between orthodontic treatment and TMD has increased dramatically during the past decade. Despite the compelling current evidence, some professionals in orthodontics are reluctant to change and continue to still hold onto past unscientific beliefs that lead to the use of outdated treatment approaches. It is critical that orthodontists continually pay attention to the new research developments so that they can ultimately provide their patients with the best and most appropriate possible care.

Keywords: TMD, orthodontics, multifactorial.

INTRODUCTION

The temporomandibular joint (TMJ) is the joint between the lower jaw and the base of the skull. TMJ disorders (TMD) refer to a group of disorders with symptoms that include pain, clicking, grating in the jaw joint and/or problems with chewing or opening the jaw. According to the American Academy of Orofacial Pain, the term TMD refers to a set of clinical problems that involve the masticatory musculature, the TMJ and associated structures, or both, being identified as the leading cause of non-dental pain in the orofacial region and is considered a subclass of musculoskeletal disorders. This condition can be known by a variety of terms including craniomandibular disorders (CMD) and is a frequent cause of facial pain problems.¹

Temporo-mandibular problems are frequently occurring disorders with 45 to 70% of the general population showing some signs of it, 30% being aware of its presence, but only 3 to 12% seeking treatment for it. These disorders are quite common in the general population. In fact, after dental pains, TMDs are the next most common pain complaint reported by patients in the dental office. TMD is recognised as a non-specific term representing a wide variety of painful and/or dysfunctional jaw conditions. These conditions include symptoms and disorders of the muscles of mastication, the TMJ, the nervous system and behaviour. Most cases of TMD are recognized as instances of mild, self-limiting disorders that resolve without active treatment. The most common TMD by far, comprising 90-95% of all cases is a condition with multiple musculoskeletal facial pain complaints and a variety of jaw dysfunction and without an identified structural cause.²

The signs and symptoms that indicate any abnormality of the TMJ are alteration of the mandibular movement, limitation of mouth opening, constraint function, joint noises, asymptomatic changes of the

joint and jaw locking with open mouth and closed mouth. The most common symptom associated with TMD is pain, usually located in the masticatory muscles, pre-auricular area and/or TMJ. The pain is often aggravated by chewing or other functional activities. Limitation of mouth and opening and movement, and the presence of joint noises are other common complaints in patients with TMD.³

The interest of the orthodontic speciality and of other disciplines of dentistry and medicine concerning the association, or lack of association between orthodontic treatment and TMD has increased dramatically during the past decade. Although long recognized by orthodontists as a clinical problem, the diagnosis and treatment of TMD was not emphasized within the speciality until the mid-1980's. Prior to the late 1980's, a very limited number of well-designed clinical studies focusing on this subject were available. The attention of the orthodontic community regarding TMD was heightened in the late 1980's after litigation involving orthodontic treatment as the cause of TMD in orthodontic patients.

Two main questions about TMD in relation to malocclusion and orthodontic treatment seem to be of interest. The first concerns correlation between TMD and different kinds of functional and morphological malocclusions. The other seeks to determine whether the severity and prevalence of TMD are influenced or even caused by orthodontic treatment. Therefore, a correct diagnosis of TMD therefore requires a subset of specific diagnosis for appropriate understanding of the individual patient condition.⁴

ETIOLOGICAL FACTORS FOR TMD

Over the years there has been significant controversy regarding the aetiology of TMDs. Early on dentists were very convinced that temporomandibular disorders were primarily caused by occlusal factors. Many dentists directed their therapies toward changing the patient's occlusion; and if that failed, the operator was thought to be incompetent or the patient was considered to have major psychological problems. By the mid-1980s and 1990s, however, the profession demanded more research evidence, which provided a much broader look at TMDs. Over the last 20–30 years we have learned that there are at least five known TMD etiologic factors that need to be considered. Occlusal factors remain as one of these factors, thereby maintaining TMDs as conditions that need a dental evaluation, but the manner by which the occlusion can affect the onset of a TMD must be revisited. Epidemiologic studies do not reveal a strong association between the static relationship of the teeth, such as Angle Class II or III, and the presence of a TMD.

As mentioned earlier, occlusal factors have been thought to be associated with TMDs for many years. Even today this relationship is continuously debated, with proponents remaining on both sides of the discussion. Recent data do not support the traditional belief that the static relationship of the teeth is strongly associated with TMD (e.g., deep bites, class II, cross bites, eccentric contacts). There appears to be two ways the occlusal relationship of the teeth may be associated with TMD symptoms. The first is related to an acute change in the occlusal condition, and the second is related to loading of the masticatory structures in the absence of TM joint stability.

Epidemiological studies generally document a greater frequency and severity of TMD in females than in males. In effect, TMD is seen to be up to four times more frequent in women, and these tend to seek treatment for their TMJ problems three times more often than males. Attempts have been made to explain these differences in terms of behavioural, psychosocial, hormonal and constitutional differences, though no conclusive results have been drawn to date. It has been suggested that the presence of estrogen receptors in the TMJ of women modulates metabolic functions in relation to laxity of the ligaments, and this could be relevant in TMD.

The presence of more than one symptom may be interdependent and act as a confounding factor. Further studies to identify genes associated with TMDs will enable us to specifically diagnose TMDs and improve the quality of treatment. Future research with larger sample sizes will enable us to better understand genetic association with TMDs. Recent advances have introduced new techniques like GWAS that can help us discover genes associated with TMDs

Kavuncu et al.⁶ evaluated the risk of TMD in patients with systemic and TMJ hypermobility. Local hypermobility was diagnosed in the presence of condylar subluxation, while systemic hypermobility was

assessed by means of the Beighton test. The authors found that both local and general hypermobility are more frequently detected in patients with TMD than in the controls, and that the risk of TMJ dysfunction is greater if the patient presents both alterations simultaneously. The investigators concluded that both situations may play a role in the aetiology of TMD. Certainly, trauma is a known aetiology of certain TMDs. A single blow to the face can immediately change the structures of the joint, resulting in an intracapsular issue. Trauma seems to be more related to intracapsular disorders than muscle disorders. It is common to hear a patient report that “ever since I received the blow to my face, my TMJ has been clicking.” Once joint pain begins, muscles protectively respond and then it may be difficult to separate the painful conditions.

Dorland’s Medical dictionary defines parafunction as disorderly or perverted function. Although the relationship between parafunction and muscle pain is biologically plausible, and there is some evidence to suggest a chronological relationship between the two, the fact is that controversy exists regarding this purported causal relationship. Chewing gum has been used in a number of studies to evaluate the appearance of muscle pain with over function. Karibe et al.⁷ after inducing the chewing of gum for 6 minutes, found pain to increase in both males and females in the patient group, though unexpectedly it also increased among the women in the control group – thus supporting the hypothesis of increased female susceptibility. Regarding the aetiology of bruxism, the intervention of occlusal interferences was initially postulated, though at present emotional stress is considered to be the principal triggering factor.

The possibility that orthodontic treatment could cause TMJ pathology has been extensively dealt with in the scientific literature. Despite the diverse methodological approaches involved, the great majority of studies conclude that orthodontic treatment neither improves nor worsens TMD. Kim⁸ reviewed 31 publications on orthodontics and TMD. He drew attention to the heterogeneity of the methodologies involved in these studies, and pointed out that only one of the reviewed articles found tooth extraction during orthodontic treatment to change the prevalence of TMD. The author concluded that orthodontic treatment does not increase the prevalence of TMD. Mohlin et al.⁹ is of the same opinion. In a study conducted in Gothenburg (Sweden) involving 337 patients followed-up on between 11 and 30 years of age, they found that orthodontic treatment neither prevents nor improves dysfunction of the TMJ.

DIAGNOSIS OF TMD

The gold standard¹⁰ of diagnosis in TMD consists of

- (1) patient history,
- (2) physical evaluation, and, in most chronic cases,
- (3) behavioural or psychologic assessment.

This evaluation should include a detailed pain and jaw function history as well as objective measurements of such jaw functions as interincisal opening, opening pattern, and range of eccentric jaw motions. TMJ sounds should be described and related to symptoms. Techniques for muscle evaluation should also include control (sham or placebo) site evaluation. Psychosocial and behavioural factors are important, as are physical alterations; the former relate specifically to our current understanding of pain. Because dentists’ recognition of psychologic factors is inaccurate, use of a valid screening instrument or referral to an appropriate professional may help in formulating a complete diagnosis.

A “dual diagnostic” approach, detailing physical findings in muscle, joint, and disk as well as behavioural and psychosocial findings, is the present science-based standard of care in the diagnosis of TMD. The panoramic radiograph is the standard screening radiograph for bony jaw structure in TMD, and more advanced techniques may be indicated on the basis of the panoramic film or the clinical factors. The use of tomography or computed tomography and magnetic resonance imaging are current standards for hard and soft tissue TMJ imaging, respectively. The following baseline records should normally be made for patients suspected of having a TMJ disorder: medical and dental histories, clinical examination, radiographic examination of the teeth and TMJ, and diagnostic casts. In addition, newer techniques of soft

tissue radiation or sonics, arthrography, and mandibular motion data can prove to be of important diagnostic value. A thorough history may be the most important means of diagnosing TMJ disorders, and the dentist must be willing to spend the necessary time to make a comprehensive history.¹¹

TMD signs were examined during initial orthodontic diagnosis following the methods proposed by Helkimo¹² and Krogh-Poulsen.

- 1) Temporomandibular joint sounds, including clicking and crepitation, were determined on palpation of both TMJs laterally and posteriorly during opening and closing of the mandible.
- 2) Temporomandibular pain was examined on palpation of both TMJs from the lateral and posterior sides.
- 3) Muscle tenderness was determined on palpation of the temporalis, masseter, and medial and lateral pterygoid muscles.
- 4) Maximum pain-free mouth opening was measured by use of callipers. Difficulty of jaw movement was defined as mandibular opening of 35 mm or less.

TREATMENT MODALITIES

The first step in treatment is symptomatic care which usually consists of (1) a soft diet, (2) mild anti-inflammatory agents, (3) moist heat packs and/ or ice, and (4) voluntary self-disengagement of the teeth. For some patients this may be the only treatment necessary to relieve their symptoms. The current standard of care for common chronic non-structural TMD is management with multidisciplinary cognitive behavioural therapy and muscle relaxation measures. Dentistry plays a cooperative, coordinating, and supportive role in managing these patients. Educating and advising the patient is paramount because of the recognition that most instances of TMD are not oral or tooth-related disorders. Treatment of a TMJ sound is not indicated unless pain and/or dysfunction requires treatment; treatments are primarily aimed at pain and/or dysfunction.¹³

The most common dental treatment in TMD is a **splint or interocclusal orthosis**, an intraoral device that is designed to fit over either the maxillary or the mandibular teeth and provide an artificial occlusal surface. The current standard of care recognizes that a dental splint should not permanently alter tooth or jaw position. The dental literature has documented harmful splint effects. Patients generally perceive a splint to be at least partially effective in symptomatic improvement; however, a scientific basis for the efficacy of dental splints is lacking. It is reasonable to consider an oral splint to be an adjunct for pain management—a “healing aid” rather than a definitive treatment. In general, patients with TMD improve in time without intervention. Predictors of outcome for treatments of TMD are behavioural, psychologic, and psychosocial factors rather than physical or structural factors. Long-term outcomes in pain may be independent of clinical signs, and improvement in pain may correlate with improvement in psychologic status. Assessing a prognosis for TMD cases therefore requires a behavioural or psychologic assessment and multifactorial diagnosis according to the current standard of care for diagnosis. Predictors of poor outcome relate to depression, somatization, anxiety, and low self-esteem.¹⁴

RELATIONSHIP OF ORTHODONTICS AND TMD

Orthodontic patients presenting with painful clicking and popping sounds in the temporomandibular joint should always be managed medically at first. The objective is to eliminate the pain, and this is accomplished by allowing the retrodiscal tissues to heal and function as a new “disc”. The clicking and popping can only be eliminated surgically, and this is indicated only if medical management does not stop the pain. Persistent locking may also respond favourably to medical management and jaw exercises in some patients. For those who do not respond to such treatment in a reasonable period, arthrocentesis should be the initial therapy; arthroscopic surgery, discoplasty, or discectomy should only be done if this fails. It is evident that orthognathic surgical treatment can sometimes produce TMDs in patients who did not have such problems presurgical. Such problems can be minimized by an understanding of the various contributing factors, but are probably not completely preventable. Therefore, patients need to be informed of these potential risks as well as of the benefits of orthognathic surgery. It is also evident that

orthognathic surgery is not a predictable treatment approach for TMDs. Thus, there must always be indications for performing orthognathic surgery in these patients other than the treatment of a TMD.

Orthodontic treatment in general has not been found to cause TMD. Orthodontics is generally described as TMD “neutral,” in that it neither causes nor cures (or mitigates) TMD. Orthodontics does not prevent the development of TMD in patients who have malocclusion. Therefore, it is not evidence based for orthodontists or others in the dental profession to advise patients and parents of young children that orthodontic treatment is indicated to address a child’s malocclusion to mitigate the risk of TMD developing in the future. The utilization of any specific type of orthodontic treatment, or appliance, such as headgear, elastics, chin cup, or whether extractions are performed, has not been shown to lead to any increased risk for TMD.

The need to investigate on the relationship between orthodontics and TMD came from the occurrence of legal cases in which patients blamed orthodontists for causing TMD symptoms during or after orthodontic treatment. From the late 1980s, the orthodontic community was alerted and gave funds to investigate the relationship between orthodontic treatment and TMD. In 1995, a review of this topic by McNamara, Seligman and Okeson listed eight conclusions that refute this possible association.

- 1) Signs and symptoms of TMD occur in healthy individuals
- 2) Signs and symptoms of TMD increase with age, particularly during adolescence. Thus, TMD that originates during orthodontic treatment may not be related to the treatment.
- 3) Orthodontic treatment performed during adolescence generally does not increase or decrease the chances of developing TMD later in life.
- 4) The extraction of teeth as part of an orthodontic treatment plan does not increase the risk of developing TMD.
- 5) There is no elevated risk for TMD associated with any particular type of orthodontic mechanics.
- 6) Although a stable occlusion is a reasonable orthodontic treatment goal, not achieving a specific gnathologically ideal occlusion does not result in TMD signs and symptoms.
- 7) No method of TMJ disorder prevention has been demonstrated.
- 8) When more severe TMD signs and symptoms are present, simple treatments can alleviate them in most patients.

The hypothesis that different orthodontic techniques (e.g. functional appliances, class II or class III elastics, chin-cup, headgear, fixed or removable appliances) and treatment plans can be involved as aetiological factors for TMD has also been tested in recent decades. Dibbets and van der Weele¹⁵ compared groups of children who were treated with different orthodontic treatment procedures, functional appliances, Begg light wire, chin cups, four-first premolars extracted, all other types of extraction and no extraction. Patients were monitored for a 20-year period after the start of orthodontic treatment. Although signs and symptoms of TMD increased with age, after 20 years neither orthodontic treatment nor extraction showed a causal relationship with the signs and symptoms of TMD. Therefore, the authors concluded that neither orthodontic treatment nor extraction had a causal relationship with the signs and symptoms of TMD.

This topic of whether orthodontic treatment prevents TMD is the most difficult to investigate, given the prevalence of signs and symptoms of TMD in healthy persons and the many types of orthodontic treatment philosophies, goals, and techniques in existence today. The question of whether orthodontic treatment can prevent TMD is complicated further by many of the unsubstantiated viewpoint articles that claim preventive capabilities of non-extraction treatment, functional appliances, and some of the more non-traditional orthodontic treatment protocols (e.g., extraction of the second molar extraction and replacement of the third molar) that have been advocated vigorously. As previously discussed, most

studies that have compared treated and untreated populations have found no differences between groups in the occurrence of TMD signs and symptoms.

The term TMD encompasses a number of clinical problems of multifactorial aetiology that involve the masticatory musculature and the TMJs. The historic mechanical and dental-based model has been gradually replaced by a medical model used in the treatments of TMD and other acute and chronic musculoskeletal disorders. The contemporary biopsychosocial approach to TMD management focuses on the integration of biologic, clinical, and behavioural factors that may ultimately account for the onset, maintenance, and remission of TMD. Genetics (vulnerabilities related to pain), endocrinology, behavioural risk- conferring factors, and psychosocial traits and states appear to be the variables currently being researched and receiving the most attention. Despite the compelling current evidence, some professionals in orthodontics are reluctant to change and continue to still hold onto past unscientific beliefs that lead to the use of outdated treatment approaches. It is critical that orthodontists continually pay attention to the new research developments so that they can ultimately provide their patients with the best and most appropriate possible care.

CONCLUSION

The findings of current research on the relation of orthodontic treatment to the TMDs can be summarized as follows:

1. Signs and symptoms of TMD may occur in healthy persons.
2. Signs and symptoms of TMD increase with age, particularly during adolescence, until menopause. Therefore, TMDs that originate during orthodontic treatment may not be related to the treatment.
3. In general, orthodontic treatment performed during adolescence does not increase or decrease the odds of developing TMD later in life.
4. The extraction of teeth as part of an orthodontic treatment plan does not increase the risk of TMD.
5. There is no evidence of an elevated risk for TMD associated with any particular type of orthodontic mechanics.
6. Although a stable occlusion is a reasonable orthodontic treatment goal, not achieving a specific gnathological ideal occlusion does not result in the development TMD signs and symptoms.
7. Thus far, there is little evidence that orthodontic treatment prevents TMD, although the role of unilateral posterior crossbite correction in children may warrant further investigation.

Orthodontic treatment does not seem to predispose subjects to TMD problems nor is it indicated as an initial therapy for TMD patients.

Based on this concept, orofacial pain and TMD require a comprehensive team approach. It is important to rule out other causes of facial pain before investigating the teeth as the potential aetiological factor. According to evidence-based dentistry, dental practitioners should use current best evidence when making decisions about the treatment of each patient, integrating individual clinical expertise with the best available clinical evidence.

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