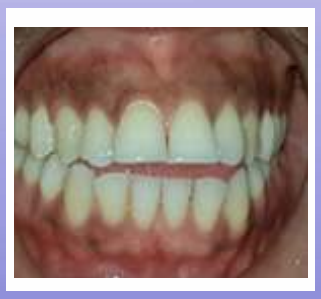
WEST AFRICAN JOURNAL OF ORTHODONTICS

ISSN 2315-9502

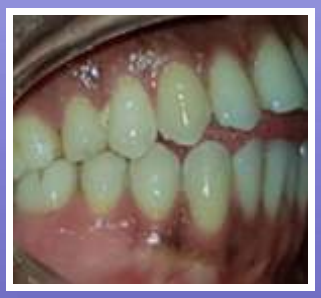
VOLUME 8, NUMBER 1

JUNE 2019

Digit Sucking and Hyoid Bone Position



Evaluation of treatment changes in Class II Div I using Advansync 2 Appliance



Orthodontic Treatment and Temporo-Mandibular Disorders

Orthodontic Treatment of Moderate Lower Anterior Crowding

Orthodontic Treatment of AOB in an Adult Patient

OFFICIAL PUBLICATION OF ORTHODONTIC ASSOCIATIONS IN THE WEST AFRICA SUB-REGION

"DENTISTRY'S FIRST SPECIALTY JOURNAL IN SUB SAHARAN AFRICA"

Orthodontic Treatment and Temporo-mandibular Disorders - A Tale of Two Paradoxes .

Otuyemi OD, Olabintan AA

Abstract

The controversy on the causal or curative relationship between orthodontic treatment and Temporo-Mandibular Disorders (TMD) has been reported for several decades. This review highlighted the associations between orthodontic treatment of malocclusion and TMDs. It also provided empirical evidence on the relationship between malocclusion, orthodontic treatment mechanics and extraction of teeth protocols on TMDs. Thus far, there is no concrete evidence that demonstrates an elevated risk of developing TMD through orthodontic treatment as well as evidence that TMD can be permanently cured by orthodontic treatment

Authors' Affiliation
Orthodontic Unit, Department of Child Dental Health, Obafemi Awolowo University, Ile-Ife. Nigeria

Correspondence:
Prof O.D Otuyemi,
Dept. of Child Dental Health,
Obafemi Awolowo University Ile-Ife, Nigeria

Introduction

The controversy on the causal or curative relationship between orthodontic treatment and Temporo-Mandibular Disorders (TMD) is still rife.[1, 2] The association between Orthodontics and TMDs have been widely reported in the literature for many years through observations and experts' opinions.[3,4] Orthodontists have also been implicated for causing TMD following orthodontic treatment and similarly complimented for curing the disease. A paradox of the time! The phrase "Orthodontics plays an important role as both a cause and treatment for TMD" is made repeatedly by some groups within the orthodontic profession, whereas others believe in the contrary. [3,4]

TMD is a collective term that involves a number of clinical conditions that affect the masticatory muscles, the temporomandibular joint (TMJ) and the associated structures.[5] It sometimes present with signs and symptoms such as pain from the temporomandibular joints and muscles, pain on joint movement, joint sounds, locking or luxation of joints as well as restricted mandibular movement.[6] The aetiology and pathophysiology of TMD is poorly understood, but it is believed to be multifactorial.[6-10] Unstable occlusion, psychosocial factors, parafunctional activity, trauma, individual predisposition and structural conditions have been considered as possible aetiologic factors.[6-10] TMDs, especially TMJ sounds, are often reported in children and adolescents with increase in prevalence between ages 15 and 25 years.[1] Prevalence of patients with at least one sign or symptom of TMD was reported to be 63% for sign and 41% for symptom by Jagger et al,[11] while Otuyemi et al[10] reported 62.8% for signs and 29.2% for symptoms of TMDs among Nigerian medical and dental students from Obafemi Awolowo University, Ile-Ife.

The purpose of this review was to highlight the associations between orthodontic treatment of

malocclusion and TMDs. This relationship remains an important but complex existential issue in orthodontics as a profession.

The attention of the orthodontic profession and the public was heightened in the late 1980s following a litigation instituted by a patient who allegedly developed TMD symptoms following orthodontic treatment. In the Michigan case of Brimm vs Malloy, Susan Brimm, a 16 year-old female patient, with Class II Division 1 malocclusion complicated by 7mm anterior open bite was treated by an experienced board certified orthodontist in Michigan, United States of America[12, 13]. Her treatment included the removal of her upper first premolars; use of a headgear, banding, and bonding of her upper and lower teeth. She exhibited no TMD at the onset of orthodontic treatment but symptoms (joint pain and headache) of TMD started after debanding/debonding and this was aggravated with wearing of a retainer. With increased discomfort she was referred to an Oral Surgeon who removed her lower third molars. Her TMD symptoms markedly increased with complaints of severe pain, clicking and locking of the joints.

A complaint was filed against the Oral Surgeon by Susan's attorney, with the allegation that the force of extractions caused trauma to the joints and that the Surgeon breached his duty to diagnose TMJ dysfunction and failed to make an appropriate referral for care. The trial took place between July 6-15, 1987 under Honorable James S. Thorburn, the case against the Oral surgeon was settled out of court for $2,500.

Another complaint was filed against the Orthodontist, that the plaintiff's teeth migrated in various directions causing an improper occlusion and deformity of the jaws/ surrounding mouth area as a result of the Orthodontist's substandard treatment. The Orthodontist was also alleged to have inflicted severe clicking in the joint, severe pain/crepitus in TMJ and limited mouth opening following treatment. Two experts for the plaintiff who were not licensed dentists in Michigan testified against the defendant orthodontist, stating that his treatment should not have involved the extraction of maxillary premolar teeth which led to distal placement of her mandible thus resulting in TMD due to excessive retraction of her maxillary incisors. Notwithstanding what the expert Michigan board certified specialist witnesses had to say on behalf of the defendant, the six jurors selected by the court to hear the case between July 6-15, 1987, found the orthodontist guilty (5-1) and awarded the plaintiff $850,000 ($1.3m with added costs).

Post-trial motions were argued in December 1987, but the trial court issued a written opinion denying all the defendant's post-trial motions. The defendant Counsel filed a claim of appeal with the appellate court. The AAO also filed an “Amicus Curiae Brief” on behalf of the defendant in the appellate court.

Some legal lessons from Susan Brimm's case include:

1. Juries don't decide cases and set precedents, decisions not landmark, but Appellate courts.
2. Precedents are established on legal principles, not on whether bicuspids should or should not be extracted.
3. The outcome of jury trials were not “recorded” in the manor as appellate court cases.
4. Should precedent be established in one geographic jurisdiction, it is not binding in another.
5. It is difficult, if not impossible, to discover on what basis a jury decides in favour of a litigant in this case.

Implications of litigation

This litigious climate resulted in an increased need for risk management as well as methodologically-sound clinical research works. Many clinicians avoided extraction protocols during orthodontic treatment at that critical period. Between 1988 and 1989, there was a flurry of clinical, experimental research works embarked on and sponsored by various research grant agencies across the US. Research works were published in subsequent editions of AJODO between 1991-1992[13,14].

The following key questions seem pivotal:

Does malocclusion lead to TMD?

Does orthodontic treatment with fixed or removable appliances lead to a greater incidence of TMD?

Does extraction of premolars as part of an orthodontic treatment plan result in a greater incidence of TMD?

Does orthodontic treatment prevent or cure TMD?

How should Orthodontic patients be managed if they present with TMDs before or during treatment?

Does malocclusion lead to TMD?

The role of occlusion in the aetiology of TMD is highly controversial.[15] Costen posited in 1934 that TMJ problems were as a result of nerve impingement from overclosure of occlusal bites, missing posterior teeth, and malocclusion.[16]

Malocclusion was reported to cause displacement of the condyle postero-superiorly, thus implying that correcting dental malocclusion would favourably affect the TMD symptoms.[17] McNamara[18] however, showed no difference in the occurrence of TMD symptoms in orthodontically treated and untreated patients.

Consistently, the only occlusal condition that may be of significant interest when exploring the role of malocclusion and onset of TMD symptoms is Unilateral Posterior Crossbite (UPC). Pullinger et al[19, 20]suggested that uncorrected UPC in childhood may NOT always result in sufficient condylar adaptation to avoid TMD symptoms.

Thilander[4] advocated that UPC should be corrected to avoid condylar displacement. Egermark et al[15] in a 20 year follow-up study, also found occlusal wear and deep bite as predictors of TMDs. However, Iodice et al[21] in a 2013 review, reported that no conclusion could be drawn of a causal relationship between posterior crossbites and TMDs.

A systematic review (1966-2005) of the association between different malocclusions and TMD by Mohlin et al[6] using Medline and Cochrane databases, reported that associations between certain malocclusions and TMD were discernible in some studies, whereas majority of the articles failed to identify significant and clinically important associations. They concluded that association between specific types of malocclusion traits and development of signs and symptoms of TMD could not be verified. Manfredini et al[22] in a 2017 systematic review also concluded that there was no clinically relevant association between occlusion and TMD. They further stated that there was no basis to consider dental occlusion as a major player in the pathophysiology of TMDs and thus encouraged practitioners to discard the old-fashioned gnathological ideology.

Does orthodontic treatment with fixed or removable appliances lead to a greater incidence of TMD?

In a review of literature (1966-1988) on Orthodontics and TMDs by Reynders,[3] 285 publications were provided by Medline, however, only 91 discussed the subject matter. The analyses were categorized into viewpoint publications, case reports and sample studies. (Tables I-III).

Viewpoint publications (VPs) and case reports (CRs) were over-represented compared with sample studies (SSs). VPs and CRs described a wide variety of conflicting opinions with little or no value in assessment of the relationship between treatment and TMDs.

Twenty viewpoint publications cited specific treatment mechanics as the cause of TMDs i.e. class II and cross-bite elastics, headgear, chin-cups and first premolar extraction.[3] Eight viewpoint publications claimed that TMDs were as a result of treatment not finished according to gnathologic standards.[3]

Sample studies indicated that orthodontic treatment was not responsible for creating TMDs regardless of orthodontic technique.[3] Also, Rinchuse et al[23] in their review of 2004 and 2017 systematic reviews on TMDs which assessed the 8 relevant systematic reviews in 2004 and the 110 relevant systematic reviews in 2017, following two PubMed searches, stated that traditional orthodontic treatment does not cause TMD. They identified an increased role of genetics and psychosocial factors in the aetiology of TMDs.

Table 1: Viewpoint publications on the relationship between Orthodontics and TMDs

Author	Journal	Year	Relationship between Orthodontics and TMDs	Origin viewpoint
Ricketts	Am J Orthod	1966	±	PVA
Mathews	Angle Orthod	1967	+	PVA
Silverman	Am J Orthod	1968	±	PVA
Wilson	Orthodontist	1971	-	PVA
Marbach	Am J Orthod	1972	-	PVA
Perry HT	Am J Orthod	1973	±	PVA
Perry HT	Am J Orthod	1975	-	PVA
Freer	Aust Orthod J	1975	0	PVA
Spyropoulos et al	Am J Orthod	1976	-	CRO
Williamson	Angle Orthod	1976	±	PVA/CRA
Lewis	Am J Orthod	1976	±	CRO
Timm and Ash	J Clin Orthod	1977	±	PVA
Bench et al	J Clin Orthod	1978	±	PVA
Aubrey	Am J Orthod	1978	±	PVA/PVO/CRA/CRO
Levy	Int J Orthod	1979	±	PVA
Roth	J Clin Orthod	1981	±	PVA
Roth et al	J Clin Orthod	1981	±	PVA
Roth	J Clin Orthod	1981	±	PVA
Roth et al	J Clin Orthod	1981	±	PVA
Williamson	J Clin Orthod	1981	±	PVA
Williamson	J Clin Orthod	1981	±	PVA
Libin	Int J Orthod	1981	-	PVA
Greene	Angle Orthod	1982	0	CSSO
Haden	J Craniomandibular Prac	1982	+	PVA
Williamson	J Clin Orthod	1982	+	PVA
Bellavia	J Craniomandibular Prac	1983	+	PVA

Author	Journal	Year	Relationship between Orthodontics and TMDs	Origin viewpoint
Bell	J Clin Orthod	1984	0	PVA
Bean	Funct Orthod	1984	±	PVA
Mehta	Funct Orthod	1984	+	PVA
Witzig	Funct Orthod	1984	±	PVA
Stack	Funct Orthod	1985	+	PVA
Kussick	Funct Orthod	1985	±	PVA
Bowbeer	Funct Orthod	1985	±	PVA/CRA
Bean	Funct Orthod	1985	±	PVA
Grummons	Funct Orthod	1985	+	PVA
Bowbeer	Funct Orthod	1986	±	PVA
Perry SS	Funct Orthod	1986	±	PVA/CRA
Broadbent	Funct Orthod	1986	-	PVA
Broadbent	Funct Orthod	1986	+	PVA
Broadbent	Funct Orthod	1986	+	PVA
Broadbent	Funct Orthod	1986	±	PVA
Gerber	Funct Orthod	1986	+	PVA
Bowbeer	Funct Orthod	1986	±	PVA
Thompson	Angle Orthod	1986	±	PVA
Gelb	Funct Orthod	1987	-	PVA
Gelb	Funct Orthod	1987	-	PVA
Wyatt	Am J Orthod Dentofac Orthop	1987	±	PVA
Rinchuse	Am J Orthod Dentofac Orthop	1987	0	CSSO
Bowbeer	Funct Orthod	1987	±	PVA/PVO/CRA
Bowbeer	Funct Orthod	1987	±	PVA
McLaughlin	Angle Orthod	1988	-	PVO
Alpern et al	Angle Orthod	1988	±	PVA
Spahl	Funct Orthod	1988	±	PVA
Bowbeer	Funct Orthod	1988	±	PVA/CRA
Livingston	Funct Orthod	1988	±	PVO

--, Orthodontics causes TMDs; +, orthodontics cures TMDs; 0, orthodontics does not influence TMDs; ±, orthodontics can both cause and cure TMDs. PVA, Personal viewpoint, author(s); PVO, personal viewpoint, other author(s); CRA, case report, author(s); CRO, case report, other author(s); CSSA, controlled sample study, author(s); CSSO, controlled sample study, other author(s); USSA, uncontrolled sample study, author(s); USSO uncontrolled sample study, other author(s). (Reynders RM. American Journal of Orthodontics and Dentofacial Orthopedics 1990;97(6):463-471.)

Table 2: Viewpoint publications on the relationship between Orthodontics and TMDs

Author	Journal	Year	Relationship between Orthodontics and TMDs	No of cases
Roth	Angle OrthodAm	1973	±	7
Ingervall	J Orthod	1978	+	6
Parker	Am J Orthod	1978	±	5
Owen	J Craniomandibular Pract	1984	+	4
Callender	J Clin Orthod	1984	+	2
Bronson	Funct Orthod	1984	+	1
Owen	J Craniomandibular Pract	1984	±	6
Bandeen	Am J Orthod	1985	±	1
Bronson	Funct Orthod	1985	±	1
Williamson	Facial Orthop Temporomandibular Arthrol	1985	+	1
Williamson	Facial Orthop Temporomandibular Arthrol	1986	+	1
Thompson	Angle Orthod	1986	±	3
Williamson	Facial Orthop Temporomandibular Arthrol	1987	+	1
Bledsoe	Funct Orthod	1987	+	6
David	Funct Orthod	1988	+	1
Lynn	Funct Orthod	1988	+	1
Mintz	Funct Orthod	1988	+	1
Owen	Am. J. Orthod Dentofac Orthop	1988	±	3

- orthodontics causes TMDs +, orthodontics cures TMDs 0, orthodontics does not influence TMDs ±, orthodontics can both cause and cure TMDs (Reynders RM. American Journal of Orthodontics and Dentofacial Orthopedics 1990;97(6):463-471.)

Table 3: Sample studies on the relationship between Orthodontics and TMDs

Author	Journal	Year	Relationship between Orthodontics and TMDs	Number of cases	Appliance	Control	Design
Larsson and Ronnerman	Eur J Orthod	1981	+	23 Experimental	Fixed Functional	No	Retrospective
Janson and Hasund	Eur J Orthod	1981	+	60 Experimental 30 control	Fixed Functional	Yes	Retrospective
Sadowsky and Begole	Am J Orthod	1980	0	**75 Experimental** 75 control	Fixed	Yes	Cross sectional
Sadowsky and Begole	Am J Orthod	1984	0	207 Experimental 214 control	Fixed	Yes	Cross sectional
Pancherz	Am J Orthod	1985	0	20 Experimental	Herbst	Yes	Before-After
Dibbetts and van der Weele	Am J Orthod Dentofac Orthop	1987	0	63 Functional 72 Fixed	Fixed Functional	Yes	Longitudinal

- orthodontics causes TMDs + orthodontics cures TMDs, 0 orthodontics does not influence TMDs,
± orthodontics can both cause and cure TMDs (Reynders RM. American Journal of Orthodontics and Dentofacial Orthopedics 1990;97(6):463-471.)

Does extraction of premolars as part of an orthodontic treatment plan result in a higher incidence of TMD?

Prentiss,[24] in 1918 suggested that TMJ problems were a result of teeth extraction, since it would result in upward movement of the condyle because of the musculature, leading to atrophy of the meniscus.

Members of the National Survey of 814 AAO between November 1989 and January 1990 showed that their extraction rate had dropped significantly. Reasons for this reduction included "medico-legal reason" from 9.8% respondents,[25] while 14.8% respondents believed that a causative association between premolar extraction and TMD may exist.

This attitude is influenced by viewpoints and texts that showed that the removal of premolars increases the risk of TMD. Witzig[26] reported in 1991 that extraction of the 1st premolars caused loss of vertical dimension, leading to "a pathological positioning of the condyle".

However, in 1994, Stagger[27] showed no TMD symptoms in premolar extraction cases despite an increase in lower anterior-facial height, following a pre- and post-treatment cephalogram evaluation of class I malocclusion (45 non-extraction; 38 extraction) cases.

Other studies evaluated the prevalence of signs/symptoms of TMDs of former orthodontic patients, with and without premolar extraction and found no differences in the positive scores on a list of 62 signs and symptoms commonly associated with TMD. Sadowsky[28] concluded that extraction as part of orthodontic treatment strategy does not constitute an increased risk for the development of TMDs. Also, Conti et al[29] in a cross-sectional study which evaluated the prevalence of TMDs before and after orthodontic treatment among 200 participants, reported no association between prevalence or severity of TMDs and the extraction protocol.

Does orthodontic treatment prevent or cure TMD?

Viewpoint articles and uncontrolled case reports claimed that non-extraction treatment, second molar extraction, facemask, functional or other removable appliances can prevent and cure TMD[3,30-32] Similarly, non-traditional orthodontic treatment protocols, for instance, second or third molar extraction have been reported to prevent/cure TMD.[3]

Janson & Hasund [33] evaluated 3 groups of Class II division 1 malocclusions retrospectively of 30 cases each; treatment with extraction, treatment without extraction, and untreated cases. They concluded that early orthodontic therapy without extraction can be regarded as prophylactic treatment with regards to functional disorders in class II division 1 malocclusion.

Thilander[4] recommended the treatment of posterior cross-bite at a young age to prevent not only asymmetrical facial growth, but also unilateral condylar displacement. Muscular hyperactivity on the crossbite side may influence unfavourable craniofacial cum TMJ growth. On the basis of her longitudinal studies, interceptive orthodontics is recommended in children to selectively equilibrate deflecting supracontacts in the deciduous teeth.

However, the majority of the studies[1,3,34-36] carried out with appropriate study design and relevant outcome measures were unable to show that orthodontic therapy has a preventive or curative effect on the occurrence of TMD.

How should Orthodontic patients be managed if they present with TMDs before or during treatment?

Proper TMJ clinical examinations should be done prior to orthodontic treatment (Figure 1) and any findings documented. Informed consent should also be obtained from the patient. If there are signs and symptoms of TMD prior to treatment (Figure 2), proper diagnosis of the condition has to be made and then treated, conservative and reversible treatment approaches are favoured and could require an interdisciplinary approach.[37] Orthodontic treatment can then be commenced after symptoms must have abated. e orthodontic treatment may be resumed.[1,13]

Figure 1: Temporo-Mandibular Joint examination

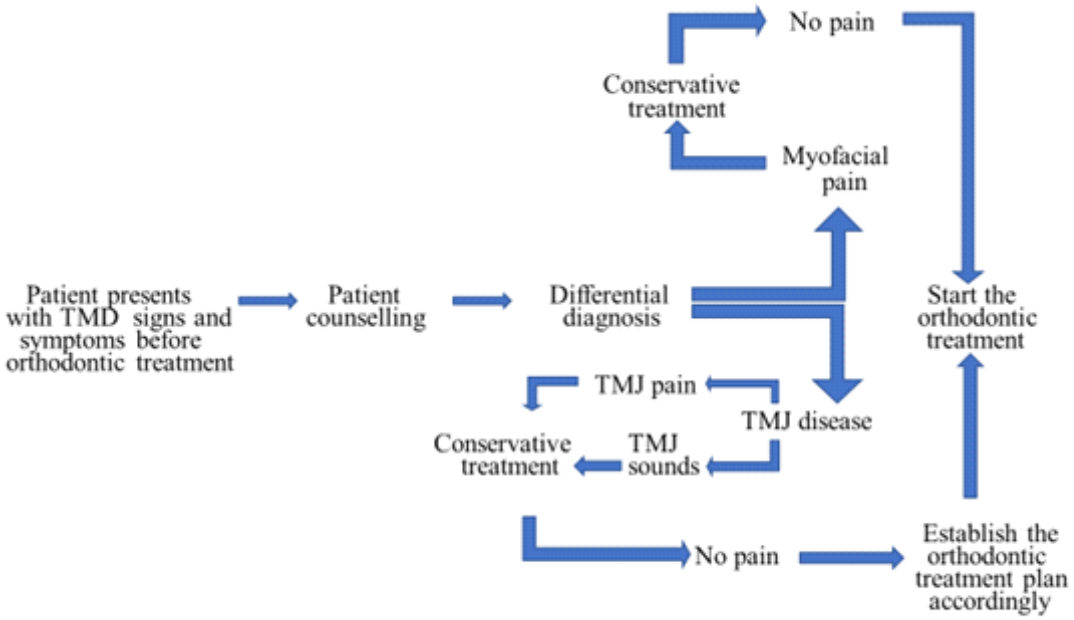


Figure 2: Management protocol for patients with TMD signs and symptoms before orthodontic treatment.

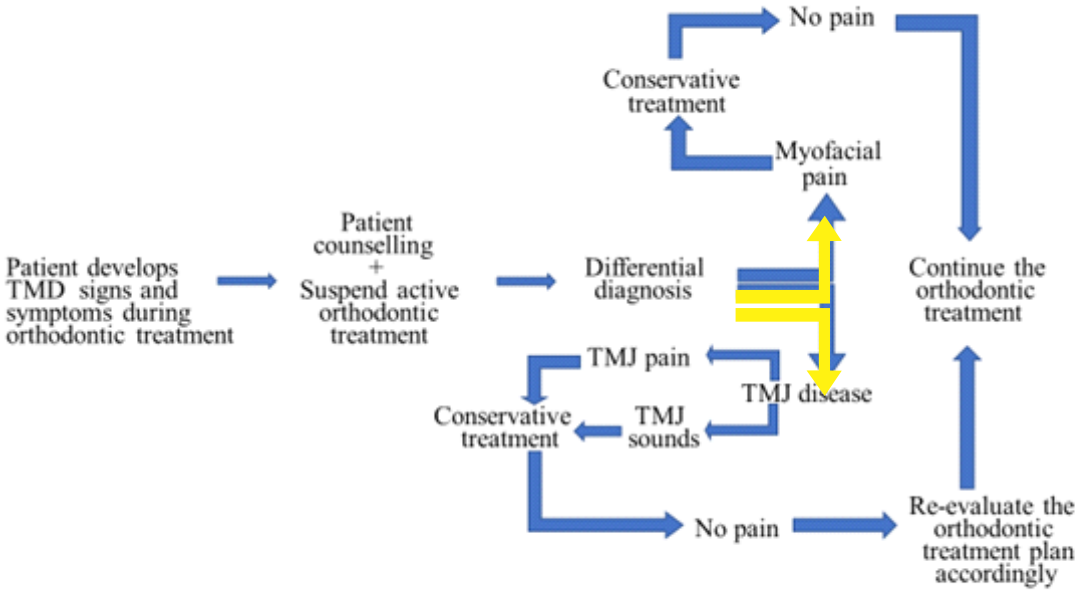


Figure 3: Management protocol for patients who develop TMD signs and symptoms during orthodontic treatment

Conclusions

TMDs signs/symptoms sometimes occur in healthy individuals.

Prevalence of TMD increases with age and could be of sudden onset.

Associations between malocclusion traits and development of TMD could not be verified.

Orthodontic treatment performed during adolescence is equivocal in developing TMD signs/symptoms later in life.

No significant evidence of an elevated risk for TMD

associated with any particular type of orthodontic mechanics.

The extraction of teeth as part of an orthodontic plan does not increase the risk of developing TMD.

Thus far, there is little evidence that orthodontic treatment prevents TMD.

There is no substantiated evidence that TMD can be cured by orthodontic treatment.

Proper patient examination, diagnosis, and management of TMD signs and symptoms should be made prior to, or during orthodontic treatment.

There is a need for more longitudinal studies in a randomized controlled manner on this important subject.

Funding: Self

Conflict of Interest: Nil

Contribution of authors: All authors contributed substantially to the work

References

1. Michelotti A, Iodice G. The role of orthodontics in temporomandibular disorders. J Oral Rehabil 2010;37(6):411-429.
2. Sim H-Y, Kim H-S, Jung D-U, et al. Investigation of the association between orthodontic treatment and temporomandibular joint pain and dysfunction in the South Korean population. Kor J Orthod 2019;49(3):181-187.
3. Reynders RM. Orthodontics and temporomandibular disorders: a review of the literature (1966–1988). Am J Orthod Dentofacial Orthop 1990;97(6):463-471.
4. Thilander B, Bjerklin K. Posterior crossbite and temporomandibular disorders (TMDs): need for orthodontic treatment? Eur J Orthod 2012;34(6):667-673.
5. De Leeuw R, Klasser GD. Orofacial pain: guidelines for assessment, diagnosis, and management: Quintessence Publishing Company, Incorporated Hanover Park, IL; 2018.
6. Mohlin B, Axelsson S, Paulin G, et al. TMD in relation to malocclusion and orthodontic treatment: a systematic review. Angle Orthod 2007;77(3):542-548.
7. Okeson JP. Evolution of occlusion and temporomandibular disorder in orthodontics: Past, present, and future. Am J Orthod Dentofacial Orthop 2015;147(5):S216-S223.
8. Bair E, Gaynor S, Slade GD, et al. Identification of clusters of individuals relevant to temporomandibular disorders and other chronic pain conditions: the OPPERA study. Pain 2016;157(6):1266.
9. Osiewicz M, Lobbezoo F, Ciapała B, Pytko-Polończyk J, Manfredini D. Pain predictors in a population of temporomandibular disorders patients. J Clin Med 2020;9(2):452.
10. Otuyemi O, Owotade F, Ugboko V, Ndukwe K, Olusile O. Prevalence of signs and symptoms of temporomandibular disorders in young Nigerian adults. J Orthod 2014;27:61-65
11. Jagger R, Woolley S, Savio L. Signs and symptoms of temporomandibular disorders in Ecuadorian Indians. J Oral Rehabil 2004;31(4):293-297.
12. Pollack B. Cases of note: Michigan jury awards $850,000 in ortho case: a tempest in a teapot. J Michigan Dent Assoc 1988;70(11-12):540-542.
13. Kandasamy S, Rinchuse DJ, Greene CS, Johnston Jr LE. Temporomandibular disorders and orthodontics: What have we learned from 1992-2022? Am J Orthod Dentofacial Orthop 2022;161(6):769-774
14. Behrents RG, White RA. TMJ research: responsibility and risk. Am J Orthod Dentofacial Orthop 1992;101(1):1-3.
15. Carlsson GE, Egermark I, Magnusson T. Predictors of signs and symptoms of temporomandibular disorders: a 20-year follow-up study from childhood to adulthood. Acta Odontol Scand 2002;60(3):180-185.

16. Costen JB. I. A syndrome of ear and sinus symptoms dependent upon disturbed function of the temporomandibular joint. Ann Otol Rhinol Laryngol 1934;43(1):1-15.
17. Thompson Jr. The temporomandibular articula-functioning masticatory system. Temporomandibular Joint 1964:146-184.
18. McNamara Jr JA. Orthodontic treatment and temporomandibular disorders. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1997;83(1):107-117.
19. Pullinger AG, Seligman DA. Quantification and validation of predictive values of occlusal variables in temporomandibular disorders using a multifactorial analysis. J Prosthet Dent 2000;83(1):66-75.
20. Pullinger AG, Seligman DA, Solberg WK. Temporomandibular disorders. Part II: Occlusal factors associated with temporomandibular joint tenderness and dysfunction. J Prosthet Dent 1988;59(3):363-367.
21. Iodice G, Danzi G, Cimino R, Paduano S, Michelotti A. Association between posterior crossbite, masticatory muscle pain, and disc displacement: a systematic review. Eur J Orthod 2013;35(6):737-744.
22. Manfredini D, Lombardo L, Siciliani G. Temporomandibular disorders and dental occlusion. A systematic review of association studies: end of an era? J Oral Rehabil 2017;44(11):908-923.
23. Rinchuse DJ, McMinn JT. Summary of evidence-based systematic reviews of temporomandibular disorders. Am J Orthod Dentofacial Orthop 2006;130(6):715-720.
24. Prentiss HJ. A preliminary report upon the temporo-mandibular articulation in the human type. Dent Cosmos 1918;60:505-512.
25. O'Connor BM. Contemporary trends in orthodontic practice: a national survey. Am J Orthod Dentofacial Orthop 1993;103(2):163-170.
26. Witzig J, Spahl T. The clinical management of basic maxilofacial orthopedic appliances, Vol. 3. Temporomandibular Joint: PSG Publishing Company, Boston; 1991.
27. Staggers JA. Vertical changes following first premolar extractions. Am J Orthod Dentofacial Orthop 1994;105(1):19-24.
28. Sadowsky C. The risk of orthodontic treatment for producing temporomandibular mandibular disorders: a literature overview. Am J Orthod Dentofacial Orthop 1992;101(1):79-83.
29. Conti A, Freitas M, Conti P, Henriques J, Janson G. Relationship between signs and symptoms of temporomandibular disorders and orthodontic treatment: a cross-sectional study. Angle Orthod 2003;73(4):411-417.
30. Petersohn I. Use of orthodontic appliances in temporomandibular joint disorders. ZWR 1972;81(13):628-635.
31. Stack B. Orthopedic/orthodontic case finishing techniques on TMJ patients. Funct Orthod 1985;2(2):28-44.
32. Hertrich K. Treatment of myoarthropathies with functional orthodontic devices. Fortschr Kieferorthop 1987;48(6):516-526.
33. Janson M, Hasund A. Functional problems in orthodontic patients out of retention. Eur J Orthod 1981;3(3):173-179.
34. Luther F, Layton S, McDonald F. Orthodontics for treating temporomandibular joint (TMJ) disorders. Cochrane Database Systematic Rev 2010(7).
35. Leite RA, Rodrigues JF, Sakima MT, Sakima T. Relationship between temporomandibular disorders and orthodontic treatment: a literature review. Dent Press J Orthod 2013;18(1):150-157.
36. Shroff B. Malocclusion as a cause for temporomandibular disorders and orthodontics as a treatment. Oral Maxillofac Surg Clin 2018;30(3):299-302.
37. Rinchuse DJ, Greene CS. Scoping review of systematic review abstracts about temporomandibular disorders: Comparison of search years 2004 and 2017. Am J Orthod Dentofacial Orthop 2018;154(1):35-46. e9.