

Evaluation of TMD signs and symptoms in individuals undergoing orthodontic treatment

Avaliação de sinais e sintomas de DTM em indivíduos em tratamento ortodôntico

Michelle Mayumi Yokoya TANAKA¹, Renato Morales JÓIAS², Erika JOSGRILBERG³, Sigmar de Mello RODE⁴, Renata Pilli JÓIAS⁵

1 - Dentistry School - Methodist University of São Paulo - São Paulo - SP - Brazil.

2 - Department of Prosthodontics, Dentistry School, Methodist University of São Paulo - São Paulo - SP - Brazil.

3 - Department of Pediatrics - Dentistry School, Methodist University of São Paulo - São Paulo - SP - Brazil.

4 - Science and Technology Institute - UNESP - Univ Estadual Paulista - Department of Dental Materials and Prosthodontics - São José dos Campos - SP - Brazil.

5 - Department of Orthodontics - Dentistry School - Methodist University of São Paulo - São Paulo - SP - Brazil.

ABSTRACT

Objective: To verify the presence of TMD signs and symptoms in patients undergoing orthodontic treatment. **Material and methods:** 28 individuals undergoing orthodontic treatment at the university clinics were selected. To assess TMD, the Research Diagnostic Criteria for Temporomandibular Disorders (RDC-TMD) was used. Pain was assessed by Visual Analogue Scale (VAS). The amplitude, sound, and pain during jaw movements, as well as pain on palpation of intra- and extraoral muscles were assessed by craniomandibular index (CMI). The pain to pressure threshold was evaluated by algometer. Mean values and standard deviation were obtained and the analysis was expressed in percentage. **Results:** RDC-TMD demonstrated that most of the individuals did not have TMD; 3.57% presented osteoarthritis, 10.71% arthralgia, 3.57% disc displacement without reduction, 7% myofascial pain, and 14.28% myofascial pain with opening limitation. The VAS evidenced average pain of 1.37 cm (SD=1.4). CMI average was 0.26 (SD = 0.14). The pain to pressure threshold measured with algometer was 3.7 (SD = 1.7) for the anterior temporal and 3.00 (SD = 1.2) for superficial masseter. **Conclusion:** It was observed TMD signs and symptoms in 39.13% of the individuals undergoing orthodontic treatment.

KEYWORDS

Orthodontics; Temporomandibular Joint Disorders; Epidemiology.

RESUMO

Objetivo: verificar a presença de sinais e sintomas de DTM em indivíduos em tratamento ortodôntico. **Material e Métodos:** foram avaliados 28 indivíduos que estavam em tratamento ortodôntico na clínica de uma faculdade do estado de São Paulo. Para identificar a presença de DTM foi utilizado o Research Diagnostic Criteria for Temporomandibular Disorders (RDC-TMD). A dor foi avaliada pela Escala Visual Analógica (EVA). A amplitude, dor e ruído durante os movimentos mandibulares, além da dor à palpção de músculos intra e extra orais e cervicais foram aferidos pelo Índice Craniomandibular (ICM). O limiar de dor à pressão foi avaliado por meio de algômetro. Os valores médios e desvio padrão foram obtidos e a análise foi expressa em porcentagem. **Resultados:** o RDC-TMD demonstrou que a maioria dos indivíduos não apresentaram DTM, que 3,57% apresentaram osteoartrite, 10,71% artralgia, 3,57% deslocamento de disco sem redução, 7% dor miofascial e 14,28% dor miofascial com limitação de abertura; A EVA evidenciou dor média de 1,37 cm (DP=1,4). A média do ICM foi de 0,26 (DP=0,14). O limiar de dor à pressão aferido com algômetro foi de 3,7 (DP=1,7) para o m. temporal anterior e de 3,00 (DP=1,2) para o feixe superficial do m. masseter inferior. **Conclusão:** foram observados sinais e sintomas de DTM em 39,13% dos indivíduos em tratamento ortodôntico.

KEYWORDS

Ortodontia; Transtornos da Articulação Temporomandibular; Epidemiologia.

INTRODUCTION

Epidemiology studies the factors determining the frequency and distribution of diseases in human population; a specific group addresses diseases of unknown etiology or etiology not fully understood [1]. The temporomandibular disorder (TMD) has the latter etiology, and it can be defined as a group of pain or not functional conditions involving the mastication muscles and/or the temporomandibular joints (TMJ) [2], divided into muscle, articular, and mixed disorders [3].

Currently, TMDs are the most prevalent condition of orofacial chronic pain and the third most prevalent chronic pain type, only behind common pains as headache and back pain [4]. Prevalence studies report that approximately 75% of the population has at least of TMD sign such as alteration in the mandibular movement, articular sound, or pain to palpation and, approximately 33% has at least on symptom as facial or joint pain [5]. The orofacial pain generated by TMD is directly related to oral health and the individual's quality of life [6], evidencing the necessity of better understanding this disorder.

TMD etiology is multifactorial and may involve unstable occlusion, malocclusion, stress, anxiety [7], depression, psychological factors, trauma, genetic predisposition, race, social status, and psychological status [8]. Over the last years, the relationship between orthodontics and TMD is increasingly gained attention. The literature still does not reach consensus [9], but some studies verified that occlusal factors play some role in TMD development [10].

The need to investigate TMD signs and symptoms in individuals undergoing or who will undergo the orthodontic treatment is based on the increasing number of lawsuits against the responsibility of orthodontists in Brazil. In some lawsuits, the patients accused the orthodontist to cause TMD during or after the orthodontic

treatment [11]. It is believed that by performing the pre-, trans-, or post-treatment evaluation, the signs and symptoms the results are the same [12]. Thus, the epidemiological screening of patients undergoing orthodontic treatment is not contraindicated, although TMD signs and symptoms fluctuate are unpredictable and can appear during orthodontic treatment [13].

Taking into consideration that the epidemiologic screening of the current situation of a given population is important to plan and execute the dental prevention and treatment [14], this study aimed to analyze the prevalence of TMD signs and symptoms in individuals undergoing orthodontic treatment.

MATERIALS AND METHODS

This study was approved by the Institutional Review Board regarding the ethical aspects under protocol no. #38570414.8.0000.5508.

4.1 Sample

Twenty-eight individuals undergoing orthodontic treatment at the university clinics were evaluated according to the inclusion and exclusion criteria.

4.1.1 Inclusion criteria

To be included in the study, the patients should:

- be at complete permanent dentition (second molars) with or without pre-molar extraction;
- age between 13 and 44 years;
- Undergo corrective orthodontic treatment.

4.1.2 Exclusion criteria

To be included in the study, the patients should not:

- undergo treatment with occlusal splint
- use continually the following drugs: analgesic, anti-inflammatory, myorelaxants antidepressants, anxiolytics

4.2 Methods

4.2.1 Application of Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD)

The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) aims to identify the presence of TMDs, classifying TMD into muscular, articular, or mixed [15]. This procedure was performed by a single examiner, previously calibrated.

RDC/ TMD (Annex 1) is composed by two axes (axis I and axis II). Axis I evaluates the clinical and functional parameters; axis II assesses the psychological aspects. In this study, we used RDC/TMD axis I, composed by three parts: questionnaire on the aspects related to pain progression, which was answered by the patient him/herself; clinical examination, in which the TMD signs and symptoms were assessed, performed by a single and calibrated examiner; and flowchart, in which the questionnaire and clinical examination data were tabulated and enabled the classification of TMD type.

4.2.2 Visual Analogue Scale (VAS)

Visual Analogue Scale (VAS) is a subjective method already very studied by the literature that estimate the pain intensity [16] reported by the individual him/herself. After RDC, the individuals classified the magnitude of their pain on a linear visual scale, measuring 10 cm in length, with two thresholds on the endings: "with pain" and "the worst pain already felt".

4.2.3 Craniomandibular index (CMI)

The craniomandibular index (CMI) was developed to be used in clinical and

epidemiological TMD studies, enabling to measure the objective severity of the craniomandibular symptoms and TMD and myofascial dysfunction severity. This index assessed the visual signs, the mandibular movement symptoms, and the alterations during mandibular movements with articular noises, limitations in movements and muscular and articular pain [17]. CMI has simple, clear, and defined methods aiming at quantifying the evolution of TMD signs and symptoms.

At all following-up appointments, the examiner filled in a chart with information on aspects related to muscle sensitivity (Palpation Index) and the presence of limitation or noise during the mandible's functional movements (Dysfunction Index), generating CMI, ranging from zero to one.

4.2.4 Algometer

The algometer is an instrument with which a determined force is applied on the muscles to verify the pain sensitivity of the patient against the pressure [18]. The patient was seated on dental chair, the most vertical as possible. The algometer was placed perpendicular to the muscle to be examined (anterior Temporal and superficial Masseter), and an increasing and constant pressure of approximately 0.5 kg/cm² / second was exerted until the patient reported a pain sensation.

At that moment, the pressure stopped and the value corresponding to the pain threshold was recorded. While the algometer was used with one hand, the other hand held the patient's head, so that he/she did not move it, which would affect the collection of the data.

4.2.5 Data analysis

Data were presented as mean and standard deviation and the results were expressed as percentage.

RESULTS

Table 1 shows the percentage of individuals with and without TMD according to RDC-TMD.

The data of VAS, CMI, and pain to pressure threshold measured by the algometer are seen in table 2.

Table 3 displays the amplitude and presence or absence of pain during excursive mandibular movements.

Table 1 - Percentage of individuals with and without TMD according to RDC-TMD.

Diagnosis	%
Myofascial pain without limitation in opening	7.00
Myofascial pain with limitation in opening	14.28
Disc displacement without reduction	3.57
Arthralgia	10.71
Osteoarthritis	3.57
without TMD	60.87

Table 2 - Mean and standard deviation values of VAS, CMI, and pain to pressure threshold (algometer).

	Mean	SD
Algometer (kg)	rT	3,78
	lT	3,77
	rM	2,9
	lM	3,06
VAS (cm)	1,37	1,4
CMI	DI	0,25
	PI	0,23
	CMI	0,26

rD- right TEMPORAL; lE- left TEMPORAL; rD- right MASSETER; lE- left MASSETER; DI - Dysfunction Index; PI- Palpation Index

DISCUSSION

The literature lacks evidence on the cause-effect relationship between orthodontic treatment and TMD [19]. Although very controversial, recent studies show that neither malocclusion nor orthodontic mechanics predisposes to TMD [20] regardless of the extraction of the pre-molars [21]. Indeed,

Table 3 - Amplitude of mandibular opening, lateral movements, and protrusion (cm) and pain (%).

Mandibular opening	Maximum, unassisted, without pain	Mean	40.67	
		SD	7.55	
	Maximum, unassisted	Mean	46.92	
		SD	6.34	
	Maximum, assisted	Mean	48.78	
		SD	6.11	
Right lateral movement		Mean	12.82	
		SD	4.12	
	Pain	yes	21.42%	
		no	78.58%	
Excursive mandibular movements	Left lateral movement	Mean	11.75	
		SD	3.42	
	Pain	yes	25%	
		no	75%	
	Protrusion		Mean	5.53
			SD	3.57
Pain		yes	18%	
		no	82%	

longitudinal studies¹⁰ do not reveal TMD symptoms occurring during the treatment. After 20-year following-up period [22], the only factors identified were greater TMD prevalence in females and greater prevalence of TMD signs and symptoms at adolescence.

Although no scientific evidence shows that orthodontic treatment is a risk factor for TMD development, there are evidences on the positive effect of proper orthodontic treatment during childhood on TMJ function during adult life [23]. The muscular signs improved after orthodontic treatment of Class II malocclusions [10], which can be explained by the greater occlusal stability due to the reduction of interferences and increase of occlusal contacts after treatment. This improvement in muscular discomfort can be observed during the orthodontic treatment, probably due to the decrease in the activity of the masticatory muscles caused by the increasing in tooth sensitivity associated to orthodontic mechanics [10].

This study allowed to recognize the population treated at the orthodontic clinics of the institution regarding the presence of TMD signs and symptoms. Thus, preventive measures and collective actions can be adopted aiming at TMD treatment and a better quality of life of the patients. RCD-TMD [21], as already reported, was adequate for TMD diagnosis [10]. The standardization of the diagnosis criteria is of extreme importance to make easy the assessment and comparison of the research's results. After the application of RDC-TMD, the patients were classified as follows: Group I (muscular disturbs) = 21.42%; Group II (disc displacement) = 3.57%; and Group III (arthralgia, osteoarthritis, osteoarthritis) = 25%. A review study on general population [24] (n=2,491) observed the prevalence of 9.7% of group I, 11.4% of group II, and 2.6% of group III. The literature reports low TMD index [12]: 1% of group I, 3% of group II, and 1% of group III, of 200 individuals randomly selected.

In this study, the pain measured by VAS was in average 1.37 cm (SD=1.4), which was very below that of a research on tension headache and TMD (4.10 cm and 1.95 cm, TMD pre-treatment and post-treatment, respectively) [25]. Pain to pressure threshold mean value of the muscles analyzed through the algometer was 3.73kgf/cm² for anterior Temporal and 2.93 kgf/cm² for superficial Masseter. This result was different from that of other study [26], in which the authors found 1.5 kgf/cm² for superficial Masseter and 2.66 kgf/cm² for anterior Temporal. The mean CMI was 0.27, in this study, a value very smaller than that of other study [27].

It is very likely that TMD signs and symptoms begin during the orthodontic treatment due to synchronicity, but not to orthodontic treatment itself. The rationale behind this fact is that the age of patients seeking orthodontic treatment matches the age range of greater TMD prevalence [23]. TMD signs and symptoms seem to increase with age, mainly from adolescence to menopause, and therefore,

TMD begins during the orthodontic treatment, unrelated to it DTM [28].

Some studies attempted to assess the possible effect of occlusal factors on TMD development [10]. Possibly, occlusal factors play little etiologic role in pain and functional alterations of the stomatognathic system, but the literature lacks consensus on the role of occlusal problems in TMD etiology [22].

Based on the literature and on the results of this study, it can be concluded that the orthodontic treatment does not increase TMD signs and symptoms, and therefore, the orthodontic treatment is not a risk factor for TMD development. Possibly, individuals having TMD signs and symptoms during the evaluation already had them prior to orthodontic therapy. Thus, it is recommended referring these patients, during or after orthodontic treatment, to undergo therapies aiming at decreasing pain and maintaining TMJ health.

CONCLUSION

TMD signs and symptoms occurred in 39.13% of the individuals undergoing orthodontic treatment, with low pain prevalence (VAS) and low CMI. The mean pain to pressure threshold was 3.7 kgf/cm² for anterior Temporal and 3.00 kgf/cm² for superficial Masseter, which are considered within the normal standards of healthy individuals.

REFERENCES

1. Rothman K, Greenland S, Lash T. *Epidemiologia moderna*. 3 ed. São Paulo: Art Med, 2011.
2. Conti PC, Bonjardi LR. Temporomandibular disorder, facial pain and the need for high level information. *J Appl Oral Sci*. 2014 Jan-Feb; 22(1):1.
3. Dworkin SF. Research diagnostic criteria for Temporomandibular Disorders: current status & future relevance. *J Oral Rehabil*. 2010 Oct; 37(10):734-43.
4. Dworkin SF. Orofacial pain: prospective evaluation and risk assessment (OPPERA). *J Orofacial Pain*. 2011; 11(3):T1-T3.
5. Luther F, Layton S, McDonald F. Orthodontics for treating temporomandibular joint (TMJ) disorders. *Cochrane Database of Systematic Rev*. 2010 Jul; 7(7):1-17.

6. Rusanen J. Pathways between temporomandibular disorders, occlusal characteristics, facial pain, and oral health-related quality of life among patients with severe malocclusion. *Eur J Orthod.* 2012 Ago; 34(4):512–517.
7. Monteiro DR., Zuim PR, Pesqueira AA, Ribeiro Pdo P, Garcia AR. Relationship between anxiety and chronic orofacial pain of temporomandibular disorder in a group of university students. *J Prosthodont Res.* 2011 Jul; 55(3):154-158.
8. Melo GM, Barbosa FS. Parafunção x DTM: a influência dos hábitos parafuncionais na etiologia das desordens temporomandibulares. *POS- Prespect. Oral Sci.* 2009; 1(1):43-48.
9. Santos ECA. Avaliação clínica de sinais e sintomas da disfunção temporomandibular em crianças. *R Dental Press Ortodon Ortop Facial.* 2006 Mar-Abr; 11(2):29-34.
10. Egermark I, Magnusson T, Carlsson GE. A 20-year follow-up of signs and symptoms of temporomandibular disorders and malocclusions in subjects with and without orthodontic treatment in childhood. *Angle Orthod.* 2003 Abr; 73(2):109-115.
11. Melani RFH, Silva RD. A relação profissional-paciente. O entendimento e implicações legais que se estabelecem durante o tratamento ortodôntico. *R. Dental Press Ortodon Ortop Facial.* 2006 Nov-Dez; 11(6):104-13.
12. Sakrania MH, Kamalib AT, Rehman AS. Comparison of signs and symptoms of temporomandibular disorders in orthodontic and non-orthodontic patients presenting at a tertiary care hospital in Karachi, Pakistan. *POJ.* 2014; 6(1):12-8.
13. Michelotti A, Wijer A, Steenks M, Farella M. Home exercise regimes for the management of non-specific temporomandibular disorders. *J Oral Rehabil.* 2005 Nov. 32(11):779-85.
14. Brito DI, Dias PF, Gleiser R. Prevalência de más oclusões em crianças de 9 a 12 anos de idade da cidade de Nova Friburgo. *Rev. Dent. Press Ortodon. Ortop. Facial.* 2009 Dez; 14(6):118-24.
15. Leite RA, Rodrigues JF, Sakima MT, Sakima T. Relationship between temporomandibular disorders and orthodontic treatment: a literature review. *Dental Press J Orthod.* 2013 Jan-Feb; 18(1):150-7
16. Martinez JE, Grassi DC, Marques LG. Análise da aplicabilidade de três instrumentos de avaliação de dor em distintas unidades de atendimento: ambulatório, enfermaria e urgência. *Rev. Brasileira Reumatol.* 2011 Jul-Ago; 51(4):299-308.
17. MAYDANA, V.T. Possíveis fatores etiológicos para desordens temporomandibulares de origem articular com implicações para diagnóstico e tratamento. *Dental Press J Orthod.* Maringá. 2010; 15(3):18-86.
18. Kinser AM, Sands WA, Stone MH. Reliability and validity of a pressure algometer. *J Strength Condit Res.* 2009 Jan; 23(1):312–4.
19. Coelho TGS, Caracas HCPM. Perception of the relationship between TMD and orthodontic treatment among orthodontists. *Dental Press J Orthod.* 2015 Jan-Fev; 20(1):45-51.
20. Bourzgui F, Sebbar M, Nadour A, Hamza M. Prevalence of temporomandibular dysfunction in orthodontic treatment. *International Orthodontic Journal.* 2010 Dez; 8(4):386-98.
21. Machado E, Grehs RA, Cunalí PA. Imaginologia da articulação temporomandibular durante o tratamento ortodôntico: uma revisão sistemática. *Dental Press J Orthod.* 2011 Mai-Jun; 16(3):54.
22. Macfarlane TV, Kenealy P, Kingdon HA, Mohlin BO, Pilley JR, Richmond S, Shaw WC. Twenty-year cohort study of health gain from orthodontic treatment: temporomandibular disorders. *Am J Orthod Dentofacial Orthop.* 2009 Jun; 135(6):692.e1-8.
23. Magnusson T, Guimarães AS. Is orthodontic treatment a risk factor for temporomandibular disorders? *Dental Press J Orthod.* 2012 Mar-Apr; 17(2):97-103
24. Manfredini D. Research diagnostic criteria for temporomandibular disorders: a systematic review of axis I epidemiologic findings. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2011 Out; 112(4):453-62.
25. Gomes MB, Guimarães FC, Guimarães SMR, Claro Neves AC. Limiar de dor à pressão em pacientes com cefaléia tensional e disfunção temporomandibular. *Cienc Odontol Bras* 2006 Out-Dez; 9(4):84-91
26. Santos Silva R S, Conti PC, Lauris JR, da Silva RO, Pegoraro LF. Pressure pain threshold in the detection of masticatory myofascial pain: an algometer -based study. *Journal of Orofacial Pain.* 2005; 19(4):318-24
27. Friction JR, Schiffman EL. Reliability of a craniomandibular index. *Journal of Dental Research.* 1986 Nov; 65(11):1359–1364.
28. Varga ML. Orthodontic therapy and temporomandibular disorders. *Medical Sciences.* 2010 Mar; 34:75-85.

César Rogério Pucci
(Corresponding address)

Av. Eng. Francisco José Longo, 777 - Jd. São Dimas
São José dos Campos/ SP/BRAZIL, CEP 12245-000
E-mail: cesar@fosjc.unesp.br

Date submitted: 2016 Jan 12

Accept submission: 2016 Feb 29