

Relationship Between Orthodontics and Temporomandibular Disorders: A Prospective Study

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Aims: To investigate the possible relationship between the orthodontic treatment of Class II malocclusion and the development of temporomandibular disorders (TMD). **Methods:** A total of 40 patients was evaluated at four time points: the day before the start of treatment employing bilateral Class II elastics (baseline), as well as at 24 hours, 1 week, and 1 month after the start of treatment. The development of TMD pain complaints in the orofacial region and changes in the range of mouth opening were assessed at these times. Shapiro-Wilk, McNemar, and Friedman tests with 5% significance level were used to analyze the data. **Results:** The treatment produced pain of a transitory, moderate intensity, but there was no significant change from baseline after 1 month. There were no restrictions in the range of jaw motion or any evidence of limitations in mouth opening. **Conclusion:** Orthodontic treatment with bilateral Class II elastics does not cause significant orofacial pain or undesirable changes in the range of mouth opening. Furthermore, this modality of orthodontic treatment was not responsible for inducing TMD. *J Oral Facial Pain Headache 2016;30:134–138. doi: 10.11607/ofph.1574*

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Although several types of treatment are available, the correction of Class II malocclusion remains a challenge. Intermaxillary elastics create forces capable of producing desirable tooth movement that, together with other elements, allows the correction of Class II malocclusion.¹ There is speculation that the vectors produced by these Class II elastics may induce some temporomandibular disorders (TMD) as the mandible advances, causing a reduction in mouth opening, bite force, and rapid movements at the onset of pain.² However, these changes related to pain are considered adaptations, since the reduced motion and strong contraction of muscles should prevent further damage and favor healing.^{3–5}

In addition, intermaxillary elastics apply forces and generate load changes in the masticatory muscles that may initially produce muscular pain and injuries.⁶ Unaccustomed eccentric muscle contraction can lead to delayed-onset muscle soreness (DOMS) that manifests 24 to 48 hours after the increase in muscle load. It is believed that DOMS is due to tissue damage caused by excessive mechanical force applied to the tissues.^{7–9} There is no definitive explanation for the physiologic processes underlying DOMS. It has been hypothesized that damage of the muscle cells caused by the increased load leads to disruption of calcium homeostasis, thereby causing an inflammatory response and stimulation of free nerve endings, resulting in pain and edema.¹⁰ On the other hand, physiologic studies¹¹ and clinical trials^{12,13} have advocated the “effect of repeated sessions,” where the continuity of the applied forces results in muscle recovery or adaptation, minimizing the symptoms of injury and muscle soreness.

Because TMD encompass a broad spectrum of clinical problems related to orofacial muscles and the temporomandibular joint (TMJ), including pain, joint noise, and abnormal or limited TMJ movement,¹⁴⁻¹⁷ TMD could substantially influence the orthodontic treatment of Class II patients.

The major aim of the present study was to investigate the possible relationship between orthodontic treatment of Class II malocclusion and the development of TMD. Specifically, this study aimed to quantify the prevalence and intensity of pain complaints in the orofacial region, as well as changes in the range of mouth opening, during four different active phases of application of bilateral Class II elastics.

Materials and Methods

The study was conducted in accordance with the recommendations for ethical and human observational studies, in conformity with the Declaration of Helsinki, and was approved by the ethics committee of the Faculty of Dentistry São Leopoldo Mandic according to Protocol 2008/0373. A total of 40 patients were recruited, consecutively selected according to their indication for orthodontic treatment employing Class II bilateral elastics. All patients were treated during the years 2012 and 2013 by an orthodontic specialist. The sample comprised patients who were treated with orthodontic mechanics of Class II bilateral elastics without extractions, who had no current TMD or previous history of TMD (none of the patients were diagnosed with TMD according to the Research Diagnostic Criteria for TMD [RDC/TMD]¹⁵), and who agreed to participate in the study by signing an informed-consent form.

The patients were evaluated at four time points: (1) the day before starting the treatment with elastics; (2) 24 hours after the first day of treatment; (3) 1 week after the first day of treatment; and (4) 1 month after the start of treatment.

The 1/8-inch (GAC/Dentsply) elastics were fixed on hooks of the orthodontic brackets placed bilaterally on the maxillary canines and mandibular second premolars, with a force of approximately 200 g per side. The patients were instructed to replace the elastics every 24 hours to keep the force constant during the study period. Four questions were addressed to patients to evaluate the pain complaints:

1. Did you feel pain when you opened your mouth widely or chewed?
2. Did you feel pain in your temples, face, TMJ, or jaw?
3. Did you have headaches?
4. Have you recently had problems of jaw locking or limited mouth opening? If yes, how often?

When pain was reported in response to the first three questions, pain intensity was evaluated by using a 0 to 10 visual analog scale (VAS), with 0 = no pain and 10 = worst imaginable pain; muscle pain and tenderness were also confirmed using muscle palpation according to the RDC/TMD.^{15,18} Some patients experienced transitory pain, but none met the RDC/TMD criteria at any of the four periods of evaluation.

The maximum mouth opening from the mandibular to the maxillary right central incisors was measured with digital calipers (Zaas Precision, 0 to 150 mm) at the four time points previously described. The values of maximum mouth opening at the four time points were compared. Values greater than 40 mm were considered normal.^{15,17}

The McNemar test (5%) was used to evaluate significant differences related to the mouth-opening variable and to the answers to the four questions to determine if there were significant differences in the data among the four time points. Because mouth opening and pain were not normally distributed (Shapiro Wilk test, $\alpha = .05$), a nonparametric test (Friedman, $\alpha = .05$) was applied to compare values among the four time points, followed by a nonparametric test for multiple comparisons ($\alpha = .05$). Differences between groups were then examined; age and gender were variables analyzed by descriptive statistics (BioStat 5.0 software).

Results

A total of 40 patients, 31 (77.5%) female and 9 (22.5%) male, with a mean age \pm standard deviation (SD) of 29 ± 13 years, were selected. Based on their answers to the four questions, it was found that: (1) pain upon wide mouth opening or chewing, (2) pain in the temples, face, TMJ, or jaw, and (3) headaches all significantly increased at 24 hours and at 1 week after the elastics were fixed, but after 1 month there were no significant differences in comparison with baseline. Furthermore, no significant problems of jaw locking or limited mouth opening were reported at the time points studied (Table 1).

Some patients reported pain just before the orthodontic treatment, but this pain did not meet the RDC/TMD criteria and was not related to the orthodontic treatment but to some existing pain condition (eg, headache). Reports of moderate pain intensity (4 to 6 on the VAS) were frequent during the active phase of the elastics treatment, although there were only minor and nonsignificant increases in pain levels at 24 hours and at 1 week after the elastics were fixed (Table 2).

Tables 3 and 4 show the prevalence of individuals with restricted mouth opening and the comparison of

Table 1 Frequency of Positive (“Yes”) Answers to the Questions Asked of Patients at the Different Time Points

Question	Before orthodontics	After 24 h	After 1 wk	After 1 mo
1. Pain when opening mouth	2.5%	60.0%*	27.5%*	15.0%
2. Orofacial pain	7.5%	50.0%*	27.5%*	15.0%
3. Headache	2.5%	40.0%*	22.5%*	15.0%
4. Limited mouth opening	2.5%	2.5%	–	–

Statistical analysis refers to each isolated question according to the period of evaluation (* $P < .05$).

Table 2 Median (Range) Pain Intensity of Patients Who Reported Pain at the Different Time Points

	Before orthodontics	After 24 h	After 1 wk	After 1 mo
PI	4.0 (2–5)	6.0 (1–10)	5.0 (1–9)	4.0 (1–9)

PI = pain intensity on the 0–10 visual analog scale.

Table 3 Number and Percentage of Patients Who Presented Restricted (≤ 40 mm) and Normal (> 40 mm) Mouth Opening at the Different Time Points of the Study

Mouth opening	Before orthodontics	After 24 h	After 1 wk	After 1 mo
≤ 40 mm	4 (10.0%)	5 (12.5%)	5 (12.5%)	4 (10.0%)
> 40 mm	36 (90.0%)*	35 (87.5%)*	35 (87.5%)*	36 (90.0%)*

Statistical analysis compared the amplitude of mouth opening at each time point (* $P < .05$).

Table 4 Mean Maximum Mouth Opening (\pm Standard Deviation) at the Different Time Points

	Before orthodontics	After 24 h	After 1 wk	After 1 mo
Mouth opening (mm)	46.57 \pm 4.54	45.82 \pm 3.88	46.17 \pm 3.86	46.25 \pm 3.85

the magnitude of maximum mouth opening at the different time points. One of the 36 patients who did not present restricted mouth opening experienced a transitory limitation. There was no statistical significance in the mouth-opening measurements, and most of the patients had a normal range of more than 40 mm.

Discussion

This study has demonstrated that orthodontic treatment using elastics to correct Class II malocclusion does not produce any evidence of TMD. Transitory and minor changes in maximum mouth opening and orofacial pain were observed after the placement of orthodontic elastics, but these symptoms remained only for 1 week. One month after the start of the orthodontic treatment, the functional parameters and pain symptoms reduced to the values close to the initial values measured before the placement of the

elastics. Since the occurrence of TMD is common in the general population^{19–23} and the present study aimed to test if orthodontic treatment leads to signs and symptoms of TMD, a control group was not considered necessary. Furthermore, TMD could have been developed in any of the patients during the study period.

Despite TMD now being considered a multifactorial condition, they were long considered to be primarily the result of malocclusion.²⁴ More recently, other factors causing TMD have been recognized,²⁴ although malocclusion is still considered important to explain some TMD.²⁵ At present, the etiology of TMD is seen as a complex association of several factors interacting together in a specific way, so that some agents may be more important than others, varying between individuals.^{26,27} Thus, the combination of factors underlying TMD may interact in a multidisciplinary manner.^{14,15,17,26,27} Several controversies regarding TMD make many clinicians unsure of

the diagnosis, and therefore the treatment, of TMD. Eventually, the uncertainty in choosing the best treatment can lead to therapeutic failure.²⁷

Other viewpoints about orthodontic treatment vis-à-vis TMD should be noted. Orthodontic treatment can have positive^{28,29} or even negative but not significant³⁰ effects on signs and symptoms of TMD. However, there is no evidence linking orthodontic treatment to TMD, either causative or preventive.³¹ Thus, the present findings are important in supporting the view that orthodontic treatment is not a primary etiologic factor for TMD. To better clarify this issue, further studies should be conducted, including routine orthodontic treatments other than those using Class II elastics.

The present findings also showed that orthodontic treatment does not affect the range of mouth opening. Most of the patients presented a normal opening range and only one individual experienced a transitory limitation. Thus, Class II orthodontic elastics may temporarily reduce mouth-opening movements but not limit them. Elastics are used to keep the force constant throughout the period of treatment; when applied, they change the jaw position and may generate an adaptive response of the masticatory muscles.^{2,5} Onset pains related to the orthodontic treatment were observed in the present study but did not develop into TMD. The onset of pain likely occurs due to the load change on the masticatory muscles.^{2,9,10,22} This event could be a replication of DOMS, which has been described in many studies.^{7,8,10} Interestingly, and in accordance with the findings of the present study, the continuity of the applied forces results in muscle recovery or adaptation (“effect of repeated sessions”), minimizing the symptoms of injury and muscle soreness.¹¹ Although many theories have been proposed to explain DOMS,^{10–13} the specific mechanism responsible for it is still unknown.

Conclusions

This study suggests that the use of orthodontic forces with bilateral Class II elastics does not cause TMD symptoms such as severe pain or undesirable changes in the range of mouth opening.

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