

Orthodontic therapy and the prevalence of temporomandibular dysfunction

Smaranda Buduru, Antonela Berar, Malina Pinet, Oana Almășan, Mirela Fluerașu, Simona Iacob, Silvia Balhuc, Andreea Kui

Prosthodontics Department, Faculty of Dental Medicine, “Iuliu Hațieganu” University of Medicine and Pharmacy, Cluj Napoca, Romania.

Abstract. Objectives: The present study had two objectives, namely: (1) highlighting a cause-effect relationship between orthodontic treatment and the occurrence of temporo-mandibular joint (TMJ) pathology, and (2) highlighting a possible causal relationship between the presence of occlusal interferences and the development of temporo-mandibular disorders (TMD). Material and methods. The study was performed on students from the Faculty of Dental Medicine and General Medicine of the “Iuliu Hațieganu” University of Medicine and Pharmacy, Cluj-Napoca, aged between 20 and 22 years. The inclusion criteria for the subjects: orthodontic Angle Class 1, presence of orthodontic treatment in their medical history, good general health condition, without any other systemic pathology. Each subject underwent clinical examination (extraoral and intraoral) after the completion (within the anamnesis) of a questionnaire that included inquiries regarding the general and dental pathological history, facial trauma, orthognathic surgery, medication, prosthetic and orthodontic treatments. TMJ diagnoses were DDWR (disk displacement with reduction) or DDWoR (disk displacement without reduction). Results. From 50 subjects included in the study, 27 was women (54%) and 23 men (46%), 38 (76%) with previous orthodontic treatments, 12 (24%) without orthodontic treatments in their history and 44 (88%) with occlusal interferences and 6 (12%) with no occlusal interferences. Out of the 38 subjects with orthodontic treatment, 23 subjects (60.5%) developed joint pathology and 15 (39.5%) did not show signs of joint dysfunction. Out of the 12 subjects who had no orthodontic treatment in their history, only 1 subject (8.3%) showed signs of joint dysfunction, and the remaining 11 (91.7%) subjects did not show any sign of joint impairment. Regarding the causal relation between the existence of occlusal interferences and the pathology of the temporomandibular joint, the statistical analysis has detected a $p=0.443$ ($p>0.05$). Conclusion. Based on the data obtained from this retrospective observational study, we can state that orthodontic treatments may be correlated with the occurrence of the temporomandibular dysfunctions. The data obtained could not reveal a correlation between the presence of interferences in the static and dynamic occlusal relations and TMD development.

Key Words: temporomandibular disorders, occlusal interferences, orthodontic treatment.

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Corresponding Author: A. Berar, email: antonela_berar@yahoo.com

Introduction

Temporomandibular dysfunctions (also called temporomandibular disorders) are known to have a multifactorial etiology. In this etiological context occlusal interferences are considered to be one of the main causes of these pathologies (Antonarakis et al 2017; Celic et al 2003).

Regarding a possible causal relation between orthodontic treatments and temporo-mandibular dysfunctions, contradictory opinions are conveyed: on one hand there are researchers who suspect that orthodontic treatments also imply the risk of dysfunctions of the temporomandibular joint (TMJ), but there are also researchers who support the theory that, on the contrary, orthodontic treatments reduce the risk of joint pathology (Egermark et al 1992; Egermark et al 2005; Ohlsson and Lindquist 1995; Mao and Duan 2001). Even in the case of orthodontic treatments combined with surgical treatments of the Angle Class 3, there are authors suggesting that orthognathic surgical techniques may represent a risk of temporomandibular dysfunction

(TMD) occurrence in initially asymptomatic patients, or may even worsen manifestations in already symptomatic patients (Wolford et al 2003; Dujocquoy et al 2010; Lindenmeyer et al 2010; Iannetti et al 2013; Jung et al 2015).

Some researchers have shown that during the active phases of orthodontic treatments, the signs and symptoms of TMDs are reduced, this probably being determined by the fact that the teeth are more sensitive to contact, so the occlusal parafunctions are reduced, as is the activity of the masticatory muscles (Egermark and Ronnerman 1995; Henrikson et al 1999).

Controversies still exist regarding the causal relationship between orthodontic treatments and TMJ dysfunctions (De Boever et al 2000; Greene 2001; Ash 2003). Therefore, in this context, we consider that the role of orthodontic therapy in the occurrence of TMDs is not completely elucidated and that the subject requires solid, long-term studies in order to establish a causal relationship.



Fig.1 – TMJ's palpation



Fig. 2- TMJ's auscultation

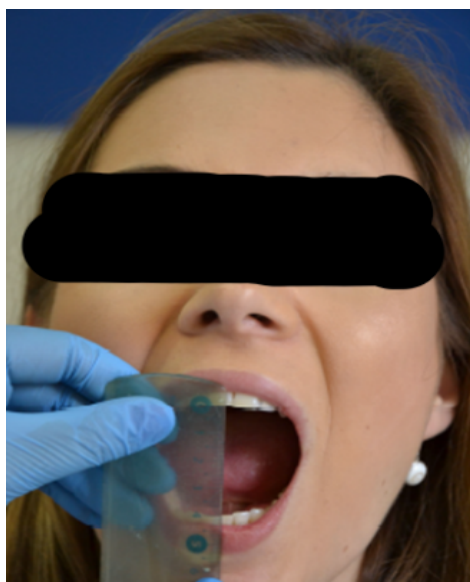


Fig. 3 – Measuring the maximum opening of the mouth



Fig. 4 – Extraoral palpation of temporal muscle

The present study had two objectives, namely: (1) highlighting a cause-effect relationship between orthodontic treatment and the occurrence of TMJ pathology, and (2) highlighting a possible causal relationship between the presence of occlusal interferences and the development of a TMD.

Material and methods

The present study was performed on students from the Faculty of Dental Medicine and General Medicine of the “Iuliu Hațieganu” University of Medicine and Pharmacy, Cluj-Napoca, between February and June 2018. After the Ethics Committee of the University of Medicine and Pharmacy “Iuliu Hațieganu” approved the study, all patients included in the study signed an informed consent to participate in the study, as well the consent to use their protected medical data in the current study.

The study inclusion criteria were as follows:

- orthodontic Angle Class 1;
- presence or absence of orthodontic treatment in their medical history;
- good general health condition;

- without any other systemic pathology.
- The exclusion criteria were as follows:
- the existence of an ongoing orthodontic treatment;
 - history of orthognathic surgery;
 - history of cervico-facial trauma;
 - history of complex prosthetic restorations (i.e., more than 1 prosthetic restoration);
 - acute or chronically orofacial muscle pain.

Each subject completed first a health questionnaire. Based on the answers, the subjects were examined further or excluded from the study (as they did not correspond with the inclusion criteria). The questionnaire included questions regarding the general and dental pathological history: facial trauma, orthognathic surgery, medication, prosthetic and orthodontic treatments. Afterwards, clinical examination (extraoral and intraoral) has been performed. The extraoral clinical examination included the examination of the TMJ (using inspection, palpation and auscultation), the evaluation of the quality of the mandibular limit movements (maximum opening, lateral and protrusion



Fig. 5 – Occlusal contacts marked with blue articulating paper in MI



Fig.6 – Inferior interincisal line right side deviated



Fig. 7 – Sagittal 1st molar Angle relationship



Fig. 8 – Edge to edge position at the end of anterior guidance

movement), as well as the palpation of the masticatory muscles (Fig.1, 2, 3, 4).

During intraoral examination, after examining the oral mucosa and the dentoalveolar structures, a complete analysis of the occlusal static and dynamic relationships was performed (maximum intercuspation - MI, centric relation - CR, lateral and anterior guidance). For each patient, the researchers also assessed the amplitude and quality of the eccentric mandibular movements, protrusion and right/left laterality (Fig. 5, 6, 7, 8).

The muscular examination was performed for 4 masticatory muscles: the temporalis muscle, the masseter muscle, the medial and the lateral pterygoid muscles. The existence of hypertrophy, hypertonia, and myalgia and muscle contraction was verified through palpation.

All information gathered from the clinical examinations was entered into the examination chart of each subject, subsequently being evaluated for establishing a complete diagnosis, with or without joint dysfunction. TMJ diagnoses were considered either DDWR (disk displacement with reduction) or DDWoR (disk displacement without reduction). DDWR showed the following clinical signs: maximum opening, protrusion and lateral movement within normal limits, sinusoidal opening, clicking in any movement. DDWoR presented limitations in mouth opening, deviation of movement towards the affected side, lack of joint noises, possible pain.

The variables monitored in this study were regarding the presence of occlusal interferences and premature contacts in static occlusion (MI and CR) as well in dynamic occlusion and regarding the presence or absence of any form of TMJ pathology (no disorder, DDWoR or DDWR).

The data obtained for each patient was subsequently quantified and inserted into a Microsoft Excel-type table. Statistical analysis of the centralized data was performed using Epiinfo® software.

Results

Initially, 98 patients were invited to participate in the present study. After the completion of the health questionnaire, followed by a further complete examination and applying the inclusion criteria, 50 patients were included in the study.

The distribution of the subjects was as follows – 27 women and 23 men, the age ranged between 20 years until 22 years. Gathering the data, the statistical analysis revealed that 38 subjects had previously benefited from an orthodontic treatment and 12 subjects had not undergone such treatment (Table 1 and Fig. 9).

The data were statistically analyzed in the Microsoft Excel and Epiinfo® software, and data distribution was tested in order to identify which statistic test is suitable to be applied. In order to test the relationship between the history of orthodontic treatments and the presence of TMD, Chi-Square (χ^2) test was applied.

Out of the 38 subjects with orthodontic treatment, 23 subjects (60.5%) developed joint pathology and 15 (39.5%) did not show signs of joint dysfunction. Out of the 12 subjects who had no orthodontic treatment in their history, only 1 subject (8.3%) showed signs of joint dysfunction, and the remaining 11 (91.7%) subjects did not show any sign of joint impairment. Comparing the relationship between the history of an orthodontic treatment and TMD, χ^2 test revealed a $p=0.002$ and a relative risk (RR) of 7.263 were found. The confidence interval of the RR was between 1.417 and 143.666.

Twenty-two subjects had both occlusal interferences, as well as articular pathology, while other 22 subjects had occlusal interferences but no signs of joint pathology. 2 subjects had no occlusal interferences, but were diagnosed with joint pathology, and 4 of the 50 subjects had neither occlusal interferences, nor any kind of articular pathology (Table 2 and Fig.10).

Regarding the establishment of a causal relationship between the existence of occlusal interferences and the pathology of the temporomandibular joint, the Chi-Square test revealed also $p=0.4$ ($p>0.05$).

Discussions

There are numerous previous researches, both clinical studies and literature reviews that have tried to either disprove or confirm

Table 1 - Distribution of subjects based on some variables (age, sex, presence or absence of orthodontic treatments or of occlusal interferences)

Subjects distribution	Age (years)			Sex		Orthodontic treatment (yes/no)		Occlusal interferences (yes/no)	
	20	21	22	F	M	Y	N	Y	N
	17 (34%)	18 (36%)	15 (30%)	27 (54%)	23 (46%)	38 (76%)	12 (24%)	44 (88%)	6 (12%)
Total	50 (100%)								

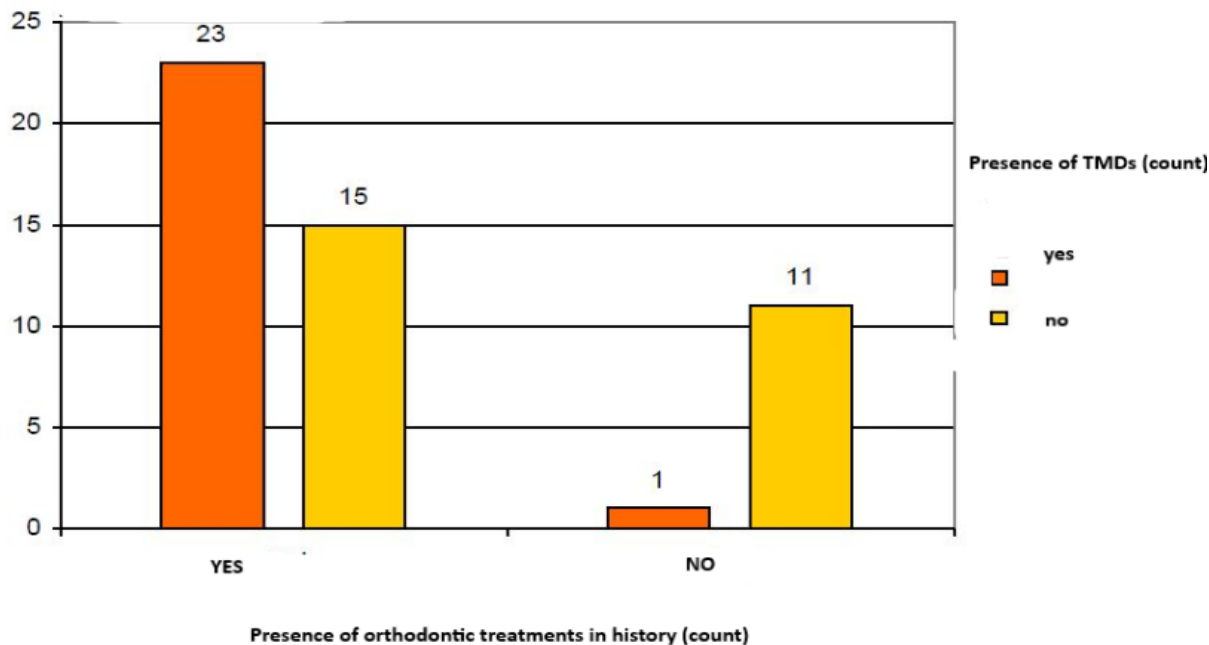


Figure 9 - Distribution of subjects according to the presence of orthodontic treatments in their history

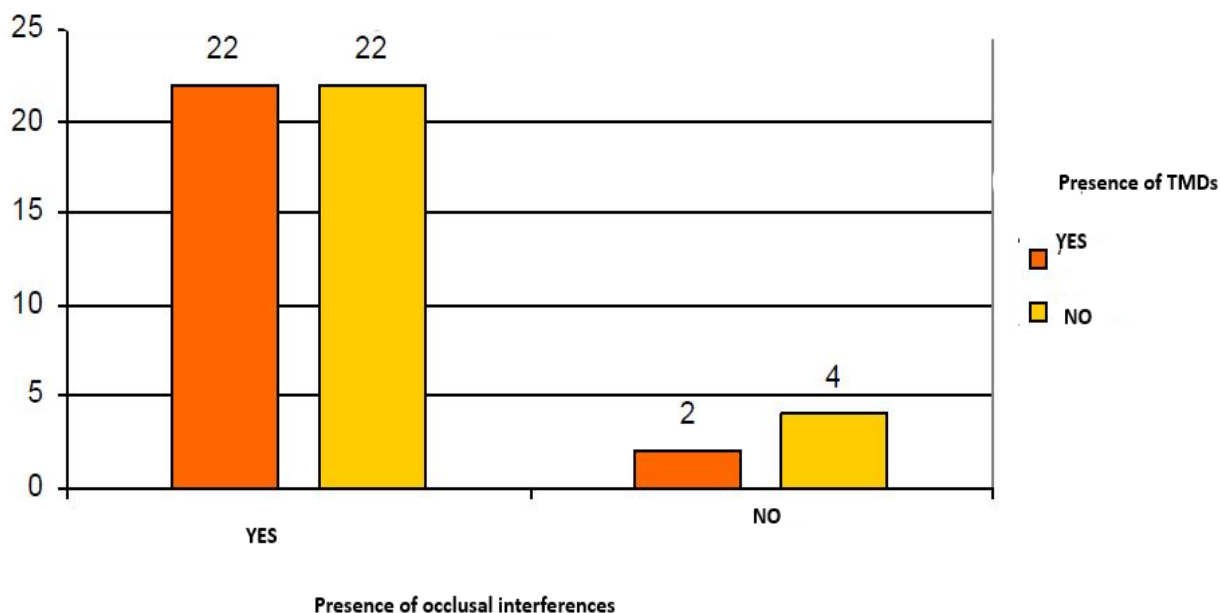


Figure 10 - Distribution of subjects according to the presence or absence of occlusal interferences

Table 2 – Subjects distribution based on the occlusal interferences and the presence or absence of TMJ pathology

TMD	Occlusal interferences		Total
	Yes	NO	
	22 (44%)	22(44%)	44 (88%)
No TMD	2 (4%)	4(8%)	6 (12%)
Total	24 (48%)	26 (52%)	50 (100%)

a possible correlation between orthodontic treatments and impairments of the temporomandibular joints (McNamara 1997; Luther 1998; Kim et al 2002). However, the conflict between the different opinions published in the literature is not fully resolved, given that some studies have reported fewer signs and symptoms of TMDs in patients who have undergone orthodontic treatment, compared to other patients who have not undergone such kind of therapies. Moreover, Aubrey argues that when occlusal relations correspond to the musculo-skeletal mechanisms, any pathology of the temporomandibular joint has virtually been cancelled (Celic et al 2003; Egermark et al 1992).

Based on the answers obtained from the health questionnaire and during clinical examination, the subjects who underwent previous orthodontic treatment were, at the moment were the study took place, at least 6 months after the orthodontic treatment ended, all of them with permanent contentions (in order to help maintaining the results) and all of them with a class I Angle. One of the hypotheses of this study was that orthodontic treatments can cause dysfunction of the temporomandibular joint. The statistical test used was Chi-Square, given the fact that the sample size is relatively small, and because of the distribution between cells. To test the first hypothesis, namely that the presence of orthodontic treatments can cause TMDs, the statistical χ^2 test was used revealed a significant association between the history of an orthodontic treatment and the presence of TM joint pathology ($p=0.002$; $p<0.005$); this result suggests that the hypothesis is valid in the context of a relative risk (RR) of 7.263, the results meaning that people who have received orthodontic treatment have a 7.263-times higher risk of joint damage compared to those who have never benefited from an orthodontic treatment. However, the results were not consistent with other studies, such as the one published by Hye-Young et al. in 2019. In their study, 5567 patients were included, with or without previous orthodontic treatments. The authors concluded that they could not associate the temporomandibular dysfunctions with the orthodontic treatments in the examined population.

Regarding the establishment of a causal relation between the existence of occlusal interferences and the pathology of the temporomandibular joint, the statistical analysis detected a $p=0.443$ ($p>0.05$). Thus, the hypothesis that there is a causal relationship between the occurrence of articular pathology and the presence of occlusal interferences could not be confirmed.

In the same context, Porto et al. (2015) published a study related to the desire and ease with which orthodontists manage to diagnose and treat TMDs. 8870 orthodontists were questioned regarding the identification and treatment of temporomandibular dysfunctions. The authors concluded that in the specialty of orthodontics and dental-facial orthopedics, changes are needed in the curriculum, so that future orthodontic specialists can identify and treat TMDs more easily.

The present study, being a retrospective study, has limitations regarding the detection of a causal relationship between orthodontic treatments and TMJ pathology, since pre-orthodontic TMJ diagnosis is not exactly known. Therefore, we believe that prospective, long-term clinical studies are needed to determine if, indeed, there is a cause-effect relationship between the different types of orthodontic treatments and the appearance of TMJ pathology.

Conclusions

Based on the data obtained from this retrospective observational study, we can state that orthodontic treatments may be correlated with the occurrence of the temporo-mandibular dysfunctions. Also, the data obtained could not reveal a correlation between the presence of interferences in the static and dynamic occlusal relations and TMD development.

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- 32 Clinicilor Street, 400006, Cluj-Napoca, Romania, EU; email: smarandabuduru@yahoo.com
- Antonela Berar, Prosthodontics Department, Faculty of Dental Medicine, “Iuliu Hatieganu” University of Medicine and Pharmacy, 32 Clinicilor Street, 400006, Cluj-Napoca, Romania, EU; email: antonela_berar@yahoo.com
 - Malina Pinot, Prosthodontics Department, Faculty of Dental Medicine, “Iuliu Hatieganu” University of Medicine and Pharmacy, 32 Clinicilor Street, 400006, Cluj-Napoca, Romania, EU; email: malina.pinot@gmail.com
 - Oana Almasan, Prosthodontics Department, Faculty of Dental Medicine, “Iuliu Hatieganu” University of Medicine and Pharmacy, 32 Clinicilor Street, 400006, Cluj-Napoca, Romania, EU; email: ocrisst@gmail.com
 - Mirela Fluerașu, Prosthodontics Department, Faculty of Dental Medicine, “Iuliu Hatieganu” University of Medicine and Pharmacy, 32 Clinicilor Street, 400006, Cluj-Napoca, Romania, EU; email: mfluerașu@yahoo.com
 - Simona Iacob, Prosthodontics Department, Faculty of Dental Medicine, “Iuliu Hatieganu” University of Medicine and Pharmacy, 32 Clinicilor Street, 400006, Cluj-Napoca, Romania, EU; email: simona72cj@yahoo.com
 - Silvia Balhuc, Prosthodontics Department, Faculty of Dental Medicine, “Iuliu Hatieganu” University of Medicine and Pharmacy, 32 Clinicilor Street, 400006, Cluj-Napoca, Romania, EU; email: syylvya@yahoo.com
 - Andreea Kui, Prosthodontics Department, Faculty of Dental Medicine, “Iuliu Hatieganu” University of Medicine and Pharmacy, 32 Clinicilor Street, 400006, Cluj-Napoca, Romania, EU; email: andreeakui@gmail.com

Authors

•Smaranda Buduru, Prosthodontics Department, Faculty of Dental Medicine, “Iuliu Hatieganu” University of Medicine and Pharmacy,

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