



Orthodontic History as a Potential Risk Factor for Temporomandibular Dysfunction: A Descriptive-Analytical Pilot Study

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SUMMARY/ABSTRACT

Starting point: Temporomandibular dysfunction represents a heterogeneous group of disorders with multifactorial etiology involving biomechanical, muscular, psychosocial, and neurophysiological factors. The association between orthodontic history and the development of TMD remains unclear. While some meta-analyses report a slightly increased risk after orthodontic treatment, other large-scale studies do not confirm this relationship. Individual predispositions and malocclusions appear to play a stronger role than orthodontic treatment itself.

Group: The study included 28 patients aged 18–68 years diagnosed with temporomandibular joint pain. Seventeen participants (60.7%) reported previous orthodontic treatment.

Methods: Patients were divided according to orthodontic history. The primary outcome was temporomandibular joint pain intensity measured using a VAS scale (0–10). Normality of distribution was assessed using the Shapiro–Wilk test, histogram inspection, and comparison of mean and median values. Due to non-normal distribution, nonparametric tests (Mann–Whitney U and chi-square) were applied. Statistical significance was set at $p < 0.05$.

Results: Patients with orthodontic history showed a median VAS score of 5 (IQR 5–6), mean 5.35, while those without demonstrated a median of 6 (IQR 5–6), mean 5.55. The difference was not statistically significant ($p > 0.05$). Headaches were reported by 76.5% of patients with orthodontic history and 81.8% of those without, with no significant difference.

Conclusions: Orthodontic history was not associated with increased pain intensity or higher headache prevalence in this TMD cohort. The findings support the multifactorial understanding of TMD and indicate that orthodontic treatment is unlikely to represent a primary risk factor.

KEYWORDS

temporomandibular dysfunction, orthodontic treatment, pain, VAS, headache

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1 INTRODUCTION

Temporomandibular dysfunction (TMD) is a group of disorders affecting the temporomandibular joint (TMJ), masticatory muscles, and related structures. Typical symptoms include pain in the joint or masticatory muscles, limited mouth opening, joint noises, and dysfunction during chewing, speaking, and other daily activities (Okeson, 2019; Ohrbach & Dworkin, 2016). The etiology of TMD is multifactorial

and includes biomechanical, muscular, psychosocial, and neurophysiological factors (Suvinen et al., 2005; List & Jensen, 2017).

The relationship between orthodontic treatment and TMD has been a topic of discussion, especially in recent years (Jeong et al., 2024; Azimi et al., 2025). Some older studies have suggested that orthodontic occlusion adjustments may cause or exacerbate TMD, but more recent systematic reviews have not clearly confirmed this association and instead point to the role of other factors such as bruxism, stress, or general pain syndromes (Yakkaphan et al., 2022). Nevertheless, the idea that orthodontic treatment may be a risk factor for TMD persists in clinical practice, and many patients and doctors consider this possibility (Liu et al., 2022).

2 GROUP AND METHODS

This is a pilot observational, descriptive-analytical study. The data were obtained from a clinical cohort of patients enrolled in a research project focused on the treatment of chronic temporomandibular joint pain and the use of high-intensity laser therapy (HILT) within a diploma thesis project conducted at the outpatient clinics of the Faculty of Physical Education and Sport, Charles University, during the years 2024–2025. All patients were referred after examination at the temporomandibular joint outpatient clinic of the Department of Dentistry for Children and Adults, Second Faculty of Medicine, Charles University, and Motol University Hospital. This section describes a part of the data collection from the currently ongoing study.

The research includes four intervention groups: the first group undergoes three physiotherapy sessions combined with HILT application; the second group receives physiotherapy only; the third group receives HILT application only; and the fourth group serves as a control group. All groups underwent identical baseline and follow-up examinations, completed the RDC/TMD questionnaire, and provided written informed consent. The Czech–English version of the questionnaire from 2016, developed by the University of Washington, was used. Physiotherapy interventions included mobilization techniques, soft tissue techniques, post-isometric relaxation of the masticatory muscles, and treatment of active trigger points within the masticatory muscles.

Ethics Committee

The study was approved by the Ethics Committee of the Faculty of Physical Education and Sport, Charles University. All participants signed an informed consent form before enrollment. All procedures were performed in accordance with institutional and national ethical standards and the Declaration of Helsinki, including its subsequent revisions, and their participation in the study was entirely voluntary and unpaid.

Inclusion criteria:

Patients were eligible if they were between 18 and 65 years of age; however, two individuals slightly exceeding this limit were included due to the long-term persistence of their symptoms. Further criteria included a clinically confirmed diagnosis of temporomandibular disorder with a predominant painful component and the ability to complete the questionnaire and undergo a clinical examination.

Exclusion criteria:^[1]_[SEP]

Patients were excluded if they had recently undergone extensive dental surgery or extraction, presented with severe degenerative TMJ pathology, experienced acute trauma in the TMJ region, suffered from

acute inflammatory or rheumatic disease, or had received an injection in the TMJ area within the previous three months.

Variables monitored:

During the baseline examination conducted prior to the first therapeutic session, the following data were recorded for each patient:

Table 1: Overview of monitored variables

Variables monitored	Question	Assessment
Year of birth	In which year were you born?	Self-reported
Gender	Please select your gender.	Male / Female
Orthodontic history	Have you ever undergone orthodontic treatment?	Yes / No
Bite splint use	Do you actively use a bite splint?	Yes / No
TMJ pain intensity	Please select the intensity of your TMJ pain on a scale from 0 to 10.	Visual Analogue Scale (VAS 0–10)
Orthodontic history	Have you ever undergone orthodontic treatment?	Yes / No

Based on orthodontic history, the patients were divided into two groups: the ORTHO+ group, consisting of patients with a history of orthodontic treatment (n = 17), and the ORTHO– group, comprising patients without orthodontic history (n = 11).

Statistical analysis

Descriptive statistics (absolute and relative frequencies, mean, median, interquartile range – IQR) were used to describe the data set. Pain intensity (VAS) between the ORTHO+ and ORTHO– groups was compared using the nonparametric Mann–Whitney U test. The chi-square test was used to compare the frequency of headaches between groups. The level of statistical significance was set at $p < 0.05$.

3 STARTING POINT, OBJECTIVE, TASKS

Current scientific literature offers conflicting conclusions regarding the relationship between orthodontic history and the risk of developing TMD. Some systematic reviews and meta-analyses suggest that orthodontic treatment may be associated with an increased risk of developing TMD, with individuals with orthodontic history having up to 1.8 times higher likelihood of TMD (Coronel-Zubiate et al., 2022). Similarly, some studies report a higher prevalence of TMD in individuals with a history of orthodontic treatment and a poorer quality of life related to the TMJ (Liu et al., 2022). On the other hand, other large longitudinal and case-control studies have not found a significant association between orthodontic treatment and the development of TMD (Manfredini et al., 2016; Ugolini et al., 2020). Some studies even report that orthodontic treatment has no effect on the incidence of TMD or may lead to an improvement in some symptoms (Ehrmann et al., 2024).

The presence of certain malocclusions, particularly crossbite and deep bite, classes II and III, appears to be a significant risk factor for the development of TMD (Guo et al., 2025; Lai et al., 2019).

These factors may be more important than orthodontic history alone. Furthermore, it appears that multifactorial etiology, including psychological factors, genetic predisposition, and gender (higher risk in women), contributes to the development of TMD (Ugolini et al., 2020; Liu et al., 2022).

Anamnestic data obtained using validated questionnaires (e.g., Fonseca index) allow the identification of an increased prevalence of TMD in patients with orthodontic history, but the causal relationship remains unclear (Liu et al., 2022).

Current evidence suggests that orthodontic history may be one of the risk factors for TMD, but its significance is probably less than that of certain types of malocclusion and individual predispositions. The interpretation of anamnestic data should always take into account the multifactorial nature of TMD and other risk factors. Meta-analyses show that the prevalence of headaches in patients with TMD is around 62% and the prevalence of TMD in patients with headaches is approximately 59%. In painful forms of TMD, the incidence of headaches is even higher (up to 83%) (Yakkaphan et al., 2022).

Migraine headaches are more common in patients with TMD than tension-type headaches (Memmedova et al., 2021; Yakkaphan et al., 2022). Patients with migraine or tension headaches have a 3–5 times higher risk of TMD than controls without headaches (Bizzarri et al., 2024; Réus et al., 2021).

The aim of this pilot study is to determine the prevalence of orthodontic history and compare the intensity of TMJ pain between patients with and without orthodontic history. Furthermore, it aims to compare the incidence of headaches in both groups and describe the basic differences in the demographic characteristics of both groups.

4 RESULTS

Characteristics of the sample: The sample consisted of 28 patients with TMD, of whom 18 were women (64.3%) and 10 were men (35.7%). The average age was 35.8 years (range 18–68 years). A total of 22 patients (78.6%) reported headaches.

4.1. PREVALENCE OF ORTHODONTIC HISTORY

Seventeen patients (60.7%) reported previous orthodontic treatment, while eleven patients (39.3%) had no orthodontic history. A clear gender difference was observed between the groups. In the ORTHO+ group, women predominated, with 14 females (82.4%) and 3 males (17.6%). In contrast, the ORTHO– group showed a more balanced distribution, consisting of 5 women (45.5%) and 6 men (54.5%).

Table 2: Basic characteristics of the study sample according to orthodontic history

Monitored variables - results	ORTHO+ (n = 17)	ORTHO– (n = 11)
Age - mean (years)	35.0	37.5
Women n (%)	14 (82.4)	5 (45.5)
Men n (%)	3 (17.6)	6 (54.5)

Headaches n (%)	13 (76.5)	9 (81.8)
TMJ pain intensity - median VAS	5	6
TMJ pain intensity - IQR	5-6	5-6
TMJ pain intensity - mean VAS	5.35	5.55

The mean age in the orthodontic history group was approximately 34–36 years, whereas in the group without orthodontic history it was slightly higher, around 37–38 years. Headaches were reported by 13 participants (76.5%) in the ORTHO+ group and by 9 participants (81.8%) in the ORTHO– group. Overall, the distribution of demographic characteristics and symptom prevalence demonstrated comparable findings between the two groups

4.2. TEMPOROMANDIBULAR JOINT PAIN INTENSITY (VAS) AND ORTHODONTIC HISTORY

Pain intensity based on VAS scoring showed a similar distribution between the two groups. In the ORTHO+ group, the median VAS score was 5 with an interquartile range (IQR) of 5–6, and the mean value was 5.35. In the ORTHO– group, the median reported pain level was slightly higher at 6, with the same interquartile range of 5–6, and a mean value of 5.55. Statistical analysis using the Mann–Whitney U test demonstrated that the difference in pain intensity between the groups was not significant ($p > 0.05$). These findings indicate that individuals with a history of orthodontic treatment did not experience greater temporomandibular joint pain compared to those without such history. Although the median pain level appeared slightly lower in the orthodontic treatment group, the difference was small and clinically as well as statistically insignificant.

4.3. HEADACHES AND ORTHODONTIC HISTORY

The incidence of headaches was comparable between the two groups. In the orthodontic history group (ORTHO+), 13 out of 17 patients (76.5%) reported headaches, whereas in the group without orthodontic history (ORTHO–), headaches were present in 9 out of 11 patients (81.8%). Statistical analysis using the chi-square test revealed no significant difference in headache frequency between the groups (χ^2 , $p = 0.736$; $p > 0.05$).

5 DISCUSSION

The main finding of this study is that although more than 60% of patients with TMD in our sample reported having undergone orthodontic treatment, this history **was not associated with higher TMJ pain intensity or more frequent headaches**. The VAS pain intensity was very similar in both groups, with a median of 5 in patients with orthodontic history and 6 in patients without, with no statistically significant difference. Headaches, reported by almost 80% of the entire cohort, also occurred at a similar frequency in both groups (Yakkaphan et al., 2022).

These results are consistent with most current studies, which do not demonstrate a causal relationship between orthodontic treatment and the development of TMD, and rather emphasize the multifactorial

nature of the disease. The high prevalence of orthodontic history in our sample may reflect the fact that patients with TMD typically seek more dental care, including orthodontics, or that patients with certain malocclusions are more likely to seek out both an orthodontist and subsequently a physiotherapist or TMJ specialist. Selection bias cannot be ruled out – this is a group of patients referred to a specialized facility. Another point to consider is the fact that orthodontic care has become more accessible over the last 10 years or so, whereas previously this treatment was not so readily available and therefore there is no corresponding sample of the population (Manfredini et al., 2022).

In our study, the VAS pain intensity in the group of patients with orthodontic history reached a median of 5 and in the group without orthodontic history a median of 6, with the difference not being statistically significant. This result is consistent with numerous systematic reviews and meta-analyses that report that orthodontic treatment does not represent a clear risk factor for the development of TMD. For example, a large meta-analysis (Jeong et al.; 2024) did not show that orthodontic treatment during adolescence increased the risk of developing temporomandibular disorders. Similarly, Luther (2010) stated in his extensive analysis that there is no proven causal relationship between orthodontic treatment and the development of TMD and that any associations should be understood in the context of multifactorial etiology.

Headaches were present in more than three-quarters of patients in our cohort, which corresponds to the frequency reported in the literature for patients with painful TMD (Yakkaphan et al., 2022; Schiffman et al., 2014). An interesting finding is that their occurrence was similar in patients with (76.5%) and without (81.8%) orthodontic history. These results support the conclusion that orthodontic history is not associated with an increased risk of headaches in patients with TMD. Similarly, systematic reviews show that orthodontic treatment is not consistently associated with an increased prevalence of TMD or related headaches (Manfredini et al., 2022; Liu et al., 2024). In the available literature, headaches associated with orthodontic treatment do not appear to be specifically increased and are rather considered a secondary manifestation of masticatory or cervical muscle imbalance or central sensitization (Ohrbach & Dworkin, 2016).

An interesting finding is the predominance of women in the group with orthodontic history, while in the group without orthodontics, the gender representation is more balanced. This may be related to both the higher prevalence of TMD in women in general and the fact that women are more likely to undergo orthodontic treatment for aesthetic reasons. Another point for consideration could be whether patients perceive pain or discomfort better or differently after orthodontic treatment, as they are often exposed to it during treatment. Several participants were active musicians, which corresponds with the assumption that temporomandibular disorders may occur more frequently in players of wind instruments. In the general population, the prevalence is reported to be approximately 30%, whereas in groups of musicians the prevalence of TMD exceeds 50% (Čelko & Gúth, 2018).

In our sample, more than 60% of patients had undergone orthodontic treatment, which is significantly higher than the average prevalence in the general population (20–35%) (Liu et al., 2024). This disproportion may be related to the fact that patients with TMD more often seek dental and orthodontic care as early as adolescence, for example due to aesthetic or functional difficulties, which, however, may not be directly related to the later onset of TMD (Manfredini et al., 2022). The significant predominance of women in this group (82%) is also consistent with the literature, which shows that women are more frequent patients of orthodontic treatment and at the same time individuals with a higher predisposition to painful forms of TMD — probably due to hormonal, structural and psychosocial factors (Slade et al., 2016).

6 CONCLUSIONS

A high prevalence of orthodontic history (60.7%) was found in a group of 28 patients with TMD. However, the intensity of temporomandibular joint pain and the incidence of headaches did not differ statistically significantly between patients who had undergone orthodontic treatment and those who had not. These results support the opinion and findings of recent studies that orthodontic treatment is unlikely to be an independent risk factor for the development of painful TMD, and emphasize the need for a comprehensive, multifactorial view of the etiology of this disease.

In practice, this means that information about orthodontic treatment alone should not be interpreted as the main cause of TMD. It is more important to focus on the functional state of the TMJ, muscle balance, psychosocial factors, and the overall musculoskeletal system. However, more extensive studies with more precise characteristics of orthodontic interventions are needed to confirm these conclusions.

7 ZUSAMMENFASSUNG

Ausgangspunkt: Die craniomandibuläre Dysfunktion stellt eine heterogene Gruppe von Störungen mit multifaktorieller Ätiologie dar, an der biomechanische, muskuläre, psychosoziale und neurophysiologische Faktoren beteiligt sind. Der Zusammenhang zwischen kieferorthopädischer Vorgeschichte und der Entwicklung einer CMD bleibt unklar. Während einige Metaanalysen ein leicht erhöhtes Risiko nach kieferorthopädischer Behandlung berichten, bestätigen andere großangelegte Studien diese Beziehung nicht. Individuelle Prädispositionen und Malokklusionen scheinen eine stärkere Rolle zu spielen als die Behandlung selbst.

Gruppe: Die Studie umfasste 28 Patientinnen und Patienten im Alter von 18–68 Jahren mit Schmerzen im Kiefergelenk. Siebzehn Personen (60,7 %) berichteten über eine kieferorthopädische Vorgeschichte.

Methoden: Die Teilnehmenden wurden anhand der kieferorthopädischen Vorgeschichte in Gruppen unterteilt. Die primäre Zielvariable war die Schmerzintensität im Kiefergelenk, gemessen mittels VAS-Skala (0–10). Die Datenverteilung wurde mithilfe des Shapiro–Wilk-Tests, visueller Histogrammbetrachtung und Vergleich von Median und Mittelwert geprüft. Aufgrund der fehlenden Normalverteilung wurden nichtparametrische Tests (Mann–Whitney-U- und Chi-Quadrat-Test) angewendet. Das Signifikanzniveau lag bei $p < 0,05$.

Ergebnisse: Patienten mit kieferorthopädischer Vorgeschichte zeigten einen medianen VAS-Wert von 5 (IQR 5–6), Mittelwert 5,35. Teilnehmende ohne Vorgeschichte erreichten einen Median von 6 (IQR 5–6), Mittelwert 5,55. Der Unterschied war statistisch nicht signifikant ($p > 0,05$). Kopfschmerzen berichteten 76,5 % der Patientinnen und Patienten mit Vorgeschichte und 81,8 % ohne, ebenfalls ohne signifikanten Unterschied.

Schlussfolgerungen: Eine kieferorthopädische Vorgeschichte war in dieser CMD-Gruppe nicht mit erhöhter Schmerzintensität oder Kopfschmerzprävalenz verbunden. Die Ergebnisse unterstützen den multifaktoriellen Charakter der CMD und legen nahe, dass die kieferorthopädische Behandlung wahrscheinlich keinen Hauptrisikofaktor darstellt.

8 SUPPLEMENTARY

Table 1: Overview of monitored variables

Table 2: Basic characteristics of the study sample according to orthodontic history

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lôžok na suchú hydromasáž



MEDEXIM

AQUAPEDIS II

Unikátna kombinovaná
vaňa pre vírivú
a perličkovú masáž
horných i dolných
končatín
(vhodná na podávanie
bahenných
a minerálnych
procedúr)



AQUADELÍCIA MINI



Najpredávanejšie
kompaktné
celotelové vane



INCO2

Dávkovač plynu
CO₂



Karboxyterapia
- inovatívna
metóda
v medicíne
21. storočia



AQUADELÍCIA



Celotelové anatomicky
tvarované vane pre vírivú,
perličkovú a podvodnú masáž

AQUAPEDIS I



Najpredávanejší model sedacej
vívky - jediná sedacia vírivka
s tryskami na chodidlá

AQUAPEDIS II galvanic

končatinový galvanický kúpeľ

efektívna sumácia účinku
elektrického prúdu
a hydrostatického efektu vody



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