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Temporomandibular Disorder Symptoms and Orthodontic Treatment: A Cross - Sectional Study

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Abstract: ***The relationship between temporomandibular joint TMJ disorders and orthodontic treatment of malocclusion has shown conflicting results. This study aims to assess the impact of temporomandibular disorders TMDs on the management of orthodontic cases and investigate the correlation between TMDs and various aspects of orthodontic treatment. A cross - sectional study of 242 patients using a doctor - provided questionnaire evaluated occlusion type, muscular integrity, and head and neck pain. Pre - treatment, 0.4 had moderate TMD, 16.5 had mild TMD, and 83.1 were TMD - free. Post - treatment, 2.1 had moderate TMD, 43.8 had mild TMD, and 54.1 were TMD - free. There was a statistically significant difference in TMD presence based on gender and malocclusion type post - treatment P <.05. Individualized treatment plans tailored to each patient's specific malocclusion and TMD status can minimize risks and maximize benefits.***

Keywords: TMDs, occlusion, malocclusion, temporomandibular joint, orthodontic treatment

1. Background

Malocclusion, characterized by misalignment of teeth and improper relation between dental arches, has long been associated with temporomandibular disorders (TMD). Studies suggest that certain malocclusions, such as deep bites, crossbites, and open bites, can predispose individuals to TMD symptoms. The term TMD combines between Pain and dysfunction of the temporomandibular joints and masticatory muscles. The case is represented by There are numerous symptoms, including limits in jaw movement, pain in the face and preauricular area, and noises from the TMJs during jaw motions. Chronic pain motivates patients to seek therapy since it has a negative impact on their quality of life. The cost of diagnosing and treating orofacial pain and TMD is estimated to be approximately $100 billion a year in the United States alone. [1] [2].

In 1887, a surgeon from the United Kingdom authored the first publication documenting the surgical treatment of temporomandibular joint (TMJ) disc displacements. According to Costen, dental malocclusions are associated with discomfort in the temporomandibular joints (TMJs) and the ear, along with other ear - related symptoms like tinnitus, hearing loss, and dizziness. TMD is caused by a combination of causes, not just one, as previously thought. It is a complex condition with several symptoms and indicators. Based on empirical research, it has been observed that around 75% of individuals display the presence of at least one indication of dysfunction in relation to their temporomandibular joint (TMJ), such as deviations in opening, episodic locking, or joint noise. Furthermore, it has been shown that approximately 33% of individuals have at least one symptom associated with temporomandibular disorders (TMD), such as jaw discomfort or face pain. Women have a higher susceptibility, with a ratio of 4 to 1. The prevalence of temporomandibular disorder (TMD) symptoms seems to be higher over the second and fourth decades of an individual's life. [3] [4].

Beyond this disorder, the precise causes are yet unknown. Recent research suggests that biological and psychosocial influences are complex [4]. TMJ treatment is classified into three types: noninvasive, minimally invasive, and invasive. Conservative treatments are the first - line intervention for TMDs, and it has been claimed that between 75% and 90% of TMD patients respond to these easy, inexpensive, and safe measures. [4].

The potential influence of orthodontic therapy on symptoms of temporomandibular dysfunction (TMD) has been a matter of significant interest. This is particularly relevant as orthodontic procedures are designed to address malocclusion. In the past, there has been a historical association between orthodontic interventions, specifically extractions and fast maxillary expansion, and the development of temporomandibular disorders (TMD). Nevertheless, contemporary orthodontic methodologies, like as Invisalign and personalized braces, have considerably mitigated these potential hazards. The implementation of appropriate treatment planning and meticulous biomechanical strategies has resulted in a decrease in the occurrence of difficulties associated with temporomandibular disorders (TMD) in the context of orthodontic interventions [5]. Many studies have been conducted to investigate the link between functional and morphological characteristics. Malocclusion was reported to be one of the causes of TDM infection. However, there are other causes of malocclusion, including deep bite, tooth congestion, and excessive distances between teeth. As a result, no research has been conducted on the relationship between malocclusion and TMDs. As a result, the purpose of this study is to represent and clarify the function of malocclusion and orthodontic therapy in the development of TMDs. [6] [7].

2. Methodology

A group of 242 patients (N=242) (68 males and 174 females) was randomly recruited from the orthodontics clinic in Prince Hashim bin Abdullah II Hospital. Individuals were classified based on malocclusion and orthodontic treatment received. The questionnaire consisted of assessing the functionality of the masticatory system and the presence of symptoms related to temporomandibular joint (TMJ) sounds, restricted mouth

opening, jaw discomfort and fatigue, headaches, and oral parafunctions. The proposal was first put out by Fonseca. [8].

Fonseca's questionnaire used an index to classify individuals into several categories based on the severity of their temporomandibular disorder (TMD), namely mild, moderate, severe, or absence of TMD. For the analysis, the values of 10 and 0 were given to the responses "yes" and "no" in each questionnaire, respectively. A comparison was conducted between the ultimate outcome and the categorization of patients based on the clinical index provided by Fonseca's questionnaire.

1) The total score between the range of 0 to 15 is classified as no temporomandibular disorder
2) The total score is between the range of 20 and 40 and is classified as Mild temporomandibular disorder
3) The total score is between the range of 45 and 65 is classified as Moderate temporomandibular disorder
4) The total score between the range of 70 and 100 is classified as Severe temporomandibular disorder

The statistical computations were conducted using the Statistical Package for Social Sciences 20.0 (SPSS). Frequencies were computed for the variables of Sociodemographic Characteristics and Temporomandibular Disorder (TMD) classification. A Chi - square test was used to compare the patients' TMD severity between the pre - treatment and post - treatment conditions. A significance level of less than 0.05 was used to determine statistical significance.

3. Results

Table 1 shows the sociodemographic characteristics of the study population.

Table 1: Sociodemographic Characteristics of 242 patients

		Frequency	Percent
Gender	Male	68	28.1
	Female	174	71.9
	Total	242	100
Age	<18	150	62
	18 - 25	65	26.9
	>25	27	11.2
	Total	242	100
Duration	≤1	71	29.3
	2 - 3	151	62.4
	>3	20	8.3
	Total	242	100

Table 2: Patient grouping according to Malocclusion types

Malocclusion types			
Types		Frequency	Percent
CL1	__	76	31.4
	Cross bite	8	3.3
	Open bite	3	1.2
	Total	87	35.9
CL2DIV1	__	89	36.8
	Cross bite	8	3.3
	Open bite	3	1.2
	Total	100	41.3
CL2DIV2	__	6	2.5
	Cross bite	3	1.2
	Open bite	3	1.2
	Total	12	4.9
CL3	__	27	11.2
	Cross bite	7	2.9
	Open bite	9	3.7
	Total	43	17.8

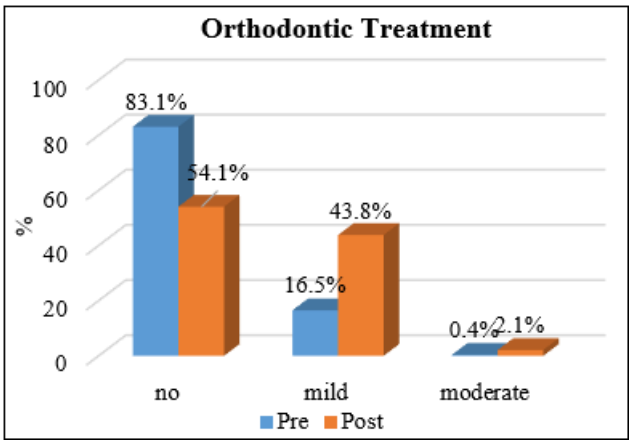

Figure 1: Pre - post with Orthodontic Treatment

When analyzing the TMD index for the whole sample, it was found that 0.4% of the participants exhibited moderate TMD, 16.5% displayed mild TMD, and the other 83.1% were classified as TMD - free (see Figure 1). The results indicated that there was no statistically significant difference seen between the groups (P >.05), and none of the participants were categorized as having severe temporomandibular disorder (TMD). Furthermore, it was observed that in the post - orthodontic treatment phase, a total of 2.1% of the participants exhibited moderate temporomandibular disorder (TMD), while 43.8% displayed mild TMD. The majority, accounting for 54.1% of the subjects, were categorized as TMD - free. Significantly, it is worth mentioning that none of the participants included in this study were categorized as having severe temporomandibular disorder (TMD). When examining the comparison of temporomandibular disorder (TMD) across different age groups, it was found that there was no statistically significant difference between the groups (P >.05) in this research, specifically in the context of pre - orthodontic treatment. Also, In the context of post - orthodontic treatment, a statistically significant difference was seen between the groups, with a p - value of less than 0.05. The following table (Table 1) presents the relevant data. A significant difference (P <.05) was seen when comparing temporomandibular disorder (TMD) prevalence between males and females after orthodontic treatment. The data presented in Table 2 indicates that a much higher proportion of females (84%) did not exhibit any symptoms of temporomandibular disorder (TMD) compared to men, where only 47% were TMD - free.

When TMD presence was associated with Duration no statistically significant association was found (P >.05) in pre - post Orthodontic Treatment (Table 3).

When TMD presence was associated with Malocclusion type there is a statistically significant association was found (P <.05) in post - Orthodontic Treatment (Table 4). The association between TMD severity and Malocclusion type is seen in Figure 2.

Table 1: Association Between Orthodontic Treatment and Age

	Age	No	Mild	Moderate	Chi - square	p - value*
Pre	<18	128	22	0	3.84	0.428
	18 - 25	51	13	1		
	>25	22	5	0		
Post	<18	85	61	4	10.96	0.027
	18 - 25	26	38	1		
	>25	20	7	0		

*The P value in the tables are generated by using Chi - square test

Table 2: Association Between Orthodontic Treatment and Gender

	Gender	No	Mild	Moderate	Chi - square	p - value*
Pre	Male	59	9	0	1.16	0.558
	Female	142	31	1		
Post	Male	47	20	1	8.55	0.014
	Female	84	86	4		

*The P value in the tables are generated by using Chi - square test

Table 3: Association Between Orthodontic Treatment and Duration

	Duration	No	Mild	Moderate	Chi - Square	P - Value*
Pre	≤1	57	14	0	4.86	0.301
	2 - 3	130	20	1		
	>3	14	1A6	0		
Post	≤1	43	26	2	9.09	0.05
	2 - 3	83	66	2		
	>3	5	14	1		

*The P value in the tables are generated by using Chi - square test

Table 4: Association Between Orthodontic Treatment and Malocclusion type

	Malocclusion type	No	Mild	Moderate	Chi - Square	P - Value*
Pre	CL1	72	15	0	4.92	0.554
	CL2DIV1	84	17	0		
	CL2DIV2	10	2	0		
	CL3	35	6	1		
Post	CL1	53	33	1	12.99	0.043
	CL2DIV1	57	43	1		
	CL2DIV2	2	9	1		
	CL3	19	21	2		

*The P value in the tables are generated by using Chi - square test

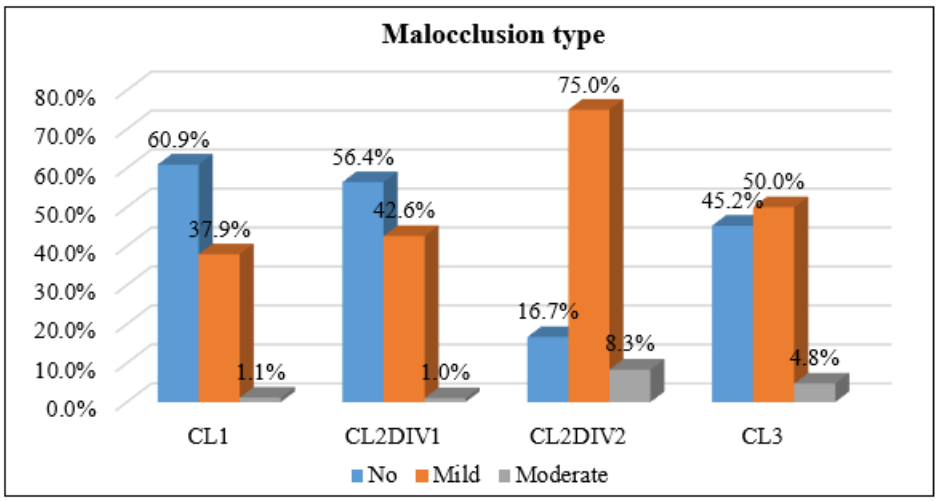

Figure 2: Post test with severity of TMD and Malocclusion type

4. Discussion

There is still some disagreement about the link between the relation of TMD and malocclusion treatment, but several reviews say it is very weak or doesn't exist [9]. Different studies examining the effect of orthodontic treatment on TMD have reached varying conclusions. Some studies found small benefits for patients who were treated, while others found no changes or bad effects between groups [10]. There is a big difference between the dysfunction that was labeled as "moderately severe" or "severe" and the amount of treatment that is thought to be needed for TMD. The number of people

with fairly severe to severe TMD is about 20% to 30%, but only about 5% need treatment [11], [12]. A lot of informal tests, like feeling the muscles and hearing the TMJs click or pop without pain, are used to describe TMD, however, the recorded signs seem to have more weight than the reported symptoms.

Before treatment, 83.1% of our sample was TMD - free, with 16.5% having mild TMD and only 0.4% having moderate TMD. No severe TMD cases were reported. After treatment, 54.1% were TMD - free, 43.8% had mild TMD, and 2.1% had moderate TMD. Again, no severe TMD cases were identified.

In the pre - orthodontic treatment phase, a small percentage (0.4%) of subjects had moderate TMD, indicating a relatively low prevalence. Most individuals exhibited either mild TMD (16.5%) or were TMD - free (83.1%). Interestingly, after orthodontic treatment, there was a noticeable increase in the prevalence of mild TMD (43.8%), although still a significant majority were TMD - free (54.1%). Notably, no subject was classified as having severe TMD at any stage, indicating a generally mild to moderate prevalence in the studied population.

When TMD prevalence was analyzed across age groups, no significant differences were observed before orthodontic treatment. However, after treatment, there was a statistically significant difference, suggesting that age might play a role in post - treatment TMD status. This finding could indicate that orthodontic treatments might have varied impacts on different age groups.

Our results also show significant gender difference in TMD prevalence was observed. Only 47% of males were TMD - free, while 84% of females showed no signs of TMD. This highlights a notable gender - based variation in TMD occurrence after orthodontic treatment. Gender - based differences could be attributed to hormonal differences between males/female, a point that needs more investigation in the future. Although gender variations were reported before [19], however, females were more susceptible to TMD than males, it would be worthy to study the effect of gender on TMD prevalence as our results indicated more males are susceptible to TMD.

A significant association was also found between TMD presence and malocclusion type, indicating that the type of malocclusion might influence the likelihood of developing TMD after orthodontic treatment. In this context, our results agree with previous studies, a study by Al - Khateeb et al found that the type of malocclusion and the presence of parafunctional habits were significant risk factors for TMD development after orthodontic treatment [13]. Another study has also shown that some morphological malocclusions are more important than others about TMD [14]. Other studies also indicated that other factors affect TMD symptoms other than malocclusion like psychological symptoms [15]. Several researchers [20, 21] consider that certain dental interventions, including orthodontics itself, may cause TMD. Relapse after orthodontic treatment has also been reported [22].

A systematic review and meta - analysis have determined a connection between orthodontic treatment and the occurrence of TMD. Individuals undergoing orthodontic treatment are reportedly up to 1.84 times more likely to develop TMD, as indicated by multiple studies [16]. This comprehensive review included case - control and cohort studies examining the relationship between orthodontic treatment and TMD [16]. Sim et al [24] suggested TMD may have a correlation with the age or gender of the patients under examination, as well as with occlusal interference occurring during orthodontic treatment. Velly et al [25] also reported orthodontic treatment as a factor related to TMD. It has also been reported that several types of orthodontic treatments could be the cause of TMD [26].

TMDs include a complex etiology including multiple factors. The causal link between occlusion and these illnesses requires greater investigation, as certain occlusal changes may be attributed to malocclusion rather than serving as its primary cause [17].

As some research suggests that malocclusions are linked to TMD, hence, orthodontic therapy is encouraged for resolving various malocclusions, aiming to decrease the risk of TMD incidence [17]. Available data indicate a significant statistical association between TMD and malocclusions, particularly concerning dental class, bite, and midline deviation. However, it's worth noting that results in the existing literature regarding this association remain contentious [18]. Longitudinal studies have emphasized the challenges in establishing malocclusion as a significant risk factor for temporomandibular disorder (TMD) since they have shown clear individual variability in the signs and symptoms of TMD over time. Recent longitudinal studies have shown evidence of a notable decline in the prevalence and manifestations of temporomandibular disorder (TMD) throughout the transition from adolescence to early adulthood [27].

Interestingly, while our results show malocclusions have a clear connection to TMD, there was no observed correlation between TMD and prior orthodontic treatment. There seem to be other factors contributing, like the effect of the psychological factor, which have been reported before [23]. To resolve the conflicting findings and fully understand the interplay between TMD and malocclusions, further longitudinal studies with robust statistical power are crucial. Most research relying on Fonsica's questionnaire, although valid, is built on patients telling their symptoms, future research should focus on clinical diagnosis beside the theoretical data provided by the questionnaire.

5. Recommendations

Orthodontic practitioners play a pivotal role in understanding the delicate balance between malocclusion, orthodontic treatment, and TMD. Thorough patient assessments, including comprehensive evaluations of dental and TMJ health, are essential before initiating orthodontic procedures. Individualized treatment plans, tailored to each patient's specific malocclusion and TMD status, can minimize the risks and maximize the benefits of orthodontic interventions.

These findings suggest that orthodontic treatment had a positive impact on reducing the prevalence of TMD, with the

majority of patients experiencing improvement or remaining TMD - free after treatment. The study underscores the importance of considering gender differences and malocclusion types in assessing TMD risks post - orthodontic intervention. Additionally, the lack of association with treatment duration indicates that the quality and type of treatment might be more critical factors than the duration alone.

This study provides valuable insights into the correlation between TMDs and orthodontic treatments, highlighting the importance of personalized treatment plans to enhance patient outcomes.

These results provide valuable information for orthodontic practitioners, indicating potential areas of focus for personalized treatment plans and preventive measures, especially concerning specific malocclusion types and gender - related differences in TMD outcomes. Further research could delve into the specific factors contributing to the observed gender and malocclusion - based disparities, aiding in the development of more targeted and effective orthodontic interventions.

6. Conclusion

According to our results, TMD is related to the type of malocclusion and gender post - treatment. Further research is needed to investigate additional factors related to TMD and to develop more targeted orthodontic interventions.

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