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Prevalence of Temporomandibular Joint Disorders in Patients with Malocclusion: A Cross-Sectional Study

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ABSTRACT

Background: Temporomandibular disorders (TMD) are multifactorial conditions affecting the temporomandibular joint and masticatory muscles. Malocclusion has been suggested as a contributing factor; however, its association with TMD remains controversial. This study aimed to determine the prevalence of TMD among patients with malocclusion and to evaluate its association with different classes of malocclusion.

Study Design: A cross-sectional study

Place and Duration of the Study: The study was conducted over a period of one year, from January 2024 to December 2024, at the Department of Orthodontics, Khyber College of Dentistry (KCD), Peshawar.

Materials and Methods: A total of 190 patients diagnosed with malocclusion were included in this study. Malocclusion was classified according to Angle's classification (Class I, II, and III), and Temporomandibular disorders (TMD) were assessed using standardized diagnostic criteria. Demographic variables were recorded for all participants. Associations between variables were analyzed using the chi-square test, while multivariable logistic regression was performed to identify independent predictors of TMD. A p-value of < 0.05 was considered statistically significant.

Results: The overall prevalence of TMD among patients with malocclusion was 41.1% (78/190). TMD prevalence was 25.0% in Class I, 50.0% in Class II, and 57.5% in Class III malocclusion. A significant association was found between malocclusion class and TMD ($\chi^2 = 14.62$, $p = 0.001$). Females had a higher prevalence of TMD than males (48.2% vs 30.8%, $p = 0.011$). Logistic regression showed that Class II (Adjusted OR = 2.89, 95% CI: 1.39–6.01) and Class III malocclusion (Adjusted OR = 3.52, 95% CI: 1.54–8.05) were significant independent predictors of TMD.

Conclusion: TMD was common among patients representing at orthodontic department of KCD, Peshawar with malocclusion, particularly in Class II and III cases. Early orthodontic evaluation and interdisciplinary management may help reduce the burden of TMD.

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Key Words
Temporomandibular Joint Disorders, TMD, Malocclusion, Prevalence, Orthodontics

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INTRODUCTION

Temporomandibular joint disorders (TMD) represent a group of musculoskeletal and neuromuscular conditions involving the temporomandibular joint (TMJ), masticatory muscles, and associated structures [1]. TMD is characterized by pain in the jaw, joint sounds such as clicking or crepitus, restricted mandibular movement, and functional impairment [2]. It is considered one of the most common causes of non-dental orofacial pain and significantly affects patients' quality of life [3].

The etiology of TMD is multifactorial and includes biological, behavioral, environmental, and psychological factors [4]. Contributing factors such as trauma, parafunctional habits, stress, occlusal discrepancies, and structural abnormalities have been widely investigated [5]. Among these, malocclusion has

long been debated as a potential predisposing or contributing factor in the development of TMD [6].

Malocclusion refers to any deviation from normal occlusion and is commonly classified according to Angle's classification into Class I, Class II, and Class III malocclusions [7]. Severe malocclusion may alter the biomechanics of the temporomandibular joint, potentially leading to abnormal loading, muscular imbalance, and joint dysfunction [8]. Several studies have suggested that certain occlusal traits, such as increased overjet, deep bite, posterior crossbite, and open bite, may be associated with signs and symptoms of TMD [9].However, the relationship between malocclusion and TMD remains controversial. While some epidemiological studies report a significant association between specific malocclusion types and TMD symptoms [10], others argue that occlusal factors play only a minor role compared to psychosocial and behavioral contributors [11]. This inconsistency in findings may be attributed to differences in diagnostic criteria, study design, population characteristics, and sample size [12].

The prevalence of TMD varies widely across populations, ranging from 10% to 60%, depending on diagnostic methods and age groups studied [13]. Higher prevalence rates have often been reported among females and young adults, suggesting possible hormonal and psychosocial influences [3, 13]. Given the high frequency of malocclusion in the general population and the potential functional implications of TMD, understanding their relationship is clinically important for orthodontists and general dental practitioners. Despite ongoing debate, there remains a need for well-designed cross-sectional studies to evaluate the prevalence of TMD among patients with different classes of malocclusion. Identifying possible associations may contribute to early detection, risk assessment, and interdisciplinary management strategies.

Therefore, the aim of the present study was to determine the prevalence of temporomandibular joint disorders among patients with malocclusion representing at orthodontic department of KCD Peshawar and to assess its association with different malocclusion classes and related demographic factors.

MATERIALS AND METHODS

Study Design and Setting

A cross-sectional study was conducted in the Department of Orthodontics, Khyber College of Dentistry (KCD), Peshawar, from January 2024 to December 2024 to determine the prevalence of Temporomandibular joint disorders (TMD) among patients with malocclusion and to evaluate its association with different classes of malocclusion.

Sample Size and Sampling Technique

The sample size was calculated using the single population proportion formula, n=Z2P(1–P)d2n = frac{Z^2 P (1 - P)}{d^2}n=d2Z2P(1–P), where Z=1.96Z = 1.96Z=1.96 (95% confidence level), P=50%P = 50%P=50% (assumed prevalence due to variability in the literature), and d=5%d = 5%d=5% (margin of error). The minimum calculated sample size was 384; however, due to feasibility constraints and the limited study duration, a total of 190 participants were included in the study. A non-probability convenience sampling technique was employed to recruit participants

Inclusion Criteria

- Patients with a clinical diagnosis of malocclusion according to Angle's classification (Class I, Class II, or Class III)
- Patients who provided informed consent to participate in the study

Exclusion Criteria

- Patients with a history of previous orthodontic treatment
- Patients with a history of maxillofacial trauma
- Patients with systemic musculoskeletal disorders
- Patients with congenital craniofacial anomalies
- Patients undergoing ongoing treatment for temporomandibular joint disorders (TMD), as these factors could influence the study outcomes

Data Collection Procedure

Ethical approval for the study was obtained from the Institutional Review Board of Khyber College of Dentistry (KCD), Peshawar (Ref. No. 7481/KCD, dated 121/10/2023). Written informed consent was obtained from all participants prior to data collection. For participants under 18 years of age, consent was obtained from parents or legal guardians. Confidentiality and anonymity of participants were strictly maintained throughout the study.Data were collected through clinical examination and structured recording forms. Demographic information, including age, sex, residence, educational level, and socioeconomic status, was recorded.Malocclusion was assessed clinically and classified according to Angle's classification into Class I, Class II, and Class III. The severity of malocclusion was categorized as mild,

moderate, or severe based on clinical judgment and occlusal discrepancies.Temporomandibular joint disorders were assessed using standardized diagnostic criteria, including evaluation of joint pain, joint sounds (clicking or crepitus), tenderness of masticatory muscles, and limitation or deviation in mandibular movements. TMD diagnosis was established when at least one of the following was present: pain on palpation of the TMJ or masticatory muscles, joint sounds (clicking or crepitus) during mandibular movement, or limitation/deviation in mandibular opening (<40 mm). The assessment was performed by a calibrated examiner to ensure consistency.The dependent variable in this study was the presence or absence of TMD. Independent variables included malocclusion class, severity of malocclusion, age group, sex, and residence.

Statistical Analysis

Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 27.0. Descriptive statistics were used to summarize demographic characteristics and calculate the prevalence of TMD. Categorical variables were expressed as frequencies and percentages.The association between TMD and independent variables was assessed using the Chi-square test. Variables that showed statistical significance in bivariate analysis were further analyzed using multivariable logistic regression to determine independent predictors of TMD. Adjusted odds ratios (OR) with 95% confidence intervals (CI) were calculated. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The study sample consisted of 190 participants, with the majority aged between 18–25 years (31.6%), followed by 26–35 years (26.3%), while individuals aged ≥46 years represented the smallest proportion (7.9%). Females (58.9%) outnumbered males (41.1%), and most participants resided in urban areas (63.2%). Regarding educational status, the largest group had a college or diploma qualification (42.1%), followed by secondary education or below (36.8%), whereas 21.1% had university or postgraduate education. Half of the participants were single (50.0%), and 42.1% were married. In terms of socioeconomic status, the majority belonged to the middle-income group (44.7%), with 39.5% in the low-income category. Clinically, Class I malocclusion was the most prevalent (42.1%), followed by Class II (36.8%) and Class III (21.1%). Most participants had moderate malocclusion severity (44.7%), while severe malocclusion was observed in 18.4% of cases. Overall, the sample was predominantly composed of young adults, females, urban residents, and individuals with moderate malocclusion.

Table 1: Demographic and Baseline Characteristics of the Study Sample (N = 190)

Variable	Category	n	%
Age group (years)	12–17	35	18.4
	18–25	60	31.6
	26–35	50	26.3
	36–45	30	15.8
	≥46	15	7.9
Sex	Male	78	41.1
	Female	112	58.9
Residence	Urban	120	63.2
	Rural	70	36.8
Education level	Secondary or below	70	36.8
	College / Diploma	80	42.1
	University / Postgraduate	40	21.1
Marital status	Single	95	50.0
	Married	80	42.1
	Divorced/Widowed	15	7.9
Monthly household income	Low	75	39.5
	Middle	85	44.7
	High	30	15.8
Angle's malocclusion class *(baseline clinical)*	Class I	80	42.1
	Class II	70	36.8
	Class III	40	21.1
Malocclusion severity *(baseline clinical)*	Mild	70	36.8
	Moderate	85	44.7
	Severe	35	18.4

The overall prevalence of temporomandibular joint disorders (TMD) among the 190 patients with malocclusion was 41.1%. When analyzed according to malocclusion class, TMD prevalence was lowest in Class I patients (25.0%), where only 20 out of 80 individuals were affected. In contrast, Class II patients showed a markedly higher prevalence of 50.0%, with 35 out of 70 patients presenting with TMD. The highest prevalence was observed in Class III malocclusion, where 57.5% (23 out of 40) of patients were diagnosed with TMD. These findings indicate a clear increasing trend in TMD prevalence from Class I to Class III malocclusion, suggesting that more severe sagittal discrepancies may be associated with a higher likelihood of developing temporomandibular joint disorders.

Table 2: Prevalence of Temporomandibular Disorders (TMD) Overall and by Malocclusion Class (N = 190)

Malocclusion Class	Total (n)	TMD Present (n)	TMD Absent (n)	Prevalence of TMD (%)
Class I	80	20	60	25.0%
Class II	70	35	35	50.0%
Class III	40	23	17	57.5%
Overall	**190**	**78**	**112**	**41.1%**

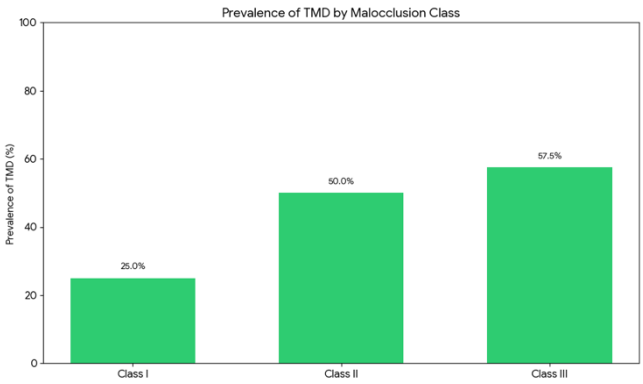

Figure 1: Prevalence of TMD

The cross-tabulation analysis demonstrated that TMD prevalence was significantly associated with sex, age group, malocclusion class, and malocclusion severity. Females exhibited a significantly higher prevalence of TMD (48.2%) compared to males (30.8%) (p = 0.011). Similarly, participants aged ≥30 years showed a higher proportion of TMD (50.0%) compared to those under 30 years (34.5%), and this association was statistically significant (p = 0.048). A strong association was observed between malocclusion class and TMD (p = 0.001), with prevalence increasing progressively from Class I (25.0%) to Class II (50.0%) and Class III (57.5%). Malocclusion severity also showed a significant relationship with TMD (p = 0.003), as prevalence increased from mild (25.7%) to moderate (47.1%) and severe cases (57.1%). In contrast, no statistically significant association was found between residence and TMD (p = 0.432), although urban participants had a slightly higher prevalence (43.3%) compared to rural participants (37.1%). Overall, the findings suggest that demographic factors such as sex and age, along with clinical characteristics of malocclusion, play an important role in the occurrence of TMD.

Table 3: Cross-Tabulation of Selected Variables with TMD (N = 190)

Variable	Category	TMD Present n (%)	TMD Absent n (%)	Total (n)	p-value
Sex	Male	24 (30.8%)	54 (69.2%)	78	**0.011**
	Female	54 (48.2%)	58 (51.8%)	112	
Age Group	< 30 years	38 (34.5%)	72 (65.5%)	110	0.048
	≥ 30 years	40 (50.0%)	40 (50.0%)	80	
Malocclusion Class	Class I	20 (25.0%)	60 (75.0%)	80	**0.001**
	Class II	35 (50.0%)	35 (50.0%)	70	
	Class III	23 (57.5%)	17 (42.5%)	40	
Malocclusion Severity	Mild	18 (25.7%)	52 (74.3%)	70	**0.003**
	Moderate	40 (47.1%)	45 (52.9%)	85	
	Severe	20 (57.1%)	15 (42.9%)	35	
Residence	Urban	52 (43.3%)	68 (56.7%)	120	0.432
	Rural	26 (37.1%)	44 (62.9%)	70	

The multivariable logistic regression analysis identified several independent predictors of temporomandibular joint disorders (TMD). Females were nearly twice as likely to develop TMD compared to males (Adjusted OR = 1.92; 95% CI: 1.05–3.50; p = 0.034), indicating a statistically significant association. Patients aged ≥30 years had higher odds of TMD (OR = 1.58); however, this association was not statistically significant (p = 0.125), as the confidence interval included 1. A strong and statistically significant association was observed between malocclusion class and TMD. Patients with Class II malocclusion were approximately 2.9 times more likely (OR = 2.89; 95% CI: 1.39–6.01; p = 0.004), and those with Class III were 3.5 times more likely (OR = 3.52; 95% CI: 1.54–8.05; p = 0.003) to develop TMD compared to Class I patients. Severe malocclusion was also a significant predictor (OR = 2.15; 95% CI: 1.08–4.30; p = 0.029). In contrast, urban residence was not significantly associated with TMD (p = 0.510). Overall, the findings indicate that malocclusion class and severity, along with female gender, are significant independent predictors of TMD.

Table 4: Multivariable Logistic Regression Analysis for Predictors of TMD (N = 190)

Variable	Adjusted OR	95% CI	p-value
Sex (Female vs Male)	1.92	1.05 – 3.50	0.034
Age ≥30 years	1.58	0.88 – 2.84	0.125
Class II vs Class I	2.89	1.39 – 6.01	0.004
Class III vs Class I	3.52	1.54 – 8.05	0.003
Severe Malocclusion	2.15	1.08 – 4.30	0.029
Urban Residence	1.21	0.68 – 2.15	0.510

DISCUSSION

The present cross-sectional study aimed to determine the prevalence of temporomandibular joint disorders (TMD) among patients representing at orthodontic department of KCD, Peshawar with malocclusion and to evaluate its association with different malocclusion classes. The overall prevalence of TMD in this study was 41.1%, indicating that TMD is relatively common among individuals presenting with occlusal discrepancies. This finding is consistent with previous epidemiological studies reporting prevalence rates ranging between 30% and 50% among orthodontic patients [14, 15].

In the present study, TMD prevalence was significantly higher among patients with Class II and Class III malocclusion compared to those with Class I malocclusion. These results align with earlier investigations suggesting that sagittal discrepancies and abnormal jaw relationships may contribute to altered temporomandibular joint biomechanics and muscular imbalance [16, 17]. Class II malocclusion, particularly when associated with increased overjet, has been linked to functional disturbances and joint instability [18]. Similarly, Class III malocclusion may predispose individuals to abnormal mandibular positioning and increased joint loading, potentially increasing susceptibility to TMD [19].

The statistically significant association observed between malocclusion severity and TMD further supports the hypothesis that greater occlusal discrepancies may increase the risk of functional disturbances within the temporomandibular joint complex. Previous studies have reported that severe malocclusion traits such as deep bite, posterior crossbite, and open bite are associated with higher odds of TMD symptoms [20]. However, some researchers argue that occlusion alone cannot fully explain the development of TMD and should be considered one of multiple contributing factors rather than a primary cause [21].

The present study also demonstrated a significantly higher prevalence of TMD among females compared to males. This finding is consistent with the literature, which consistently reports a female predominance in TMD cases [22]. Hormonal influences, particularly the role of estrogen receptors in the temporomandibular joint, have been proposed as possible explanations for this gender difference [23]. Additionally, psychosocial stress and pain perception differences may contribute to increased reporting of TMD symptoms among females [24].

Age was found to have a modest association with TMD in this study, with higher prevalence observed in adults compared to younger participants. This observation is supported by previous research suggesting that TMD symptoms tend to increase during adolescence and early adulthood [25]. Functional adaptation over time and cumulative exposure to risk factors such as stress and parafunctional habits may explain this trend. Despite the statistically significant associations identified in this study, it is important to acknowledge the ongoing controversy regarding the causal relationship between malocclusion and TMD. Some longitudinal studies have failed to establish a strong direct causal link, emphasizing instead the multifactorial nature of TMD, including psychological, behavioral, and genetic factors [21, 26]. Therefore, while malocclusion may contribute to TMD risk, it should not be considered an isolated etiological factor.The cross-sectional design of this study limits the ability to establish causal relationships between malocclusion and TMD. Additionally, reliance on clinical examination without advanced imaging modalities may have underestimated subclinical joint abnormalities. Nevertheless, the study provides valuable epidemiological insight into the burden of TMD among orthodontic patients and highlights the importance of comprehensive functional assessment during orthodontic diagnosis.

Overall, the findings suggest that patients with Class II and Class III malocclusion, as well as those with severe occlusal discrepancies, may have increased odds of presenting with TMD. These results underscore the need for early screening, multidisciplinary evaluation, and careful orthodontic treatment planning to minimize potential functional complications of the temporomandibular joint.The findings of this study have important clinical implications. Orthodontists should incorporate routine screening for TMD signs and symptoms during initial assessment of patients with moderate to severe

malocclusion, particularly in Class II and Class III cases. Early identification may facilitate timely multidisciplinary intervention and potentially prevent progression of joint dysfunction.

This cross-sectional study was conducted at a single center, which may limit the generalizability of the findings to a broader population. The use of a non-probability convenience sampling technique and a relatively smaller sample size than initially calculated may introduce selection bias. Additionally, the cross-sectional design does not allow for establishing a causal relationship between malocclusion and temporomandibular joint disorders (TMD). Clinical assessment without advanced diagnostic imaging may also have affected the accuracy of TMD diagnosis.

CONCLUSION

The present cross-sectional study demonstrated that temporomandibular joint disorders (TMD) are relatively common among patients attending orthodontic department of KCD, Peshawar with malocclusion, with an overall prevalence of 41.1%. A statistically significant association was observed between TMD and malocclusion class, particularly among patients with Class II and Class III malocclusion. Additionally, increased severity of malocclusion and female gender were identified as significant factors associated with higher TMD prevalence.These findings suggest that occlusal discrepancies, especially sagittal malrelationships, may contribute to functional disturbances within the temporomandibular joint complex. However, given the multifactorial nature of TMD, malocclusion should be considered as a potential contributing factor rather than a sole etiological determinant.Early identification of TMD signs and symptoms during orthodontic assessment is essential. A comprehensive clinical evaluation and interdisciplinary approach involving orthodontists and other dental specialists may help in reducing the burden of TMD and improving patient outcomes.Further longitudinal studies with larger sample sizes and standardized diagnostic criteria are recommended to better understand the causal relationship between malocclusion and temporomandibular joint disorders.

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AUTHORS' CONTRIBUTION

Concept & Design of Study: Dr. Saira Bilal
Drafting: Dr. Palwasha Gul
Data Analysis: Dr. Saira Bilal, Dr. Palwasha Gul
Critical Review: Asma Ahmad
Final Approval of Version: Dr. Saira Bilal, Dr.Asma Ahmad, Dr. Palwasha Gul
All authors have reviewed and approved the final manuscript.

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