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Original Article

Bruxism Burden and Masticatory Performance in Orthodontic Patients

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ABSTRACT

Background: Bruxism is highly prevalent among orthodontic patients and may negatively affect masticatory efficiency, muscular function, and pain perception. Despite increasing recognition of parafunctional jaw activity during orthodontic treatment, the functional consequences of bruxism on chewing performance remain insufficiently investigated. Objective: To assess the association between bruxism risk and masticatory performance, and to examine the relationship of bruxism risk and chewing dysfunction with pain severity among orthodontic patients. Methods: This cross-sectional observational study included 115 orthodontic patients recruited through convenience sampling from dental hospitals and clinics in Lahore, Pakistan. Bruxism risk was assessed using the Bruxism Evaluation Questionnaire (BEQ), chewing performance was evaluated using the Chewing Function Questionnaire (CFQ), and pain severity was measured using the Visual Analogue Scale (VAS). Data were analyzed using IBM SPSS Statistics version 27.0.1. Descriptive statistics and Pearson's chi-square tests were applied, with statistical significance established at $p < 0.05$. Results: High bruxism risk was identified in 88 participants (76.5%). Mild chewing difficulty was the most frequent chewing category (43.5%), while 27.0% demonstrated moderate chewing difficulty. Significant associations were observed between bruxism risk and chewing dysfunction, $\chi^2(6) = 41.967$, $p < 0.001$, bruxism risk and pain severity, $\chi^2(2) = 26.023$, $p < 0.001$, and chewing dysfunction and pain severity, $\chi^2(6) = 41.967$, $p < 0.001$. Among participants with high bruxism risk, 85.2% demonstrated some degree of chewing dysfunction, compared with 33.3% in the low-risk group. Moderate-to-severe pain was also substantially more frequent among high-risk participants. Conclusion: Bruxism risk was highly prevalent among orthodontic patients and was significantly associated with impaired masticatory performance and increased pain severity. These findings support routine bruxism screening and chewing function assessment during orthodontic treatment and emphasize the need for multidisciplinary strategies aimed at improving oral function and reducing pain-related burden. Keywords: Bruxism; masticatory performance; chewing function; orthodontic treatment; orofacial pain; parafunctional habits.

INTRODUCTION

Mastication is a highly coordinated functional activity involving synchronized interaction between the teeth, temporomandibular joints, jaw musculature, nervous system, and cervical structures. Efficient chewing is essential not only for food fragmentation and digestion but also for maintaining nutritional intake, oral comfort, and overall quality of life. Alterations in masticatory efficiency may compromise dietary behavior, muscular endurance, and oral function, particularly in individuals undergoing orthodontic treatment. Despite the functional significance of chewing performance, orthodontic outcomes are commonly evaluated through esthetic alignment and occlusal correction rather than through assessment of oral motor efficiency and patient-reported functional capacity. Functional disturbances such as chewing difficulty, muscular fatigue during mastication, and pain while eating may therefore remain underrecognized during orthodontic management. Because

orthodontic appliances alter occlusal contact patterns and neuromuscular adaptation, evaluation of masticatory function may provide clinically meaningful information regarding treatment tolerance and oral functional recovery.

Bruxism is a parafunctional jaw-muscle activity characterized by repetitive clenching, grinding, or mandibular bracing during sleep or wakefulness. It is considered a multifactorial condition influenced by neuromuscular, behavioral, psychosocial, and biomechanical factors. In orthodontic populations, bruxism has gained increasing attention because occlusal changes, appliance discomfort, altered bite mechanics, and muscle adaptation may contribute to parafunctional activity. Previous investigations have demonstrated a substantial prevalence of self-reported bruxism among patients receiving orthodontic treatment, indicating that parafunctional jaw activity may be particularly common in individuals with malocclusion or active occlusal modification. Bruxism may also interfere with orthodontic outcomes through excessive mechanical loading on teeth and appliances, resulting in bracket failure, appliance instability, abnormal tooth wear, and delayed treatment progression. In addition, orthodontic appliances such as aligners, retainers, splints, and fixed braces may interact differently with parafunctional behavior and muscular loading patterns, potentially influencing symptom severity and oral function.

The relationship between bruxism and masticatory dysfunction is supported by growing evidence demonstrating abnormal activation of masticatory muscles in affected individuals. Electromyographic studies have shown altered recruitment patterns of the masseter and temporalis muscles in patients with different forms of bruxism, suggesting that parafunctional activity may impair normal chewing biomechanics and muscular efficiency. Persistent clenching and grinding can induce muscle fatigue, reduce bite-force coordination, increase mechanosensitivity, and provoke pain within the masticatory system. These alterations may contribute to difficulty chewing foods with varying consistencies and may further reinforce pain-related motor adaptations. Bruxism has also been associated with masticatory muscle myalgia, temporomandibular discomfort, and elevated pain perception, indicating that functional chewing impairment and orofacial pain may coexist within a broader neuromuscular dysfunction pattern. Although several studies have examined bruxism in relation to temporomandibular disorders and muscular activity, limited research has specifically explored the association between bruxism risk, chewing function, and pain severity among orthodontic patients, particularly within South Asian clinical populations.

Understanding the relationship between bruxism and masticatory performance may improve orthodontic treatment planning and facilitate earlier identification of patients at risk of functional impairment. Evaluation of chewing difficulty alongside parafunctional behavior may provide insight into patient adaptation during orthodontic treatment and may support multidisciplinary interventions aimed at improving oral function and reducing pain-related burden. Therefore, the present study aimed to determine the prevalence of bruxism risk and chewing dysfunction among orthodontic patients and to examine the association between bruxism risk and masticatory performance. In addition, the study investigated the relationship of bruxism risk and chewing difficulty with pain severity. It was hypothesized that increased bruxism risk would be significantly associated with impaired masticatory performance and greater pain severity among orthodontic patients.

MATERIALS AND METHODS

A cross-sectional observational study was conducted among orthodontic patients attending dental hospitals and outpatient dental clinics in Lahore, Pakistan. The study was designed to evaluate the relationship between bruxism risk, masticatory performance, and pain severity in individuals receiving orthodontic care or post-treatment dental management. Data collection was completed over an estimated period of four months under supervised clinical conditions.

Participants were recruited using a non-probability convenience sampling technique. The required sample size was calculated using Rao-soft sample size software with a 95% confidence interval and 5% margin of error, resulting in a final sample of 115 participants. Male and female orthodontic patients aged between 13 and 60 years were eligible for inclusion. Participants included individuals with current orthodontic treatment, previous orthodontic intervention, dental anomalies, or parafunctional oral habits associated with orthodontic concerns. Exclusion criteria included neurological disorders affecting neuromuscular coordination, history of cervical spine injury or surgery, chronic musculoskeletal conditions affecting jaw function, use of medications capable of altering neuromuscular performance, pregnancy, and psychiatric conditions that could interfere with questionnaire responses or participation.

Bruxism risk was assessed using the Bruxism Evaluation Questionnaire, a self-reported screening instrument designed to evaluate parafunctional oral behavior and symptoms associated with awake and sleep bruxism. The questionnaire assessed domains including jaw clenching, tooth grinding, jaw stiffness, muscular fatigue, awareness of nocturnal grinding, and oral discomfort associated with parafunctional activity. Participants completed the questionnaire under direct supervision of the research team to ensure adequate comprehension of all items. Total scores were calculated according to the predefined scoring system. Participants with cumulative scores greater than 15 were categorized as having high risk of bruxism, whereas scores below 15 were classified as indicating no significant bruxism risk.

Chewing function was evaluated using the Chewing Function Questionnaire, a validated patient-reported instrument developed to assess functional mastication ability and perceived chewing difficulty. The questionnaire included items related to tolerance of different food consistencies, fatigue during chewing, pain while chewing, chewing efficiency, and overall satisfaction with masticatory performance. Based on cumulative scores, participants were categorized into four chewing function groups: normal chewing function (0–5), mild chewing difficulty (6–15), moderate chewing difficulty (16–25), and severe chewing difficulty (26–40). Higher scores reflected greater impairment in masticatory performance and reduced functional chewing capacity.

Pain severity was measured using the Visual Analogue Scale. Participants rated their pain intensity on a 10-cm horizontal line ranging from “no pain” to “worst imaginable pain.” Pain scores were subsequently categorized into mild pain (0–3), moderate pain (4–6), and severe pain (7–10). The VAS was selected because of its established reliability and ease of use in clinical pain assessment studies involving musculoskeletal and orofacial conditions.

Cervical proprioceptive assessment using the Cervical Joint Position Error test was also performed as part of the parent study. However, the relationship between cervical joint position error, bruxism risk, and pain severity is reported separately in a companion manuscript focused specifically on cervical sensorimotor dysfunction in orthodontic patients.

Following institutional ethical approval, eligible participants were approached in participating dental settings and informed regarding the study objectives, procedures, confidentiality measures, and voluntary nature of participation. Written informed consent was obtained before data collection. Participants first completed the Bruxism Evaluation Questionnaire, Chewing Function Questionnaire, and Visual Analogue Scale under researcher supervision to minimize incomplete responses and improve response accuracy. All collected information was coded anonymously to preserve participant confidentiality.

Data were entered and analyzed using IBM SPSS Statistics version 27.0.1. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated for demographic and baseline variables. The prevalence of bruxism risk categories, chewing difficulty categories, and pain severity groups was determined. Pearson’s chi-square test was used to examine associations between bruxism risk and masticatory performance, bruxism risk and pain severity, and chewing function and pain severity. Linear-by-linear association testing was applied to evaluate ordinal trends across severity categories. Statistical significance was established at $p < 0.05$.

The study was conducted after obtaining ethical approval from the relevant institutional authority. Participation was entirely voluntary, and written informed consent was obtained from all participants before enrollment. Participants were informed of their right to withdraw from the study at any stage without consequences. Confidentiality and anonymity were maintained throughout data collection, analysis, and reporting procedures.

RESULTS

A total of 115 orthodontic patients participated in the study, and complete data were available for all variables analyzed. Most participants belonged to the younger age category, with females representing a greater proportion of the study population. The majority of participants had normal body mass index values, while overweight and underweight categories were less common. Bruxism-related symptoms before treatment were frequently reported, and although symptom frequency appeared to decline after treatment initiation, parafunctional behavior remained common within the cohort. Night guards and fixed braces were among the most frequently used orthodontic devices.

Table 1. Demographic and clinical characteristics of participants (n = 115)

Variable	Category	Frequency (n)	Percentage (%)
Age group	13–39 years	98	85.2
	40–59 years	14	12.2
	≥60 years	3	2.6
Gender	Male	46	40.0
	Female	69	60.0
Body mass index	Underweight	13	11.3
	Normal weight	67	58.3
	Overweight	26	22.6
	Obese	9	7.8
Pre-treatment bruxism symptoms	Never	28	24.3
	Sometimes	42	36.5
	Often	31	27.0
	Always	14	12.2
Post-treatment bruxism symptoms	Never	35	30.4
	Sometimes	45	39.1
	Often	31	27.0
	Always	4	3.5
Orthodontic device used	Occlusal splint	11	9.6
	Night guard	40	34.8
	Essix retainer	12	10.4
	Hawley retainer	7	6.1
	Invisalign	20	17.4
	Braces	25	21.7

Table 2. Distribution of bruxism risk, masticatory performance, and pain severity

Variable	Category	Frequency (n)	Percentage (%)
Bruxism risk (BEQ)	No risk of bruxism (<15)	27	23.5
	High risk of bruxism (>15)	88	76.5
Chewing function (CFQ)	Normal chewing (0–5)	31	27.0
	Mild chewing difficulty (6–15)	50	43.5
	Moderate chewing difficulty (16–25)	31	27.0
	Severe chewing difficulty (26–40)	3	2.6
Pain severity (VAS)	Mild pain (0–3)	53	46.1
	Moderate pain (4–6)	44	38.3
	Severe pain (7–10)	18	15.7

Table 3. Association between bruxism risk and chewing function

Bruxism risk	Normal chewing n (%)	Mild chewing difficulty n (%)	Moderate chewing difficulty n (%)	Severe chewing difficulty n (%)	Total
No risk of bruxism	18 (66.7)	7 (25.9)	2 (7.4)	0 (0.0)	27
High risk of bruxism	13 (14.8)	43 (48.9)	29 (33.0)	3 (3.4)	88
Total	31	50	31	3	115

Test	Value	df	p-value
Pearson chi-square	41.967	6	<0.001
Likelihood ratio	40.875	6	<0.001
Linear-by-linear association	27.624	1	<0.001

The Bruxism Evaluation Questionnaire demonstrated that 88 participants (76.5%) were categorized as having high risk of bruxism, while 27 participants (23.5%) showed no significant bruxism risk. Evaluation of masticatory performance using the Chewing Function Questionnaire showed that mild chewing difficulty was the most common category, followed by normal chewing function and moderate chewing difficulty. Severe chewing difficulty was observed in only a small proportion of participants. Regarding pain severity, nearly half of the participants reported mild pain, whereas moderate and severe pain were less frequent.

A statistically significant association was identified between bruxism risk and masticatory performance. Participants categorized as high risk for bruxism demonstrated substantially greater chewing difficulty compared with those classified as having no bruxism risk. Among participants with high bruxism risk, 75 out of 88 participants (85.2%) exhibited some degree

of chewing dysfunction, whereas only 9 out of 27 participants (33.3%) in the low-risk group demonstrated chewing difficulty. Pearson's chi-square analysis confirmed a significant association between BEQ and CFQ categories, $\chi^2(6) = 41.967$, $p < 0.001$.

A significant relationship was also observed between bruxism risk and pain severity. Participants with high bruxism risk reported markedly greater moderate-to-severe pain compared with participants categorized as having no risk of bruxism. Only 3 of 27 participants (11.1%) in the no-risk group reported moderate-to-severe pain, compared with 59 of 88 participants (67.0%) in the high-risk group. Pearson's chi-square analysis demonstrated a statistically significant association between BEQ classification and VAS pain severity, $\chi^2(2) = 26.023$, $p < 0.001$.

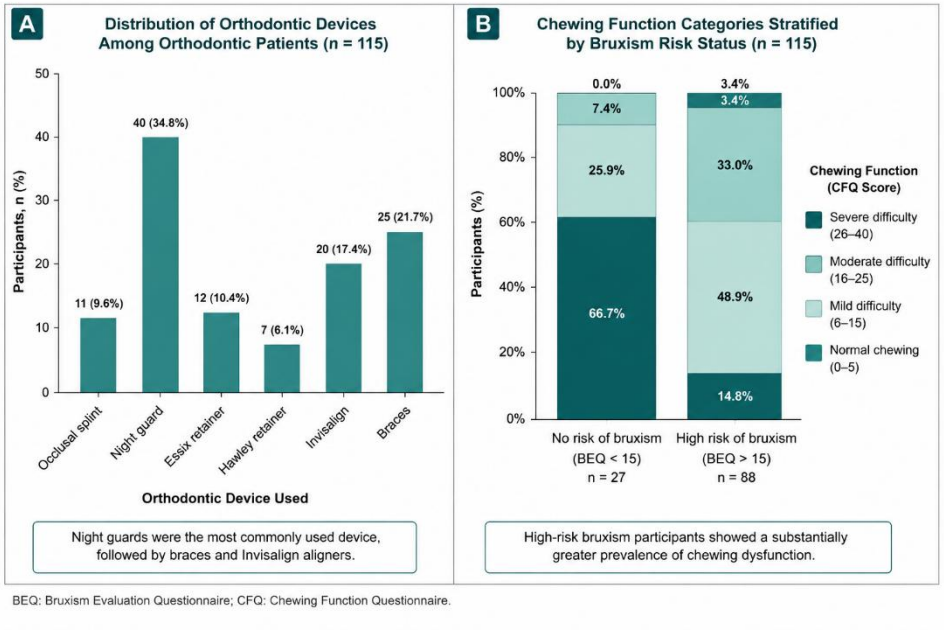

Figure 1 (A) Distribution of orthodontic devices among orthodontic patients. (B) Chewing function categories stratified by bruxism risk status. The figure illustrates the frequency of orthodontic devices used by participants, with night guards representing the most commonly reported device followed by braces and Invisalign aligners. The stacked bar chart demonstrates the distribution of normal chewing function and varying levels of chewing difficulty among participants with low and high bruxism risk. High-risk participants exhibited substantially greater chewing dysfunction compared with low-risk participants.

Table 4. Association between bruxism risk and pain severity

Bruxism risk	Mild pain n (%)	Moderate pain n (%)	Severe pain n (%)	Total
No risk of bruxism	24 (88.9)	2 (7.4)	1 (3.7)	27
High risk of bruxism	29 (33.0)	42 (47.7)	17 (19.3)	88
Total	53	44	18	115

Test	Value	df	p-value
Pearson chi-square	26.023	2	<0.001
Likelihood ratio	28.351	2	<0.001
Linear-by-linear association	19.980	1	<0.001

Table 5. Association between chewing function and pain severity

Chewing function	Mild pain n (%)	Moderate pain n (%)	Severe pain n (%)	Total
Normal chewing	26 (83.9)	5 (16.1)	0 (0.0)	31
Mild chewing difficulty	18 (36.0)	25 (50.0)	7 (14.0)	50
Moderate chewing difficulty	9 (29.0)	14 (45.2)	8 (25.8)	31
Severe chewing difficulty	0 (0.0)	0 (0.0)	3 (100.0)	3
Total	53	44	18	115

Test	Value	df	p-value
Pearson chi-square	41.967	6	<0.001
Likelihood ratio	40.875	6	<0.001
Linear-by-linear association	27.624	1	<0.001

Analysis of chewing function and pain severity demonstrated a progressive increase in pain with worsening masticatory dysfunction. Participants with normal chewing function most commonly reported mild pain, whereas individuals with

moderate and severe chewing difficulty demonstrated greater proportions of moderate-to-severe pain. All participants categorized with severe chewing difficulty reported severe pain. Statistical analysis confirmed a significant association between chewing dysfunction and pain severity, $\chi^2(6) = 41.967$, $p < 0.001$.

Overall, the findings demonstrated that bruxism risk was highly prevalent among orthodontic patients and was significantly associated with impaired chewing performance and greater pain severity. Increasing chewing difficulty was also associated with progressively higher pain levels, suggesting an interrelated functional burden involving parafunctional jaw activity, mastication, and pain.

DISCUSSION

The present study evaluated the relationship between bruxism risk, masticatory performance, and pain severity among orthodontic patients and demonstrated significant associations between parafunctional jaw activity and functional oral impairment. More than three-quarters of the participants were categorized as high risk for bruxism, indicating that parafunctional behavior is highly prevalent within orthodontic populations. Participants with elevated bruxism risk exhibited substantially greater chewing difficulty and higher pain severity than those classified as low risk. In addition, worsening chewing dysfunction was associated with progressively greater pain intensity, suggesting the presence of an interrelated functional burden involving muscular overload, impaired mastication, and pain sensitization. These findings support the interpretation that bruxism in orthodontic patients should be considered not merely as an isolated parafunctional habit but as a clinically meaningful contributor to functional and pain-related outcomes during orthodontic care.

Several biomechanical and neuromuscular mechanisms may explain the observed associations. Bruxism-related clenching and grinding expose the masticatory system to repetitive excessive loading, which may alter normal muscular recruitment patterns and compromise chewing efficiency. Electromyographic studies have shown abnormal activation of the masseter and temporalis muscles in individuals with bruxism, including altered contraction patterns, increased muscular activity during rest, and reduced motor coordination efficiency. Persistent parafunctional activity may induce muscular fatigue, impair chewing endurance, and reduce tolerance for foods requiring greater bite force or prolonged mastication. Furthermore, continuous overloading of the masticatory musculature may increase mechanosensitivity and trigger pain-related motor adaptations that further disrupt chewing performance. These alterations may explain why participants with high bruxism risk in the present study demonstrated markedly greater levels of chewing dysfunction and pain severity. Pain itself may additionally contribute to protective muscular inhibition and reduced functional jaw movement, thereby reinforcing the cycle between impaired mastication and orofacial discomfort.

The findings of this study are consistent with previous investigations examining the functional consequences of bruxism. Araya Zavala et al. reported that all participants with bruxism demonstrated altered masticatory patterns, supporting the relationship between parafunctional jaw activity and impaired chewing behavior observed in the present study. Similarly, Lan et al. demonstrated abnormal electromyographic activity of masticatory muscles in individuals with different forms of bruxism, including reduced masseter efficiency and altered temporalis activation during chewing tasks. Smaglyuk et al. also identified elevated muscular activity and abnormal rhythmic muscle patterns among bruxism patients, further supporting the biological plausibility of masticatory dysfunction associated with parafunctional activity. Nykänen et al. demonstrated increased awake bruxism behaviors among patients with masticatory muscle myalgia, highlighting the close relationship between parafunctional habits and muscular pain. Additionally, Bortoletto et al. reported improvement in bite force and muscular activity following splint therapy in children with sleep bruxism, suggesting that reduction of parafunctional loading may positively influence masticatory performance.

The present study also demonstrated a significant association between bruxism risk and pain severity. Participants categorized as high risk for bruxism reported substantially greater moderate-to-severe pain than low-risk individuals. Persistent clenching and grinding may contribute to muscular overuse, local ischemia, inflammatory sensitization, and increased nociceptive input within the masticatory system. These mechanisms may explain the elevated pain levels observed among high-risk participants. However, previous findings in the literature have not always been consistent. Chattrattrai et al. reported no significant

association between bruxism episode index and masticatory muscle pain intensity when using polysomnographic sleep bruxism measurements. The discrepancy between their findings and the present study may reflect differences in assessment methodology. Whereas polysomnography evaluates objective sleep bruxism episodes, the Bruxism Evaluation Questionnaire used in the current study captures broader behavioral and symptomatic dimensions of parafunctional activity, including awake bruxism, muscular tension, fatigue, and subjective symptom burden. Consequently, questionnaire-based assessment may better reflect the cumulative functional impact of parafunctional behavior on pain perception and chewing performance in clinical orthodontic populations.

The clinical implications of these findings are important for orthodontic practice. Routine screening for bruxism risk at orthodontic intake and during treatment progression may assist clinicians in identifying patients susceptible to functional chewing impairment and pain-related complications. Assessment of masticatory performance should also be considered an important functional outcome measure rather than focusing solely on esthetic alignment or occlusal correction. Orthodontic management may benefit from multidisciplinary interventions incorporating behavioral modification strategies, stress management, splint therapy, physiotherapeutic approaches, and patient education regarding parafunctional habits. Device-specific considerations may also be relevant because different orthodontic appliances may influence occlusal adaptation and muscular activity differently. In addition, chronic chewing difficulty may negatively affect nutritional behavior and quality of life, further emphasizing the importance of addressing functional oral impairment during orthodontic care.

This study has several strengths. It focused specifically on orthodontic patients, utilized validated assessment tools for bruxism, chewing function, and pain severity, and evaluated multiple clinically relevant functional outcomes within a single cohort. Nevertheless, several limitations should be acknowledged. The cross-sectional design limits causal interpretation and does not establish temporal relationships between bruxism and chewing dysfunction. Convenience sampling and recruitment from a single city may reduce generalizability to other populations. Bruxism assessment relied on self-reported questionnaire responses rather than objective polysomnographic or electromyographic confirmation. In addition, psychological stress, sleep quality, treatment duration, and orthodontic device-specific effects were not controlled despite their potential influence on parafunctional activity and pain perception. Future longitudinal and interventional studies using objective functional and muscular assessments are recommended to further clarify the mechanisms linking bruxism, mastication, and pain in orthodontic populations.

CONCLUSION

Bruxism risk was highly prevalent among orthodontic patients and demonstrated significant associations with impaired masticatory performance and increased pain severity. Participants with elevated bruxism risk showed markedly greater chewing dysfunction and substantially higher moderate-to-severe pain compared with low-risk individuals. Furthermore, worsening chewing impairment was associated with progressively greater pain intensity, indicating an interconnected functional burden involving parafunctional activity, mastication, and orofacial pain. These findings support the incorporation of routine bruxism screening and chewing function assessment into orthodontic evaluation protocols. Multidisciplinary management approaches integrating behavioral interventions, appliance-related strategies, and functional rehabilitation may improve oral function, reduce pain-related symptoms, and enhance orthodontic treatment outcomes.

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