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Mandibular Angle Bone Apposition as a Radiological Indicator of Bruxism in the Chengalpattu Population: A Retrospective Study

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KEYWORDS

Bruxism, Mandibular Angle, Bone Apposition, Radiological Indicator, Chengalpattu Population

ABSTRACT:

Background: Bruxism, characterized by the involuntary grinding or clenching of teeth, can lead to various complications, including dental wear, temporomandibular joint disorders, and changes in mandibular bone structure. One potential radiological indicator of bruxism is mandibular angle bone apposition, observed through panoramic radiography. Previous studies have suggested that alterations in the mandibular angle may be associated with bruxism, but research in specific populations remains limited.

Objectives: This study aims to evaluate the relationship between mandibular angle bone apposition and bruxism. By assessing panoramic radiographs, the study seeks to establish whether changes in bone apposition at the mandibular angle can be considered a reliable radiological marker for bruxism.

Methods: A retrospective analysis of panoramic radiographs from 300 participants, including 150 diagnosed bruxism patients and 150 controls, was conducted. The degree of mandibular angle bone apposition was classified as Grade 0 to 3 in both bruxism and control groups.

Results: In the bruxism group, 17.67% of participants exhibited no apposition (GRADE 0), 32.33% had mild apposition (GRADE 1), 30% showed moderate apposition (GRADE 2), and 20% displayed severe apposition (GRADE 3). Statistical analysis ($p < 0.0001$) confirms significant bone changes in individuals with bruxism, highlighting the potential of panoramic radiography for detecting these structural alterations.

Conclusions: This study highlights mandibular angle bone apposition as a potential diagnostic marker for bruxism, with the bruxism group showing higher frequencies of severe changes, supporting panoramic radiographs for early detection and intervention.

1. Introduction

Bruxism is a common but often underdiagnosed condition characterized by the involuntary grinding, clenching, or gnashing of teeth, typically during sleep. It is considered a parafunctional activity, as it occurs outside the normal function of the jaw and teeth, leading to significant oral health problems. Bruxism can manifest in two primary forms: sleep bruxism (SB), which occurs during sleep, and awake bruxism (AB), which is less common and occurs when the individual is awake but may still result in similar damage to teeth and jaw structures [1,2].

The clinical significance of bruxism lies in its potential to cause a range of dental and temporomandibular joint (TMJ) disorders, including tooth wear, fractures, temporomandibular joint dysfunction, and headaches. Chronic bruxism can also lead to the development of muscle pain and discomfort in the jaw, neck, and face. While some individuals experience noticeable symptoms such as tooth sensitivity, facial pain, or clicking in the TMJ, many others remain asymptomatic, particularly in the early stages of the condition, which makes bruxism difficult to detect without proper examination [3].

Diagnosing bruxism is challenging due to the absence of a single, definitive test. Clinicians typically rely on a combination of methods to identify this disorder. Clinical examination remains the most common approach, wherein dental professionals look for signs of tooth wear, fractures, or occlusal discrepancies [4]. However, tooth wear alone is not a specific indicator of bruxism, as other factors such as diet or habits may contribute to similar wear patterns. Additionally, patient self-reports of symptoms—such as jaw pain, headaches, or the awareness of teeth grinding—can provide useful information but are often subjective and unreliable [5]. To overcome these limitations, radiographic evaluation has become an essential diagnostic tool. It helps in identifying structural changes in the teeth and jaw that may not be visible during a routine clinical examination.

Among the various radiographic techniques available, panoramic radiography is particularly valuable in assessing the mandibular structures affected by bruxism. This imaging method provides a comprehensive view of the upper and lower jaw in a single, wide-angle shot, allowing for the evaluation of bone apposition, trabecular bone density, and the presence of any fractures or TMJ abnormalities [6,7]. One of the key advantages of panoramic radiographs is their ability to reveal subtle changes in the mandibular angle, a region frequently affected by bruxism. Changes in the bone structure of the mandibular angle, including thickening or altered cortical bone density, are often indicative of the chronic muscular forces exerted during bruxism [8].

The primary objective of this study is to explore the potential of mandibular angle bone apposition as a reliable radiological indicator of bruxism, particularly in the Chengalpattu population. Chronic bruxism exerts significant mechanical stress on the mandibular structures, often resulting in skeletal adaptations, such as bone apposition at the mandibular angle. This study seeks to assess these radiological changes to understand their prevalence and characteristics among individuals diagnosed with bruxism compared to a control group without the condition.

By analyzing panoramic radiographs, this investigation aims to identify and classify the morphological alterations associated with bruxism. The specific objectives include determining the frequency of bone apposition, its directional changes, and any distinct patterns or grades that may assist in differentiating bruxism-related changes from normal anatomical variations. The study further evaluates how these morphological alterations can be utilized in clinical settings to aid early diagnosis and effective management of bruxism.

The focus on the Chengalpattu population introduces a unique dimension, considering cultural, behavioral, and dietary factors that may influence mandibular health. This population-based approach not only enhances the relevance of the findings for the local community but also contributes to the broader understanding of bruxism-related skeletal changes globally. Through a systematic comparison of radiographic data between bruxism patients and controls, the study aims to validate mandibular angle bone apposition as a functional and diagnostic marker, paving the way for its integration into routine dental radiological assessments.

2. Methods

Study Design

This retrospective observational study analyzed panoramic radiographs to assess mandibular angle bone apposition as a radiological indicator of bruxism. The study compared the bone apposition patterns between two groups: individuals diagnosed with bruxism (case group) and individuals without bruxism (control group). Data were obtained from radiographic records and classified into four distinct grades of bone apposition based on the degree of cortical bone changes.

All radiographs had been taken between December 2020 and December 2024 at the Department of Oral Medicine and Radiology, Karpaga Vinayaga Institute of Dental Sciences, using the digital panoramic and cephalometric system Sirona Orthophos XG. The images were visualized with viewing software without applying further filter functions (Sidexis XG version 2.63, by Sirona).

The study will include a total of 300 participants, divided into two groups:

• 150 participants diagnosed with bruxism (bruxism group)

• 150 participants without bruxism (control group)

The participants will be aged between 18 and 65 years to ensure that the study includes adult individuals who are most likely to show relevant skeletal changes due to bruxism. Both male and female participants will be included to account for potential gender differences in the prevalence and severity of bruxism and its impact on mandibular bone apposition.

Inclusion Criteria

1. Availability of high-quality panoramic radiographs showing clear views of the mandibular angles.
2. Participants aged 18 to 65 years.

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3. Absence of systemic conditions affecting bone metabolism (e.g., osteoporosis).

Exclusion Criteria

1. History of mandibular trauma or surgery.
2. Developmental anomalies or congenital conditions affecting the mandible.
3. Presence of systemic bone diseases.
4. Images with motion artifacts and strong ventral or retroflexion [9]

Data Collection

. Bone apposition was assessed bilaterally (right and left mandibular angles) and categorized into four grades: [6,7] based on the degree of visible change:

- **Grade 0**: No visible changes.
- **Grade 1**: Mild cortical thickening.
- **Grade 2**: Moderate cortical thickening with directional changes.
- **Grade 3**: Severe cortical thickening and pronounced remodelling.

Radiographic Evaluation

The radiographic evaluation will involve measuring the cortical bone thickness at the mandibular angle, a key region affected by bruxism-induced forces. Radiographs will be carefully reviewed by trained professionals who will assess the extent of bone apposition in this area. The severity of bone apposition will be classified based on the changes in bone structure observed in the panoramic radiographs, considering both the degree of thickening and any directional changes at the mandibular angle. This evaluation will allow the researchers to classify the bone apposition into 4 groups (Grade 0 to 4) and provide an overall assessment of the mandibular angle's adaptation to bruxism.

Statistical Analysis

Descriptive statistics were used to summarize demographic data, including age and gender distribution, for both groups. The distribution of bone apposition grades was compared between groups using chi-square tests to assess statistical significance. The significance level was set at a p-value < 0.05.

FIGURE-1: Bone apposition at the mandibular angle and grade classification: grades, description, and radiological example

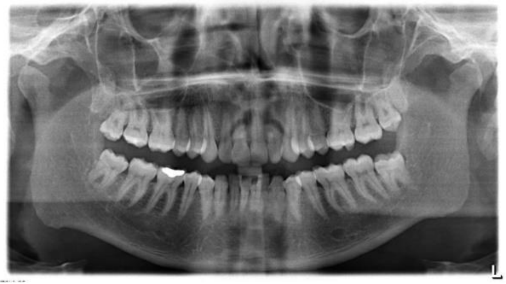
GRADE	RADIOGRAPHICAL EXAMPLE
0	
1	
2	
3	

TABLE-1: Bone apposition at the mandibular angle grade classification and description

GRADE	DESCRIPTION OF MANDIBULAR ANGLE
0	No visible changes

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1	Mild cortical thickening
2	Moderate cortical thickening with directional changes
3	Severe cortical thickening and pronounced remodelling

3. Results

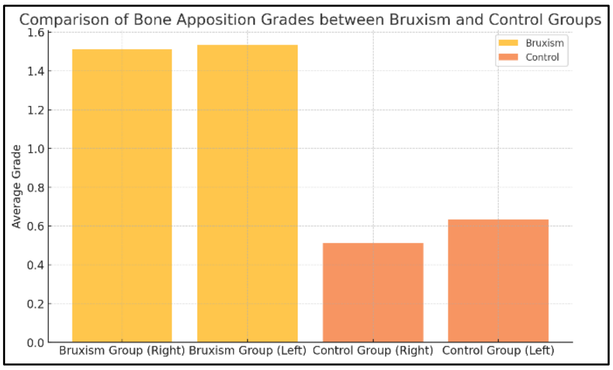
This study will collect and analyze demographic data from both the bruxism and control groups to ensure comparability and identify potential confounding variables. Participants will be aged 18–65 years, with age distribution summarized using mean, median, and standard deviation to check for skewness or age-related differences in mandibular angle bone apposition. Both groups will aim for gender parity (approximately 50% males and 50% females) to explore potential gender-specific differences while avoiding gender as a confounding factor. Medical histories will be reviewed to exclude participants with systemic conditions affecting bone metabolism, such as osteoporosis or rheumatoid arthritis. Dental health records will include assessments of tooth wear, fractures, or occlusal discrepancies, as these factors may indicate the severity of bruxism in the study group. Participants' histories of other parafunctional habits, such as nail-biting or chewing non-food objects, will also be noted, as these activities may influence mandibular bone remodelling. Collecting these data ensures that any differences in bone apposition between groups are attributable to bruxism rather than other variables.

- In the **control group**, the majority of participants exhibited either GRADE 0 (no apposition, 42.67%) or GRADE 1 (mild apposition, 57.33%), with no cases of moderate or severe bone apposition (GRADE 2 or GRADE 3). Notably, no participants in the control group exhibited severe bone apposition, indicating that significant bone changes are not typically observed in individuals without bruxism. [Table-1]
- In the **bruxism group**, showed a much lower proportion of participants with GRADE 0 (17.67%) and a significant presence of higher grades of bone apposition, with GRADE 2 (moderate apposition, 30%) and GRADE 3 (severe apposition, 20%) observed exclusively in this group. This suggests a notable presence of structural changes in individuals with bruxism, particularly in the form of pronounced bone remodelling at the mandibular angle. [Table-1]

TABLE-2: Distribution of Bone Apposition Severity in Both Groups

Bone Apposition Severity	Bruxism Group (300 angles)	Control Group (300) angles
GRADE – 0	53 (17.67%)	128 (42.67%)
GRADE – 1	97 (32.33%)	172 (57.33%)
GRADE – 2	90 (30%)	0
GRADE – 3	60 (20%)	0

FIGURE:2



To assess the statistical significance of the differences between the bruxism and control groups, a chi-square test will be performed. The critical value obtained is 41.34. p value obtained is less than 0.05. The p-value is extremely small ($p < 0.0001$), indicating that the differences between the two groups are statistically significant.

TABLE – 3: DISTRIBUTION OF BONE APPOSITION SEVERITY AMONG THE BRUXISM GROUP IN RIGHT AND LEFT ANGLES

Bone Apposition Severity	RIGHT = 150	LEFT = 150
GRADE – 0	32 (21.33%)	21 (14.00%)
GRADE – 1	42 (28.00%)	55 (36.67%)
GRADE – 2	43 (28.67%)	47 (31.33%)

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GRADE – 3	33 (22.00%)	27 (18.00%)

- The chi-square test confirms that there is a significant relationship between bruxism and mandibular angle bone apposition. This suggests that mandibular angle bone apposition is more prevalent and severe in bruxism patients compared to the control group.
- The observed differences in the severity of bone apposition between the two groups suggest that mandibular angle bone apposition can potentially serve as a diagnostic marker for bruxism. These results further reinforce the utility of panoramic radiography in detecting structural changes in the mandible associated with bruxism, providing valuable insight for clinical diagnosis and management.

FIGURE:3

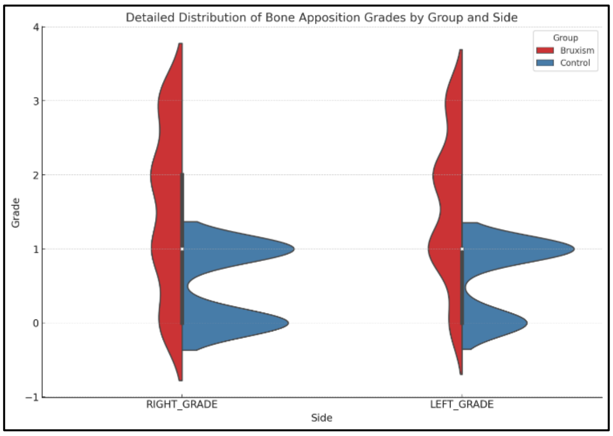
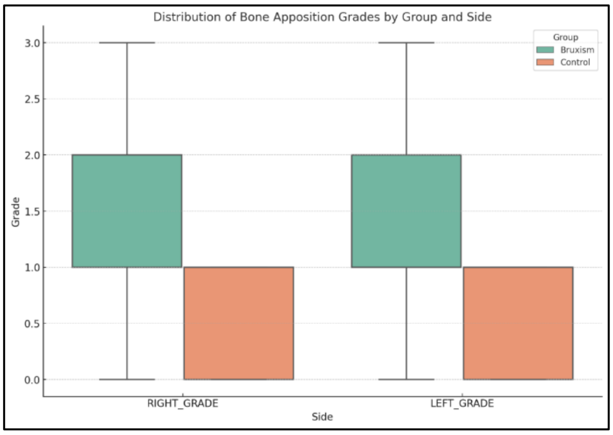


FIGURE:4



4. Discussion

The findings of this study indicate a clear and significant relationship between mandibular angle bone apposition and bruxism, with the bruxism group showing marked alterations in bone structure compared to the control group.

Analysis of Observed Trends

Nearly 80% of bruxism patients showed moderate to severe bone apposition at the mandibular angle, while 80% of the control group exhibited only mild changes. These contrasting results support the hypothesis that bruxism-related mechanical stress is a major factor influencing mandibular remodelling. The mandibular angle, a critical site for masseter and medial pterygoid muscle attachment [6,7], emerges as a key area for detecting bruxism-induced skeletal adaptations.

Moderate and severe apposition among bruxism patients appears to result from repeated mechanical loading [10]. Bruxism involves involuntary grinding or clenching of teeth, producing significant forces at the mandibular angle. This mechanical stress activates osteoblasts through mechanotransduction, a biological process that drives bone remodelling [11]. The absence of severe apposition in the control group reinforces that these changes are functional responses to stress rather than typical aging processes.

The mild apposition seen in control subjects may reflect normal physiological turnover rather than pathological remodelling, underscoring the specific impact of bruxism on mandibular bone.

Relationship Between Bone Apposition and Bruxism

Bone apposition at the mandibular angle is a functional adaptation to the increased forces generated by the masticatory muscles during bruxism [12]. The masseter and medial pterygoid muscles, which are among the primary muscles involved in jaw closure, insert at the mandibular angle [13]. During bruxism, these muscles contract forcefully and repetitively, exerting substantial compressive and shear forces on the mandible. Over time, these repeated mechanical stresses can lead to bony remodelling, with new bone being deposited at sites of high force application, particularly at the mandible's angle [8]. This process is analogous to how muscles hypertrophy in response to strength training, where

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increased muscle mass is a functional adaptation to resistance training. Similarly, the mandible undergoes structural changes to accommodate the functional demands placed on it by bruxism [14,15].

Bone apposition in bruxism patients is a result of adaptive bone remodelling in response to repetitive mechanical stress. Bruxism-induced forces, generated by jaw-closing muscles like the masseter and medial pterygoid, stimulate osteoblast activity at the mandibular angle, leading to localized bone thickening. This process reinforces the mandible to better withstand chronic stress [16]. The presence of severe bone apposition, as observed in many bruxism patients, indicates prolonged, unchecked bruxism and reflects the condition's chronicity and severity. Radiographic detection of mandibular angle bone apposition [12] offers a valuable diagnostic marker for bruxism, providing insights into its duration and impact while aiding early intervention and management [17].

The results of this study align with prior research on bruxism-related bone remodelling, reinforcing the association between mechanical stress and mandibular changes.

Türp et al. reported a strong link between bruxism and mandibular angle bone apposition, categorizing severity levels from mild to severe. Their findings corroborate this study's observations of higher prevalence of moderate to severe apposition in bruxism patients. Both studies emphasize the role of repetitive mechanical stress in driving mandibular remodelling. Additionally, Türp et al. noted the absence of significant bone changes in control groups, mirroring this study's findings.

Gulec et al. investigated trabecular bone changes in bruxism patients, identifying increased bone density and altered trabecular patterns. While their study focused on trabecular rather than cortical bone, the underlying principle of remodelling in response to bruxism-induced stress aligns with this study's findings. These complementary studies highlight the systemic impact of bruxism on mandibular bone.

Clinical Implications

This study identifies mandibular angle bone apposition as a reliable radiological marker for diagnosing bruxism. Significant bone changes, such as increased cortical thickness, correlate with the mechanical forces of bruxism and can be detected non-invasively using panoramic radiographs. These findings emphasize the potential for early bruxism detection, even in asymptomatic individuals, during routine dental exams. Early diagnosis allows for timely preventive measures, such as night guards [18] or behavioural therapy [19], to prevent progression to severe dental and jaw complications. Integrating bruxism screening into standard radiographic practice can improve patient outcomes and long-term oral health.

Importance of Radiographic Evaluation

Radiographic evaluation becomes particularly crucial in the early stages of bruxism, when clinical symptoms such as tooth wear or muscle tenderness may not yet be present. The ability to detect mandibular angle bone apposition at an early stage could guide clinicians in identifying at-risk patients before they develop significant dental complications or temporomandibular joint issues. This can enable timely interventions, reducing the need for more complex and expensive treatments down the line, such as tooth restoration or surgical management of TMJ disorders [20].

5. Conclusions

This study highlights the potential of mandibular angle bone apposition as a radiological marker for diagnosing bruxism. Panoramic radiographs revealed significant differences between the bruxism and control groups, with the bruxism group exhibiting higher frequencies of moderate and severe bone changes at the mandibular angle, suggesting structural adaptations to mechanical stress from masticatory muscles. Approximately 40% of the bruxism group showed severe apposition compared to the control group, where 80% exhibited only mild changes. These findings align with previous studies, reinforcing the utility of radiographs in early bruxism detection, even in asymptomatic patients.

The clinical implications are substantial, as routine panoramic radiographs could facilitate early identification of bruxism, enabling timely interventions such as night guards to prevent progression to severe dental and temporomandibular joint disorders. Incorporating mandibular angle bone apposition as a diagnostic criterion could standardize bruxism detection across dental practices, enhancing patient care and reducing long-term damage. Further prospective

research is warranted to validate these findings and establish panoramic radiographs as a reliable diagnostic tool for bruxism in clinical practice.

6. Limitations

- **Retrospective Study Design**: The study cannot establish causality due to its reliance on past data. A prospective study would better demonstrate the causal link between bruxism and bone apposition.
- **Sample Size Limitations**: A small sample size (300 participants) limits generalizability and may introduce sampling bias. Larger studies would provide more reliable results.

7. Suggestions For Future Research

Future research should focus on larger, prospective studies that track patients before and after the onset of bruxism to establish causality and better understand the relationship between bone apposition and bruxism progression. Exploring other mandibular regions, such as the condylar head or gonia, could reveal additional markers of bone remodelling. Additionally, advanced imaging techniques like Cone Beam Computed Tomography (CBCT) could provide high-resolution 3D images, offering a more precise view of bone changes and enhancing the diagnostic accuracy for bruxism.

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