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Radiologically Investigation of the Effects of Bruxism on Mandibular Cortical and Cancellous Bone: A Cross-Sectional Study

Bruksizmin Mandibular Kortikal ve Kansellöz Kemik Üzerindeki Etkilerinin Radyolojik Olarak İncelenmesi: Kesitsel Bir Çalışma

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ABSTRACT Objective: Bruxism is a repetitive masticatory muscle activity that can lead to structural changes in the mandibular bone. Panoramic radiographs, a frequently employed imaging modality in the field of dentistry, enable the observation of alterations in the cortical and cancellous constituents of the mandibular bone. The purpose of this study was to research the effects of bruxism on mandibular cortical and cancellousbone using panoramic radiographs. **Material and Methods:** This retrospective study analyzed panoramic radiographs of 54 individuals with bruxism and 54 without bruxism. Fractal analysis was performed to evaluate cancellous bone complexity, while Mandibular Cortical Index (MCI) and mandibular angle bone apposition classifications assessed cortical bone alterations. Statistical comparisons between the bruxism and control groups were conducted using SPSS. **Results:** The mean fractal dimension (FD) values in the mandibular angle region of bruxism group were significantly lower than those in the control group ($p<0.05$). Mandibular angle bone apposition was significantly more prevalent in the bruxism group ($p<0.05$). A significant correlation was observed between FD values and MCI, with bruxism group exhibiting a higher prevalence of MCI-C2 and MCI-C3. **Conclusion:** Bruxism appears to have a dual effect on the mandibular bone, with catabolic changes in calleous bone and anabolic changes in cortical bone. These findings highlight the importance of radiological assessments in diagnosing and managing bruxism-related bone changes.

Keywords: Bruxism; fractal; cortical bone; cancellous bone; mandible

ÖZET Amaç: Bruksizm, mandibular kemikte yapısal değişikliklere yol açabilen tekrarlayıcı bir çiğneme kas aktivitesidir. Diş hekimliği alanında sıklıkla kullanılan bir görüntüleme yöntemi olan panoramik radyografiler, mandibular kemiğin kortikal ve kansellöz bileşenlerindeki değişikliklerin gözlemlenmesini sağlar. Bu çalışmanın amacı, bruksizmin mandibular kortikal ve kansellöz kemik üzerindeki etkilerini panoramik radyograflar kullanarak araştırmaktır. **Gereç ve Yöntemler:** Bu retrospektif çalışmada, bruksizmi olan ve olmayan 54 bireyin panoramik radyografileri analiz edildi. Kansellöz kemik karmaşıklığını değerlendirmek için fraktal analiz yapılırken, Mandibular Kortikal İndeks (MKİ) ve mandibular açı kemik apozisyon sınıflandırmaları ile kortikal kemik değişiklikleri değerlendirildi. Bruksizm ve kontrol grupları arasındaki istatistiksel karşılaştırmalar SPSS kullanılarak yapıldı. **Bulgular:** Bruksistlerin mandibular angulus bölgesindeki ortalama fraktal boyut (FB) değerleri kontrol grubuna göre anlamlı derecede düşüktü ($p<0,05$). Mandibular angulus bölgesinde kemik apozisyonu bruksistlerde anlamlı olarak daha yaygındı ($p<0,05$). FB değerleri ile MKİ arasında anlamlı bir korelasyon gözlenmiş, bruksistlerde MKİ-C2 ve MKİ-C3 prevalansı daha yüksek bulunmuştur. **Sonuç:** Bruksizmin mandibular angulus bölgesinde kansellöz kemik üzerinde katabolik, kortikal kemik üzerinde ise anabolik değişiklikler ile ikili bir etkisi olduğu görülmektedir. Bu bulgular, bruksizmle ilişkili kemik değişikliklerinin teşhis ve yönetiminde radyolojik değerlendirmelerin önemini vurgulamaktadır.

Anahtar Kelimeler: Bruksizm; fraktal; kortikal kemik; kansellöz kemik; mandibula

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Bruxism involves repetitive masticatory muscle activity, including clenching, grinding, and other jaw movements. A 2018 international consensus report clarifies that in healthy individuals, bruxism is not classified as a sleep disorder but rather as a behavior that may pose either a risk factor or a protective function in clinical outcomes.[1]

A classification system is employed in the diagnosis. The diagnosis of possible bruxism is based on the results of questionnaires and self-report. Questionnaires are practical method for groups with large sample sizes, but may result in an under- or overestimate the current situation. Probable bruxism is based on self-report and physical examination. Clinical examination is a valuable method, but some findings used as markers of bruxism, such as tooth wear, are subject to differential diagnosis due to their dependence on the duration of masticatory muscle activity. It is therefore recommended that definitive bruxism be based on self-report, clinical examination, audio/video recordings and polysomnographic evidence. Although polysomnography is considered the gold standard in diagnosis, it is a costly method that can only be used in small sample groups due to its limited availability.[2] Apart from polysomnography, for which diagnostic criteria have been established, further elaboration is required for other diagnostic techniques.

Muscle activity plays a key role in bone remodeling, which is vital for maintaining skeletal integrity and adapting bone structure to mechanical stress. Bruxism, resulting from excessive activation of jaw muscles, leads to adaptive changes in the mandibular regions affected by these forces.[3] Several studies have focused on the effects of bruxism on the mandibular condyle and temporomandibular joint.[4] Recent research has identified macroscopic bone apposition in the mandibular angle region, where the masseter and medial pterygoid muscles insert. Türp et al. proposed a classification system consisting of 4 grades G0, G1, G2, and G3 to assess the severity of these bone formations.[5]

The Mandibular Cortical Index (MCI) is a valuable tool to evaluate the quality of mandibular bone mass on panoramic radiographs and to detect marks of resorption that may indicate conditions such as osteopenia. In this index, the porosity of the mandibular basal bone is determined. It shows a correlation between bone mineral density and changes in mandibular cortical bone.[6] The MCI and mandibular angle bone apposition classification are methods that focus on macroscopic changes in cortical bone. However, given that cancellous bone exhibits a greater metabolic fuction than cortical bone, it is of greater significance in evaluating alterations in bone structure.[7] By quantifying the roughness, irregularities and fractal dimensions of cancellous bone interfaces, fractal analysis provides a comprehensive approach to understanding bone structure and assessing bone health.[8] The method assesses the complexity of the bone architecture and allows to calculate it as a numerical value.[9] In dentistry, fractal analysis has been demonstrated to be a precious tool for the evaluation of bone structures and the detection of changes associated with conditions such as periodontitis and temporomandibular disorders.[10] Fractal analysis is an objective method that can be employed to elucidate the structural alterations induced by bruxism in cancellous bone.

According to our knowledge, although methods such as fractal analysis, MCI classification and mandibular angle bone apposition classification have been used to evaluate the changes in the jaw bone of individuals with bruxism, these 3 methods have not been compared in the same study. The aim of this paper was to retrospectively assess the structural changes of the cortical and cancellous portions of the mandible in individuals with and without bruxism. This was achieved by employing fractal analysis, MCI and mandibular angle bone apposition classification on panoramic radiographs.

MATERIAL AND METHODS

STUDY DESIGN

The research was constructed with a retrospective methodology. Panoramic radiographs taken for various reasons (impacted tooth, malocclusion etc.) of individuals who applied to the dentomaxillofacial radiology department between 2023-2024 and diagnosed as probable sleep bruxism were examined retrospectively. The radiological examinations were conducted by a dentomaxillofacial radiology specialist (MEA) who was unaware of the participants' allocation to either the bruxism or control group. A 2nd radiological examination was conducted 2 weeks later by same specialist (MEA). A power analysis was applied to define the optimal sample size (G*Power, 3.1.). A total of 54 individuals with bruxism and 54 individuals control were included in the study.

ETHICAL CONSIDERATIONS

The research protocol was designed in accordance with the tenets of the Declaration of Helsinki. Prior to the commencement of the research, ethical approval was provided from the Burdur Mehmet Akif Ersoy University Ethics Committee (date: February 2, 2024; no: 2024/92). A written informed consent form was signed by participants.

Inclusion Criteria for Bruxism Group

Individuals who had been previously examined and recorded in the hospital information management system with a diagnosis of probable bruxism were included in the study. The diagnosis of possible bruxism is based on a synthesis of self-report and clinical examination findings. In addition to self-reported sleep bruxism and/or the presence of teeth grinding sounds reported by a sleep partner, participants must have at least one of the following physical signs: tooth wear, hypertrophy of the masseter muscles, hyperkeratosis of the buccal mucosa, dental impression lines on the tongue or lips, fractures of teeth or dental restorations due to biting forces.

Exlusion Criteria for Bruxism and Control Group

- Individuals below the age of 18 years
- Those with a systemic disease affecting bone metabolism, including osteoporosis, hyperparathyroidism, Paget's disease, and others
- Female participants who were in menopause
- The presence of artefacts in radiographs that prevent the evaluation of bone structure

Radiographic Assessment

All panoramic radiographs were obtained by the same technician using a MyRay Hyperion X5 (Italy; 66 kV, 9 mA, and 16 s exposure time). Patient positioning was done according to standard protocols. All radiological examinations were conducted on a Dell Precision T5400 computer (Dell, Round Rock, TX, USA) with a 22-inch 1920×1080 resolution monitor (BARCO MDRC-2222, Belgium) in a semi-dark room.

Mandibular Angle Bone Apposition Classification

The classification system suggested by Türp et al. was used to evaluate the bone apposition in the mandibular angulus region on the panoramic radiographs.[5] The angulus region of the mandible was examined bilaterally in the panoramic radiographs of the whole sample.

G0: Convex course of the basal cortex. No directional alteration, no apposition.

G1: Directional change from the convex course of the basal cortex. No apposition.

G2: Directional change plus generalized bone apposition with inhomogeneous surface.

G3: Directional change plus localized bone apposition at one or more sites (Figure 1).

MCI Classification

Mandibular cortical index by Klemetti et al. was applied.[6]

C1: The endosteal cortical margin is equal and keen bilaterally, normal cortex

C2: The endosteal margin has semilunar defects or endosteal cortical residues (1 to 3 layers) are observed unilaterally or bilaterally

C3: The cortical layer consisted of abundant endosteal cortical residues and had considerable porosity (Figure 2).

Fractal Analysis Procedure

The fractal dimension (FD) values were analysed by a dentomaxillofacial radiology specialist for all digital radiographs. The fractal analysis was conducted using the ImageJ v1.52 software, which is a version of the National Institutes of Health Image. The software was downloaded from the following website: https://imagej.nih.gov. Following the download of the software, the images were saved in the tiff format. Three regions of interest (ROIs) were delineated

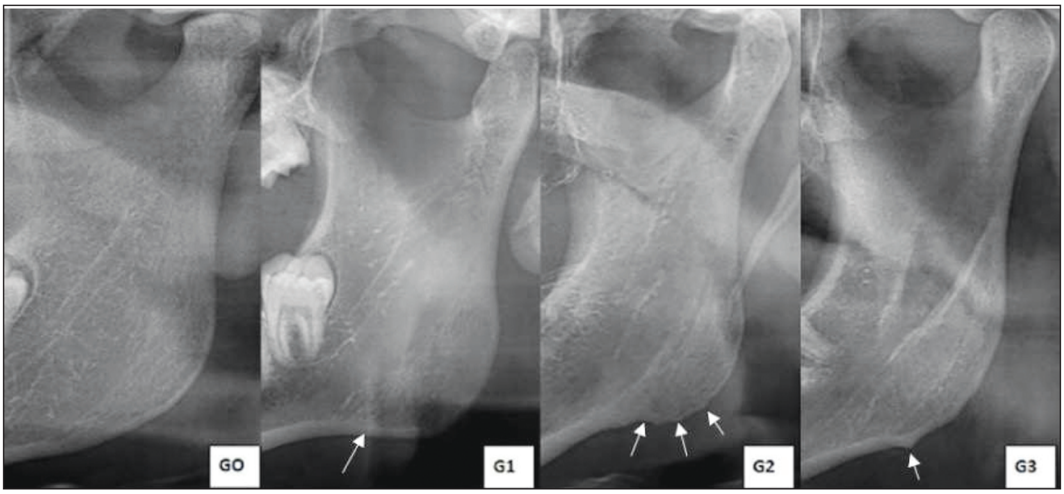


FIGURE 1: Mandibular angle bone apposition classification on cropped panoramic radiographs. G0: Convex course of the basal cortex. No directional change, no bone apposition; G1: Directional change from the convex course of the basal cortex. No bone apposition; G2: Directional change plus generalized bone apposition with inhomogeneous surface; G3: Directional change plus localized bone apposition at one or more sites

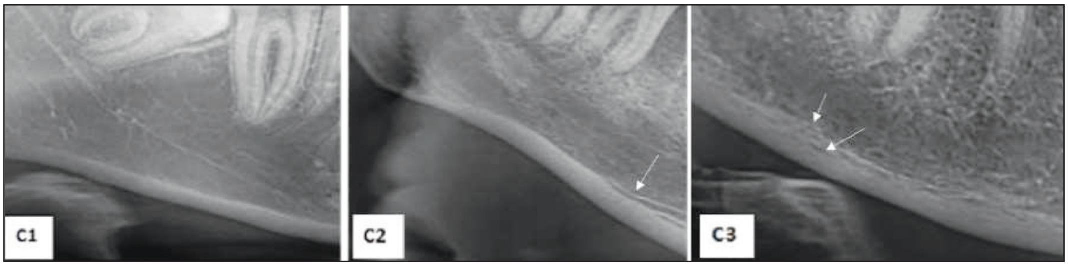


FIGURE 2: MCI classification on cropped panoramic radiographs. C1: The endosteal cortical margin is even and sharp on both sides, normal cortex; C2: The endosteal margin has semilunar defects or endosteal cortical residues (1 to 3 layers) are observed on 1 or both sides; C3: The cortical layer formed heavy endosteal cortical residues and had considerable porosity

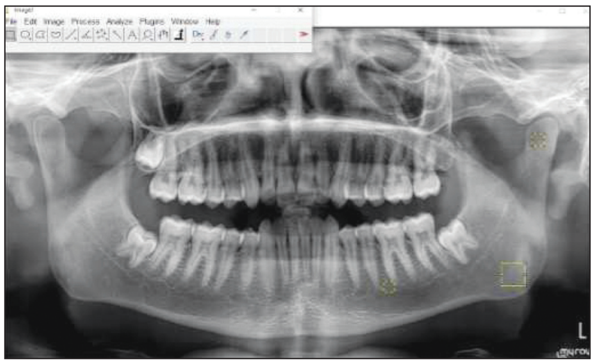
from distinct areas of the mandible on both sides, comprising a total of 6 ROIs.

ROI-1: Condylar region, size 50x50 pixels

ROI-2: Mandible angle region, size 100x100 pixels

ROI-3: Apical regions of the between 2nd premolar and 1st molar roots, size 50x50 pixels (Figure 3).

A fractal analysis was conducted on each sample using the methodology described by White and Rudolph (Figure 4). The image was initially cropped within the defined ROI and converted to an 8-bit format. Subsequently, the cropped image was duplicated, subjected to blurring using a Gaussian filter, and subtracted from the original image. The resulting image was then assigned a grey value of 128 for each pixel. Subsequently, the image was subjected to



FUGURE 3: ROIs used for fractal analysis measurement on panoramic radiography

binarisation, erosion and dilation operations. Subsequently, the image underwent inversion and skeletonization. Subsequently, the fractal dimension was evaluated following the implementation of the skeletonization process. The fractal dimension was deter-

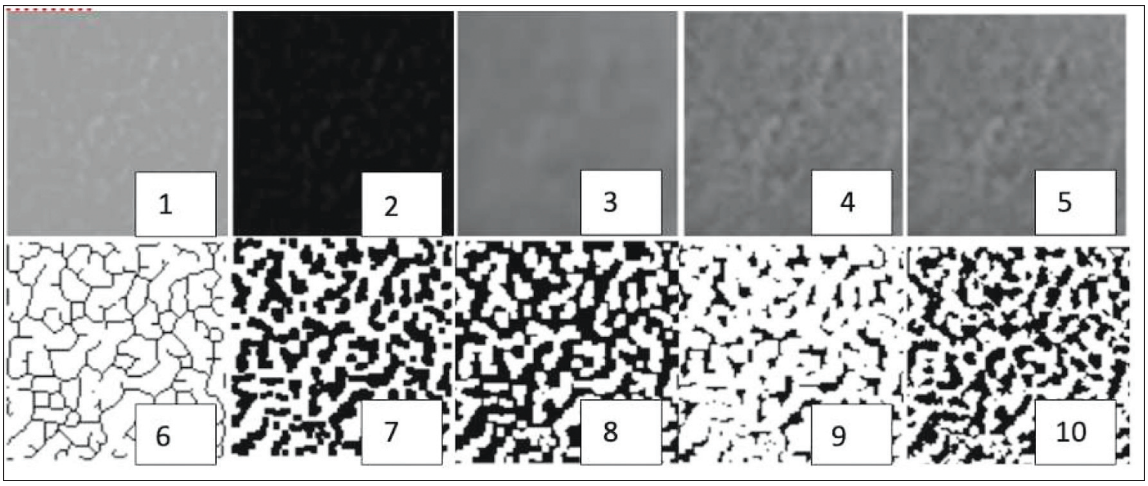


FIGURE 4: Steps of the fractal analysis process. 1) Cropping of ROI; 2) Duplication of the cropped ROI; 3) Blurring of the dublike image with a Gaussian filter; 4) Subtraction of the blurred image from the original image; 5) Adding 128 grey values to the subtracted image; 6) binarisation of the result image at a brightness value of 128; 7) Erosion process of binarised image; 8) Dilatation; 9) Inversion; 10) Skeletonization

mined using the box-counting method, which involves dividing the skeletonized image into squares of 2, 3, 4, 4, 6, 8, 12, 32 and 64 pixels. The total number of frames in the skeletonized image and the number of frames containing trabeculae were evaluated. A logarithmic graph was constructed for these values. A line was drawn with respect to the graph points, and the slope of this line provided the FD value, which indicated the complexity of the cancellous architecture.

STATISTICAL ANALYSIS

This study was conducted on 108 individuals, comprising 54 with bruxism and 54 control group. IBM SPSS 22.0 was employed for the purpose of data analysis. In the subsequent statistical analysis phase, descriptive statistics pertaining to the demographic features of the individuals were initially presented. The data were subjected to a preliminary analysis to detect whether they were normally distributed, according to the level of the factor of interest and the statistical analysis method to be employed. The Shapiro-Wilk and Kolmogorov-Smirnov normality tests were employed to ascertain whether the data were normally distributed. The independent samples t-test was employed for normally distributed 2-category variables, whereas the Mann-Whitney U test was utilized for 2-category variables that were not normally distributed. The analysis of variance test was employed for normally distributed variables with more than 2 categories. The Tukey test was employed for the purpose of conducting pairwise comparisons. Chi-square test was used to determine the relationship between qualitative variables. Spearman's rank correlation coefficient was employed to investigate the relationship between quantitative variables. The intraobserver agreement was determined using the kappa statistic. All statistical tests were conducted at the 95% confidence level.

RESULTS

The total sample size was 108, comprising 54 individuals in the bruxism group (12 males and 42 females) and 54 in the control group (21 males and 33 females). The mean age of the bruxism group was 30.15±9.95 years, while the mean age of the control group was 38.89±11.71 years. A Kappa analysis was performed to evaluate intrarater reliability. The Kappa values for mandibular angle bone apposition classification were 0.970 for the right and 0.884 for the left. For MCI, the Kappa value was 0.929. There was almost perfect agreement in both classifications.

The results of the FD measurements for the regions are monitorised in Table 1. The mean FD values of the right and left mandibular angles were found to be significantly lower in the bruxism group than in the control group ($p<0.05$).

TABLE 1: Comparison of control and bruxism groups in terms of fractal dimension measurements				
Region	Bruxism ($\bar{X}$±SD)	Control ($\bar{X}$±SD)	Test st.	p value
Left condyle	1.54±0.03	1.55±0.01	t=-0.783	0.435
Left mandible angle	1.52±0.02	1.53±0.03	U=1,883.50	0.009*
Left periradicular region	1.53±0.02	1.54±0.02	U=1,607.00	0.355
Right condyle	1.54±0.03	1.54±0.02	U=1,568.00	0.496
Right mandible angle	1.52±0.03	1.53±0.03	t=-1,632	0.106
Right periradicular region	1.53±0.02	1.54±0.02	t=-0.901	0.370
Mean condyle	1.54±0.02	1.54±0.02	U=1,599.50	0.383
Mean mandible angle	1.52±0.02	1.53±0.02	U=1,849.50	0.016*
Mean periradicular region	1.53±0.02	1.54±0.01	t=-1,194	0.235

*p<0.05. SD: Standard deviation; Test st: Test statistic

The relationship between control and bruxism groups and MCI was investigated, and the results are presented in Table 2. The analysis yielded a statistically significant relationship between the group and MCI (p<0.05). While C1 was more prevalent in the control group, C2 and C3 were more prevalent in the bruxism group.

The relationship between the bruxism and control groups and mandibular angle bone apposition classification was investigated, and the results are presented in Table 3. It was found that while G0 was more prevalent in the control group, G3 and G4 were more prevalent in the bruxism group. However, no statistically significant difference was found (p>0.05).

TABLE 2: Comparison of control and bruxism groups in terms of MCI						
		MCI				
		C1	C2	C3	χ^2 test st.	p value
Group	Bruxism	23	25	6	14,852	0.001*
		42.6%	46.3%	11.1%		
	Control	41	13	0		
		75.9%	24.1%	0.0%		

*p<0.05. MCI: Mandibular Cortical Index; χ^2 Test st: chi-square test statistic

TABLE 3: Comparison of control and bruxism groups in terms of mandible angle bone apposition classification							
		Left					
		G0	G1	G2	G3	χ^2 test st.	p value
Group	Bruxism	15	26	8	5	6,589	0.086
		27.8%	48.1%	14.8%	9.3%		
	Control	23	27	2	2		
		42.6%	50.0%	3.7%	3.7%		
		Right					
		0	1	2	3	χ^2 test st.	p value
Group	Bruxism	13	28	7	6	7,457	0.059
		24.1%	51.9%	13.0%	11.1%		
	Control	25	23	2	4		
		46.3%	42.6%	3.7%	7.4%		

*p<0.05. χ^2 Test st: chi-square test statistic

TABLE 4: Comparison of control and bruxism groups in terms of fractal dimension measurements and Mandibular Cortical Index

	MCI (Bruxism)	n	$\bar{X}$	SD	Test st.	p value
Mean FD	1	23	1.53	0.02		
	2	25	1.53	0.01	F=4.507	0.016*
	3	6	1.55	0.01		
	MCI (Control)	n	$\bar{X}$	SD	Test st.	p value
	1	41	1.54	0.02	t=-1.613	0.113
	2	13	1.55	0.01		
	MCI (Bruxism)	**n**	$\bar{X}$	**SD**	**Test st.**	**p value**
Mean angulus FD	1	23	1.52	0.02		
	2	25	1.51	0.02	F=4.159	0.021*
	3	6	1.55	0.03		
	MCI (Control)					
	1	41	1.53	0.03	t=-2.010	0.049*
	2	13	1.54	0.02		

MCI: mandibular cortical index; SD: Standard deviation; Test St: Test statistic; FD: Fractal dimension

The mean FD values were measured according to the regions and the relationship between them and MCI was analysed (Table 4). A statistically significant correlation was found between the mean FD and MCI in the bruxism group. FD was found to be significantly higher in MCI-C3 ($p<0.05$). A significant difference was observed between the mean FD measurements in the mandibular angle region and MCI in both the bruxism and control groups. In the bruxism group, the mean angle region FD was found to be significantly higher in MCI-C3 than in MCI-C1 and MCI-C2 ($p<0.05$). In the control group, the mean angle region FD was found to be significantly higher in MCI-C2 than in MCI-C1 ($p < 0.05$).

The relationship between the FD measurements of the mandibular angle region and the mandibular angle bone apposition classification was analysed (Table 5). In the bruxism group, a significantly higher FD was observed in G3 on the right side in comparison to the other groups (G0, G1, G2) ($p<0.05$). Upon analysis of all participants, a higher FD was observed in G3 in comparison to the other groups (G0, G1, G2) on the right side ($p<0.05$).

DISCUSSION

This study aimed to investigate how bruxism affects both cortical and cancellous bone structures within the mandible. Unlike previous studies, it simultaneously employed fractal analysis, MCI classification, and mandibular angle bone apposition classification in a single research framework using panoramic radiographs. Panoramic radiography is an imaging technique commonly used in dentistry for various diagnostic purposes. However, one of the limitations of panoramic radiographs is the presence of non-uniform magnification factors.[11] The aforementioned magnification, coupled with distortion, can impact the accuracy of linear and angular measurements obtained from panoramic radiographs. Although some studies have indicated that vertical and angular measurements can be made accurately on panoramic radiographs if the patient is correctly positioned, the use of images for measurements is questionable due to the potential for magnification and distortion.[12] In this context, it seems more accurate to analyse panoramic radiographs using classifications based on macroscopic evaluation, such as MCI and mandibular angle bone apposition classification.

Previous research has linked bruxism to structural changes in the mandibular angle, with the masseter and medial pterygoid muscles exerting significant forces in this region.[5,9,13,14] Gulec et al. found no significant difference between the bruxism and control groups in the gonial region in terms of FD.[4] Eninanç et al. observed that FD values in the gonial region were affected by bruxism.[15] The mean FD

TABLE 5: Comparison of control and bruxism groups in terms of fractal dimension measurements of mandibular angle and mandibular angle bone apposition classification

	Left grade (total)	n	$\bar{X}$	SD	Test st.	p value
Left angle FD	0	38	1.53	0.03		
	1	51	1.53	0.02		
	2	9	1.52	0.02	F=0.173	0.915
	3	10	1.53	0.03		
	(Bruxism)					
	0	13	1.52	0.03		
	1	28	1.52	0.02	F=0.034	0.991
	2	7	1.52	0.02		
	3	6	1.52	0.03		
	(Control)					
	0	25	1.53	0.03		
	1	23	1.53	0.02	F=0.953	0.422
	2	2	1.55	0.01		
	3	4	1.56	0.02		
	Right grade (total)	**n**	$\bar{X}$	**SD**	**Test st.**	**p value**
Right angle FD	0	38	1.52	0.03		
	1	53	1.52	0.03	F=3.080	0.031*
	2	10	1.49	0.02		
	3	7	1.53	0.04		
	(Bruxism)					
	0	15	1.52	0.03		
	1	26	1.52	0.02	F=2.813	0.049*
	2	8	1.49	0.02		
	3	5	1.53	0.04		
	(Control)					
	0	23	1.52	0.03		
	1	27	1.53	0.03	F=0.317	0.813
	2	2	1.52	0.02		
	3	2	1.54	0.03		

SD: Standard deviation; Test st: Test statistic; FD: fractal dimension

values in the bilateral gonial regions of bruxism group were found to be significantly lower. In a separate study, Unal Erzurumlu et al. reported mean FD measured from the gonial region significantly lower in bruxism group than in control group reported that the mean FD measured from the gonial region was significantly lower in bruxism group than in control group.[13] The present study yielded similar results to those reported by Eninanç et al. and Unal Erzurumlu et al. with a significantly lower mean FD observed in the mandibular angle region in bruxism group.[13,15] Kurt et al. observed that FD was higher in the mandibular angle region and cortical bone in individuals with probable bruxism than in control group G0 individuals.[9] The difference in the findings of Kurt et al. may be attributed to the fact that the control group was comprised solely of G0 individuals.[9]

To date, there have been few studies in which fractal dimension analyses have been performed on the mandibular condyle region of individuals with bruxism. In a research by Gulec et al. individuals who were determined to have bruxism based on anamnesis and clinical examination exhibited significantly lower fractal dimension values in the right condyle region when compared with the control group.[4] The authors postulate that this condition may have developed as a consequence of unilateral masticator habits. In the study conducted by Eninanç et al. no significant difference was found between the bruxism and control groups in terms of fractal dimension values in the mandibular condyle region.[15] In the present study, similar to the study of Eninanç et al. no statistically significant difference was found between the fractal dimension values in the condyle region.[15] The disparate outcomes observed between the studies may be attributed to the differing diagnostic criteria employed for bruxism and the failure to consider the duration of exposure to bruxism among the participants.

MCI is a Radiomorphometric Index utilized in panoramic radiographs to evaluate and quantify the quality of mandibular bone mass, particularly in relation to osteoporosis.[16] Yilmaz et al. reported a statistically significant difference between the MCI and bruxism G0/control G0 groups.[14] It was observed that MCI-C1 was higher in the control group G0 individuals, whereas MCI-C2 was higher in bruxism group G0 individuals. However, in this study, the control group was selected only from G0 participants. Isman employed MCI in panoramic radiographs and observed a significant difference between the groups, with MCI-C2 and MCI-C3 being more prevalent in the bruxism group.[17] Similarly, in the current study, a significant difference was found between the groups and MCI. While MCI-C1 was more prevalent in the control group, MCI-C2 and MCI-C3 were more prevalent in the bruxism group.

The current definition of bruxism is masticatory muscle activity without movement disorder or sleep disturbance in healthy individuals.[1] The masseter and medial pterygoid muscles are attached to the tuberosities of the mandibular angulus region and are known to contribute up to 65% of the intrinsic forces that occur in jaw closure. In a research Türp et al. observed an increase in bone apposition in the mandibular angulus region in individuals with bruxism.[5] This apposition was classified according to its severity. It was proposed that bone apposition in the mandibular angles represents a functional adaptation to the increased stresses caused by repetitive masticatory muscle activity due to bruxism. Isman referred to the bone positions in the mandibular angle region as "bone peaks" and reported that they were found in 31.7% of bruxism group and 5% of control group, with a significant difference between the groups.[17] Unal Erzurumlu et al. indicated that bone peaks in the mandibular angle region was approximately 3 times higher in bruxism group than in control group.[13] In the present study, 72.2% of the bruxism group and 57.4% of the control group exhibited bone apposition in the mandibular angle region (G1, G2 and G3). When the grades were evaluated separately, no statistically significant difference was found. However, when the absence (G0) and presence (G1, G2 and G3) of bone apposition were evaluated, a significant difference was found. The study revealed that while G0 (absence of bone apposition) was more prevalent in the control group, G3 (bone apposition with a non-homogeneous surface) and G4 (localised bone apposition in one or more areas) were more prevalent in the bruxism group.

It has been shown that mechanical stimuli have significant effects on both muscle and bone tissues and the interdependent nature of the musculoskeletal system.[18] The potential effect of various stimuli generated by muscle, including low intensity, high-frequency stimuli, on bone has been discussed.[19] Ward et al. found that low intensity, high-frequency mechanical stimuli are anabolic for cancellous bone.[20] The results of the study indicated that the mean FD values in the mandibular angle region were lower in the bruxism group than in the control group. Nevertheless, an increase in bone apposition in the mandibular angle region was observed in bruxism group. The mechanism by which bruxism affects cancellous bone anabolically but cortical bone catabolically remains unclear.

CONCLUSION

In conclusion, the evidence indicates that bruxism has an anabolic effect on cortical bone and on catabolic effect on cancellous bone in the mandibular angulus region. It should be noted that this study is limited by the lack of information regarding certain variables, including dietary habits, unilateral chewing habits, previous anatomy, and the duration of exposure to bruxism. The diagnostic value of the signs and symptoms commonly associated with bruxism is insufficient when evaluated alone. It is therefore necessary to collect the patient's medical history and combine various signs and symptoms to obtain a comprehensive diagnostic evaluation. Before radiological signs can be used to support other signs and symptoms in bruxism, further longitudinal studies are required.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

***Idea/Concept:** Şule Erdem; **Design:** Şule Erdem; **Control/Supervision:** Şule Erdem; **Data Collection and/or Processing:** Şule Erdem, Mehmet Egemen Aydemir; **Analysis and/or Interpretation:** Şule Erdem, Mehmet Egemen Aydemir; **Literature Review:** Şule Erdem, Mehmet Egemen Aydemir; **Writing the Article:** Şule Erdem, Mehmet Egemen Aydemir; **Critical Review:** Şule Erdem.*

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