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The association between bruxism and mandibular morphology: A cross-sectional study

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Original Article

Abstract

BACKGROUND AND AIM: The aim of this study was to investigate the effect of bruxism on mandibular morphology, by comparing different mandibular measurements of bruxers and non-bruxers on panoramic radiographs.

METHODS: Data of 71 patients (32 bruxers and 39 non-bruxers) who referred to the Department of Oral and Maxillofacial Surgery, School of Dentistry, Ordu University, Ordu, Turkey, from 2016 to 2019, were retrieved from the archival records. The canine-molar height, ramus width, coronoid height-width, and gonial angle were measured with Turcasoft software on panoramic radiographs obtained from the patients' radiographic archival records. Statistical analyses were performed using the SPSS software, and comparisons of the measurements between bruxers and non-bruxers were performed using independent samples t-test or Mann-Whitney U test, as appropriate. The categorical data were analyzed using chi-square test.

RESULTS: Data of 71 patients (22 males, 49 females) aged 15-51 years were analyzed in this study. Regarding coronoid measurements, the left and right coronoid height and left coronoid width measurements were found significantly higher in bruxers than those in non-bruxers ($P = 0.025$, $P = 0.041$, $P < 0.001$). Although all gonial angle, ramus width, and molar and canine height measurements were higher in bruxers than those in non-bruxers, these differences were not statistically significant. Additionally, no significant differences were observed in any variable between bruxers and non-bruxers for both genders.

CONCLUSION: Given the results of the present study, the morphological changes of the mandible as a consequence of bruxism may be expressed with the changes in coronoid dimensions. However, to reach a definitive conclusion, further prospective clinical studies with larger sample sizes and longer follow-up periods are needed.

KEYWORDS: Muscles; Mandible; Bruxism

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A constant remodeling occurs in the skeleton during the postnatal growth to maintain a form appropriate to the biomechanical demand. This functional adaptation has been extensively explained by Wolff's law, which pointed out that the magnitude of muscle or extra-functional forces affecting the bone leads to morphological changes.[1-3] Because of their embryological origin, maxillofacial bones have been reported to be more susceptible to these forces than long bones of the extremities.[4] The masticatory muscles attached to the bones in the maxillofacial region lead to morphological changes by creating forces on the bone surface during contraction and movement.[1] Thus, the masticatory muscles are considered as important players in determining the morphology of the facial skeleton.[5] The mandible is composed of different anatomical units which can show adaptive changes in morphology related to the muscles' activity.[1] Experimental and clinical studies have

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suggested that changes in the masticatory muscle activity lead to changes in mandibular morphology.[3,6-9]

Bruxism is a detrimental parafunctional habit characterized by microarousals, grinding and clenching of the teeth, resulting in excessive stress on the stomatognathic system that may lead to temporomandibular disorders, tooth wear, and changes in the masticatory muscles' activity. Although the etiology is not clear, psychosocial, pathophysiological, and peripheral factors are considered among the contributing factors.[10,11] Bruxism can be diurnal and occur during the day while the individual is awake, or nocturnal that occurs during sleep.[10,12] Sleep bruxism (SB) affects approximately 80-95% of the world's population and is more prevalent in the age group of 15 to 40 years.[11] The masticatory muscles are continuously stimulated in bruxers; they show an abnormal increase in the function that triggers changes in dentofacial morphology. However, the exact relationship between craniofacial morphology and SB has not yet been completely clarified.[10,11,13]

The aim of this study was to investigate the effect of bruxism on mandibular morphology by comparing different mandibular measurements of bruxers and non-bruxers on panoramic radiography.

Methods

This retrospective study was conducted on the clinical and radiological data of 71 patients who referred to the Department of Oral and Maxillofacial Surgery, School of Dentistry, Ordu University with Temporomandibular Joint (TMJ) complaints, between 2016 and 2019. The sample size was calculated with G*Power version 3.1, based on the significance level of 0.05 and the power of 0.90, to detect a clinically significant difference for the variable of gonial angle with an estimated effect size of 0.86. Therefore, the minimum sample size was obtained to be 29 individuals per group.[10] The study protocol was approved by the Ethics Committee of Ordu University (Ethical code: 2020/177) and conducted according to the ethical standards specified in the Declaration of Helsinki (DoH) (1964) and its subsequent amendments.

The study inclusion criteria were:

Systemically healthy patients

Patients with complete demographic, clinical, and radiological data

Patients who did not have facial asymmetry, history of craniofacial trauma, or degenerative injury of TMJ

Patients who did not have a psychiatric disease or did not receive medication

And the exclusion criteria were:

Patients who had low-quality radiographic images that precluded the measurements

Patients with incomplete data

The diagnosis of the SB was performed according to a physical sign of bruxism in teeth, such as abnormal tooth wear or wedge defects, or pain in the masticatory muscles or TMJ during the clinical visit of the patients. In order to evaluate the effects of bruxism on mandibular morphology, the measurements were performed in the molar and canine regions, ramus, coronoid, and mandibular angle on the orthopantomograph (Figure 1). Age and gender were also recorded.

Radiographic evaluation: The orthopantomographs in the archive which had been obtained for each patient using Kodak 8000C Digital Panoramic Imaging System (Kodak Dental Systems, Rochester, New York, USA) in a standardized position were included. The measurements were performed using Turcasoft software (Turcasoft Dent, Samsun, Turkey) by an independent examiner on radiographs in two separate sessions with a one-week interval and the average of the two measurements was recorded. The following measurements were performed on the orthopantomographs in both groups (Figure 1):

The molar height: Measured as props descending from the vertex of the interdental bone at the first molar distal side to the Gonion-Menton line from each side (E).

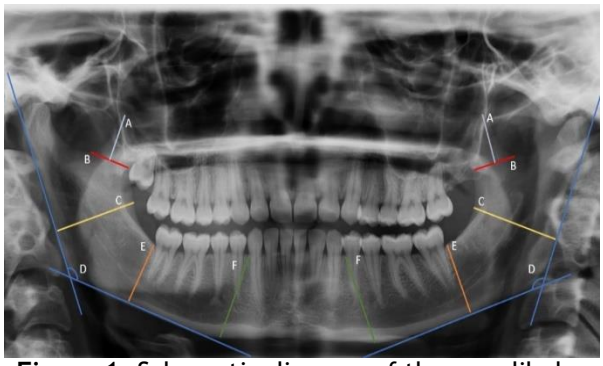

Figure 1. Schematic diagram of the mandibular measurements on the panoramic radiograph

The canine height: Measured as props descending from the vertex of the interdental bone at the canine distal side to the Gonion-Menton line from each side (F).

The ramus width: Between the anterior and posterior border of the widest part of the ramus from each side (C).

The coronoid height: The vertical distance between the peak point of the coronoid and the coronoid process width line from each side (A).

The coronoid width: The distance between the deepest point in the mandibular notch and the anterior border of the coronoid process parallel to the Gonion-Menton line from each side (B).

The gonial angle: The angle between the inferior border of the mandibular body and the posterior border of the ramus (D).[8]

Statistical analyses were performed using SPSS software (version 23, IBM Corp, Armonk, NY, USA). Kolmogorov-Smirnov test was used to assess the data normality. The measurements were compared between bruxers and non-bruxers using independent samples t-test or Mann-Whitney U test, as appropriate. The categorical data were analyzed using chi-square test. All tests were two-tailed and based on the significance level of 0.05.

Results

Data of 71 patients were analyzed in this study, 22 of whom were male and 49 of whom were female patients, and their ages ranged from 15 to 51 years. No significant differences were observed between the groups in terms of age (P = 0.940) and gender (P = 0.133) distribution. The demographic data of the groups are shown in table 1.

The mean values of the morphologic measurements are presented in table 2. Regarding coronoid measurements, the left and right coronoid height measurements were found to be significantly higher in bruxers than those in non-bruxers (P = 0.025, P = 0.041). Coronoid width measurements showed a significant difference only on the left side measurement (P < 0.001) between bruxers and non-bruxers. Although the results of all gonial angle, ramus width, molar, and canine height measurements were higher in bruxers than those in non-bruxers, these differences were not statistically significant. Moreover, no significant differences were observed in any variable between bruxers and non-bruxers for both genders.

Discussion

Although there were no significant differences among all parameters, the results of the present study showed that bruxers have higher mean values of the morphologic measurements. The researchers declare that bruxism may cause masticatory muscle hyperactivity, and their characteristics lead to adaptive changes in the morphology of the mandible, based on the magnitude of the stress generated on the bone surface. To date, several animal and clinical studies have been conducted to explore these adaptive changes.

Table 1. Group demographic variables of the bruxers and non-bruxers

Variable	Bruxers (n = 32)		Non-Bruxers (n = 39)		P
	Mean ± SD	Min-Max	Mean ± SD	Min-Max	
Age	29.71 ± 10.47	(15-51)	28.76 ± 6.47	(20-43)	0.940*
Gender					
Male	7		15		0.133¥
Female	25		24		

*Mann-Whitney U test, ¥Chi-square test
SD: Standard Deviation

Table 2. Comparison of morphologic measurements between the groups

Variables (mm)	Bruxers		Non-Bruxers		P
	Side		Side		
	Right	Left	Right	Left	
Gonial angle	123.80	123.69	120.92	120.71	(R) 0.149§ (L) 0.099§
Ramus width	290.94	289.32	277.51	280.51	(R) 0.074§ (L) 0.222§
Molar height	258.29	259.87	250.97	251.97	(R) 0.465§ (L) 0.450§
Canine height	310.29	307.94	308.18	304.62	(R) 0.804§ (L) 0.510*
Coronoid height	157.55§	158.61	142.26§	146.92	(R) 0.041* (L) 0.025*
Coronoid width	178.32	188.00	170.79	168.08	(R) 0.130* (L) 0.000§

*Independent samples t-test, §Mann-Whitney U test

In an experimental study on adult rats, Odman et al. investigated the influence of the masticatory functional changes on mandibular morphology. They found that low masticatory activity for 7 months had a significant effect on the lateral shape of the mandibular bone.[3] Similar results have been reported in a study by Mavropoulos et al. on growing rats.[6] In a clinical study consisting of 80 male adult volunteers, Kubota et al. suggested that masticatory function influences the morphology.[4] In another study, Sella-Tunis et al. found a relationship between mandibular muscle activity and morphology.[8]

SB is a common parafunctional habit or orofacial disorder believed to have multifactorial etiology with ongoing controversies. Bruxism is thought to be a part of the arousal response, which describes the changes in the sleep depth. Furthermore, psychosocial factors like depression or less commonly, peripheral factors, like occlusal variables, have been considered among the etiologic factors that trigger the occurrence of SB.[9,10] The repeated activity of bruxers leads to hypertrophy of masticatory muscles as well as the higher bite force.[10,11] However, in some previous studies, no differences were found in bite force between bruxers and non-bruxers.[10-12,14] On the other hand, Pizolato et al. evaluated the maximum bite force of bruxers, and they found decreased maximum bite force in bruxers for both genders.[15] The results of the studies about the relationship between bruxism and bite force change still seem to be a controversial issue and requires further clinical studies to clarify. In the present study, the measurements of the patients' masticatory muscles thickness or bite force were not performed because of the retrospective nature of the study and incomplete data regarding the magnetic resonance imaging (MRI) scans of the patients.

Studies suggest that individuals with thick mandibular muscles or strong bite forces have wider transversal dimensions, a small gonial angle, a smaller anterior and greater posterior facial height, a small lower facial height, and a rectangular facial shape.[1,16-18] Besides, it was reported that maxillary and mandibular bone resorption occurs due to the prolonged clenching of the teeth.[19] In the present study, to evaluate the morphology of the mandible, canine-molar heights, ramus width, coronoid height-width, and gonial angle were measured, and the results were compared between bruxers and non-bruxers. Significant differences in coronoid height (left-right) and coronoid width (left) were found between the groups. These differences may be due to the changes in the tonus of the temporalis muscle in bruxers. No significant difference was found in the other measurements between the groups. Menapace et al.[13] and Young et al.[20] found no difference in dentofacial morphology between bruxers and non-bruxers. In another study, Kiliaridis et al. reported a small gonial angle in bruxers.[16] Karakıs and Dogan in their clinical study, reported that the craniofacial morphological parameters measured in their study did not differ significantly between male bruxers and non-bruxers, but female bruxers had higher mandibular corpus length and smaller gonial angle.[10] In the present study, no difference was found between

bruxers and non-bruxers in terms of gender.

Orthopantomography is used as a matter of routine in general dental practice; it provides a great deal of diagnostic information.[21] In panoramic radiography with proper patient positioning, vertical measurements can be performed with small errors and mandibular angular measurements can be performed with a high degree of accuracy.[17] Because of the availability of the panoramic radiography in the clinical studies and the incomplete data regarding the patients' MRI scans, the measurements on the panoramic radiographs were performed.

The present study had some limitations owing to the retrospective design. The masticatory muscle thickness, tooth wear, or bite force of the patients could not be evaluated. Additionally, the data regarding gender were skewed.

Conclusion

On the basis of the results of the present study, the morphological changes of the mandible, as a consequence of bruxism, may be expressed through the changes in coronoid dimensions. However, to reach a definitive conclusion, further prospective clinical studies with larger sample sizes and longer follow-up periods are needed.

Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

None.

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