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RESEARCH ARTICLE

Differences in mandibular morphology between bruxism and non-bruxism patients based on the Levandoski analysis

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ABSTRACT

Bruxism is a condition that involves grinding and clenching which can place a large load on the mandible, so it can change the morphology of the mandible. Based on the Levandoski analysis, this study aimed to determine whether there are differences in the mandibular morphology between bruxism and non-bruxism patients**.** This study was a cross-sectional analytic study conducted on the panoramic radiographic samples of bruxism and non-bruxism patients with a total sample of 30 patients (n = 30) in each group, obtained from the radiographic archives at the Radiology Installation of RSGM Universitas Padjadjaran which have been confirmed as bruxism and non-bruxism patients. Measurements were carried out using ImageJ software based on the reference lines by Levandoski. The results of the study were analyzed using SPSS software by performing normality and homogeneity tests, followed by a statistically independent t-test or Mann-Whitney test. The results of the independent t-test showed that three lines had a p-value < 0.05, namely the line from the point gonion to the maxillary vertical line on the right side, the distance from the top point of the condyle to the maxillary interincisal point on the right side, and the distance from the top point of the condyle to the mandibular interincisal point on the right side. The Mann-Whitney test results showed that two lines had a p-value < 0.05, namely the maxillary vertical midline and the distance from the condyle to the left maxillary vertical line. The other line had a p-value> 0.05. There were differences in the mandibular morphology between bruxism and non-bruxism patients based on the Levandoski analysis, namely the length of the maxillary vertical midline, the distance from the condyle top point to the maxillary vertical midline, the distance from the point gonion to the maxillary vertical midline, the distance from the top point of the condyle to the maxillary interincisal point on the left side, and the distance from the top point of the condyle to the mandibular interincisal point on the left side. On the other four lines, there was no significant difference between bruxism and non-bruxism patients.

Keywords: bruxism; levandoski analysis; panoramic radiograph

INTRODUCTION

Bruxism is a disorder in the oral cavity with repetitive jaw muscle activities characterized by clenching or grinding of teeth and/or by tightening the mandible.[1] According to The American Academy of Sleep Medicine (AASM), bruxism is an oral activity characterized by grinding or clenching teeth during sleep.[2] Bruxism has a highly multifactorial etiology such as peripheral, psychosocial, physiological, and exogenous factors. Peripheral factors suggest that a mismatch of occlusion and articulation of teeth can cause bruxism. Psychosocial factors include stress, anxiety, and emotional factors. Physiological factors include genetic factors, while exogenous factors include alcohol consumption and drug use.[3,4] Bruxism is divided into two classifications, namely, sleep bruxism and awake bruxism.[1] Sleep bruxism has a prevalence of 10 to 13% in the general adult population, is not related to sex, and decreases in the elderly. Meanwhile, the prevalence of awake bruxism is 22 to 31% in adults.[1] Clinical manifestation of bruxism includes a sound when clenching teeth, tooth wear, tooth loss, periodontal ligament widening, tooth mobility, and recession.[5]

Levandoski analysis is a system for analyzing panoramic radiographs, especially of the temporomandibular joint. Levandoski analysis was then extended to analyze facial and dental

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asymmetry. Levandoski panoramic analysis is a useful screening method for analyzing tooth and mandibular asymmetry.[6] Research on mandibular morphological changes in patients with bruxism is not a new thing. The study of Gulec et al[7] stated that excessive occlusal pressure on the teeth can result in tooth wear, increased mobility, and percussion sensitivity with increased periodontal ligament space, thickening of the lamina dura, alveolar bone loss, and an increase in the number and size of trabeculae on radiographic examination. In addition, hypercementosis and root fracture may occur. In 2013, Ozcan et al[8] conducted a simulation of bruxism in laboratory animals and found changes in periodontal tissue that included resorption of the alveolar bone walls, cement, and dentin. In 2013, Rahmi et al[9] stated that the magnitude of the bite force in patients with bruxism can affect many things, such as dentofacial morphology. Fauziah et al[10] conducted a study and stated that there was no significant difference in the height of the cortical bone between bruxism and non-bruxism patients.

Some of these studies support the possibility of differences in the mandibular morphology in patients with bruxism. However, research on bruxism and its effect on the mandibular morphology using the Levandoski analysis method is still rarely done. Levandoski analysis is a method to analyze symmetry and morphological differences. Measurements can be made on each side to determine the difference between the two sides. This study aimed to determine whether there are differences in the mandibular morphology between bruxism and non-bruxism patients based on the Levandoski analysis method.[6]

MATERIALS AND METHODS

This cross-sectional analytic study aimed to determine the differences in mandibular morphology between bruxism and non-bruxism patients. The research population consisted of patients who came to RSGM Unpad. The samples were digital panoramic radiographs of bruxism and non-bruxism patients in the archives of the Radiology Installation of RSGM Unpad from 2016 to 2021. There were a total of 30 samples in this study for each group of bruxism and non-bruxism patients. The diagnosis was made based on the medical record filled by the residents at the PPDGS Prosthodontics Installation, RSGM Unpad. The panoramic radiographic samples were from patients aged 20-50 years, who had complete teeth up to the second molars, a panoramic photo with a bite block, no cysts and fractures in the observed area, had no developmental disorders or syndromes affecting the size of the mandible, and had no superimposition on the area to be analyzed. The minimum age for the inclusion criteria was 20 years because bone growth stops around age 21 for men and 18 for women and the prevalence of bruxism at a young age was higher.[11] The maximum age was 50 years because the prevalence of bruxism in the elderly decreases.[12] The sampling used a purposive sampling method which was limited to a certain period. The data analysis technique used the basic reference lines proposed by Levandoski.[6]

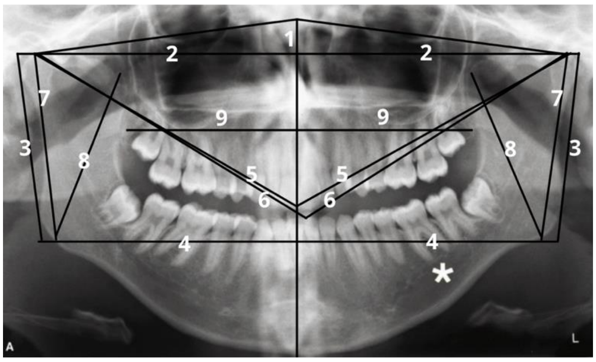

Figure 1. Levandoski's Basic Reference Line[6]

Line 1 is the maxillary vertical midline, determined from the line's junction that traces the condyle top point to the lowest point of the orbital wall, to the lowest point of the symphysis, and must pass through the nasal septum. Line 2 is drawn perpendicularly from the left and right top point of the condyles to the maxillary midline. Line 3 is the posterior border of the ramus (right and left). Line 4 is a line drawn bilaterally from the point where line 1 crosses the lower border of the mandibular symphysis in each direction to the gonion. Line 5 is drawn bilaterally from the top point of the condyle to the maxillary interincisal point. Line 6 is defined from the top point of the condyle to the mandibular interincisal point. Line 7 is drawn from the top point of the condyle to the gonion. Line 8 runs from the point gonion to the coronoid process, and Line 9 runs from the top of the maxillary tuberosity and is drawn perpendicular to the maxillary midline.[6]

The lines on the panoramic radiographs were measured using the ImageJ software version 1.53e Wayne Rasband and the National Institute of Health, USA which was equipped with the MorphoLibJ plugin. The data were then analyzed by statistical tests using the SPSS application version 26.0.0.0.

This research was conducted from December–May 2022. The research received ethical clearance from the Health Research Ethics Committee Universitas Padjadjaran Number: 1040/UN6.KEP/EC/2021. A permission letter from RSGM Universitas Padjadjaran to collect the sample data was obtained with Number 1977/UN6.RSGM/TU.00/2021.

RESULTS

Based on the results, the characteristics of the research subjects could be seen (Table 1). Levandoski recommended reference lines to compare between bruxism and non-bruxism patients (Table 2). The normality and homogeneous tests were carried out in this study. If the results of the Shapiro-Wilk and Kolmogorov Smirnov test showed a p-value > 0.05, the data were normally distributed; if the p-value was < 0.05, the data were not normally distributed. Furthermore, the homogeneity of the research data was tested with One-Way ANOVA. If the p-value > 0.05, the data were homogeneous; if the p-value < 0.05, the data were not homogeneous. If the data were normally distributed and homogeneous, then the data should be tested by an independent statistical t-test to compare the differences on each of the predetermined lines. On the other hand, if the data were neither normally distributed nor homogeneous, or not normally distributed but homogeneous, the Mann-Whitney test should be performed as an alternative to compare the differences on each of the predetermined lines.

Table.1. Characteristics of Research Subjects

Groups	Gender		Age
	Male	Female	20-35
Bruxism	7	23	30
Non-Bruxism	14	16	30
Total	21	39	60

Table 2. Benchmark Average Score by Levandoski (mm)

Line	Variable	Bruxism		Non-Bruxism	
		Right	Left	Right	Left
1	Maxillary vertical midline	137.53		134.79	
2	Distance from the highest condyle point to the maxillary vertical line	116.80	110.77	113.92	114.78
3	Ramus height	78.43	77.80	77.74	78.01
4	Line from gonion point to maxillary vertical line	110.93	106.56	104.71	105.63
5	The maxillary condyle-interincisal points of the maxilla	131.08	125.55	126.35	127.42
6	The maxillary condyle-interincisal points of the mandible	133.98	129.47	129.08	130.03
7	Line from highest condyle to gonion point	78.52	77.95	77.58	77.73
8	Line from point of gonion to coronoid process	74.76	72.79	74.50	73.62
9	Distance from the tip of the maxillary tuberosity and drawn perpendicular to the midline of the jaw	77.98	74.76	76.15	76.09

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Table 3. Statistical Test Results of Patients and Non-Bruxism Patients

Line	Variable	Side	Normality Test Distribution	Homogeneity Test	Statistic Test	p-value	Description
1	Maxillary vertical midline		Abnormal	Inhomogeneous	Mann-Whitney test	0.001	Significant
2	Distance from the highest condyle point to the maxillary vertical line	Right	Normal	Homogeneous	Independent t-test	0.112	Not Significant
		Left	Abnormal	Homogeneous	Mann-Whitney test	0.009	Significant
3	Ramus height	Right	Normal	Homogeneous	Independent t-test	0.680	Not Significant
		Left	Normal	Homogeneous	Independent t-test	0.898	Not Significant
4	Line from gonion point to maxillary vertical line	Right	Normal	Homogeneous	Independent t-test	0.007	Significant
		Left	Normal	Homogeneous	Independent t-test	0.632	Not Significant
5	The maxillary condyle-interincisal points of the maxila	Right	Normal	Homogeneous	Independent t-test	0.008	Significant
		Left	Normal	Homogeneous	Independent t-test	0.250	Not Significant
6	The maxillary condyle-interincisal points of the mandible	Right	Normal	Homogeneous	Independent t-test	0.007	Significant
		Left	Abnormal	Inhomogeneous	Mann-Whitney test	0.564	Not Significant
7	Line from highest condyle to gonion point	Right	Abnormal	Homogeneous	Mann-Whitney test	0.842	Not Significant
		Left	Abnormal	Homogeneous	Mann-Whitney test	0.790	Not Significant
8	Line from point of gonion to coronoid process	Right	Normal	Homogeneous	Independent t-test	0.879	Not Significant
		Left	Normal	Homogeneous	Independent t-test	0.652	Not Significant
9	Distance from the tip of the maxillary tuberosity and drawn perpendicular to the midline of the jaw	Right	Normal	Homogeneous	Independent t-test	0.233	Not Significant
		Left	Normal	Homogeneous	Independent t-test	0.375	Not Significant

In this study, the measurements were done in two repetitions. Therefore, to determine the degree of agreement of the measurement repetition by the same rater, intra-rater repeatability was used with a two-way mixed effect model, single measurement type, and absolute agreement definition. Intra-rater repeatability was measured using the intra-class coefficient (ICC). In all the groups, the ICC value > 0.8 indicated very good reliability of the measurement by the same rater.

DISCUSSION

Bruxism is repetitive masticatory muscle activity characterized by clenching or grinding of the teeth and/or tightening the mandible, and is divided into sleep bruxism or awake bruxism.[12]

Bruxism can affect the teeth, periodontal tissues, temporomandibular joints, and mandible.[7,9] All the study samples were in the age range of 20-35 years (Table 1). These results are consistent with several studies which state that bruxism is more common at a young age. A study of Ella *et al*.[1] stated that the prevalence of awake bruxism was 22 to 31% in adults, with higher rates among women and younger subjects. Wetselaar et al[13] stated that the two youngest age groups (25-34 and 35-44) were reported to have bruxism more frequently (6.5% and 7.8%) compared to the older age group. Sleep bruxism had a higher prevalence than awake bruxism, with the two youngest age groups (25-34 and 35-44) showing the highest rates. The samples in this study consisted mostly of women. Wetselaar et al[13] in their research also stated that both awake bruxism and sleep bruxism were more common in women than men with a ratio of 6.4% in women and 3.2% in men for awake bruxism and 18.6% in women and 13.9% in men for sleep bruxism. This might be because women are more sensitive to stress, where stress is one of the factors that can trigger bruxism. Women are also more open to admitting to having habitual bruxism or other TMD symptoms.[14]

Line 1, which is the maxillary vertical midline in patients with and without bruxism, showed a significant difference. According to Marangoni et al,[15] changes in the occlusal vertical dimension show the occurrence of masticatory muscle hyperactivity and TMD symptoms; every increase in the vertical distance unit indicates a higher tendency to develop TMD. In patients with bruxism, the occlusal vertical dimension distance can decrease due to attrition of the incisal and occlusal surfaces of the teeth.

Line 2, i.e., the line from the top point of the condyle to the maxillary midline on the right side showed an insignificant difference, while the left side showed a significant difference. The measurements were made separately between the left and right sides. If combined, the statistical results showed different results, namely there was no significant difference between bruxism and non-bruxism patients. According to Isman,[16] the effect of bruxism on the fractal dimension significantly reduced in the condyle of patients with bruxism. The distance of line 3, i.e., the posterior border of the right and left sides of the ramus, showed no significant difference in the length of the left ramus between bruxism and non-bruxism patients. This is, however, different from previous research by Rahmi et al[9] which stated that in patients with bruxism there was an increase in the ramus height. This difference could be because of a different number of samples between the two studiesand the number of female bruxism samples was greater than that of male bruxism samples. According to research by Xiong et al,[17] genders are associated with the ramus height. Males have a longer ramus and a larger mandible than females.

The distance on Line 4, namely the length of the gonion to the maxillary vertical line, had a significant difference on the right side but no significant differences on the left side. The measurements were carried out separately between the left and right sides. If combined, the statistical results showed different results, namely there was no significant difference between bruxism and non-bruxism patients. According to research by Isman,[16] the bone crests detected in the cortex of the mandibular gonion in bruxism patients had a higher distance than that in non-bruxism patients. This is caused by excessive bite force by bruxism patients. Research by Biagi et al[6] also showed that abnormal muscle function can also cause dental and bone asymmetry due to abnormal muscle strain. According to research by Rahmi et al,[9] there was a significant difference in the bigonial width between bruxism and non-bruxism patients.

In Line 5, i.e., the distance from the top point of the condyle to the maxillary interincisal point on the right side, and Line 6, i.e., the distance from the top point of the condyle to the mandibular interincisal point on the right side, there were statistically significant differences between bruxism and non-bruxism patients. According to research by Yazıcıoğlu and Çiftçi,[18] patients with bruxism showed an increase in the deviated midline. This means that bruxism can cause problems with the incisal relationship. Inboth the right and left sides of Line 7, no significant difference was observed between the top point of the condyle to the gonion in bruxism and non-bruxism patients. This is different from an opinion of Rahmi et al[9] who stated that in patients with bruxism there was an increase in the ramus height and bigonial width, but there was a decrease in the gonial angle. This study also found that there was a significant correlation between the ramus height, gonial angle, and bigonial width. A different opinion was expressed by Ahila et al[19] who stated that in patients with bite abnormalities, namely deep bite, there was no correlation between the ramus height and gonial angle. This difference can be caused by a different number of samples between the two studiesand the number of female bruxism samples was higher than the number of male bruxism samples.

The distance of Line 8 (gonion length to the coronoid process) on the right and left showed no significant difference between patients with and without bruxism. According to Padmaja et al,[20] the coronoid process has a marginal increase in the surface area in patients with bruxism when compared to non-bruxism patients. The hyperactivity of the masticatory muscles, especially the temporalis, could be a logical explanation for the hyperplasia. From this explanation, it can be concluded that the changes that occur in the coronoid process in patients with bruxism are changes in the surface area, not changes in the height of the coronoid process. In Line 9 (distance from the top of the maxillary tuberosity and drawn perpendicular to the maxillary midline) on the right and left sides, there was no significant difference between bruxism and non-bruxism patients. Similarly, whehn the measurements were combined between the left and right sides, the results showed the same results between bruxism and non-bruxism patients. In line with research of Hazar et al,[21] there was no significant difference in terms of the arch length and width in children with and without bruxism.

The limitation of this study is the lack of secondary data that can be used, so the number and variation of age and sex in the samples were limited. It is important to explore the effect of bruxism on mandibular morphological differences in depth. Further research can collect primary data in the form of subjective examination, objective examination, and clinical examination to obtain a larger number of samples with diverse and accurate characteristics. As the secondary data, the panoramic radiographs did not show the duration that a patient has had bruxism, other abnormalities the patients had, and the patients' bad habits such as chewing on one side. Future studies can consider this during primary data collection or use secondary data in the form of cone-beam computed tomography (CBCT) to improve the accuracy of the size and shape of the mandible.

CONCLUSION

This study concluded that there were significant morphological differences between bruxism and non-bruxism patients based on the reference lines proposed by Levandoski on the maxillary vertical midline, the distance from the top point of the condyle to the maxillary vertical midline, the point gonion to the maxillary vertical midline, the top point of the condyle to the maxillary incisor, and the distance from the top point of the condyle to the mandibular incisor. Meanwhile, the other four lines showed no significant morphological differences between bruxism and non-bruxism patients.

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