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Importance of Digastric Muscle Sensitivity in Bruxism

Bruksizmde Digastrik Kas Hassasiyetinin Önemi

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ABSTRACT

Objective. It was aimed to assess the differences in the sensitivities of masticatory and digastric muscles during examination because of continuous and excessive forces in case of bruxism.

Material and Method. From the masticatory muscles of 162 individuals with bruxism and 162 control individuals, masseter, temporalis, medial / lateral pterygoideus muscles and digastric muscles were examined. Perceived sense of discomfort-pain during muscle examinations was scored according to a numerical rating scale and recorded as right and left.

Results. In individuals with bruxism, the pain scores of the patients for each examined muscle were higher than the control group ($p<0.05$). In the ROC analysis performed in bruxism, cut-off values for digastric muscle, lateral pterygoideus muscle and other muscles were 2.5, 1.5 and 0.5, respectively. The sensitivity and specificity of the digastric muscles were found to be higher than other muscles (sensitivity: right=72.8%, left=72.8%, specificity: right=18.5%, left=17.9%).

Conclusion. Bruxism affects digastric muscles more than masticatory muscles. Digastric muscles and other masticatory muscles should be evaluated in addition to masseter muscle pain, hypertrophy and fatigue in the clinical diagnosis of bruxism.

Keywords: Bruxism, digastric muscle, masticatory muscles, muscle examination, pain

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ÖZET

Amaç. Bruksizmde meydana gelen devamlı ve aşırı kuvvetler sonucu muayene sırasında çiğneme kasları ve digastrik kasın duyarlılıklarındaki farklılıkları araştırmak amaçlandı.

Materyal- Metod. 162 bruksist ve 162 kontrol grubu bireyin çiğneme kaslarından masseter, temporal, medial / lateral pterygoid kaslar ve digastrik kas muayene edildi. Kas muayeneleri sırasında hissedilen rahatsızlık-ağrı hissi sayısal değerlendirme ölçeğine göre skorlanarak sağ ve sol olarak kaydedildi.

Bulgular. Bruksist bireylerde incelenen her kasa ait hastaların belirttiği ağrı skorları kontrol grubuna göre daha yüksek bulundu ($p<0,05$). Yapılan ROC analizinde bruksistlerde kestirim değerleri digastrik kas için 2,5, lateral pterygoid kas için 1,5 ve diğer kaslar içinse 0,5 olarak hesaplandı. Digastrik kasın sensitivitesi ve spesifitesi diğer kaslara göre daha yüksek bulundu. (sensitivite: sağ=%72,8, sol=%72,8, spesifite: sağ=%18,5, sol=%17,9).

Sonuç. Bruksizmden digastrik kas çiğneme kaslarına göre daha fazla etkilenmektedir. Bruksizm klinik tanısında masseter kas ağrısı, hipertrofisi ve yorgunluğuna ilaveten diğer çiğneme kasları ve digastrik kas da değerlendirimelidir.

Anahtar Kelimeler: Bruksizm, digastrik kas, çiğneme kasları, kas muayenesi, ağrı

1. Introduction

Bruxism is defined as repetitive nocturnal (rhythmic or non-rhythmic) or diurnal masticatory muscle activity (repetitive and continuous) due to tooth clenching and tooth grinding [1]. Overall, these parafunctional jaw movements without patient awareness are produced as a result of rhythmic or continuous tonic contractions of masticatory muscles [1,2].

Involuntary contraction-relaxation movements in bruxism are thought to cause muscle fatigue, pain and myospastic activity in jaw muscles [3], muscle hypertrophy [4], headache, temporomandibular dysfunction, tooth wear [5] and broken tooth restorations or failure [6-9].

In a study, it was shown that parafunctions might cause trigger points inside muscles by causing long-term, excessive function in muscles [10]. Excessive loads cause dynamic and isometric muscle contractions and thus, ischemic pain occurs because of lactic acid accumulation due to an inadequate supply of muscles with ATP, if there is not enough resting period of the muscles. Consequently, muscle cramps, acute pain and restrictions in jaw movements might be seen [11].

There are 4 pairs of masticatory muscles including the masseter, temporalis, and medial / lateral pterygoideus muscles [7,12]. Active masseter muscle may be sensitive mainly at the first segment or more rarely at insertion during tooth clenching. In the case of parafunction, the pain might be felt mostly in the temporalis muscle on the anterior side of the temple, while referred pain occurs in the preauricular region during muscle examination against resistance in lateral pterygoideus muscles. The effects of parafunction on the muscles are hypothesized because clinical examination of the medial pterygoideus muscle gives inconclusive results [13]. The other elements that assist in the opening of the jaw and are crucial for mandibular movement are the suprahyoid muscles and the infrahyoid muscles. The digastric muscle, one of the suprahyoid muscles above the hyoid bone, is explained as auxiliary masticatory

muscle, and there are literature that emphasize the importance of this muscle along with the masticatory muscles [14,15,16]. The posterior belly of the digastric muscle is one of the muscles that pull the mandible back and it is sensitive on the posterior side of the mandibular ramus and submandibular region in individuals who have a habit of bruxism and do so with the anterior teeth [13].

This study was planned after the authors detected that there was more pronounced sensitivity during muscle examinations, especially on palpations in the digastric muscle region among patient groups in outpatient clinics with symptoms of bruxism. This study aimed to rate the effects of continuous and excessive forces on susceptible muscles with a pain scale in patients with a “probable bruxism” and explore the importance of digastric muscle among all these muscles. To the best of the authors’ knowledge, there has been no study with a similar design in the literature, and a null hypothesis was created that there is no difference between the sensitivity of masticatory muscles and digastric muscle in bruxism.

2. Material and Method

Patient Selection

The present study was approved by Sivas Cumhuriyet University Noninterventional Clinical Studies Ethics Committee with the decision number 2021-06/06 (23.6.2021). All principles of Declaration of Helsinki were followed. The study was conducted with 162 individuals with bruxism and 162 individuals from control group who applied to Sivas Cumhuriyet University Faculty of Dentistry the Department of Oral & Maxillofacial Radiology. Informed consent was signed by all volunteer individuals with age range of 18 – 55 years.

In the bruxist group, it was required to have been clenching/grinding teeth for at least 6 months. Exclusion criteria were as follows: past or ongoing orthodontic treatment, any neurological and psychiatric diseases, other habits such as pen biting or nail biting, any pathology around temporomandibular joint region on panoramic radiographies, any temporomandibular dysfunction other than masticatory muscle disturbance, the presence of prosthetic restoration in any teeth and restoration that creates premature contact in occlusion region, lack of >1 tooth in upper or lower jaw (excluding 3th molar teeth), severe malocclusion (overjet and overbite >6 mm, unilateral and anterior cross-closure, positional difference between centric relation and maximum intercuspidation >5mm), dental pain due to untreated caries and advanced periodontal disease, not being cooperative in muscle examinations, and history of masseter and temporalis muscle botox treatment.

Clinical Examination

In the present study, patients were diagnosed with ‘probable bruxism’ [1] according to survey suggested by Pintado et al. [17] and clinical criteria recommended by Rompre et al. [18] Bruxist individuals met the criteria of both researchers. Survey and clinical examination were performed by an oral, dental and maxillofacial radiologist (İ.E.) with 12 years of clinical experience including 6 years of experience of maxillofacial radiology.

While evaluating the selection criteria of Pintado et al., it was considered that individuals with bruxism should have answered positively to at least 2 of the following survey questions [17]:

1. Has anyone previously told you that you grind your teeth at night?
2. Have you ever felt fatigue in your jaw in the morning?
3. Have you ever felt pain in your teeth and gum in the morning?
4. Have you ever had headache in the morning?
5. Have you previously noticed that you grind your teeth during the day?
6. Have you previously noticed that you clench your teeth during the day?

Individuals who met all of clinical criteria proposed by Rompre et al [18] were accepted as bruxist. The criteria of Rompre et al were as follows:

1. The patient has tooth clenching and sounds of tooth grinding for at least 6 months, more than 3 nights a week
2. Tooth wear in accordance with the movements of jaw in the normal or eccentric position
3. Masseter muscle hypertrophy in voluntary contraction
4. Discomfort, fatigue or stiffness in masticatory muscles in the morning.

Muscle Examination

In this study, masseter, temporalis, medial / lateral pterygoideus muscles and digastric muscle were examined in all individuals from bruxist and control groups. Superior, middle and inferior fibers of the masseter muscle and anterior, middle and posterior fibers of temporal muscle were palpated extra orally.

Medial pterygoideus muscle examination was performed intraorally by pressing on the ramus from inside to outside.

Palpation has no validity and safety for detection of sensitivity as lateral pterygoideus muscle is inaccessible with manual palpation. In this study in which the muscle is fixed, patient resistance a safe technique was used [13]. According to this technique, the patient was required to open mouth and resist to the examiner who tries to close the patient's jaw from below and in the meantime, the degree of pain in the preauricular region was recorded.

In the examination, the posterior belly of the digastric muscle was pressed with a little finger from distal towards the ramus of the mandible.

Numerical pain rating scale was used to measure the sensitivity of the muscles to palpation. The numerical rating scale is one of the most commonly used pain scales in healthcare services and is designed to be used by individuals over the age of nine. Pain could be graded verbally from "0" to "10". "0" points signify no pain, while "10" points the most severe pain ever. It helps to classify pain as mild, moderate or severe [19,20] (Figure 1).

The discomfort-pain felt during muscle examination in individuals with bruxism was scored with a numerical rating scale and recorded on the right and left.
The study was explained in detail to all patients before the pain grading and a trial examination was performed at the first stage, and then the pain felt in the second examination was recorded.

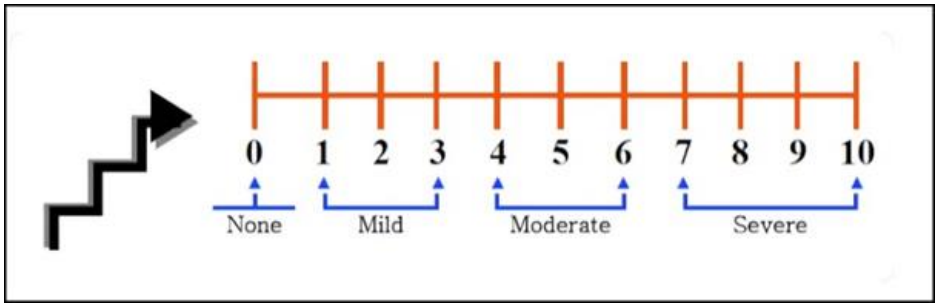

Figure 1. Numerical pain rating scale

G Power 3.1.9.4 program was used in this study. When α=0.05, β=0.10, effect size (w) = 0.272, 1 – β = 0.80 were considered, it was necessary to take a minimum of 153 individuals for both the bruxist group and the control group and test power was found to be P=0.80188 [10].

Statistical Analysis

The data obtained from the study was loaded to SPSS (22.0) program and evaluated. The normality of the data was checked with the Kolmogorov-Smirnov test. Independent sample t test was used for two independent groups for data that met parametric data, and Mann Whitney U Test was used for those

who did not. ROC analysis was performed to find cut-off values. Data were given in tables as mean, standard deviation, and median and the level of error was taken as 0.05 and $p<0.05$ was considered statistically significant.

3. Results

The mean age of all participants was 26.38±7.36 years. The mean ages of the bruxism group and the control group were 27.02±8.06 years and 25.73±6.55 years, respectively. Differences between groups were insignificant in terms of age ($p>0.05$). The study included 324 individuals in total, 76 males and 86 females in each group.

The pain scores of the right and left masticatory muscles and digastric muscles of the bruxism and control groups were compared. According to this, pain scores reported by individuals with bruxism from each examined muscle were higher than the control group ($p<0.05$) (Table 1).

Table 1. Pain scores reported by patients during muscle examination

		N	Mean±SD	Median	Minimum	Maximum	P
Right Masseter	Bruxist	162	1.64±1.92	1.00	0.00	9.00	**0.001***
	Control	162	0.09±0.41	0.00	0.00	3.00	
Left Masseter	Bruxist	162	1.62±1.88	1.00	0.00	9.00	**0.001***
	Control	162	0.09±0.44	0.00	0.00	3.00	
Right Temporalis	Bruxist	162	1.34±1.89	0.00	0.00	10.00	**0.001***
	Control	162	0.15±0.58	0.00	0.00	5.00	
Left Temporalis	Bruxist	162	1.30±1.86	0.00	0.00	10.00	**0.001***
	Control	162	0.15±0.58	0.00	0.00	5.00	
Right Pterygoideus Medialis	Bruxist	162	1.86±2.23	1.00	0.00	10.00	**0.001***
	Control	162	0.28±0.85	0.00	0.00	5.00	
Left Pterygoideus Medialis	Bruxist	162	1.93±2.24	1.00	0.00	10.00	**0.001***
	Control	162	0.42±0.96	0.00	0.00	4.00	
Right Pterygoideus Lateralis	Bruxist	162	1.6±2.05	1.00	0.00	8.00	**0.001***
	Control	162	0.18±0.71	0.00	0.00	5.00	
Left Pterygoideus Lateralis	Bruxist	162	1.64±2.05	1.00	0.00	8.00	**0.001***
	Control	162	0.23±0.77	0.00	0.00	5.00	
Right digastric	Bruxist	162	4.15±2.61	4.00	0.00	10.00	**0.001***
	Control	162	1.18±1.79	0.00	0.00	9.00	
Left digastric	Bruxist	162	4.15±2.65	4.00	0.00	10.00	**0.001***
	Control	162	1.17±1.71	0.00	0.00	8.00	

*Mann-Whitney U test (SD: standard deviation, p: significance level, *: significant at the p<0.05 level.)*

ROC analysis was performed to find cut-off values of masticatory muscles in individuals with bruxism, area under the curve was calculated and the size of this area was found statistically significant ($p<0.05$).

Sensitivity, specificity and cut-off values of right and left digastric muscles were higher than other muscles (Table 2).

Table 2. Sensitivity, Specificity and Cut-off Values of Muscles in Bruxism

Risk Factor	AUC (95%)	Cut-off Value	Sensitivity (%)	Specificity (%)
Right Masseter	0.762 (0.709-0.815)	0.5	0.562 (56.2%)	0.049 (4.9%)
Left Masseter	0.767 (0.714-0.820)	0.5	0.574 (57.4%)	0.049 (4.9%)
Right Temporalis	0.701 (0.643-0.758)	0.5	0.475 (47.5%)	0.093 (9.3%)
Left Temporalis	0.704 (0.646-0.761)	0.5	0.475 (47.5%)	0.08 (8%)
Right Pterygoideus Medialis	0.728 (0.673-0.784)	0.5	0.562 (56.2%)	0.13 (13%)
Left Pterygoideus Medialis	0.710 (0.653-0.766)	1.5	0.469 (46.9%)	0.105 (10.5%)
Right Pterygoideus Lateralis	0.727 (0.671-0.783)	0.5	0.525 (52.5%)	0.08 (8%)
Left Pterygoideus Lateralis	0.719 (0.663-0.775)	0.5	0.525 (52.5%)	0.099 (9.9%)
Right digastric	0.818 (0.771-0.866)	2.5	0.728 (72.8%)	0.185 (18.5%)
Left digastric	0.820 (0.773-0.867)	2.5	0.728 (72.8%)	0.179 (17.9%)

AUC: Area under the curve

In individuals with bruxism, the sizes of the area under the curve of posterior segments of right / left digastric muscles were statistically significant, 0.818, and 0.820, respectively. 95% confidence intervals of the sizes of these areas were 0.771-0.866 and 0.773-0.867, respectively. Accordingly, the cut-off value was detected 2.5. For the right digastric muscle, the sensitivity value was found as 0.728 (72.8%) specificity value was 0.185 (18.5%), while there were 0.728 (72.8%) and 0.179 (17.9%) for the left digastric muscle, respectively (Figure 2).

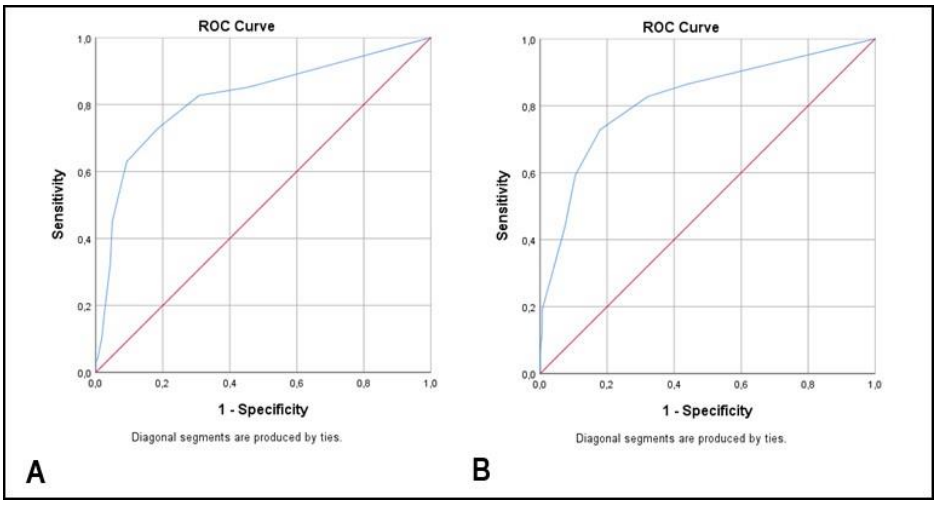

Figure 2. ROC analysis plots for A. right / B. left digastric muscles

In individuals with bruxism, the sizes of area under the curve of right / left masseter muscles in ROC analysis were 0.762 and 0.767, respectively. The sizes of these areas were statistically significant, and 95% confidence intervals were 0.709 - 0.815 for right masseter muscle, and 0.714 - 0.820 for left masseter muscle. Cut-off value of masseter muscle was 0.50. Sensitivity values of right and left masseter muscles were 0.562 (56.2%) and 0.574 (57.4%), respectively and specificity values of both sides were 0.049 (4.9%) (Figure 3).

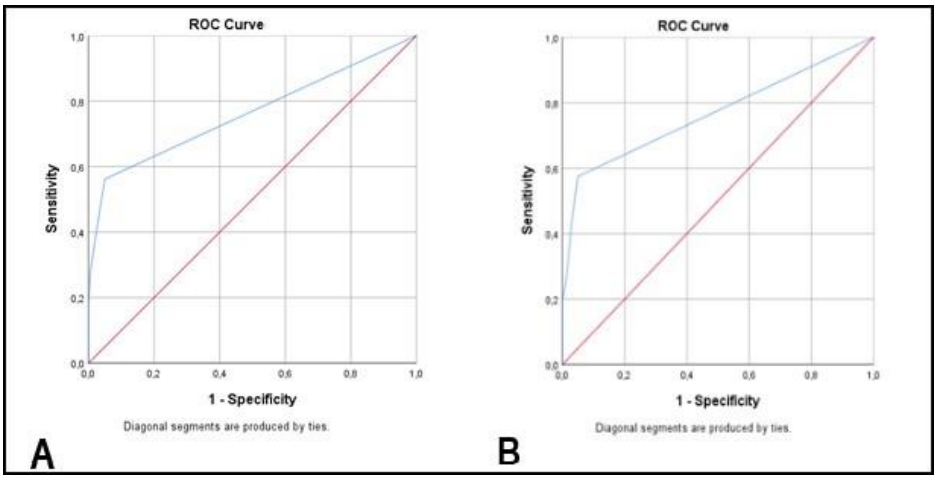

Figure 3. ROC analysis plots for A. right / B. left masseter muscles

In individuals with bruxism, the sizes of area under the curve of right / left temporalis muscles in ROC analysis were 0.701 and 0.704, respectively. The sizes of these areas were statistically significant, and 95% confidence intervals were 0.643 - 0.785 for right temporalis muscle, and 0.646 - 0.761 for left temporalis muscle. Cut-off values of both masseter muscles were 0.50. Sensitivity values of right and left temporalis muscles were 0.475 (47.5%) and 0.475 (47.5%), and specificity values were 0.093 (9.3%) and 0.08 (8%), respectively (Figure 4).

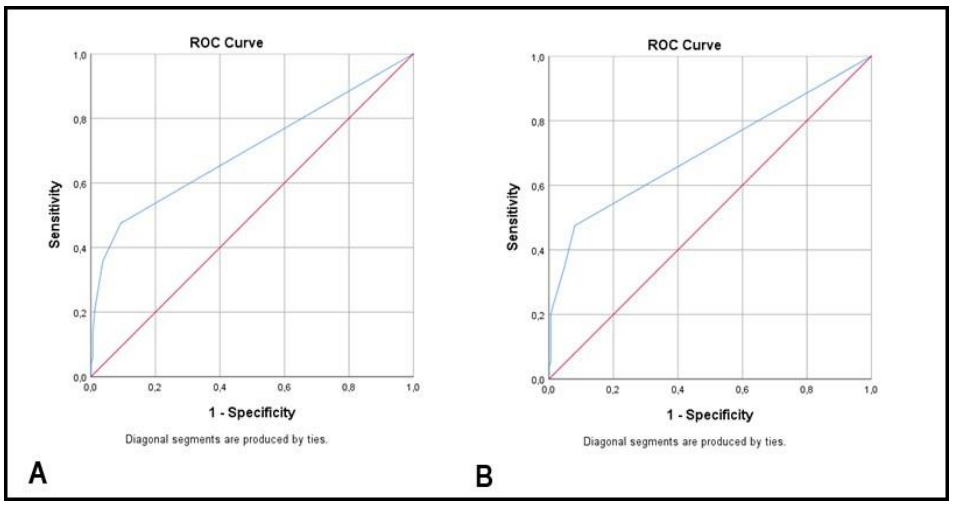

Figure 4. ROC analysis plots for A. right / B. left temporalis muscles

Once more, the areas under the curve for the right and left medial pterygoideus muscles in ROC analysis were 0.728 and 0.710, and these values were statistically significant. The medial pterygoideus muscles on the right and left had 95% confidence ranges of 0.673 and 0.784, and 0.653 - 0.766, respectively. Cut-off values were 0.50 for right and 1.5 for left medial pterygoideus muscles. Right and left medial pterygoideus muscles' sensitivity values were 0.562 (56.2%) and 0.469 (46.9%), and specificity values were 0.13 (13.0%) and 0.105 (10.5%), respectively (Figure 5).

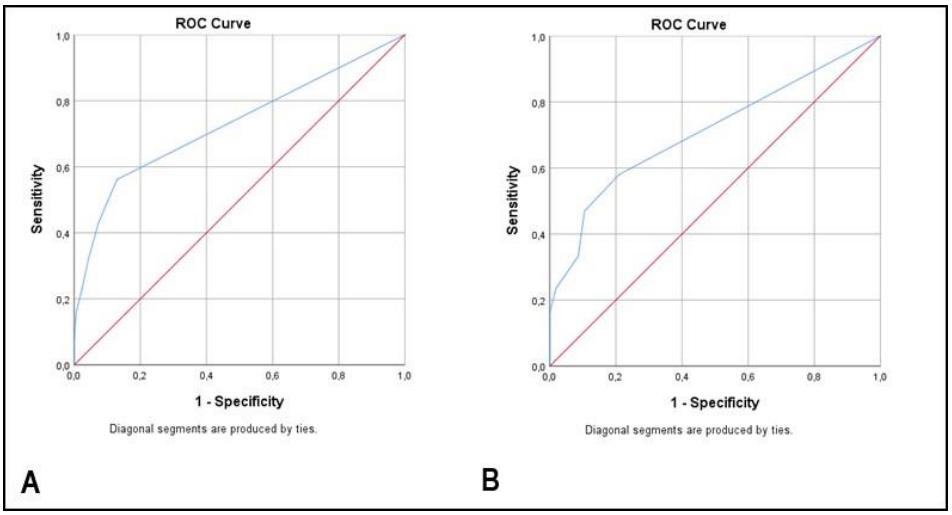

Figure 5. ROC analysis plots for A. right / B. left medial pterygoideus muscles

The sizes of the area under the curve of right / left lateral pterygoideus muscles with ROC analysis in individuals with bruxism were statistically significant and calculated areas were 0.727 and 0.719, respectively. 95% confidence intervals for right and left lateral pterygoideus muscles were 0.671 - 0.783, and 0.663 - 0.775, respectively. Cut-off values for both sides were 0.50. Sensitivity values of right and left lateral pterygoideus muscles were 0.562 (56.2%) and 0.525 (52.5%), and specificity values were 0.08 (8.0%) and 0.099 (9.9%), respectively (Figure 6).

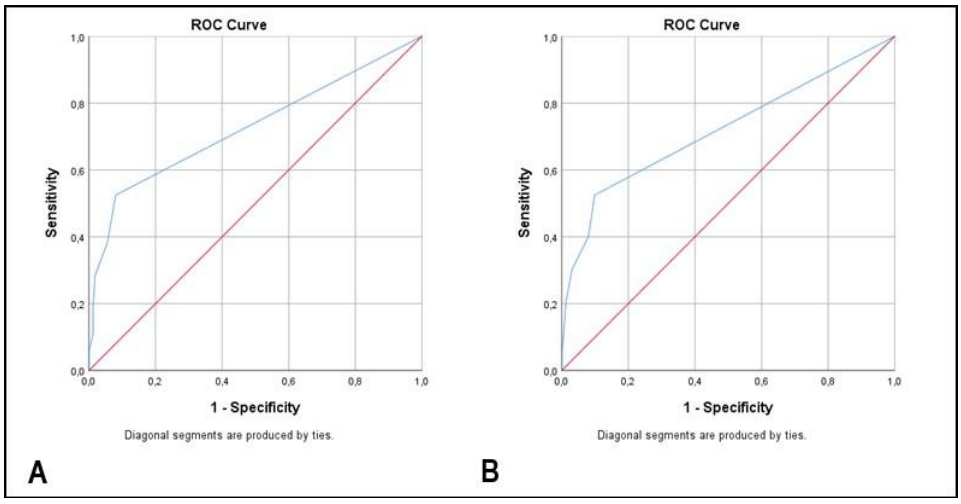

Figure 6. ROC analysis plots for A. right / B. left lateral pterygoideus muscles

4. Discussion and Conclusion

Bruxism is characterized by hyperactivity, fatigue, muscle spasms, myofascial pain and masticatory muscle activity that causes morpho-functional changes in masticatory system as a result of non-physiological force and contraction [21].

Sleep bruxism might lead to hypersensitivity on palpation and hypertrophy especially in powerful and superficial muscles such as masseter and temporalis muscles [1,22]. Since individuals who met all Rompre et al. criteria were included in the study as individuals with bruxism, all individuals with bruxism had masseter hypertrophy and tooth wear.

Myofascial pain is most often caused by parafunctions such as clenching and grinding, however, they rarely occur due to mechanical factors such as occlusal premature contacts or high dental restorations

[23]. In this study, individuals with toothache, premature contact and occlusal irregularities were controlled with a biting paper to exclude myofascial pain other than bruxism and were excluded from the present study.

Experimental studies have shown that interstitial pressure increases and intramuscular edema develops because of bruxism. Muscle pain is a natural outcome of intramuscular edema [24]. Ash Ramfjord [25] stated that the masticatory muscle is sensitive to palpation in individuals with bruxism. According to the results of the current study; pain which was thought to be caused by edematous changes in masseter and temporalis muscles together with medial / lateral pterygoideus muscles and digastric muscles in individuals with bruxism showed a statistically significant increase compared to healthy individuals.

It is stated that sensitivity occurs in insertion points of jaw muscles, and temporalis muscles in individuals with tooth grinding and masseter muscles in tooth clenching after parafunction. Furthermore, it is suggested that the posterior belly of the digastric muscle is sensitive in individuals who perform parafunction with anterior teeth [13]. In the literature, the masseter muscle has been mentioned as the most affected muscle in myofascial pain and such pain is generally described as jaw pain. It is followed by the temporalis muscle and is defined as headache [26]. Glaros et al. [27] reported that tooth clenching is related to masseter muscle activity and increased pain.

In the current study, the sensitivities of individuals with bruxism who were not differentiated in terms of tooth clenching and tooth grinding were recorded. Pain felt in digastric muscle had higher scores than other masticatory muscles. The fact that digastric muscle had wider area under the curve in ROC analysis and had higher sensitivity and specificity compared to other muscles indicates that bruxism has a predilection to this muscle or that the affected groups might demonstrate anterior parafunction. The fact that its cut-off value is higher than other muscles indicates that individuals who feel pain in this region have higher scores. In this case, the pain felt in this muscle >2.5 in individuals with suspected bruxism according to the pain scale support the diagnosis of bruxism. On the other hand, although its specificity is higher than other evaluated muscles, its lack of sufficient level indicates that digastric muscle sensitivity cannot fully differentiate from healthy individuals. The reason of low specificity might be the use of probable bruxism diagnostic criteria based on survey and clinical examination instead of certain bruxism diagnosis made by electromyography (EMG) and polysomnography (PSG) and this a limitation of our study. Established clinical selection criteria for the diagnosis of bruxism might have some shortcomings and should be modified. For example, there are some opinions that the two most reliable signs of active bruxism are the presence of tooth marks on tongue and linea alba [13] and these soft tissue symptoms are not included in the selection criteria used in the current study. Therefore, conducting the study with individuals with bruxism who have EMG and PSG records might provide data that are more reliable. Since there has been no study in the literature that aimed to measure sensitivity with clinical muscle examination based on similar methodology, a comparison could not be made.

It is thought that the contribution of this study and its importance to the literature is especially in the treatment phase. The diagnosis of bruxism which is essential to make accurate treatment plans in complex cases is very important to prevent pending injury on the masticatory system before it occurs. Nowadays, there are treatment methods frequently applied to masseter and temporalis muscles to decrease myofascial pain symptoms (e.g., masseter and temporalis muscle botox) [9,28,29]. These treatment methods may cause further damage to the stomatognathic system and increased sensitivity in the relevant region by increasing the forces loaded on the other masticatory muscles and digastric muscle, whose sensitivity is determined to be at least as important as the masseter and temporal muscles. The authors think that other masticatory muscles and especially digastric muscle should be added to the masseter muscle fatigue that is considered in the diagnosis of bruxism.

Conclusion

In addition to masseter muscle pain, hypertrophy and fatigue, which are prominent in the clinical diagnosis of bruxism, other masticatory muscles and digastric muscle findings should also be considered. Moreover, the digastric muscle is more susceptible to bruxism than other masticatory muscles, so it is more suggestive than other muscle examinations in individuals with probable bruxism. In further studies, treatments focusing on muscles other than the digastric muscle in bruxists should be investigated in terms of the effects on the complaints of the individuals and the stomatognathic system.

Declaration of Ethical Code

In this study, we undertake that all the rules required to be followed within the scope of the "Higher Education Institutions Scientific Research and Publication Ethics Directive" are complied with, and that none of the actions stated under the heading "Actions Against Scientific Research and Publication Ethics" are not carried out.

The present study was approved by Sivas Cumhuriyet University Noninterventional Clinical Studies Ethics Committee with the decision number 2021-06/06 (20.6.2021). All principles of Declaration of Helsinki were followed.

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