Original paper

Investigation of the relationship between probable sleep bruxism, awake bruxism and temporomandibular disorders using the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD)

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Abstract

Background. The causal relationship between bruxism and temporomandibular disorders (TMD) is not clear.

Objectives. The present study investigated which TMD are associated with probable sleep bruxism (SB) and awake bruxism (AB) according to the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD). The study further evaluated the association between probable SB and AB and TMD.

Material and methods. A total of 143 patients were selected – bruxers (SB and AB) and non-bruxers. A diagnosis of probable bruxism was made after a physical examination and when the symptoms were detected. The patients were evaluated using DC/TMD. From among Axis I assessment instruments, the TMD Pain Screener, the Symptom Questionnaire and the Clinical Examination Form were used. Moreover, the Graded Chronic Pain Scale (GCPS) (v. 2), the Jaw Functional Limitation Scale-8 (JFLS-8), the Patient Health Questionnaire-4 (PHQ-4), and the Oral Behaviors Checklist (OBC) were applied within the scope of Axis II.

Results. Diagnoses of muscle disorders and disk displacement with reduction were significantly more frequent in the SB and AB groups than in non-bruxers. A diagnosis of arthralgia was significantly more prevalent in the AB group than in non-bruxers. The JFLS-8 scores and the TMD Pain Screener scores were higher in the AB group than in the SB group and in non-bruxers. Distress levels, and the GCPS and OBC scores were higher in the SB and AB groups as compared to non-bruxers. The results of binary logistic regression analysis showed that only the OBC score was significantly higher in the TMD subgroup (*OR* (odds ratio) = 1.228; 95% *CI* (confidence interval): 1.014–1.488).

Conclusions. Both SB and AB were associated with pain-related TMD and intra-articular joint disorders. The muscle disorders and disk displacement with reduction subtypes were associated with SB and AB. Unlike SB, AB was also associated with arthralgia. Bruxers (both SB and AB) displayed parafunctional habits. However, AB was associated with greater functional limitation of the jaw as compared to SB.

Keywords: pain, temporomandibular disorders, jaw, sleep bruxism, awake bruxism

Cite as
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Introduction

Temporomandibular disorders (TMD) occur because of problems with the temporomandibular joints and the masticatory muscles.[1] The etiology of TMD is multifactorial and numerous risk factors have been reported in the literature. Trauma, anatomical differences, genetic predisposition, the psychological status, and parafunctional habits are among the TMD risk factors.[2–6] Activities such as chewing gum, yawning, squeezing objects between the teeth, playing wind instruments, supporting the jaw with the hands, and chewing on one side are all considered to be parafunctional habits.[7] Such parafunctional habits lead to the overuse of the temporomandibular joints and the surrounding muscles.

The etiology of bruxism is unclear, though recent studies reported genetic predisposition for sleep bruxism (SB).[8,9] Additionally, low plasma sodium concentration and inflammatory markers have been associated with SB.[10,11] Moreover, SB has been linked to the motor activity of the jaw muscles.[12,13]

International consensus on the evaluation of bruxism states that bruxism should be examined separately as SB and awake bruxism (AB).[14] Both SB and AB are associated with mastication muscle activity. In SB, phasic and tonic activity is observed during sleep. Meanwhile, AB is characterized by such activities as the continuous contact of the teeth and/or pushing the mandible during wakefulness.[14] Bruxism is diagnosed through symptoms, examination findings and quantitative methods.[14] Quantitative methods include electromyography and polysomnography.[14] Lobbezoo et al. graded bruxism into 3 sub-categories, including possible bruxism, probable bruxism and definite bruxism.[14] A diagnosis of possible SB/AB is symptom-based only, probable SB/AB is diagnosed based on clinical findings, whereas definite SB/AB is diagnosed based on instrumental evaluation.[14]

In a recent review, the relationship between bruxism and TMD was not clearly established.[15] Moreover, a recent polysomnographic study that focused on the relationship between TMD and SB reported that SB was not a risk factor for the development of TMD.[16] Additionally, the distribution of TMD was equal in SB and non-bruxer patients.[16] One study also reported no relationship between SB and TMD-related pain.[17] However, AB and myofascial TMD have been associated with painful conditions, such as headaches.[18] In light of this information, and since SB and AB are considered 2 different types of bruxism, it appears that their effects on TMD are different. The present study evaluated the effects of SB and AB on TMD by comparing them with a non-bruxer group.

Bruxism is not evaluated through a separate questionnaire in the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) tools. Instead, bruxism is examined within the Oral Behaviors Checklist (OBC) of the DC/TMD Axis II.[19] The DC/TMD were created based on the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD).

The DC/TMD are valuable tools, since they allow investigators to examine TMD by dividing them into diagnostic subgroups. According to DC/TMD, TMD are stratified into 4 different groups, which are pain-related TMD and headaches, intra-articular joint disorders, degenerative joint disorders, and subluxation.[20]

Some studies investigating the relationship between bruxism and TMD questioned about TMD symptoms and pain. Most of them used RDC/TMD to classify the diagnosis of TMD.[15,21,22] The present study aimed to examine the relationship between bruxism and TMD using the current DC/TMD criteria.

The primary purpose of our study was to demonstrate which TMD types are associated with probable SB and AB according to DC/TMD. The secondary aim was to determine the relationship between probable SB and AB and TMD.

Material and methods

Compliance with ethical standards and ethical approval

The present study was conducted according to the 1964 Declaration of Helsinki, and all participants provided voluntary informed written consent before being enrolled in the study. Approval was granted by the Clinical Research Ethics Committee at Yozgat Bozok University, Turkey (approval No.: 2017-KAEK-189_2021.03.10_19). The study was registered at ClinicalTrials.gov (NCT04866849).

Participants

This observational cross-sectional study involved 143 healthy volunteers, aged 18–65 years. The study was conducted between May 2021 and August 2021. The participants were selected from among the relatives of the patients who reported to the outpatient clinic at Yerkoy State Hospital, Yozgat, Turkey. All participants were evaluated by the same physiatrist (B.C.K.), who is experienced in diagnosing and treating patients with TMD. After a physical examination, the participants were split into 3 groups – SB, AB or non-bruxers – according to their diagnosis of bruxism. Accordingly, 25 participants were determined to have SB, 42 participants were determined to have AB, and 76 participants were determined to be non-bruxers. The exclusion criteria were congenital temporomandibular joint disease, and the history of previous temporomandibular region trauma or surgery. Participants treated with oral analgesics or muscle relaxants in the past week, participants who used immunosuppressive drugs, and those with cancer or systemic inflammatory disease were also excluded from the study. Patient recruitment was terminated when the appropriate sample size was reached.

Diagnosis of bruxism

Bruxism was evaluated as probable SB or probable AB by questioning the participants about symptoms, and also based on the findings of the physical examination. The DC/TMD OBC question 1 was used to ask about SB symptoms, and questions 3 and 4 were used to ask about AB symptoms. The participants were asked to fill out the OBC questionnaire before the physical examination.

The abnormal wear of the teeth, the presence of tooth marks in the buccal region, the presence of tooth marks on the tongue, and the hypertrophic appearance of the masseter muscle were investigated during the physical examination. The presence of at least one of the above 4 findings was sought in the investigation of SB/AB.

Lobbezoo et al. stated that a physical examination and symptoms should be used for the diagnosis of probable bruxism.[14] Therefore, in this study, the participants had to be diagnosed with bruxism based on symptoms and physical examination findings to be considered a bruxer (SB/AB).

Participants not diagnosed with bruxism and those who did not undergo a physical examination were considered non-bruxers, and were included in the control group. Patients who did meet these criteria were excluded from the study.

Measurements

All participants were evaluated according to the DC/TMD Axis I and Axis II findings.[19] While classifying TMD, symptoms such as jaw sounds, the presence of locking as well as headaches were examined using the Symptom Questionnaire. Pain was assessed using the TMD Pain Screener. Additionally, the Clinical Examination Form was used for the standard examination of the patients. The Symptom Questionnaire, the TMD Pain Screener and the Clinical Examination Form were included in the DC/TMD Axis I assessment tools.[19]

The patients were evaluated the using DC/TMD Axis II assessment tools – the Graded Chronic Pain Scale (GCPS) (v. 2), the Jaw Functional Limitation Scale-8 (JFLS-8), the Patient Health Questionnaire-4 (PHQ-4), and OBC. The participants were asked to open their mouths widely so that the maximum mouth opening could be measured. With the help of a ruler, the distance between the front teeth was also measured and recorded.[23] Additionally, symptom duration, age, gender, the education level, and the body mass index (BMI) were recorded.

The Symptom Questionnaire is a tool that collects information about pain, headaches, temporomandibular joint sounds, and jaw locking in patients with TMD.[19,24] The TMD Pain Screener evaluates the stiffness of the jaw, the presence of pain during various activities and the persistence of pain in patients with TMD. Moreover, the TMD Pain Screener checks for pain in the last 30 days.[24] The OBC assesses parafunctional habits through self-reporting. The OBC checks if the patient overuses the jaw joints and the surrounding muscles.[19,24] The JFLS is available in 2 forms: short (JFLS-8), consisting of 8 items; and long (JFLS-12), consisting of 12 items. In the present study, JFLS-8 was used to evaluate the functional limitation of the jaw. It was also used to assess the functional limitation experienced by the patient while performing various activities, with a 10-point Likert scale used for each item.[19,24] The GCPS assesses the severity of chronic pain and pain-related disability in patients with TMD.[19,24] The PHQ was developed to assess mood states, such as depression and anxiety, as well as concentration problems and energy in TMD patients. The questionnaire occurs in 2 different forms: PHQ-4; and PHQ-9. The PHQ-4 form, which mostly assesses anxiety and depression, was used in this study.[19,24]

Sample size calculation

Study sample size calculations were performed with the G*Power software, v. 3.1.9.4 (Heinrich Heine University of Düsseldorf, Germany; https://www.psychologie.hhu.de/arbeitsgruppen/allgemeine-psychologie-und-arbeitspsychologie/gpower). The effect size was 0.3 for the χ^2 tests with $\alpha = 0.05$ and power of 0.80. The total sample size was estimated at 143.

Statistical analysis

The IBM SPSS Statistics for Windows software, v. 25.0 (IBM Corp., Armonk, USA) was used for data analysis. Descriptive statistics were used to summarize the participant data as frequency or as mean and standard deviation ($M \pm SD$). The data distribution was evaluated with the Kolmogorov–Smirnov test. The χ^2 test and Fisher's exact test were used to compare categorical data between 2 groups. The independent sample t test and the Mann–Whitney U test were used to compare quantitative variables. The independent variables with a significance value of $p < 0.20$ for the difference between them were analyzed by binary logistic regression. Odds ratios (*OR*s) and their respective 95% confidence intervals (*CI*s) were also estimated. Moreover, $p < 0.05$ was used to define statistical significance.

Results

A total of 143 participants were selected: 76 were non-bruxers; 25 were in the SB group; and 42 were in the AB group. The mean age of the participants was 44.23 ±10.20 years, with a BMI of 26.69 ±4.67. When the demographic data was analyzed in the 3 groups, no statistical difference was identified in terms of age, gender, BMI, education, occupation, or the marital status ($p > 0.05$). The prevalence of smoking, chewing gum, nail biting, and cheek/lip biting was higher in the SB and AB groups than in the control group ($p < 0.05$) (Table 1).

Table 1. Demographic characteristics of the participants

Variable		Control group $n = 76$	SB group $n = 25$	AB group $n = 42$	*p*-value
Age [years] *M* ±*SD*		43.19 ±10.86	44.12 ±8.95	46.50 ±9.54	0.254
Gender M/F		26/50	6/19	9/33	0.289
BMI [kg/m^2] *M* ±*SD*		26.26 ±4.32	28.34 ±3.96	27.66 ±4.25	0.058
Education *n* (%)	elementary	25 (32.9)	11 (44.0)	16 (38.1)	0.105
	secondary	24 (31.6)	9 (36.0)	20 (47.6)	
	university	27 (35.5)	5 (20.0)	6 (14.3)	
Occupation *n* (%)	unemployed	25 (32.9)	4 (16.0)	10 (23.8)	0.332
	desk worker	30 (39.5)	15 (60.0)	18 (42.9)	
	physically demanding	21 (27.6)	6 (24.0)	14 (33.3)	
Marital status *n* (%)	married	60 (78.9)	20 (80.0)	37 (88.1)	0.452
	unmarried	16 (21.1)	5 (20.0)	5 (11.9)	
Habits *n* (%)	smoking	7 (9.2)	11 (44.0)	15 (35.7)	<0.001[a,b]
	alcohol	13 (17.1)	4 (16.0)	7 (16.7)	0.992
	chewing gum	14 (18.4)	11 (44.0)	23 (54.8)	<0.001[a,b]
	nail biting	12 (15.8)	9 (36.0)	18 (42.9)	0.002[a,b]
	pen biting	5 (6.6)	3 (12.0)	7 (16.7)	0.203
	cheek/lip biting	15 (19.7)	12 (48.0)	20 (47.6)	0.002[a,b]

SB – sleep bruxism; AB – awake bruxism; *M* – mean; *SD* – standard deviation; M – male; F – female; BMI – body mass index; statistically significant difference: [a] between the control and SB groups; [b] between the control and AB groups.

Table 2. Comparison of the assessment results between the groups

Variable		Control group $n = 76$	SB group $n = 25$	AB group $n = 42$	*p*-value
Mouth opening [mm] *M* ±*SD*		42.74 ±5.12	41.75 +5.21	40.07 ±4.09	0.045[b]
TMD Pain Screener score *M* ±*SD*		0.43 ±0.86	2.88 +0.92	4.85 ±1.04	<0.001[a,b,c]
JFLS-8 score *M* ±*SD*		0.20 ±0.52	1.68 +0.68	2.58 ±0.56	<0.001[a,b,c]
OBC score *M* ±*SD*		4.39 ±4.16	16.28 +5.24	20.71 ±5.39	<0.001[a,b]
PHQ-4 score *M* ±*SD*		0.89 ±1.20	4.72 +2.09	6.07 ±1.20	<0.001[a,b]
GCPS score *n* (%)	0	65 (85.5)	–	–	<0.001[a,b]
	1	9 (11.8)	12 (48.0)	8 (19.0)	
	2	2 (2.6)	10 (40.0)	18 (42.9)	
	3	–	2 (8.0)	13 (31.0)	
	4	–	1 (4.0)	3 (7.1)	

TMD – temporomandibular disorders; JFLS-8 – Jaw Functional Limitation Scale-8; OBC – Oral Behaviors Checklist; PHQ-4 – Patient Health Questionnaire-4; GCPS – Graded Chronic Pain Scale; statistically significant difference: [a] between the control and SB groups; [b] between the control and AB groups; [c] between the SB and AB groups.

Mouth opening was decreased in the AB group (40.07 ±4.09 mm) as compared to non-bruxers (42.74 ±5.12 mm). The JFLS-8 scores and the TMD Pain Screener scores were higher in the AB group than in both the SB group and non-bruxers. Additionally, the JFLS-8 scores and the TMD Pain Screener scores were higher in the SB group than in non-bruxers. Distress levels, and the GCPS and OBC scores were increased in the SB and AB groups as compared to non-bruxers ($p < 0.001$) (Table 2).

The post-examination diagnoses of the participants were compared. Diagnoses of muscle disorders and disk displacement with reduction were significantly

more frequent in the SB and AB groups than in non-bruxers. Additionally, the arthralgia diagnosis was significantly more prevalent in the AB group than in non-bruxers ($p < 0.05$) (Table 3). All participants were divided into 2 subgroups – diagnosed with TMD or not diagnosed with TMD. The factors affecting the diagnosis of TMD were then examined. The results of binary logistic regression analysis showed that only the OBC score was significantly higher in the TMD subgroup (*OR* = 1.228; 95% *CI*: 1.014–1.488) (Table 4).

Table 3. Comparison of the participants' diagnoses

Diagnosis		Control group *n* = 76	SB group *n* = 25	AB group *n* = 42	*p*-value
Normal		64 (84.2)	0 (0)	0 (0)	–
Pain-related TMD and headaches	muscle disorders	5 (6.6)	10 (40.0)	22 (52.4)	<0.001[a,b]
	arthralgia	1 (1.3)	2 (8.0)	5 (11.9)	0.021[b]
	headaches attributed to TMD	1 (1.3)	2 (8.0)	1 (2.4)	0.231
	total	7 (9.2)	14 (56.0)	28 (66.7)	<0.001[a,b]
Intra-articular joint disorders	DD with reduction	3 (3.9)	7 (28.0)	7 (16.7)	0.003[a,b]
	DD with reduction, with intermittent locking	1 (1.3)	2 (8.0)	3 (7.1)	0.077
	DD without reduction, without limited opening	0 (0)	1 (4.0)	2 (4.8)	0.140
	DD without reduction, with limited opening	0 (0)	0 (0)	1 (2.4)	0.441
	degenerative joint disorders	1 (1.3)	1 (4.0)	1 (2.4)	0.797
	total	5 (6.6)	11 (44.0)	14 (33.3)	<0.001[a,b]

Data presented as number (percentage) (*n* (%)). DD – disk displacement; statistically significant difference: [a] between the control and SB groups; [b] between the control and AB groups; [c] between the SB and AB groups.

Table 4. Univariate logistic regression analysis of the factors affecting temporomandibular disorders (TMD)

Factor		TMD no *n* = 64	TMD yes *n* = 79	*p*-value	*OR*	95% *CI* (lower–upper)	*p*-value
Age [years] *M* ±*SD*		41.03 ±11.90	44.67 ±9.59	0.045	0.976	0.900–1.058	0.239
Gender M/F		22/42	19/60	0.175	1.025	0.864–1.855	0.554
BMI [kg/m2] *M* ±*SD*		25.97 ±3.87	27.57 ±4.63	0.030	1.025	0.864–1.216	0.076
Education *n* (%)	elementary	23 (35.9)	29 (36.7)	0.467	–	–	–
	secondary	21 (32.8)	32 (40.5)		–	–	
	university	20 (31.3)	18 (22.8)		–	–	
Occupation *n* (%)	unemployed	26 (40.6)	37 (46.8)	0.100	ref.	–	0.100
	desk worker	15 (23.4)	26 (32.9)		3.746	0.566–24.801	
	physically demanding	23 (35.9)	16 (20.3)		0.555	0.055–5.651	
Marital status *n* (%)	married	46 (71.9)	11 (13.9)	0.036	0.689	0.164–2.895	0.611
	unmarried	18 (28.1)	68 (86.1)				
SB *n* (%)	yes	–	25 (31.6)	<0.001	0.000	0.000	0.997
	no	64 (100)	54 (68.4)				
AB *n* (%)	yes	–	42 (53.2)	<0.001	0.000	0.000	0.998
	no	64 (100)	37 (46.8)				
OBC score *M* ±*SD*		3.74 ±3.26	17.32 ±6.82	<0.001	1.228	1.014–1.488	0.036*
PHQ-4 score *M* ±*SD*		0.78 ±1.09	4.94 ±2.67	<0.001	1.154	0.609–2.189	0.660

OR – odds ratio; *CI* – confidence interval; ref. – reference; * statistically significant.

Discussion

The results showed that SB and AB were associated with muscle disorders and disk displacement with reduction. Unlike SB, AB was also associated with arthralgia. However, it has been previously reported that no relationship exists between SB and TMD,[16] or between SB and TMD-related pain.[17] Those studies evaluated SB using polysomnography,[16,17] and the discrepancy could also be due to the fact that in the current study, probable SB was evaluated. Nonetheless, in a study in which SB was evaluated clinically without using polysomnography, a relationship between SB and painful TMD was found, similar to the results of the present study.[22] Reissmann et al. also reported that both SB and AB were associated with painful TMD.[25] Meanwhile, AB has been associated with myofascial TMD in the literature.[18] In another study, self-reported bruxism was associated with painful TMD.[26] Our results also support these findings. Commisso et al. reported that bruxism could cause joint damage by increasing frictional stress on the disk,[27] which was supported by another recent study.[28] The latter study reported that disk displacement and joint-related pathologies might occur in bruxers.[28] Thus, our results show that intra-articular joint disorders are associated with both SB and AB.

Although previous studies reported AB to be associated with pain-related TMD, bruxism may be associated with intra-articular joint disorders, degenerative joint disorders, and subluxation. Our results also support this hypothesis by showing that SB and AB are associated with pain-related TMD and intra-articular joint disorders. We also found SB and AB to be associated with muscle disorders and disk displacement with reduction, using DC/TMD. Thus, in patients with bruxism, apart from increased muscle activity or muscle-related causes, the temporomandibular joint is also affected. The presence of bruxism also increases the severity of TMD.[29] Therefore, in clinical practice, the investigation and management of bruxism are important in the intra-articular joint disorder subtypes, such as disk displacement with reduction.

Silva et al. found a relationship between AB and headache.[18] However, no relationship was found between bruxism (both SB and AB) and TMD-related headache in the current study, though SB and AB were associated with painful TMD. Similar to our results, previous studies discovered no relationship between headache and bruxism, and the presence of bruxism did not increase the risk of headache.[30] A recent study demonstrated that AB increased the risk of tension-type headache.[31] In the current study, only TMD-related headache was examined according to DC/TMD, and headache types such as migraine and tension-type headache were not investigated. Thus, the data should be interpreted with caution.

Parafunctional habits result in the overuse of the muscles in the orofacial region. Thus, changes in muscle length and muscle dysfunction can cause myofascial pain.[30] In this study, smoking, alcohol consumption, gum chewing, nail biting, pen biting, and cheek/lip biting were evaluated as parafunctional habits. The results suggest that people with bruxism (both SB and AB) also develop parafunctional habits. Although the causal relationship between bruxism and TMD is unclear, studies have reported that parafunctional habits are a risk factor for TMD,[15,32] which is consistent with our findings.

Cumulative smoking and tobacco use are associated with bruxism. Indeed, nicotine can increase bruxism, and can also cause the excessive use of the jaw joints and the surrounding muscles. Thus, a link may exist between nicotine intake and bruxism.[33] We found that smoking habits were more common in bruxers (both SB and AB) than in healthy subjects. We attributed the greater prevalence of smoking in bruxers to the relationship between nicotine and bruxism, which shows that smoking is a parafunctional habit similar to bruxism.

A recent study that examined TMD-related factors using DC/TMD reported that the female gender and increased stress levels were associated with TMD severity.[29] Our study revealed that stress was not a risk factor for TMD, although the bruxism groups (both SB and AB) reported more distress and chronic pain. In a meta-analysis, TMD patients were reported to be more sensitive to pain than healthy subjects.[34] Therefore, the relationship between bruxism and chronic pain might be related to the coexistence of painful TMD and bruxism. It may also be associated with the complex nature of bruxism and central hypersensitivity. The relationships between bruxism, TMD, pain, and distress also show that in the case of bruxism, multidisciplinary management strategies are vital. In our study, the female gender was not considered a risk factor for TMD, which is consistent with the results of other studies that examined TMD risk factors.[32,35]

We revealed that a minimal decrease was found in the maximum mouth opening measurement in the AB group in comparison with healthy subjects. However, the measurements were within the functional mouth-opening range in both bruxers and healthy subjects.[23] We also found a relationship between bruxism (both SB and AB) and the functional limitation of the jaw. Additionally, AB was associated with greater functional limitation of the jaw as compared to SB. This correlation may be due to the association of bruxism with TMD. The correlation may also be due to the fact that bruxism can affect the masticatory muscles, which limits jaw functions.

Limitations and strengths

A major limitation of our study is that bruxism could not be measured quantitatively. Electromyography or polysomnography are necessary for the diagnosis of definite SB/AB.[14] However, it has been reported that the diagnosis of probable SB/AB through a physical examination

and symptom questioning may be sufficient, especially in cases where the sample size is large.[14]

A relationship has been noted between SB and obstructive sleep apnea syndrome and simple snoring.[36,37] However, these confounding factors could not be distinguished, since a polysomnographic examination was not performed in this study. Moreover, the subject's symptoms fluctuated because of the nature of bruxism and TMD, which can also be considered a limitation of this study. Since the sample consisted of a healthy population, this issue should be considered when generalizing our findings. Despite all of these limitations, this study used the current and valid DC/TMD tools. The diagnostic classification of the patients and the physical examination were performed by the same evaluator, which are the strengths of the study. Another strength is that probable SB and probable AB were evaluated separately.

Conclusions

Both SB and AB were associated with pain-related TMDs and intra-articular joint disorders. The muscle disorders and disk displacement with reduction subtypes were associated with SB and AB. Unlike SB, AB was also associated with arthralgia. Bruxers (both SB and AB) displayed parafunctional habits, and a relationship was noted between parafunctional habits and TMD. Although the bruxism groups (both SB and AB) reported more distress and chronic pain, no relationship was found between stress and TMD. Awake bruxism was associated with greater functional limitation of the jaw as compared to SB.

Trial registration

The study was registered at ClinicalTrials.gov (NCT04866849).

Ethics approval and consent to participate

The present study was conducted according to the 1964 Declaration of Helsinki, and all participants provided voluntary informed written consent before being enrolled in the study. Approval was granted by the Clinical Research Ethics Committee at Yozgat Bozok University, Turkey (approval No.: 2017-KAEK-189_2021.03.10_19).

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

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