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Literature Review

Intra- and Extraoral Signs of Probable Bruxism (Scoping Review)

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ABSTRACT

Bruxism is a repetitive masticatory muscle activity that has received attention in dental literature for its association with dental restoration failures, orofacial pain, neurological disease, and obstructive sleep apnea. As a determining factor in the diagnosis, parameters regarding the type and classification of intraoral and extraoral signs of probable bruxism are needed. This study aimed to identify the intraoral and extraoral signs of bruxism in the literature. A literature search was performed in the National Library of Medicine (PubMed) to identify all the articles published assessing intra and extraoral signs of bruxism. The selected articles were then screened and structurally read by three persons and summarized in PICO tables. Out of 551 initially retrieved references, 39 articles met the inclusion criteria and were thus included in the scoping review. The studies were divided into six categories based on the type of oral signs: buccal mucosa ridge (n=4), masseter hypertrophy (n=3), tongue indentation (n=4), tooth fracture (n=5), torus mandibularis (n=3), and tooth wear (n=20). This study concluded that the available studies utilize various methods in subjective and clinical data collection. Buccal mucosa ridge, tongue indentation, and torus mandibularis were common in subjects with bruxism. The association of masseter hypertrophy and tooth fracture with bruxism is not conclusive. Although studies on tooth wear in bruxism subjects are the most prevalent among other oral signs, no study has been able to establish a direct link between bruxism and tooth wear.

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INTRODUCTION

Bruxism is a repetitive masticatory muscle activity characterized by tight tooth contact, teeth grinding or clenching, or thrusting the mandible during sleep.[1] Bruxism has received attention in the dental and medical literature because it is often associated with dental restoration failures, orofacial pain, neurological disease, and obstructive sleep apnea.[2]

Bruxism is divided into two categories based on the time of occurrence, namely awake and sleep bruxism. Awake bruxism has mainly clenching clinical manifestations that appear to be related to stress and anxiety.[3] In contrast, sleep bruxism is generally a mixture of the rhythmic and spasmodic activity or grinding and clenching in clinical signs.[4] Bruxism identification has been classified into possible, probable, and definite activity.[1,5] Possible bruxism relies on subjective reports of bruxism activity, while probable bruxism requires intra- and extraoral signs with or without bruxism reports. Polysomnography and electromyography recordings, primarily used for research purposes, are required to establish a definite bruxism diagnosis.[1]

Based on the available literature, there are still no standardized criteria for bruxism signs detection. Tooth wear, linea alba, tongue indentation, torus mandibularis, and tooth fracture are among the signs associated with bruxism in many studies, though without clear evidence. The findings of varying clinical signs in various literature can be caused by differences in the age of the study subjects, as well as different methods of observation and research objectives.[6,7] Therefore, it is necessary to study the literature to determine the intra- and extraoral signs associated with bruxism and the elaboration of each study in the method of observing these signs.

METHODS OF LITERATURE RESEARCH

This literature study was conducted in the form of a scoping review from January to July 2021. The literature search method used population, concept, and context (PCC) criteria. Bruxism activity posed as the population, intra-oral and extra-oral clinical signs of bruxism as the concept, and research and case reports on signs of bruxism as the context. The articles were later grouped based on the signs and analyzed using the problem, intervention, control, and outcome (PICO) method.

The literature research in this scoping review was done by following PRISMA guidelines for literature review (Figure 1). The inclusion criteria were articles and case reports containing bruxism signs published in the last 20 years. The terminology used for the literature search was based on our PCC criteria. For intraoral and extraoral signs as the concept, we incorporated tooth wear, lip indentation, tongue scalloping, lingual indentation, tooth fracture, buccal mucosa rigging, masseter hypertrophy, torus palatinus, and torus mandibularis. Exclusion criteria were research articles that only contain bruxism as the supplementary variables or observation.

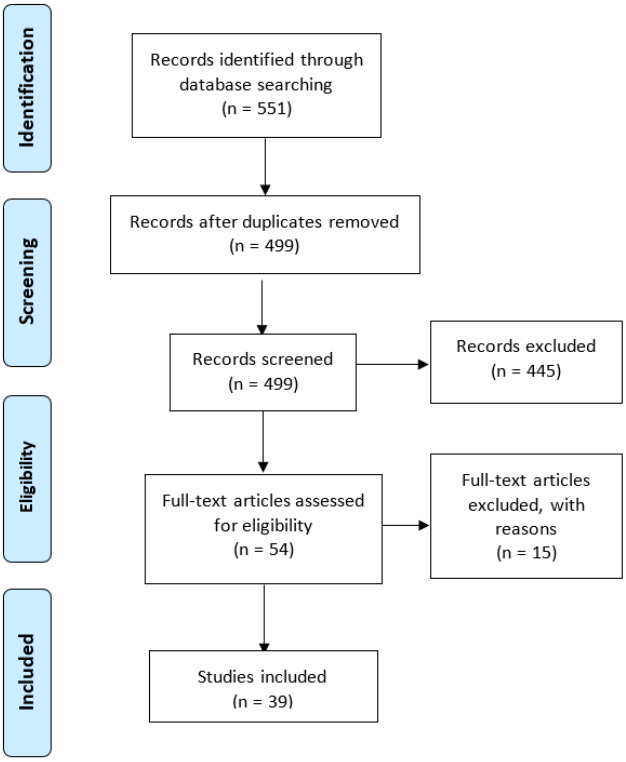

Figure 1. Prism diagram showing the initial findings of 549 articles, which was narrowed down to 39 articles to be analyzed.

RESULTS

In a literature search in the PubMed database using specified terms on July 7, 2021, 550 article titles were found. The number of articles found from the specified terminology is shown in Table 1. Of this number, 52 articles were duplicates. Further screening by two dental specialists (CM, YP) showed 20 articles without abstracts, 417 articles without specific signs of bruxism, and 8 articles not in English.

The abstract screening was done to make sure that bruxism and oral signs were the main topics of the literature. Fifty-four articles were later obtained for full journal reading, which led to 39 articles found to be in accordance with the research study. The flow of the literature search was recorded as a prism diagram, as shown in Figure 1. The articles were further grouped

Table 1. Data extraction on Buccal Mucosa Ridge, masseter hypertrophy, tongue indentation, tooth fracture, torus mandibularis, and tooth wear

	No.	Author, Year	Problem (P)	Intervention (I)	Control (C)	Outcome (O)
Buccal Mucosa Ridge	1.	Mizutani et al., 2014	2101 subjects (1164 male, 937 female) Age: 18-29 years	Observational study	None	Malocclusion and gender are related to BMR formation.
	2.	Morita et al., 2018	262 subjects (56 male, 206 female) Age: ±74 years	Observational study	Subjects without Buccal Mucosa Ridge	BMR is an indication of active oral function. Subjects with BMR have a higher buccinator force.
	3.	Salgueiro et al., 2019	76 subjects (35 male, 41 female) Age: 6-12 years	Experimental study	None	There is a significant relation between Sleep bruxism and BMR.
	4.	Takagi et al., 2003	21 subjects (13 male, 8 female) Age: ± 25 Tahun	Experimental study	Subjects without Buccal Mucosa Ridge	No relation between BMR and Sleep Bruxism. Changes in oral forces due to bruxism did not relate to BMR presence.
Tongue Indentation	1.	Meirelles et al., 2016	40 subjects Age: 27 years	Experimental study	20 subjects without bruxism	There is an increased maximum tongue pressure against teeth indicated in patients with sleep bruxism.
	2.	Sutin et al., 2010	470 subjects (268 male, 202 female) Age: 56 years	Observational study	None	The evidence of physical damage caused by bruxism showed that approximately 50% of subjects had tongue indentations.
	3.	Vinod et al., 2017	One subject (female) Age: 50 years	Case report	None	There is a scalloped tongue without macroglossia, obesity, hypothyroidism and history of atopy, but showed the history of nocturnal bruxism.
	4.	Yanagisawa et al., 2007	24 young adults (15 male, 9 female) Age: 22 years	Experimental study	16 subjects without tongue indentations	There is no significant difference was found between groups but tongue width at rest plays an important role in the formation of tongue indentations.
Tooth Fracture	1.	Bader et al., 2004	200 subjects with teeth fracture (47 male, 53 female) Age: 50 years	Observational study	252 subjects without teeth fracture	Two indicators associated with tooth fracture are fracture line and amount of restoration. There is no direct relation between tooth fracture and sleep bruxism.
	2.	Cohen et al., 2003	36 subjects (11 male, 25 female) Age: 52 years	Observational study	None	Tooth fractures were found on two vital teeth in two different male patients with a history of bruxism.
	3.	Cohen et al., 2006	227 subjects (108 male, 119 female) Age: 52 years	Experimental study	None	65% of patients with root fractures reported no history of bruxism.
	4.	Hilton et al., 2017	2975 subjects (1081 male, 1893 female) Age: 54 years	Observational study	None	Symptomatic cracked teeth are mostly found in patients with bruxism.
	5.	Hilton et al.,2018	2878 subjects (1065 male, 1813 female) Age: 54 years	Observational study	None	66% of patients with tooth fractures reported a history of bruxism. Pain and tooth fracture-related with bruxism complaint.
Torus Mandibularis	1.	Yoshinaka et al., 2012	664 subjects (294 male, 370 female) Age: 60-82 years	Observational study	None	Significant relation between torus mandibularis and sleep bruxism.
	2.	Canto et al., 2012	200 subjects (66 male, 134 female) Age: 20-62 years	Observational study	Subjects without torus mandibularis	Significant relation between torus mandibularis and subjective report of bruxism

	No.	Author, Year	Problem (P)	Intervention (I)	Control (C)	Outcome (O)
Torus Mandibularis	3.	Kerdpon and Sirirungrojying, 1999	609 subjects (183 male, 426 female). Age: 10-80 years	Observational study	None	Significant relation between torus mandibularis and subjective report of bruxism
Tooth Wear	1.	Abe et al., 2009	130 subjects (54 male, 76 female) Age: 27 years	Case control study	23 subjects without bruxism	The sleep bruxism group showed higher tooth wear than the control group.
	2.	Alamoudi et al., 2001	502 Saudi children (235 male, 267 female) Age: 3-7 years	Observational study	None	There is no relation found between attrition with symptoms of TMD, but there are relations between attrition with TMJ pain, muscle pain and jaw lock.
	3.	Baba et al., 2004	16 subjects (8 male, 8 female) Age: 30 years	Observational study	8 subjects	Tooth wear scores were significantly higher in patients with bruxism than in the control group.
	4.	Dıraçoğlu, et al., 2011	58 subjects (12 male, 46 female) Age: 34 years	Observational study	29 subjects	Maximal bite force correlated with tooth wear.
	5.	Emodi et al., 2012	244 children (61 male, 183 female) Age: 5-12 years	Observational study	None	Most of the children showed enamel tooth wear, with rare severe tooth wear on the permanent teeth.
	6.	Gomes et al., 2018	761 pre-school children (5 yo) with their parents/caregivers	Cross-sectional study	None	Sleep bruxism is associated with tooth wear and poor sleep quality for the child.
	7.	Hammoudi et al., 2019	125 subjects (96 male, 29 female) Age: 43 years	Observational study	None	Tooth wear is related to the risk factors of bruxism, but not directly related to the bruxism activity.
	8.	Jain et al., 2013	120 subjects Age: 36 years	Observational study	60 subjects	Maximum bite force was found significantly lower in the experimental group.
	9.	Jonsgar et al., 2015	32 subjects (5 male, 11 female) Age: 24 years	Observational study	16 subjects without teeth attrition	The prevalence of sleep bruxism was significantly higher in the attrition group than in the control group, but EMG activity showed no difference.
	10.	Kapagiannidou et al., 2021	63 subjects (19 male, 44 female) Age: 39 years	Observational study	None	There is no significant correlation was found between tooth wear and episode/hour of sleep.
	11.	Manfredini et al., 2019	41 subjects (18 male, 23 female) Age: 29 years	Observational study	None	There is no significant correlation between tooth wear and different sMMA variables.
	12.	Okura et al., 2017	1 male subject, age: 21 years	Observational study	None	Increased bite force in sleep bruxism related to tooth wear
	13.	Pergamalian et al., 2003	84 subject (16 male, 84 female) Age: 18-60 years	Observational study	None	Tooth wear-related to age, and did not differentiate between patients with or without bruxism in the TMD population.
	14.	Pigno et al., 2001	71 subjects, Age: 32-80 years	Observational study	None	Age, gender, bite force, and bruxism are significantly related to tooth wear.
	15.	Shah et al., 2009	119 subjects, Age: > 21 years	Observational study	66 subjects	There is a significant difference in tooth wear between the control group and the study group.
	16.	Sutin et al., 2010	470 subjects (268 male,202 female) Age: 56 years	Observational study	None	There is tooth wear in patients with bruxism, but emotional stability and objectivity are not related to tooth wear.

	No.	Author, Year	Problem (P)	Intervention (I)	Control (C)	Outcome (O)
Tooth Wear	17.	Tokiwa et al., 2008	50 subjects (21 male, 29 female) Age: 41 years	Observational study	None	There is a correlation between the grinding pattern in sleep bruxism with periodontal attachment and tooth mobility.
	18.	Tsiggos et al., 2008	102 subjects. Age: 30-55 years	Observational study	None	Bruxism associated with attrition, abfraction and occlusal pits.
	19.	Verhoeff et al., 2018	708 subjects. Age: >65 years	Observational study	None	Bruxism is associated with Parkinson's disease.
	20.	Yoshizawa et al.,2014	17 subjects (8 male, 9 female) Age: 27 years	Observational study	None	Subjects with bruxism and tooth wear showed a higher masticatory muscle activity score than subjects without bruxism.
Masseter Hypertrophy	1.	Castroflorio et al., 2015	45 subjects (19 male, 26 female). Age: 28 years	Observational study	19 subjects without bruxism	There is no relation between sleep bruxism and masseter hypertrophy.
	2.	Garip et al., 2018	100 patients with heavy bruxism (18 male, 82 female) Age: 33 years	Observational study	None	All patients showed pronounced masseter and temporalis hypertrophy.
	3.	Yoshizawa et al., 2013	17 subjects (8 male, 9 female) Age: 27 years	Observational study	Subjects without hypertrophy	Subjects with hypertrophy showed lower EMG activity.

based on the six oral signs. Furthermore, the grouping and analysis of articles were carried out further using the PICO method, as described in Table 1.

DISCUSSION

Information about the signs of bruxism is needed to establish a probable bruxism diagnosis. In a consensus paper that was written by experts in oral physiology, several intraoral and extraoral signs were described.[1] However, the evidence for the association of these signs with bruxism activity, both during sleep and awake, was not presented. This scoping review discusses the six intra- and extraoral clinical signs presented in the consensus articles in 2013 and 2018.[1,5]

Buccal mucosa ridge (BMR) is a clinical sign theoretically formed via pressure from the buccal mucosa to the tooth surface. Early studies have shown that differences in occlusion, both anterior and posterior, do not change the buccal mucosal pressure in the resting position.[8,9] Over time, a number of studies have indicated an increase of buccal mucosal pressure toward the tooth surface during clenching.[10–13] This is not in accordance with the findings of Takagi et al., who used an experimental design in their research. They suggested that only swallowing activity has a significant effect on BMR formation.[14] However, the two different opinions have something in common: high oral activity is associated with buccal mucosa ridge formation. Morita et al. broadly supported both of these views in their study of elderly subjects. BMR is not directly related to bruxism activity but is related to active oral function. Differences in findings regarding the association of malocclusion and BMR were seen in cross-sectional studies.[15,16] Further studies with meta-analyses can be explored to see if the association between malocclusion, BMR, and oral activity is only coincidental.

Masseter muscle hypertrophy has long been associated with bruxism. Even since 1987, the treatment of bruxism with the application of the botulinum toxin to reduce masseter muscle activity has been reported.[17] However, this scoping review shows that there are still many pros and cons about the relationship between masseter muscle hypertrophy and bruxism activity. Several studies examining the condition of the masseter and temporalis muscles place greater emphasis on pain during muscle palpation.[6,18,19] Thus, these three articles were not included in this scoping review. Of the three articles included in this study, one article showed that patients with severe bruxism had more than normal muscle thickness by magnetic resonance imaging. Two other studies used electromyograms (EMG) to observe muscle activity with and without hypertrophy. Both showed similar results, that there was no relationship between sleep bruxism activity and muscle hypertrophy. Since the observations of bruxism activity were brief, the fluctuating nature of bruxism could be the cause of the results of these two studies.

Literature research on tongue indentation has shown consistent results regarding its association with bruxism. Two studies conducted on adult subjects demonstrated an association between high tongue-to-tooth pressure and the presence of tongue indentation.[20–22] This higher pressure was found in subjects who reported bruxism activity[21,23] and was more prominent in subjects with large tongues.[20] However, the examination of bruxism relies on the subject's report (self-report) without any confirmation by polysomnography or electromyography, which are the gold standard for examining sleep and awake bruxism. Thus, the validity of tongue indentation as a sign of bruxism activity should be investigated further.

There were two conflicting results from the five articles that examined the relationship between bruxism and tooth fracture and fractured teeth. Cohen and Bader found that most subjects with tooth fractures did not report any bruxism activity.[24-26] In the three articles, the series of questions used to obtain bruxism data were not described. This is also the case in studies that found a positive relationship between cracked teeth and bruxism. Different research tools may produce data that do not reflect the same bruxism activity. This has been cited as one of the shortcomings of studies on bruxism. Therefore, the 2013 and 2018 consensus articles[1,5] suggested using standardized questions such as the BRUX scale and the Oral Behavior Checklist. Moreover, these five studies did not use the same criteria to assess fractured and fractured teeth.

A literature study on the torus mandibularis showed more consistent results. Cross-sectional studies of more than 600 subjects showed that the torus mandibularis was significantly associated with bruxism.[27,28] Moreover, another observational study with a control group also showed a similar result.[29] This is in accordance with a systematic review that showed that the torus mandibularis was more related to bruxism activity than the torus palatinus.[30] However, the study stated that there was still insufficient quality evidence to fully support its association with bruxism due to the unstandardized subjective nature of the diagnosis.

Research on the relationship between tooth wear and bruxism is most widely found among other intra- and extraoral signs. In these studies, bruxism data collection can be divided based on instruments, namely polysomnography (PSG) or EMG, and questionnaires. Most of the data obtained from PSG and EMG cannot

confirm a direct relationship between bruxism and tooth wear.[31–34] This is also compounded by the lack of congruence between reports of bruxism from subjects and polysomnographic results.[32,33] Fluctuations in bruxism activity and difficulty in detecting involuntary activities such as sleep bruxism may cause this finding. Bruxism data collection with questionnaires also showed varying results. The validity of the questionnaire method is often questioned because the subjects may not be aware of the bruxism activity and lack knowledge about it. It has been suggested that a one-week activity observation period before data collection with a questionnaire should be applied to solve the problem.[1] The existing studies show that EMG and clinical examination cannot distinguish between clenching and grinding. Tooth wear due to attrition is caused more by grinding activity, not only by excessive biting force.[34] Therefore, it is necessary to differentiate the type of bruxism activity in terms of its relationship to tooth wear.

CONCLUSION

This literature study showed that there are still conflicting results on the relation between oral signs and bruxism activity. The use of unstandardized criteria and methods for bruxism and oral signs detection are the cause of various findings in the literature; thus, a clear determination of oral signs associated with bruxism cannot be finalized. Therefore, a consensus on standardized diagnostic criteria of oral signs is needed to study probable bruxism diagnosis further.

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