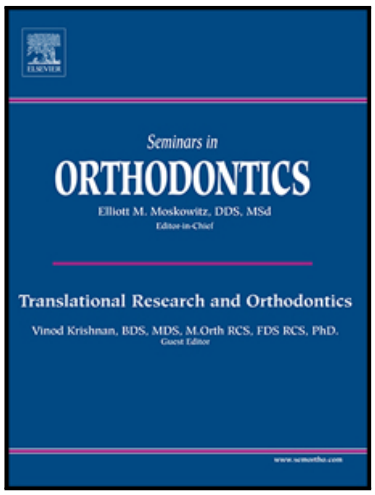
Bruxism: an orthodontist's perspective



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Bruxism: an orthodontist's perspective

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ABSTRACT

The aim of the present manuscript is to give a narrative overview for clinicians summarizing the knowledge concerning a phenomenon that they may frequently come across in both children and adults: sleep (SB) and awake (AB) bruxism. Indeed, prevalence rates in adults range from 8% to 16% for SB and 22% to 30% for AB, whilst in children they raise up to 40%.

The complex relationship between bruxism, the most common underlying primary and/or comorbid conditions, and the potential clinical consequences for both AB and SB in children and adults will be considered.

In addition, in view of the fact that over the last few decades the demand for orthodontic treatment at all ages has increased, the correlation between bruxism-related masseter muscle activity (MMA) and the use of orthodontic appliances (i.e., fixed appliances and clear aligners) is also discussed, along with the proposal of some clinical recommendations.

KEYWORDS: bruxism, orthodontics, aligners, awake bruxism, sleep bruxism, masseter muscle activity

BRUXSIM: THE STATE OF THE ART

Definition

Bruxism is a much-debated oral condition that interests several disciplines, such as dentistry, psychology, neurology, and sleep medicine, in both research and clinical settings. In this scenario, due to the constantly evolving knowledge and the different specialties involved in the study of bruxism, several definitions have been proposed over the past decades, until the point that the need to find a common language emerged. [1-5]

Two expert consensus papers contributed substantially to define the construct of bruxism as an umbrella term to embrace a multifaceted spectrum of masticatory muscle activities (MMA), not limited to the act of grinding teeth while asleep.[1-2]

The bruxism activities that were classically considered in the dental literature (viz., teeth grinding and clenching) were included in the consensus definitions together with an enlarged spectrum of analogue jaw muscle activities without tooth contact, such as mandible bracing (that is, clenching without teeth contact) or thrusting (that is, grinding without teeth contact). According to the proponents, this was a needed addition to achieve a better comprehension of the etiology and clinical consequences. In addition, bruxism activities were defined separately according to the circadian rhythm:

- *"Sleep bruxism is a masticatory muscle activity during sleep that is characterized as rhythmic (phasic) or non-rhythmic (tonic) and is not a movement disorder or a sleep disorder in otherwise healthy individuals."*
- *"Awake bruxism is a masticatory muscle activity during wakefulness that is characterized by repetitive or sustained tooth contact and/or by bracing or thrusting of the mandible and is not a movement disorder in otherwise healthy individuals."* [2]

Note that both definitions begin with 'masticatory muscle activity' (MMA), a wording intended to emphasise that focus is put on motor phenomena and the role of the masticatory muscles during sleep and wakefulness as the source of potential clinical consequences, independently on any specific neurological correlates. This suggests an ongoing paradigm shift with respect to the early concept of bruxism as a sleep-time motor activity featuring a specific pattern of masseter contraction (i.e., rhythmic masseter muscle activity [RMMA]) and being accompanied by teeth grinding sounds. [5-7]

This wording also intends to point out that bruxism should not be considered a disorder but rather a muscle behaviour that can have different aetiologies and that can be harmless,[8,9] harmful (e.g., intrinsic mechanical tooth wear,[8-12] masticatory muscle and temporomandibular joint pain,[13,14] temporomandibular disc displacements[15] and fractures of teeth, restorations, and implants)[12,16] or even potentially part of protective mechanisms with respect to several health outcomes (e.g., increasing upper airway patency which would aid in the prevention of airway collapse leading to obstructive sleep apnea[17-19] or reducing the risk of detrimental chemical tooth wear by increasing salivation in case of gastro-oesophageal reflux[20]).

Aetiology and pathophysiology

The concepts about the aetiology of bruxism mirrors the ongoing paradigm shift from peripheral to central regulation that is interesting several stomatognathic phenomena.

Increasing evidence suggests that a certain amount of bruxism activity can be considered physiological in all individuals, and that additive bruxism may be due to a combination of several psychosocial (e.g. stress sensitivity and anxiety)[21-25] biological, genetic, and exogenous factors (e.g., alcohol, smoking, caffeine, recreational substances and some drugs).[26-28] On the contrary, morphological factors (e.g., features of the facial skeleton and dental occlusion) are no longer considered important.[4,29]

In this view, whilst a multifactorial model is generically involved in the aetiology of bruxism, it must be underlined that each specific factor may have a different relationship with the different types of MMA.[1-3,5]

It is also important to remark that AB is commonly characterised by teeth contacting habits or mandible bracing, whislt SB features a combination of all bruxism activities. [3,5,28] Such different patterns of motor activity as a function of the circadian rhythm may also reflect different etiologies. On one hand, AB is mainly related to psychosocial factors, with a close association with certain personality traits;[3,5,22,30,32] in other words, AB may be viewed as a stress-coping habit that is particularly frequent in patients with musculoskeletal symptoms.[33] On the other hand, SB is centrally mediated, with a complex interaction of all factors influencing autonomic system function during sleep.[3,34-36]

Epidemiology

Data on the prevalence of bruxism are mainly related to SB, and are almost exclusively referred to questionnaire reports. Reported prevalence in adults range from 8% to 15% while the reported AB prevalence rates drawn from questionnaire studies range from 22% to 30%. No consistent data about time related fluctuations exists.[3,37] In the recent years the development of Ecological Momentary Assessment (EMA) strategies made it possible to overcome some of the previous limitations concerning AB reports[33,38-49] and allowed evaluating the frequency of reported AB behaviors compared to the self-reported activities identified in questionnaires. The results of the most recent smartphone-based EMA studies have suggested that the frequency of AB behaviors in young adults is within the 28.3–40% range of alerts received over one week of EMA monitoring.[49] In detail, teeth contact is the most common finding, whilst the report of teeth grinding is almost absent.[49] These preliminary findings could be seen as a reference point for future investigations on the epidemiological features of AB as well as for comparison with selected populations with comorbid conditions (e.g., sleep disorders, psychological and social features, muscle fatigue and muscle pain) in order to contribute a better understanding of this complex topic.[30,49]

Assessment

The 2013 consensus paper[1] suggested a diagnostic grading system for the operationalisation of bruxism diagnosis (i.e., possible, probable, and definite sleep/awake bruxism) with the aim of defining the advantages and limitations of the available diagnostic approaches, but it is now clear that current knowledge and strategies are not sufficient to pursue such a hierarchical, stackable approach to bruxism evaluation.[1-3,5,30,50]

In view of this, a Standardized Tool for the Assessment of Bruxism (STAB) has been recently proposed by an international expert panel. The main challenge was to answer the question “how to assess an individual’s bruxism in a reliable, valid, and relevant way?”. In addition to the presence or absence of MMA, clinicians should be able to screen for the potential risk factors, and comorbid conditions, as well as to determine the point at which bruxism becomes more likely associated with clinical consequences.[51,52]

In general terms, approaches for assessing bruxism can be distinguished as non-instrumental or instrumental, and a combination of both approaches will likely emerge as the best available choice.[1-3,51,52]

Non-instrumental approaches

Non-instrumental approaches for assessing bruxism include clinical examination and self-report (questionnaires, oral history) which can be used both for SB and AB.[1-3]

As suggested in the STAB, the clinical examination should include an extraoral evaluation and an intraoral inspection (i.e., domains on joints and muscles, intra-and extra-oral tissues, and teeth and restorations) to identify the signs and symptoms that possibly related with bruxism.[1-3,51,52]

Concerning the clinical evaluation of joints and muscles, the examiner may evaluate the masseter muscle for the presence of hypertrophy, assess the presence of one or multiple Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) diagnoses,[53] and evaluate functional symptoms (e.g., difficulty opening the mouth wide).

Regarding the Intra-oral tissues, the recommendation is to evaluate the presence of the following different signs: tongue scalloping, linea alba, lip impression, alveolar bone exostosis, tongue traumatic lesion. Concerning teeth and restorations wear and/or fracture, the evaluation is based on the Tooth Wear Evaluation System (TWES).[10] It is also suggested to assess the presence of perforations and/or marks on an oral appliance/mouthguard and to perform a periodontal screening. In addition, clinical assessment may include optional items for selected research purposes, such as the skeletal class (e.g., Class I, II, III), facial pattern (e.g., hypo-, normo-and hyper-divergent) and tongue position based on the modified Friedman.[51,52]

As a general note, it must be remembered that clinical assessment is actually deemed to evaluate the presence of the supposed clinical consequences of bruxism, rather than the actual bruxism activity (i.e., bruxism status) and that it is impossible to differentiate between consequences of SB and AB.[30]

As for self-reported information, it can be obtained from questionnaires and history taking (i.e., oral interviews), allowing to gather information on perceived bruxism activities and the possible associated factors.[54,55]

As pointed out in an early paper on the STAB project, there are currently no universally adopted questionnaires specifically designated for the assessment of AB.[51,52] Examples of instruments that address AB as part of a more global report are the Oral Behaviors Checklist (OBC)[56] and the BRUX scale.[57] For this reason, timespan and frequency in which the report of AB is referred varies among the different questionnaires.

Considering SB, not only the patients themselves but also multiple informants can be interviewed (i.e., bed partner or, in the case of children, their parents). The patient and partner are asked to monitor behaviour concerning teeth grinding, teeth clenching and/or jaw bracing preferably using a diary. It is important to underline that, in the case of SB, the validity of findings is questionable due to the unconsciousness of patients during sleep.[58]

Whilst the advantage of this approach is intuitively represented by the possibility to recruit large samples and to screen for the possible presence of bruxism at the individual level, the limitations are also well known.

First, it is important to underline that the intensity and duration of specific MMA cannot be exactly quantified via self-report. In addition, it cannot be excluded that the bruxism-psyche relationship could affect self-reporting, reflecting distress rather than masticatory muscle activity per se.[59,60] Factors such as cognitive awareness, discriminatory ability and memory may also influence the report and, subsequently, the derived evaluation of bruxism status.

Therefore, the derived 'diagnosis' risks of having incomplete value because of its subjectivity, but it is nevertheless a basis for getting deeper into the assessment process and to gather data for epidemiological purposes and to screen for the possible presence of bruxism at an individual level.[54,55,61]

Instrumental approaches

Instrumental approaches for assessment are currently available for both circadian forms of bruxism, although with differences related to the different characteristics presented by AB and SB.

Several devices have been available for years to record SB activities, where electromyography (EMG) and polysomnography (PSG) findings are fundamental to provide key evidence of motor activity and on the other hand to provide an evaluation of SB within the sleep architecture. For this reason, full PSG is recommended when the presence of other sleep disorders (e.g., apnoea) is suspected;[2,3,6] on the contrary, its use cannot be justified for routine cases due to the costs and limited availability of the needed technical equipment. To overcome these limits, in recent years some EMG devices for in-home recordings have emerged as a valid option for an easier approach to assess the motor activity.[62-67]

EMG recordings during wakefulness may indeed provide measurements of AB but performing an hour-long EMG recording of jaw muscle activity during wakefulness is difficult for technical reasons and for the potentially poor patients' compliance; in addition, it's not easy to perform due to the paucity of dedicated devices on the market. Recent developments in this direction are promising, but on-field studies are yet to be performed on a large scale, also with the aim of refining the discrimination between AB and non-AB activities during wakefulness.[3]

In this scenario, it is important to underline that PSG/SB criteria that are still adopted in the field of dental sleep medicine are based just on the count of masseter EMG events associated with sleep arousals, thus providing only a partial picture of the complex range of jaw-muscle activities. Long-lasting, prolonged, low activity contractions, that are now incorporated within the bruxism definition, are excluded from that count, thus putting into serious doubt the internal validity of previous PSG/SB literature findings concerning the etiology and consequences of SB. In addition to that, definitive criteria have never been established for awake bruxism measurement. In view of this, the expert consensus panel pointed out the need to evaluate this phenomenon in its continuum. [3,50, 66, 68]

As recently suggested by several studies[33, 38-49] and by the expert consensus papers on bruxism definition,[1,2] these limitations may be overcome by adopting EMA strategies, also called experience sampling methodology (ESM), to report AB behaviors, since it is a simple method to collect real-time data in the natural environment.

The EMA approach may be optimized with the use of smartphone apps, which are easy to use and intuitive;[69,70] for this reason, this approach also belongs to the category of instrumental approaches.

This data-recording strategy can find applications for both research and clinical purposes: in the research setting it can be used to increase knowledge on several aspects of AB (e.g., natural course and fluctuations of signs, symptoms, and exposure to etiological factors); in the clinical setting, it helps patients to recognize their habits, monitor changes over time, and adopt corrective measures.

In general terms, as suggested by the international expert group, assessing bruxism with a combination of the different approaches may represent the best possible strategy to overcome the limitations of the different stand-alone methods.[1-3]

Differential diagnosis

From a clinical point of view, it is interesting to underline that there are a series of conditions for which a differential diagnosis with bruxism may be necessary. Amongst these, noteworthy disorders are: Oromandibular dystonia, Huntington's disease, Tourette's syndrome, Hemifacial spasms, Parkinson's disease, Tardive dyskinesia and REM-behaviour disorder.

For more details the readers are referred to the original publications.[3,71]

Management

In the light of the paradigm shift that emerged over the past quarter of a century (i.e., bruxism should not be considered a disorder but rather a muscle behaviour that can have different aetiologies and that can be harmless, harmful or even protective with respect to several health outcomes) it is strongly suggested to be prudent with the management of bruxism.[8, 68, 71]

In this scenario, management should be comprehensively based on common sense conservative approaches, referring to the so-called 'Multiple-P' approach as the standard of reference:[72]

- Pep talk (counselling)
- Psychology (cognitive-behavioural strategies)
- Physiotherapy (exercises of the jaw muscles)
- Plates (oral appliances)
- Pills (drugs)

The most important "P" is nonetheless the Patient, whose expectations and individual features should steer any clinical decisions. Importantly, it must be remarked that bruxism must always be seen as a condition that mirrors some underlying disorders. As such, the actual treatment, viz., the reduction of bruxism activity, must be discriminated from the management of clinical consequences. The former can be achieved just by addressing the potential cause or comorbid conditions, such as any psychological, neurological, or sleep disorder or any habit that is associated with an additive bruxism.

An important issue for clinicians is that performing irreversible occlusal changes with the aim to decrease pain symptoms in the jaw muscles and/or the TMJ or to reduce bruxism activities is not recommendable, since the association of bruxism with occlusal features is negligible, if at all present.[73-75]

BRUXISM IN PEDIATRIC AGE

Bruxism has always been considered an important phenomenon in children, especially due to the worries of parents who reports hearing teeth grindings sounds during their child's sleep. Actually, data about the clinical impact and management of such condition are scarce.

Concerning the epidemiology, as in the case of the adult population, the reported prevalence of SB in pediatric age varies among different studies and is based on parental report of teeth grinding. A recent systematic review suggested that the SB prevalence in children is between 3.5 and 40.6%, without gender differences and decreasing with age (e.g., 3.5-8.5% in children aged under 5 years, and less than 6% in children aged between 7 and 11 years). [76]

Regarding the prevalence of bruxism in adolescents, in a sample of Israeli subjects, AB and SB were reported by 19.2% and 9.2% of participants, respectively, with no gender differences;[77] while a prevalence of 8.7% and 14.8% for AB and SB respectively, has been reported in a sample of Dutch adolescents.[78] In addition, according to other studies, higher prevalence rates were found in children and adolescents (3–49%) than in adults (1–15%) .[73]

Among the possible factors that are associated to SB in children, several studies assessed the relationship between parental-reported SB with secondhand smoke and concurrent sleep disturbances (e.g., nocturnal breathing symptoms, bedtime problems, night awakening, nocturnal and mooring symptoms).[79-81]

Other studies found an association with behavioral problems, such as poor school performance, hyperactivity, and attention deficit. Also genetics, anxiety, psychological reactions and some personality features (e.g., high sense of responsibility), concurrent headaches, peer problems, emotional symptoms, mental health problems, aggressive behavior, ADHD and unsteady family environment seem to present a possible association with bruxism in pediatric age.[82-85]

Comparable findings have been found in teenagers (11 to 19 years): headache, sleep disturbances (snoring in particular), tooth wear, and jaw muscle fatigue, seem to be related to SB.[86] In addition, in young teenagers SB seem to be also associated with a history of episodes of verbal school bullying.[87]

For assessment purposes, parental-reported tooth grinding remains the most common choice to perform investigations on a large scale, especially due to the difficulty of performing sleep studies with PSG in the pediatric age due to the important cost and the needed technical equipment. Consequently, the correlation of PSG findings with parental-reported tooth grinding is currently under investigation.[88]

In children, efforts have always been mainly directed to the study of SB and its correlates, whilst information on AB frequency and its associated factors is missing; in view of this, as for adults, the use of EMA approaches is recommended as a strategy to get deeper into this issue at least in the adolescence age groups.

In view of the fact that bruxism in the pediatric age is a symptom of underlying health, lifestyle and biopsychosocial disorders, it is recommended that bruxism management is based on the identification of the underlying condition,

whenever possible.[89-91] In this scenario considering that the data on the natural course suggest that SB decreases progressively after the age of 9-10 years, relaxation techniques may be the best option for young children, whilst oral appliances are not suggested due to the ever-changing occlusal conditions.[89-91]

Regarding pharmacological treatments, preliminary evidence indicates that hydroxyzine could be effective for parent-reported bruxism in children,[92] but its routine use is not recommendable for risk-to-benefit ratio. Consequently, considering bruxism management in children and adolescences the construction of a multidisciplinary framework is recommended.[93]

BRUXISM AND ORTHODONTICS

Over the last few decades, the demand for orthodontic treatment, both in children and adults, has increased; on the other hand, the effects of orthodontic appliances seem to have no clinically relevant effects at a population level as far as TMDs are concerned,[94] while possible changes in MMA have remained uncertain.

The neutrality of orthodontics on a large scale is due to the fact that, with the exception of some facial morphology features (e.g., skeletal Class II profiles hyperdivergent growth patterns and lower condylar volume) of which some occlusal traits may be proxy markers,[95,96] the anatomy of dental occlusion contributes minimally to the multifactorial biopsychosocial model (i.e., biological, psychological, and social factors) of TMDs.[97-98] Thus, it is understandable that the occlusal changes induced by orthodontics do not prevent or increase the risk of TMD development.[94,99]

As far as bruxism is concerned, viz., the impact of orthodontics on MMA, the literature seems to report conflicting results.

In order to understand the possible different scenarios for bruxism-ortho relationships, it is important to underline that, as suggested by the consensus papers, for both circadian manifestations, there is a need to move on from the adoption of cut-off points to discriminate between bruxers and non-bruxers and embrace an evaluation based on the amount of activities that is related with the bruxism spectrum in their continuum, thereby not only focusing on the raw number of bruxism events.[2,3,5,50-52] This is because the current line of thinking suggests that it is not the number of bruxism events per se to represents a risk factor for possible clinical consequences, but rather the general level of EMG activity, which was for instance found to be higher in TMD patients.[3,68]

To this aim, the few devices available on the market for the assessment of AB should be enhanced to provide a better picture of the situation.[66, 100]

In recent years, the demand for orthodontic treatments has grown, not only in children and adolescents, but also among adults. Another interesting point is the significant increase in cases treated with invisible aligners, instead of fixed traditional orthodontics, due to the possibility of achieving an aesthetic improvement with a reduced impact on social life, fewer emergencies, greater compliance, and better periodontal health compared to traditional orthodontics,[101-103] both in adults and adolescents.[104,105]

Within the clinical community, however, there is concern about the potential effects of orthodontics, in particular in the case of aligners, on the homeostasis of the stomatognathic system, due to the potential effect on bruxism activity and the potential onset of muscle symptoms, which remain a debated issue both in clinical and research settings.[106-109]

In general, the literature on SB and AB seems to suggest a neutral effect of aligners, and more generally of orthodontics, in most cases.[106-108]

Considering AB assessed by EMG, Nota et al.,[106] and Lou et al.,[110] reported respectively a decrease in masseter activity during the first month of treatment with aligners and a subsequent return to basal levels and, on the contrary, a transient increase in masticatory muscle activity during the first two weeks of aligner treatment. Pereira et al.[107] adopted a different evaluation strategy (i.e., ecological momentary assessment approach) and concluded that both in the case of fixed appliances or clear aligners the orthodontic treatment did not influence the frequency of AB report. In detail, while the fixed therapy resulted in a decrease at the start of treatment and a return to basal levels after 6 months, the clear aligners were associated with a constant frequency of AB report throughout the observation period.

With regard to SB, Manfredini et al.[108] investigated the effects of invisible orthodontic retainers with an EMG device and suggested an absence of relevant effects on sleep MMA in healthy individuals, in line with Castroflorio et al.[111] who analyzed the possible effects of clear aligners in six consecutive months in three different groups (i.e., clear aligners, occlusal splint and placebo splint).

An ongoing study evaluated the effects of aligners on sleep and awake MMA in healthy subjects over 24-hour timespans in the home environment with an EMG device during three different sessions: before starting the orthodontic treatment, with passive aligners and with active aligners. In this case, findings suggest that orthodontic treatment with aligners has an influence only in a minority of individuals.[109]

In this context, dental professionals and orthodontists can find interesting support to the hypothesis that the use of orthodontic devices does not affect the sleep and awake bruxism activity, with minor exceptions related with inter-individual differences. For this reason, it is recommended to consider the patients' individual adaptability to prevent maladaptive behavior that is not necessarily related with the biomechanics of orthodontics.

In particular, the clinician must be able to evaluate the psychological and psychosocial aspects that play a decisive role in the etiology of most bruxism activities that, in turn, may be a crucial factor for the onset of clinical symptoms. Within this premise, patients' selection and the creation of a healthy doctor-to-patient relationship are actions that must not be underestimated for their value of good prognostic markers. When required, an orthodontist should not hesitate in looking for the involvement of other health and/or dental care professionals to provide multidisciplinary management of bruxism.

Therefore, clinicians in addition to perform a routine TMD-related examination before starting an orthodontic treatment, can use validated instruments (e.g., questionnaires) to collect information about psychosocial assessment of their patients. This would help a lot to identify those subjects who may experience an increase in bruxism-related behaviors.

CONCLUSIONS

- Knowledge on bruxism is rapidly evolving. Sleep and awake bruxism are considered masticatory muscle activities that, as an umbrella, group together several different jaw muscle activities that are not necessarily related to specific clinical consequences.

- Aetiological factors are mainly related to central rather than peripheral factors and may be different with respect to the circadian manifestations of bruxism. AB is mainly related with psychosocial factors, while SB has a more complex central mediation, with an interaction of all factors influencing autonomic system function during sleep.

- To assess bruxism, both non-instrumental and instrumental approaches can be recommended. A combination of both will likely emerge as the best available choice based on the concept of a multidimensional assessment of the bruxism status.

- Bruxism management is centered on the possible presence of clinical consequences and is based on "Multiple-P" approach (i.e., pep talk, psychology, physiotherapy, plates, pills) centered around the most important "P": the patient. Therefore, performing irreversible occlusal changes (e.g., orthodontic treatment) is not recommendable.

- As for children and adolescents, in case of severe tooth wear and/or high frequency of parental-reported tooth grinding, special focus should be put on the search for comorbid conditions that may represent the actual health concern (e.g., respiratory disturbances, neurological disorders).

- In general, the literature suggests a neutral effect of orthodontic oral appliances (i.e., fixed appliance and clear aligners) on MMA both during wakefulness and sleep, with minor exceptions related with inter-individua differences.

- Before starting orthodontic treatment, clinicians are encouraged to evaluate the patients' individual psychological adaptability to avoid the occurrence of maladaptive behavior.

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Declaration of competing interest

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Declaration of interests

☒The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: