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Correlation between self-reported and clinically based diagnoses of bruxism in temporomandibular disorders patients

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SUMMARY **The present investigation was performed in a population of patients with temporomandibular disorders (TMD), and it was designed to assess the correlation between self-reported questionnaire-based bruxism diagnosis and a diagnosis based on history taking plus clinical examination. One-hundred-fifty-nine patients with TMD underwent an assessment including a questionnaire investigating five bruxism-related items (i.e. sleep grinding, sleep grinding referral by bed partner, sleep clenching, awake clenching, awake grinding) and an interview (i.e. oral history taking with specific focus on bruxism habits) plus a clinical examination to evaluate bruxism signs and symptoms. The correlation between findings of the questionnaire, viz., patients' report, and findings of the interview/oral history taking plus clinical examination, viz., clinicians' diagnosis, was assessed by means of ϕ coefficient. The highest correlations were achieved for the sleep grinding referral item (ϕ = 0·932) and for the awake clenching item (ϕ = 0·811), whilst lower correlation values were found for the other items (ϕ values ranging from 0·363 to 0·641). The percentage of disagreement between the two diagnostic approaches ranged between 1·8% and 18·2%. Within the limits of the present investigation, it can be suggested that a strong positive correlation between a self-reported and a clinically based approach to bruxism diagnosis can be achieved as for awake clenching, whilst lower levels of correlation were detected for sleep-time activities.**

KEYWORDS: **bruxism, diagnosis, self-report, clinical examination**

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Introduction

Bruxism is an umbrella term grouping together different motor activities of the jaw muscles, characterised by clenching or grinding of the teeth and/or by bracing or thrusting of the mandible. It has two distinct circadian manifestations, occurring during sleep (indicated as sleep bruxism) or during wakefulness (indicated as awake bruxism) (1). The condition is gaining interest amongst both clinicians and researchers due to its potential associations with several dental and neurological conditions and disorders, such as tooth wear, temporomandibular disorders (TMD) and sleep apnoea (2). Several systematic assessments of the available literature were recently performed to summarise knowledge on the aetiology, prevalence and consequences of bruxism (3–7). A common denominator of those reviews was the poor quality of the included

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studies due to their low internal validity, which was mainly limited due to problems of bruxism diagnosis.

At present, polysomnographic (PSG) recordings in a sleep laboratory setting are the reference approach for the measurement of sleep bruxism (8, 9), and several other strategies have been defined to quantify the masticatory muscles' activity during sleep time in the home environment (10–13). As for awake bruxism, electromyographic recordings are needed, preferably in combination with the so-called ecological momentary assessment methodology that enables obtaining a true estimate of, amongst others, the frequency of tooth contacts during wakefulness (14). However, it must be borne in mind that other strategies (e.g. questionnaires, interviews, clinical assessment) appear to be more suitable for widespread data gathering in the clinical setting and for recording information on awake bruxism. Hence, studies adopting such easier diagnostic approaches account for the large majority of the bruxism literature.

Based on these observations, a recent international consensus suggested that a diagnostic grading system of 'possible', 'probable', and 'definite' sleep or awake bruxism is adopted for clinical and research purposes (1). Specifically, a self-report of bruxism by means of questionnaires and/or the anamnestic part of a clinical examination should detect 'possible' sleep or awake bruxism, whilst 'probable' sleep or awake bruxism is suggested to be based on self-report *plus* the inspection part of a clinical examination (1).

This suggestion needs to be further elaborated and integrated with any possible additional information on the validity of such grading system in all kinds of populations, amongst which a TMD pain population. Indeed, whilst it was suggested that the relationship between bruxism and pain depends on the diagnostic approach to bruxism (15, 16) and that both patients' and clinicians' preconceived ideas on bruxism may influence the validity of chair-side bruxism diagnosis in patients with TMD (17), the agreement between self-reported, viz., leading to a diagnosis of 'possible' bruxism, and clinical approaches, viz., leading to a diagnosis of 'probable' bruxism, was never assessed.

With this premise, the present investigation was performed in a population of patients with TMD, and it was designed to assess the correlation between self-reported and clinically detected bruxism. The specific clinical research question underlying the study design was 'In a population of patient with TMD pain, is there a correlation between findings of questionnaire items on patients' self-perception of bruxism activities and the clinicians' diagnosis of those bruxism activities based on oral history *plus* clinical examination?'.

Materials and methods

The study group consisted of 159 consecutive patients (79% women; mean age $32{\cdot}8 \pm 14{\cdot}2$, range 18–73 years) seeking advice for temporomandibular disorders signs and symptoms at the School of Dentistry, University of Salvador, Buenos Aires, Argentina. The patients had different Research Diagnostic Criteria for TMD (RDC/TMD) diagnoses (18) (53% muscle disorders; 42% disc displacement; 32% arthralgia/ arthritis/ arthrosis). All subjects underwent an assessment including a questionnaire investigating, amongst others, bruxism-related items and an interview (i.e. oral history taking with specific focus on bruxism habits) *plus* a clinical examination to evaluate bruxism signs and symptoms. All patients gave their written consent to participate in the study, and the investigation was approved by the local Institutional Review Board, University of Salvador, Buenos Aires, Argentina.

The bruxism questionnaire contained five items assessing awake and sleep clenching/grinding. The items were formulated as follows:

1 Sleep grinding item: Are you aware of the fact that you grind your teeth during sleep?
2 Sleep grinding referral item: Did anyone tell you that you grind your teeth during sleep?
3 Sleep clenching item: On morning awakening or on awakenings during the night, do you have your jaws thrust or braced?
4 Awake clenching item: Do you clench your teeth whilst awake?
5 Awake grinding item: Do you grind your teeth whilst awake?

All items could be answered dichotomically with either 'yes' or 'no'. The patients were instructed to answer 'yes' if considered their habit to be frequent enough to be clinically relevant (e.g. frequency of more than thrice a week and/or several hours per day).

Subsequently, patients were interviewed by two clinicians with expertise in bruxism research (D.A.P.; C.G.), after which both clinicians performed a thorough clinical examination to assess possible

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bruxism-related signs and symptoms. The clinicians were blinded with respect to the patients' answers to the questionnaire and provided their diagnoses on the same above five items. The interview/oral history taking was based upon a reformulation and explanation of the questionnaire items. Then, the complementary clinical examination was based on the assessment of clinical symptoms and signs that are potentially attributable to bruxism activities.

The following general rules were considered by the two examiners to take consensus decisions regarding the presence of bruxism activities based on the interview *plus* clinical examination:

1. Sleep grinding item: positive history for tooth grinding during sleep, as confirmed by the patient during the interview, *plus* noticeable tooth wear spots on the incisal surfaces of the anterior teeth and/or on the guiding cusps of the posterior teeth.
2. Sleep grinding referral item: confirmation by the patients of the fact that her/his bed partner reported her/his tooth grinding noises at least three times a week.
3. Sleep clenching item: positive history for tooth or jaw clenching during sleep, as confirmed by the patient during the explanatory interview, *plus* at least two of the following signs/symptoms: pain in the masseter muscles upon palpation, as diagnosed according to a positive palpation of at least one of the three masseter muscle sites per side described in the Research Diagnostic Criteria for TMD guidelines (18); masseter muscle hyperthrophy, as clinically diagnosed by visual inspection and manual palpation; 'line alba' on the cheek mucosa, defined as a bite-like impression on the internal side of the cheek mucosa, potentially featuring also some small lesions; and tongue scalloping, as identified by the visualisation of indentation on the lateral aspects of the tongue mucosa.
4. Awake clenching item: positive history for tooth or jaw clenching whilst awake, as confirmed by the patient during the interview (which focused on explaining the patients that mandible thrusting whilst awake should be also reported), *plus* the same clinical criteria as described for item 3.
5. Awake grinding item: positive history for tooth grinding whilst awake, as confirmed by the patient during the interview, *plus* the same clinical criteria as described for item 1.

The frequency of positive answers in the questionnaire (i.e. patients' report) as well as in the interview/oral history taking *plus* clinical examination (i.e. clinicians' diagnosis) was assessed for all five items. The correlation between findings of the questionnaire and those of the integrated clinical examination was assessed by means of ϕ coefficient, which is a measure of the degree of association between two binary variables and which is similar to the correlation coefficient in its interpretation. ϕ coefficient values range from $-1{\cdot}0$ to $+1{\cdot}0$, indicating different levels of negative or positive correlation. As a general rule for correlation analyses, values higher than 0·7 are considered supportive of a strong positive correlation (19). All statistical procedures were performed with the software*.

Results

Positive answers to the self-reported questionnaire items ranged from 16·7% (awake grinding item) to 50·6% (awake clenching item). The clinicians' diagnosis based on the integrated interview/oral history taking *plus* clinical examination showed positive findings for awake clenching in 52·5%, whilst awake grinding was diagnosed only in 8·3% of patients. Sleep grinding was self-reported by 25·2% of patients and diagnosed by clinicians in 17·0% of patients, whilst the sleep grinding referral item yielded a positive answer in 17·1% of questionnaires and in 16·5% of clinically diagnosed patients. The sleep clenching item was positive in 49·7% (self-report) and 42·8% (clinicians' diagnosis) of patients.

The highest correlation between the two assessments was achieved for the sleep grinding referral item ($\phi = 0{\cdot}932$). A high correlation value was achieved also for the awake clenching item ($\phi = 0{\cdot}811$), whilst correlation values were progressively lower for the sleep clenching item ($\phi = 0{\cdot}641$), for the sleep grinding item ($\phi = 0{\cdot}626$) and for the awake grinding item ($\phi = 0{\cdot}363$; Table 1).

The percentage of disagreement between the two approaches ranged between 1·8% and 18·2%. If the clinicians' diagnosis based on an integrated interview/oral history taking *plus* clinical assessment was assumed as the reference approach to detect bruxism in this

*SPSS 19.0 (IBM Statistics, Milan, Italy)

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Table 1. Prevalence of self-reported and interview *plus* clinical assessment-based diagnoses in the bruxism items and ϕ value measuring the strength of association between the two approaches

Item	Self-reported diagnosis (%)	Interview *plus* clinical diagnosis (%)	ϕ value
Sleep grinding	25·9	17·0	0·626
Sleep grinding referral	17·1	16·5	0·932
Sleep clenching	49·7	42·8	0·641
Awake clenching	50·6	52·5	0·811
Awake grinding	16·7	8·3	0·363

investigation, the percentage of false-positive reports by the patients, viz., positive self-reported items that were not confirmed by the interview/oral history taking *plus* clinical assessment, was variable from 7·4% for sleep grinding referral to up to 69·2% for awake grinding. False-negative reports, viz., positive interview/oral history *plus* clinical assessment that were not reported positively by the patients in the questionnaire, ranged between 3·8% and 38·5% (Table 2).

Discussion

An important methodological concern of many bruxism studies is related with those bruxism diagnoses that were based on single-item self-reported questionnaires. In particular, the 'standard-of-reference' approaches (i.e. PSG or EMG recordings) were seldom used in the literature on bruxism epidemiology (7, 20). Based on those observations, it was recently suggested that clearer specifications on the adopted diagnostic techniques should be provided in bruxism investigations, indicating bruxism as 'possible' if based on questionnaires/self-reports or 'probable' if self-report of bruxism is confirmed with a clinical assessment (1). Such suggestion is in line with the recently suggested approach for grading neuropathic pain (21) and is recommended by a consensus document of an expert panel as the most suitable strategy to apply the best available evidence on bruxism diagnosis (1).

Table 2. Percentage of disagreement between the two approaches, and false-positive and false-negative self-reported findings

Item	Disagreement (%)	False-positive self-reports (%)	False-negative self-reports (%)
Sleep grinding	13·2	42·5	14·8
Sleep grinding referral	1·8	7·4	3·8
Sleep clenching	18·2	25·3	13·2
Awake clenching	9·4	7·5	10·8
Awake grinding	14·7	69·2	38·5

The usefulness of such hypothesis-driven suggestion needs to be confirmed by studies investigating the validity of the proposed grading and the relationship between the different diagnostic strategies. In particular, whilst the relationship between PSG and clinical (8), self-reported (20) as well as other instrumental diagnosis (22) has been assessed, no information is available on the relationship between a bruxism finding based on self-reported questionnaires and its integration with an interview and clinical examination. For instance, the additional value of clinical data with respect to self-reported bruxism as hypothesised by the recent consensus definition document, viz., 'probable' versus 'possible' bruxism, can be revealed only when questionnaire data do not differ from oral history data alone (i.e. apart from the clinical data). Indeed, the possibility must be considered that self-reported questionnaire items may yield different findings with respect to an interview performed by a clinician who records the oral history of the patient. Also, it cannot be even excluded that the clinicians themselves, whilst performing the clinical examination, are influenced by the information referred by the patients during the oral history taking. These issues are of major importance in the field of orofacial pain, as the finding of an association between bruxism and TMD pain depends on the diagnostic approach (4). For instance, self-reported approaches were at risk of being influenced by the patients' beliefs about bruxism as the cause of pain or fatigue within the masticatory muscles (17), whilst clinical assessment may be source of circular reasoning when pain in the jaw muscles is used both for diagnosing TMD and identifying bruxism (23).

In the present investigation, which was performed in a population of patients with TMD, the prevalence of sleep grinding and sleep clenching was self-reportedly 25·9% and 49·7%, respectively, but went down to 17·0% and 42·9% when two expert practitioners interviewed, recorded the oral history and assessed

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the patients clinically. Awake clenching and grinding were reported, respectively, by 50·6% and 16·7% of patients, whilst the clinicians' diagnoses were assigned to 52·5% and 8·3% of patients. These data are hard to compare with literature findings, which were highly variable, but they are generally in line with those studies reporting that about half of the patients with TMD report sleep-time and/or wake-time bruxism (17, 24–26).

From a methodological viewpoint, it should be noted that this study was specifically designed to measure the correlation between the self-reported bruxism and a bruxism diagnosis based on a clinician's interview/oral history taking *plus* clinical assessment, so getting deeper into an aspect of the proposed 'probable' and 'possible' bruxism diagnoses. There was no intention to assess the absolute validity of either approaches, especially concerning the presence of actual/ongoing bruxism, which should be tested against the standards of reference, as recently performed in a large-sample PSG study suggesting that sleep bruxism prevalence varies between 5·5% and 12·5% on the basis of the diagnostic strategy (i.e. only PSG, only questionnaires, or both methods) (20).

Some interesting observations on the interpretation of findings with respect to the report of bruxism during sleep or wakefulness can be drawn. A high correlation between patients' report and clinicians' diagnosis was detected for awake clenching ($\phi = 0{\cdot}811$). This finding was not unexpected, as it refers to a bruxism activity of which one individual can be assumed to be conscious. On the contrary, diagnoses of sleep-time grinding ($\phi = 0{\cdot}626$) and clenching ($\phi = 0{\cdot}641$) were more likely to be influenced by several factors concerning individual beliefs on, for example, the causes of pain and/or tooth wear, as well as by the opinions expressed by the dentist. Those two reports are also representative of items with potentially false-positive questionnaire-based answers (42·5% and 25·3%), which means that the conceptual framework of 'possible' and 'probable' bruxism, as recently defined, must be reappraised by taking into account for the situations in which oral history taking (e.g. some explanation words by the clinician to help the patient better comprehend the questionnaire items) does not confirm the patient's self-report. In particular, the blind status of the clinicians with respect to the questionnaire answers is a methodological strength of this study, which allowed pointing out the need to spend some extra words with patients before giving them any anamnestic questionnaire.

These findings may provide an interesting basis for further discussion and elaboration of diagnostic criteria in the near future, but it must be pointed out that some limits temper their external validity. The consensus clinical decision here adopted to diagnose bruxism cannot be assumed as the standard of reference until a reliable clinical rating of bruxism is provided to ease comparison between different investigations. Based on this need, it is fundamental that reference diagnostic criteria and algorithms are validated for each bruxism activity and that the related strategies for the examiners' standardisation and calibration are provided in the near future. Notwithstanding that, it can be suggested that, whilst self-reported approaches cannot be proposed as standalone diagnostic strategies, an expert interview integrated with a clinical assessment of the most probable bruxism-related signs and symptoms may be suitable to elevate the bruxism diagnoses to the degree of 'probable'. Also, the high correlation between self-reported and clinicians' diagnosis of awake clenching may even suggest that this method approximates the 'definite' diagnosis. More in general, it can be suggested that performing both assessments (i.e. questionnaires and interview *plus* clinical assessment) may even be redundant for those items showing high correlation values. On the other hand, a very low agreement was found for wake-time grinding ($\phi = 0{\cdot}363$), thus suggesting that specific proxies for such activity are to be defined, with focus on the differential diagnosis of dental erosion. Moreover, it should be considered that patients may often be unable to discriminate between sleep and awake bruxism and are likely to consider 'bruxism' as a single entity, so confirming that self-report/questionnaire-diagnosed bruxism, which still remains the most suitable approach to gather large-sample data for epidemiological reasons, is poorly specific.

Based on the above, some additional information could be added to the available literature on bruxism diagnosis on the way of defining criteria for each of the motor activities characterising bruxism and their representation with respect to the circadian rhythm. Given the undoubted difficulties to achieve 'definite' PSG or EMG-based diagnoses on a large scale, this investigation may serve to improve future investigations on bruxism diagnosis by refining questionnaire-based

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approaches. The complementary interview and assessment of clinical signs/symptoms here adopted should be standardised for repeatability, and their validity to detect actual bruxism could then be assessed against quantitative measurements of bruxism activity in small-sample investigations, before being proposed as a valid instrument in the bruxism literature.

Conclusions

Within the limits of the present investigation, which was designed to assess the correlation between questionnaire-based self-reported bruxism (i.e. patients' report) and interview/oral history taking *plus* clinical examination (i.e. clinicians' diagnosis) in a patient population with TMD, it can be suggested that a strong positive correlation between the two approaches can be achieved as for diagnosing awake clenching, whilst lower levels of agreement were detected for sleep-time activities.

Disclosures

The study protocol was approved by the local ethical committee. The authors declare they received no funding for this investigation. The authors declare they have no conflict of interests.

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