

Review articles

Neurofeedback therapy used to treat sleep bruxism in adult subjects: a scoping review protocol

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ABSTRACT

Purpose: to identify evidence regarding the treatment of sleep bruxism with neurofeedback, as well as gaps in such evidence, through mapping studies, and how treatment protocols were performed.

Methods: the proposed review will be conducted in accordance with the JBI methodology for scope reviews. The search strategy will aim to locate published and unpublished studies. The main databases to search include MEDLINE, Embase, LILACS, PsycINFO, Web of Science and Scopus. Gray literature and relevant materials will be included. Two independent reviewers will select titles and abstracts for evaluation, according to the inclusion criteria for the review. The search results will be reported and presented in a PRISMA flowchart. Data will be extracted from materials included in the scoping review using a data extraction tool. The results found will be presented in an organized table with the variables, with data being presented through diagrams, narratives and tables.

Conclusion: a narrative summary will be performed that will accompany the tabulated results and describe the relationship of these results with the objectives and questions of this scoping review, that may lead to encouraging further research on this topic, bringing a new clinical approach evidence to the management of sleep bruxism.

Keywords: Sleep Bruxism; Neurofeedback; Biofeedback, Psychology; Bruxism

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INTRODUCTION

According to the most current international consensus on bruxism, sleep bruxism (SB) is defined as the activity of the masticatory muscles during sleep, characterized as rhythmic or non-rhythmic, and should not be considered a movement disorder or a sleep disorder in healthy individuals. When the behavior is associated with other clinical conditions related to sleep, a more careful assessment is usually performed¹. SB has a prevalence between 1.1% and 15.3% in the adult population², without predilection for sex, with prevalence decreasing with increasing age³.

The etiology for SB is considered to be multifactorial, with many underlying mechanisms that may play a role in its genesis, such as caffeine, alcohol and tobacco consumption, esophageal acidification and passive smoking². Currently, it is considered that, for wakefulness bruxism, psychosocial aspects seem to have some influence on its genesis, while the activation of the central/autonomic nervous system may be the main factor involved in the origin of SB⁴.

Regarding treatment, it is important to note that SB does not require intervention, however, when problems related to bruxism arise, its management is indicated. As treatment modalities, the literature proposes the use of occlusal splints, the use of occlusal devices in individuals with obstructive sleep apnea, pharmacological interventions, behavioral interventions⁵, among others. The current belief is based on the perception that SB has its origin mainly in the central nervous system, thus, behavioral strategies seem to be a promising type of approach in the management of sleep bruxism, as they can directly alter the individual's behavior⁶. One of the behavioral techniques is biofeedback, which aims to provide immediate information to individuals about their behavior, based on their own physiological stimuli, enabling their reduction⁵.

In this way, from the process of using the individual's own biological signals to achieve a change in their physiological functioning, biofeedback works with the assumption that bruxers can modify their behavior when a stimulus, visual or auditory, for example, makes them aware of their excessive jaw muscle activity⁶. When the physiological activity is neurophysiological, biofeedback is called neurofeedback (NF), and this technique thus allows the individual to modulate their brain activities⁷. Neurofeedback therapy (NFT) targets brain and cognitive functions through the use of electroencephalography (EEG), hence neurofeedback is sometimes referred to as EEG biofeedback⁸.

Thus, TNF can be considered as a method that can regulate brain activity with the aim of directly altering relevant behaviors and neural mechanisms, such as cognition. In healthy individuals, NF can provide a method of cognitive enhancement. However, it can also be used as a significant therapeutic tool to normalize the brain activity of individuals during their treatment⁹. In this way, NFT could help sleep bruxers to manage their episodes of masticatory muscle activity during sleep, on the assumption that they consciously adapt their brainwave activity to achieve targeted training goals.

In view of the published studies on biofeedback, a systematic review (SR) published in 2014 by Wang and colleagues¹⁰ aimed to identify and analyze randomized clinical trials, quasi-randomized clinical trials and controlled clinical trials performed in humans, with the objective of evaluating the effectiveness of any biofeedback treatment for sleep bruxism. Later, the SR published in 2018 by Jokubauskas and Baltrušaitytė³ updated the research published by Wang and colleagues, however, the authors considered all published studies peer-reviewed. None of the reviews obtained in their results the selection and/or inclusion of any work that has approached neurofeedback as a way of managing sleep bruxism. Therefore, a preliminary search was performed by the authors of this review in PROSPERO, MEDLINE, Joanna Briggs Institute (JBI) Evidence Synthesis, and PsycINFO and no systematic and scoping current or ongoing reviews were identified regarding neurofeedback therapies for the treatment/management of sleep bruxism.

Given the significant gaps in current knowledge about the use of neurofeedback to manage sleep bruxism, it is important to evaluate published and unpublished peer-reviewed studies to summarize the current state of knowledge and identify gaps. This scoping review aims to identify in the published and unpublished literature studies that have addressed neurofeedback treatment for sleep bruxism in adult subjects. This review will identify evidence for neurofeedback treatment for SB, as well as gaps in such evidence, through study mapping. Furthermore, this review will identify how SB treatment protocols with neurofeedback were performed and whether the treatment was associated with other therapies for SB. The purpose of this review was established following the Population, Concept, and Context (PCC) mnemonic, as recommended by the JBI for Scoping Reviews¹¹, being (P): adult sleep bruxers, (C): neurofeedback therapy

and (C): any context that addresses the management of sleep bruxism with neurofeedback therapy in adult subjects.

METHODS

As it is a scope review protocol, not involving direct participation of human beings, the review does not require approval from the research ethics committee of the home institution. The proposed scoping review will be conducted in accordance with the JBI methodology¹¹. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews (PRISMA-ScR) criteria will be used to guide reporting of the scoping review findings¹². The review protocol was registered in the Open Science Framework: <https://osf.io/e936z>.

Review Questions

Are there any studies in the literature that used neurofeedback (electroencephalography biofeedback) therapy for sleep bruxism in adults?

- I. What is the evidence on neurofeedback therapy for the treatment of sleep bruxism?
- II. How were neurofeedback training protocols performed?

Inclusion Criteria

Participants

This review will consider primary studies that include adult individuals (18 years of age or older), of both sexes, with a diagnosis of sleep bruxism having been performed in an instrumental or non-instrumental way. Secondary studies that focus on adult sleep bruxers of both sexes will also be considered.

According to the most current international consensus¹, non-instrumental approaches include self-report (questionnaires, oral history) and clinical inspection, both for sleep and wakefulness bruxism. Instrumental approaches to sleep bruxism include electromyographic recordings during sleep and such recordings from polysomnography laboratories. These will be considered diagnoses.

Thus, studies that encompass only pediatric and hebiatric individuals (under 18 years of age) as the population studied will be excluded, as well as those who did not perform the diagnosis of bruxism in a non-instrumental or instrumental way, or who did not

explicitly inform how they performed the bruxism diagnosis.

Concept

The main concept of interest in this scoping review is to specify how neurofeedback therapy has been used to treat sleep bruxism in adult subjects. Health treatment is defined as a set of means (therapies) used to overcome a disease, with the objective of improving health through the identification and treatment of problems that have already generated symptoms or complications in the individual. In this way, neurofeedback therapy is defined as a set of operant conditioning techniques, through a computational interface, used in the learning of voluntary control of specific neurophysiological responses of the bruxer, in order that the individual can learn to modify his behavior. of bruxism for their own benefit. For bruxism, the physiological stimuli captured can be muscular (electrical signals) and brain (brain waves), with biofeedback modalities such as electromyography and electroencephalography respectively, the latter being neurofeedback. The authors of this review will determine whether neurofeedback therapy was performed alone or in combination with other types of treatment for bruxism.

Context

This review will explore and consider evidence from published and unpublished literature in any context that addresses the management of sleep bruxism with neurofeedback therapy in adult subjects. This will allow the identification of the therapies used, whether the therapies were performed in isolation or associated with other ways of treating bruxism, as well as the available evidence.

Types of sources

This scoping review will consider published peer-reviewed primary studies that report on the management of sleep bruxism with neurofeedback therapy in the age group 18 years and older. The studies considered should inform how the assessment for the diagnosis of sleep bruxism was performed, whether non-instrumental or instrumental. Systematic reviews targeting the described population and concept, such as the gray literature, will also be considered. Animal studies, in vitro studies, letters to the editor and expert opinions will not be included in this review. Only full-text

research published in English, Portuguese, Spanish and French will be included for this review, due to the fluency of the languages by the independent reviewers. As for the evidence, there will be no restrictions on the date or country of origin of the studies, so that the entire scope of existing research can be included.

Search Strategy

The search strategy was developed with the help of a health sciences librarian and will aim to locate published and unpublished studies. An initial limited search through MEDLINE (via PubMed) and PsycINFO was performed to identify relevant articles on the topic. The text words contained in the titles and abstracts of relevant articles and the indexing terms used to describe the articles were used to develop a complete search strategy for the electronic databases MEDLINE (via PubMed), EMBASE, LILACS, Web of Science, PsycINFO and Scopus. The search strategy, including all keywords and indexing terms identified,

will be adapted for each database included. The search strategy developed for MEDLINE can be found in Chapter 1.

Chapter 1

Sources of unpublished studies and gray literature to be searched will include a search on Google Scholar, ProQuest, Brazilian Digital Library of Theses and Dissertations and Clinical Trials. This survey will be conducted to identify potentially relevant gray literature. Key subject terms will be searched and relevant evidence and materials will be collected until the reviewer examines 20 results without identifying a potentially relevant work.

The listed references of all studies included in the scoping review will be selected and analyzed in order to identify potentially useful studies and sources that could be included. If necessary, authors of primary studies will be contacted for further clarification of information.

Chapter 1. MEDLINE Search Strategy

Search Number	Query	Results Retrieved
#3	#1 AND #2	80
#2	(Biofeedback psychology[MeSH Terms]) OR (Alpha Biofeedback[MeSH Terms]) OR (Neurofeedback[MeSH Terms]) OR (EEG Biofeedback[MeSH Terms])	12.454
#1	(Bruxism[MeSH Terms]) OR (Sleep Bruxism[MeSH Terms]) OR (grinding disorder, teeth[MeSH Terms]) OR (grinding disorders, teeth[MeSH Terms]) OR (teeth grinding disorders[MeSH Terms]) OR (bruxism, sleep[MeSH Terms]) OR (sleep bruxism[MeSH Terms]) OR (nocturnal teeth grinding disorder[MeSH Terms]) OR (teeth grinding disorder, nocturnal[MeSH Terms]) OR (bruxism, nocturnal[MeSH Terms]) OR (nocturnal bruxism[MeSH Terms]) OR (sleep-related bruxism[MeSH Terms]) OR (bruxism, sleep-related[MeSH Terms]) OR (sleep related bruxism[MeSH Terms]) OR (Awake Bruxism[MeSH Terms]) OR (sleep bruxism, adult[MeSH Terms]) OR (adult sleep bruxism[MeSH Terms]) OR (adult sleep bruxisms[MeSH Terms])	3.223

Source: authors (2022)

Study/source of evidence selection

All identified citations will be uploaded and grouped into EndNote v.X9 (Clarivate Analytics, PA, USA), and duplicates removed. Afterwards, the titles and abstracts of the studies found through the search strategy will be screened, based on the established inclusion and exclusion criteria, by two independently trained reviewers (JHCNN and LMB). Potentially relevant studies, with full texts available in English, Portuguese, Spanish and French, will be retrieved and their citation

details imported into the JBI System for the Unified Management, Assessment and Review of Information (JBI SUMARI; JBI, Adelaide, Australia)¹³. If systematic reviews are identified in the search, the relevant studies will be extracted and analyzed individually and separately from the review, and will be used for identification and inclusion of individual studies and evidence extraction. The reasons for excluding full-text studies that do not meet the inclusion criteria will be recorded and reported in the scoping review. They will then verify

all information found and, in case of disagreement, consensus will be established through discussion or with a third reviewer, for eligibility.

The results of the search will be reported in full in the final report and presented in a Preferred Reporting Items for Systematic Reviews and Meta-analyses for Scoping Reviews (PRISMA-ScR) flow diagram¹².

Data extraction

Data will be extracted from articles included in the scoping review by two independent reviewers using a data extraction tool developed by the reviewers. The extracted data will include specific details about the population, concept, context, study methods and key recommendations relevant to the purpose of the review. An outline chart table is provided (Chapter 2). The draft data extraction tool will be modified and revised as necessary during the data extraction process for each included study¹¹. Modifications will be detailed in the full scope review report. Any disagreements that arise between reviewers will be resolved through discussion or with a third reviewer. Authors of articles will be

contacted to request missing or additional data, when necessary.

Chapter 2

Data analysis and presentation

To address the data referring to primary research, the results will be presented in a table format and will be organized with the starting category and the measured outcome variables and, within these categories, according to the study design or type of work. Data will be presented through diagrams, narratives and tables. Data extracted from studies will include year of publication, country of origin, study type and participants. Data extracted on neurofeedback treatments for sleep bruxism in adult subjects will include sleep bruxism diagnostic method, details about neurofeedback performed such as number of channels used, brain waves assessed and training protocol. A narrative summary will be performed that will accompany the tabulated results and describe the relationship of these results with the objectives and questions of this scoping review.

Chapter 2. Data Extraction Instrument

Study Characteristics	
First author and year	
Institution/organization	
Country	
Source of information (e.g., (MEDLINE/Scopus, gray literature – specify source organization)	
Study design	
Study objective/aim	
Primary outcome	
Participant Details	
Range and mean age	
Gender	
Number	
Sleep Bruxism Details	
Diagnostic method	
Treatment/management (whether neurofeedback alone or in combination with other treatments)	
Neurofeedback Details	
Interface used	
Session details	
Key findings post-neurofeedback therapy	
Level of evidence	

Source: authors (2022)

DISCUSSION

The scientific literature provides evidence about the use of different types of biofeedback for the management of sleep bruxism^{10,13}, however, there is a gap regarding the use of neurofeedback therapy in this population. Through the current belief that the activation of the central/autonomic nervous system may be the main factor in the origin of sleep bruxism⁴, behavioral therapy through neurofeedback may be promising for the management of SB.

Based on this assumption, due to the scarcity of studies that address the subject, the choice of carrying out a scope review is interesting, considering that one of the objectives of this research methodology is to identify gaps in the knowledge base, provide an overview of the evidence through the mapping of available evidence, which can be performed from any source of knowledge and research methodology^{11,14}. Therefore, the review may guide future research on the management of sleep bruxism through neurofeedback therapy, bringing evidence that can guide clinical practice.

Thus, this review aims to answer the research questions listed in the protocol from the identification of studies that used neurofeedback as a therapy for sleep bruxism in adult individuals, the available evidence and how the training protocols were performed. For this, it was established that the diagnosis of bruxism, by instrumental or non-instrumental way, must be declared in the research, which will bring greater transparency and security in the results found.

The publication of this scope review protocol follows the methodological precepts of the JBI, which allows greater transparency of the review process and its reproduction. Thus, this protocol provides the review plan for the scope review and it becomes important to limit the occurrence of reporting bias. If changes to this protocol are made during its course, these will be explained in the review^{11,14}.

The studies listed for the review will be approached in a descriptive way, it is not possible to carry out a qualitative analysis using the proposed methodology for a scope review, nor will the risk of bias be evaluated. In addition, if the search strategy needs to be modified during the review process, this will be done to suit the purpose of the review.

The results of this review will provide a current overview of the use of neurofeedback therapy in the management of sleep bruxism in adult individuals, and may not imply, since qualitative analyzes will not

be performed, but rather inform parameters for clinical practice, as well as subsidize further research.

CONCLUSION

This scope review protocol followed all the methodological precepts for the elaboration of this type of study and is now ready to be executed. The results found will be presented in an organized table with the variables, with data being presented through diagrams, narratives and tables. The review performed will present and summarize the current state of knowledge on the topic and identify gaps in the scientific evidence and, thus, may encourage further research on this topic, which may bring a new clinical approach to the management of sleep bruxism.

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