v. 5, n. 25, 2025

International Journal of Health Science

Acceptance date: 04/08/2025

TMD AND BIOFEEDBACK: A LITERATURE REVIEW

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Abstract: Temporomandibular dysfunction (TMD) involves changes in the temporomandibular joints and masticatory muscles, caused by factors such as bruxism, trauma and psychosocial influences. These dysfunctions can cause facial pain, joint noise, difficulty moving the jaw and are often associated with stress and parafunctional habits, such as teeth clenching. Bruxism, characterized by clenching or grinding the teeth, is associated with sleep disorders and emotional stress, affecting around 10% to 13% of adults during sleep and up to 31% during wakefulness. The literature presents various therapeutic alternatives for bruxism: myorelaxant plates, self-care techniques and biofeedback. EMG biofeedback allows patients to monitor and adjust their muscle activity, promoting self-control over muscle tension and parafunctional habits, resulting in significant improvements in symptoms. The aim of this study was to evaluate the literature on the use of biofeedback as a therapeutic alternative capable of promoting muscle re-education and modifying bruxism--related behavior. The methodology consisted of a literature review, in which 25 articles were selected that discuss the prevalence, etiology and treatment of TMD, with an emphasis on biofeedback. The literature findings indicate that biofeedback is effective in reducing TMD symptoms and associated stress, providing lasting relief and better quality of life for patients with bruxism, contributing to sustainable neuromuscular rehabilitation.
Keywords: TMD, Biofeedback, Electromyography, Bruxism.

INTRODUCTION

Temporomandibular Dysfunction (TMD) consists of alterations in the stomatognathic system, affecting the temporomandibular joint, the masticatory muscles or both, with a multifactorial etiology including trauma, bruxism, and morphology of the joint structures, being influenced by psychosocial factors (SILVEIRA *et al.*, 2007; BEZERRA *et al.*, 2012). TMD is related to stress, which increases muscle activity due to parafunctional habits such as bruxism and onychophagia, resulting in limited mandibular movements, joint noise, as well as headaches, otalgia, fatigue, spasm and pain. The disorders caused by TMD can affect both the dental, muscular and joint structures, the latter being more complex as they refer to structural changes in the joint surfaces and the positioning of the articular disc (GUIMARÃES., FERREIRA., 2012). The diagnosis of TMD is based on symptoms and is complemented by imaging tests. Currently, the validated DC/TMD protocol (Diagnostic Criteria for Temporomandibular Disorders) is considered the gold standard for TMD diagnosis (FEDERIC *et al*. 2025).

As for bruxism, its main causes are related to emotional stress, sleep disturbance and occlusal interferences, and it is defined as a non-chewing muscle activity resulting from apartment and/or grinding teeth manifested during the day (waking bruxism) and/or during sleep (sleep bruxism) (LOBBEZOO *et al*., 2018). The signs and symptoms of bruxism can include: pain in the masticatory and cervical muscles, limited mouth opening, TMJ clicking, headache, stress, anxiety, depression, sleep disorders and general oral health impairment such as broken restorations and dental elements (LAVIGNE *et al*., 2008; SHETTY *et al*., 2010; WETSELAAR *et al*., 2021).

According to the literature, the prevalence of TMD is 79.5% in women, while in men it is 20.5%. There are various therapeutic modalities for treating TMD, including: home care, the use of a myorelaxing plate (MP), occlusal adjustment, the use of medication, surgery, acupuncture, anesthetic blocks, biofeedback and others (FERREIRA *et al.,* 2012; WIECKIEWICZ *et al.,* 2014).

Biofeedback or surface electromyography (EMG) is a tool for assessing masticatory muscle function and recording the effectiveness of therapies for the treatment of TMD, as it quantifies neuromuscular activity, patterns and dysfunctions resulting from TMD (INCHINGOLO *et al*. 2024). Considered an excellent diagnostic and therapeutic alternative, it can be indicated for patients with bruxism, since this technique allows the state of muscle contraction to be recorded prior to treatment, as well as readjusting the behavior of clenching or grinding teeth based on informative stimuli about muscle activity, helping patients to develop self-control over parafunctional habits (JADIDI *et al*., 2013; LOBBEZOO *et al*., 2008; MOLINA *et al*., 2013). The aim of this study is to review the literature on the epidemiology of TMD and the indication for the use of biofeedback in supportive treatment for TMD.

METHODOLOGY

This is a descriptive literature review. A literature search was carried out using the following keywords: TMD, Biofeedback, Electromyography, Bruxism, using the Google Scholar and Pubmed databases. Articles, studies and clinical trials in Portuguese that addressed the etiology, prevalence or treatments for TMD were used as inclusion factors, as were those that discussed the protocol for using electromyography and biofeedback.

A total of 29 articles were selected. Of these, 6 are literature reviews dealing with TMD, its etiology and prevalence over the last 15 years. The other 23 were reviews, trials and clinical reports on the use of biofeedback.

LITERATURE REVIEW

Temporomandibular disorder (TMD) refers to a set of disorders involving the masticatory muscles, the temporomandibular joint (TMJ) and associated structures (SILVEIRA *et al.*, 2007; BEZERRA *et al.*, 2012). According to the American Academy of Orofacial Pain (AAOP), 40% to 75% of the population has some sign of TMD, 33% have some symptom and 5% to 7% seek treatment (FERREIRA *et al.,* 2012; WIECKIEWICZ *et al.,* 2014). Pain is the most frequent symptom, especially pain located in the muscles of mastication and the pre-auricular region. Jaw pain, headaches, joint noise, difficulty opening and closing the mouth and difficulty chewing are common complaints among TMD patients. According to SILVEIRA *et al.*, 2007; FERREIRA et al., 2012 the prevalence of TMD in dental students is 39% and of these cases 93% consist of joint disorders and 7% of muscle disorders. The most prevalent joint TMD, regardless of gender, was disc displacement with reduction (68%). In their study, BEZERRA *et al*., 2012, evaluated 336 students aged between 18 and 22, of whom 48.2% had mild TMD, 11.3% moderate and 3% severe.

Bruxism has a high prevalence in the population, with sleep bruxism present in 10% to 13% of adults and waking bruxism in 22% to 31% (MANFREDINI *et al*., 2015). In addition, 85% to 90% of the population has reported episodes of bruxism in their lifetime (AMORIM *et al*., 2018).

The diagnosis of TMD is clinical and is complemented by imaging tests of the anatomical structures of the face (BARRETO *et al*, 2021; GOYATA *et al*, 2010). There are various criteria for diagnosing TMD, including simple, clear, reliable and proven definitions for an anamnesis. Because TMD is related not only to neuromuscular and occlusal functional disorders, but also to psychosocial issues, an assessment of the patient's emotional pattern is also necessary to diagnose the cause of this pain (SCHIFFMAN *et al*. 2014).

Because it allows the analysis of muscle functions during standardized tasks, EMG is being used extensively in various areas of he-

alth, as it can quantify voluntary or involuntary muscle electrical activity (FEDERIC *et al*. 2025). A literature review by DOROSZ *et al*. 2024 showed that the use of electromyography is effective in proving the efficacy of therapies focused on regulating the activity of the muscles of the stomatognathic system in patients diagnosed with TMD.

According to VIEIRA, 2023, there are several alternatives for the supportive treatment of TMD: botulinum toxin, occlusal plates, pharmacotherapy, behavioral therapies and physiotherapeutic approaches and EMG (Electromyography) biofeedback.

Electromyography biofeedback is a type of neuromuscular feedback, capable of measuring muscle activity, detecting behavior and generating visual or auditory feedback demonstrating conscious or unconscious bruxism so that a behavioral change occurs in the patient, inducing learning that will persist even after the technique is discontinued (LOBBEZOO *et al*., 2008; JADIDI *et al*., 2013; MOLINA *et al*., 2013, ILOVAR *et al*. 2014). Biofeedback provides information about the individual's bodily functions with the intention of developing behavioral changes that result in the restoration of health (FRANK *et. al*, 2010). It has therefore been used to treat various dysfunctions, such as urinary and fecal incontinence (DE LA HOZ-AIZPURUA *et al*, 2011), hypertension (GREENHALGH *et al*, 2010) and rehabilitation after a stroke (BOGAARDT *et al*, 2009). Biofeedback can be classified as biomechanical, providing measurements related to postural control, forces and movements produced by the body; physiological, which can be sub-classified into cardiovascular, respiratory and neuromuscular, the latter being of great interest for the treatment of TMD (GIGGINS *et al*, 2013).

The biofeedback learning protocol was based on operant conditioning, developed by Skinner in the 1930s, making it possible to modify habits by means of environmental stimuli and reward or punishment reinforcements (EDWARD *et al*, 2006). In this way, the patient learns to recognize, modify/control the desired muscle function (DENIS, 1996). The use of EMG biofeedback allows muscle activity to be captured and transformed into sound or visual signals, thus enabling the rehabilitation of neurological and/or musculoskeletal conditions (GIGGINS *et al*, 2013). The stimulus is not harmful, but it must have the capacity to invade conscious thought and alert the patient (MOLINA *et. al*, 2013). During the training session with EMG biofeedback in the facial muscles, the patient receives responses about muscle activity, learning to reduce muscle tension during increased muscle tone or when performing parafunctional movements (FERREIRA, 2019).

According to DENIS (1996), there are some relevant aspects that must be observed during treatment with biofeedback, which will define the treatment protocol for the patient:

The interpretation of the signal: the patient needs to be aware of the signal they are going to receive and what attitude to take from it (contracting or relaxing the muscles). Punishment or reward: the individual must be aware of whether or not they have performed the required function correctly. Choice of operant response, whether the patient will receive the signal for performing correctly or has to change their attitude. Reinforcement of the operant response, these are signs that the individual is progressing in treatment. Selection of the signal by the patient, whether they will adapt better to a visual or audible signal. The organization of biofeedback sessions, quantity, duration, etc.

Considering the literature, biofeedback has emerged as an auxiliary procedure in the treatment of patients with bruxism, with proven improvements in well-being, a reduction in self-reported symptoms and muscle activi-

ty (BERGMANN *et al.*, 2020; OHARA *et al.*, 2021), and a reduction in anxiety and stress levels (RAPHAEL; SANTIAGO; LOBBEZOO, 2016). Other studies have also shown a reduction in muscle activity and pain in the masticatory muscles, which has had a positive and prolonged effect (JOKUBAUSKAS; BALTRUŠAITYTĖ, 2018; SAITO-MURAKAMI *et al.*, 2020; SATO *et al.*, 2015; WATANABE *et al.*, 2011).

FINAL CONSIDERATIONS

According to the study, it is reiterated that the prevalence of TMD is notable in the population, ranging from 40% to 70%, and stems from various pathophysiological and psychosocial factors. It is also noteworthy that, among the methods for treating and controlling the symptoms generated by these dysfunctions, EMG biofeedback is a powerful tool to help support treatment for TMD, as it allows not just a momentary treatment, but a physiological re-education in the patient that will persist for a relevant time.

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