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PHOTOBIOMODULATION THERAPY IN THE TREATMENT OF TEMPOROMANDIBULAR DISORDERS

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Abstract: Temporomandibular disorders (TMD) are a set of characteristic clinical conditions of pain or discomfort of non-dental origin, in the masticatory muscles, temporomandibular joint (TMJ) and associated structures. The main symptoms of these disorders are: cracking in the joints, difficulty in opening and closing the mouth, and pain. Therapies for treating TMD involve dietary and behavioral changes, pharmacotherapy, physical therapy, occlusal splint therapy, lasers or open joint surgery. In particular, the use of low-level laser (LLLT) is a non-invasive and non-pharmacological treatment that has shown beneficial results in the treatment of TMD-related pain. It may act through several mechanisms of action, including facilitating the release of endogenous opioids, increasing tissue repair and cellular respiration, increasing vasodilation and pain threshold, and decreasing inflammation. OBJECTIVE: To carry out a bibliographic survey on the efficacy of using LLLT in the treatment of TMD. METHODS: A narrative review was carried out, whose searches dated from November 2021 and in the databases: PubMed, Scielo, Llilacs and BBO. The descriptors "photobiomodulation therapy" and "temporomandibular disorders" and their corresponding ones in English were used. Articles published from 2011 to 2021, in Portuguese, English and Spanish, were included, prioritizing randomized clinical trials and systematic reviews. RESULTS: After reading the titles and abstracts of the 130 articles, 63 were selected for full reading. In the end, 18 were selected. There was positive corroboration among 11 of the authors regarding the effectiveness of low-power laser in improving chronic TMD pain. Its use offers advantages, as the therapeutic regimen is non-invasive, reversible, with fewer adverse effects. Despite this, there is still no consensus on the protocols to be used. Therefore, it is necessary to analyze each case and individualize the treatment in relation to the laser parameters, the number and duration of applications and the characteristics of the light beam. CONCLUSION: The evidence showed that the use of LLLT was effective in reducing symptoms resulting from TMD.

Keywords: Temporomandibular disorders. Laser therapy. Photobiomodulation

INTRODUCTION

Temporomandibular disorders (TMDs) are classified as degenerative musculoskeletal disorders that cause structural and functional abnormalities (AHMAD, 2021). They are a set of clinical conditions with signs and symptoms in the masticatory muscles, temporomandibular joint (TMJ) and associated structures and pain on palpation of the masticatory muscles (HANNA, 2021). As it is a multifactorial disease, it requires a complex therapeutic approach, with non-invasive therapies being the first option for most patients (BROCHADO, 2019).

The incidence of these disorders ranges from 21.5% to 50.5%, with a predilection for females. They are categorized into three forms: myofascial pain is the most typical form, followed by internal joint derangement and degenerative joint disease. TMDs represent a primary cause of non-odontogenic pain in the orofacial region, with 40% to 75% of individuals having at least one TMD sign, such as TMJ noise, and 33% having at least one facial symptom or pain.

TMD therapies are primarily aimed at eliminating pain, cracking in the joints and restoring TMJ functions. Thus, they involve dietary and behavioral changes, pharmacotherapy, physiotherapy, occlusal splint therapy, intra-articular injections, arthroscopy, arthrocentesis, lasers or open joint surgery (AHMAD, 2021). Low power laser (LLLT) is a non-invasive and non-

pharmacological treatment that has shown beneficial results in the treatment of TMD-related pain (SOBRAL, 2021).

Thus, this study aimed to carry out a bibliographic survey on the effectiveness of LLLT as a treatment for TMD.

MATERIAL AND METHOD

A narrative review of the literature was carried out. Searches were carried out in PubMed, Scientific Electronic Library Online (Scielo), Latin American and Caribbean Literature in Health Sciences (Llilacs) and Bibliografia Brasileira de Odontologia (BBO), in November 2021. following descriptors: "photobiomodulation therapy" and "temporomandibular disorders" together, and their corresponding terms in English, "photobiomodulation therapy" and "temporomandibular disorders", plus the term AND between them.

Inclusion criteria were: studies published from 2011 to 2021; in Portuguese, English and Spanish; evaluation study, randomized clinical trial, systematic review and meta-analysis articles whose main research focus was photobiomodulation therapy in the treatment of TMD. Exclusion criteria were: gray literature (dissertations, theses, course completion papers and the like), duplicate articles, articles outside the chosen time range and studies that did not appear to be relevant to the topic.

130 articles were found. After reading the titles and abstracts, 63 articles were selected for full reading. In the end, 18 were selected.

RESULTS ANALYSIS

Author(s)/year	Study type	Objective	Results	Conclusion
TENGRUNGSUN T, Mitrirattanakul S, Buranaprasertsuk P, Suddhasthir (2012)	Systematic review	To evaluate the effectiveness of LLLT therapy as a treatment for orofacial pain	LLLT vs placebo pooling revealed high quality trials in three of eight positive studies	Only limited evidence has indicated that LLLT is more effective than placebo, sham laser, and other active treatments.
CHEN J, Huang Z, Ge M, Gao M (2015)	Randomized trial and meta-analysis	Evaluate the effectiveness of LLLT therapy in the treatment of TMDs	LLLT was no better than placebo in reducing chronic pain from DTM. However, LLLT provided better and significant functional results in terms of maximum active vertical opening.	Indicates that the use of LLLT has limited efficacy in reducing pain in patients with TMD. However, LLLT can improve significantly the functional results of patients with TMD
DANTAS, Caroline Maria Gomes (2019)	Randomized, double-blind clinical trial	Investigated the influence of different low-intensity laser photobiomodulation therapy protocols, associated with self-care measures, on pain and mandibular mobility in patients with TMD	Active laser treatments promoted similar improvement to placebo irradiation Photobiomodulation therapy in three protocols presented was superior to placebo for reducing pain on palpation of the superficial masseter and TMJ	All tested photobiomodulation therapy protocols are capable of reducing pain on palpation in the superficial masseter and TMJ of individuals with TMD. The improvement achieved was maintained 30 days after treatment

VALLEJO ROSERO, Kleber et al (2019)	Systematic review	To establish if there is evidence that LLLT can reduce the main symptoms of TMDs and determine the most effective application protocol	The most used type of laser was GaAlAg, with a wavelength of 830 nm, number of applications ranging from 8 to 10 and 4 weeks of follow-up	LLLT can be considered an alternative for the relief of TMD symptoms
TORTELLI, Síglia Adriana Campos, SARAIVA, Leonardo and MIYAGAKI, Daniela Cristina (2019)	Randomized clinical trial	To compare the effectiveness of acupuncture, ozone therapy and laser therapy in the treatment of patients with muscular TMD, through a randomized clinical trial	There was no statistically significant difference between treatments. Regarding pain and maximum mouth opening, the groups did not show statistical difference when analyzed individually, but when compared in general, they showed statistical differences	It can be considered that all treatments were able to decrease pain and improve the maximum mouth opening capacity related to muscular TMD.
BROCHADO, Fernanda Thomé et al (2018)	Randomized clinical trial	To evaluate the effectiveness of photobiomodulation (PBM) and manual therapy (MT), isolated or combined (CT), was evaluated in pain intensity, mandibular movements, psychosocial aspects and symptoms of anxiety in patients with TMD	All groups demonstrated pain reduction and improvement on jaw movements during treatment and follow-up	All tested protocols were able to promote pain relief, improve mandibular function and reduce negative psychosocial aspects and anxiety levels in TMD patients
BROCHADO, Fernanda Thomé et al (2019)	Systematic review	Conduct a systematic review to analyze therapies most common non-invasive techniques used for the treatment of TMD	LLLT, occlusal splints (OS) and oral exercises / Behavioral education (OE/ BE) were the most used therapies. The LLLT showed significant results in improving pain and movement in most studies	Non-invasive treatments can provide pain relief and must be prescribed before surgical procedures LLLT was the therapy with the highest number of studies showing positive results
ALVES, Giorvan Ânderson dos Santos et al (2021)	Randomized and blinded clinical trial	To investigate the influence of photobiomodulation associated with orofacial myofunctional therapy (OMT) in patients with TMD	The experimental group had an increase in measures of mandibular opening and protrusion movements	The orofacial myofunctional therapy, when associated with photobiomodulation, contributed to the increase in the range of mandibular movements and with a significant improvement in the painful conditions of volunteers with TMD
ZWIRI A, Alrawashdeh MA, Khan M, et al (2020)	Systematic review	To evaluate the effectiveness of laser application in temporomandibular joint dysfunction	Most studies reported a reduction significant decrease in pain caused by the use of laser during the treatment of TMD	Laser therapy shows a promising result of pain reduction for patients with TMD. Therefore, laser therapy can be recommended for the best outcome of patients with TMD.

JING G, Zhao Y, Dong F, et al (2021)	Systematic review, meta analysis of a randomized controlled trial	To compare the effects of different LLLT energy densities on pain reduction in TMD patients	Immediately after treatment, d1 laser therapy (energy density ranging from 0 to 10 J/cm2) ranked first	For clinical application, d1 laser therapy (energy density ranging from 0 to 10 J/cm2) is recommended for the treatment of short-term pain in patients with TMD (moderate-quality evidence)
SOBRAL AP, Sobral SS, Campos TM, et al (2021)	Systematic review and meta-analysis and cost-effectiveness analysis	To evaluate the effectiveness of photobiomodulation in the treatment of myofascial pain associated with TMD through the analysis of randomized clinical trials published from 2007 to February 2019	The analysis showed that the groups treated with laser had a greater improvement in pain symptoms than the control group (placebo)	Laser-treated groups showed greater improvement in pain symptoms than the control group, and photobiomodulation was more cost-effective than placebo in patients with TMD and myofascial pain
AHMAD SA, Hasan S, Saeed S, Khan A, Khan M(2021)	Systematic review	Reassess the effectiveness of low-level laser therapy (LLLT) in the treatment of patients with temporomandibular disorders	Eighteen studies showed that LLLT was effective in decreasing TMD pain, 12 showed that LLLT was effective similar to placebo/controls/other intervention in reducing TMD pain. Four studies showed varying effects of LLLT on pain intensity, jaw movement, EMG activity and masticatory efficiency. Two studies revealed that LLLT improved aspects psychological and emotional factors associated with TMDs, joint noises, masticatory efficiency and EMG parameters, respectively. One study focused subjective tinnitus, while another study suggested laser acupuncture therapy (LAT) as a suitable alternative to LLLT	LLLT offers advantages, as the therapeutic regimen is non-invasive, reversible, with fewer adverse effects, and may also improve psychological and emotional aspects associated with TMDs Promising therapeutic regimen for TMDs
MELIS M, Di Giosia M, Zawawi KH (2021)	Systematic review	To evaluate the effectiveness of low level laser therapy (LLLT) in the treatment of temporomandibular disorders (TMD)	The results of the tests were controversial and not particularly related to any characteristics of the laser beam, the number of laser applications and their duration	No definitive conclusions can be drawn about the effectiveness of LLLT for the treatment of TMD. Many methodological differences between studies, mainly regarding the number and duration of laser applications and the characteristics of the laser beam (wavelength, frequency, output), no allow for standardized guidelines for effective treatment with LLLT

MAIA ML, Bonjardim LR, Quintans Jde S, Ribeiro MA, Maia LG, Conti PC (2012)	Systematic review	Systematically review studies that investigated the effect of low-level laser therapy (LLLT) on pain levels in individuals with TMD	A reduction in pain levels was reported in 13 studies, with 9 of them occurring only in the experimental group and 4 studies reporting pain relief for the experimental group and for the placebo	Most articles showed that LLLT seems to be effective in reducing TMD pain
MUGUNIA FM, Jang J, Salem M, Clark GT, Enciso R (2018)	Systematic review and meta analysis	To determine the effectiveness of low-level laser therapy (LLLT) in the treatment of temporomandibular myofascial pain in adults compared to placebo laser	In a meta-analysis, pain intensity was significantly reduced after treatment in the group receiving LLLT versus laser placebo	LLLT appears to be effective in reducing pain in patients with temporomandibular myofascial pain with moderate-quality evidence
TUNÉR J, Hosseinpour S, Fekrazad R (2019)	Systematic review	Comprehensively review all available documents on the application of photobiomodulation therapy in patients with TMD and suggest an evidence-based protocol for the therapeutic administration of PBM for these patients	Best results for pain relief and increased mandibular movement have been reported after application of GaAlAs diode laser, 800–900 nm, 100–500 mW and <10 J/ cm2, twice a week for 30 days at trigger points	Most articles showed that PBMT is effective in reducing pain and contributes to functional improvement in patients with TMD
HANNA R, Dalvi S, Bensadoun RJ, Benedicenti S (2021)	Systematic review and meta analysis	Governing the effectiveness of photobiomodulation therapy (PBMT) in temporomandibular disorders (TMD)	Meta-analysis on 32 of 44 studies revealed statistically significant differences between groups favoring photobiomodulation therapy compared to control treatment strategies	Most available evidence suggests that PBM from lasers or LEDs, or combined treatment modalities, have fundamental and substantial effects in ameliorating chronic TMD pain

LLLT refers to a light-based therapy that produces monochromatic, coherent light of a single wavelength. It may act through several mechanisms of action, including facilitating the release of endogenous opioids, increasing tissue repair and cellular respiration, increasing vasodilation and pain threshold, and decreasing inflammation. Furthermore, it exerts a photochemical effect, in contrast to the ablative or thermal effects related to medical laser procedures. LLLT offers advantages, as the therapeutic regimen is non-invasive, reversible, with fewer adverse effects, and can also improve the psychological and emotional aspects associated with TMDs (AHMAD et al., 2021).

Hanna and her collaborators (2021) explain that photobiomodulation therapy (PBM), laser or light emitting diodes (LEDs) have gained interest as a non-invasive tool with immunomodulatory, anti-inflammatory and bioregenerative effects in stimulating healing, pain relief and reducing inflammation. Cytochrome c oxidase (CCO) of the mitochondrial electron chain transport complex IV absorbs photonic energy of wavelengths from 600 to 900 nm, while longer wavelengths are considered to be absorbed by water and light-sensitive ion channels. PBM can also reduce oxidative stress by dissociating inhibitory nitric oxide (NO) from CCO. PBM modulates oxidative stress and reactive oxygen species (ROS)-mediated signaling in the management of TMD. PBM laser therapy has been proven to improve perfusion in bone and joint structures, stimulate osteoblasts and

chondrocytes, reduce inflammatory cytokines and chemokines, increase anti-inflammatory cytokines and reduce nerve stimulation, promote the release of endogenous opioids, improve tissue healing, increases angiogenesis, increases muscle traction force, increases pain threshold by affecting cell membrane potential, and decreases inflammation, possibly due to shrinkage.

Zwiri et al. (2020) said that patients with TMD suffer from continuous pain for a long time, even after conventional treatment. Jing et al. (2021) and Dantas et al. (2019) had promising results up to one month after treatment with d1 laser therapy (energy density ranging from 0 to 10 J/cm2), which also performed better than than the placebo and other laser groups.

Dantas et al. (2019) reported that all tested photobiomodulation therapy protocols were able to reduce pain on palpation in the superficial masseter muscle and TMJ of individuals with TMD. Vallejo et al. (2019) corroborate this in part, as after testing various low-intensity laser application protocols, they were unable to find scientific evidence that one of them was superior to the others, and all had good results.

Brochado et al. (2018) conducted a randomized clinical study to evaluate the effectiveness of photobiomodulation (PBM) and manual therapy (MT), either alone or in combination (CT). As a result, all tested protocols were able to promote pain relief, improve mandibular function and reduce negative psychosocial aspects and anxiety levels in patients with TMD. However, the combination of PBM and MT did not promote an increase in the effectiveness of both therapies alone.

Tortelli et al. (2019) conducted a randomized clinical trial to compare the effectiveness of acupuncture, ozone therapy and laser therapy in the treatment of patients with muscular TMD, finding that all treatments were able to reduce pain and improve the related maximum mouth opening capacity. to muscle TMD. They also concluded that TMD-related quality of life, in relation to the pain variable, was generally effective when compared before and after the interventions.

In the studies by Tengrungsun et al. (2012), Chen et al. (2015) and Melis et al. (2021) there was corroboration that there is only limited evidence indicating that LLLT is effective in the treatment of TMD. In contrast, most available evidence suggests that laser PBM or LEDs, or combined treatment modalities, have effective effects in improving chronic TMD pain, functionality, and quality of life. 2021; ALVES, 2021; ZWIRI, 2020; TUNER, 2019; DANTAS, 2019; VALLEJO, 2019; BROCHADO, 2019; MAGUNIA, 2018; MAIA, 2012).

In these studies, both red and NIR light, as well as red/NIR combination light sources were used to target superficial and deep target tissues, helping to improve pain and functionality. Despite this, the heterogeneity of standardization regarding laser parameters, regarding the number and duration of laser applications and the characteristics of the laser beam (wavelength, frequency, output), does not allow standardized guidelines for treatment. Therefore, researchers must hone in on specific clinical PBM protocols, therapeutic outcome measures, underlying mechanisms, and replicability in future studies.

FINAL CONSIDERATIONS

Most available evidence suggests that the use of low-power lasers or LEDs, or combined treatment modalities, improves chronic pain, functionality and quality of life of patients (negative psychosocial aspects and levels of anxiety) related to DTM. This can be inferred due to the effects of improving perfusion in bone and joint structures, stimulation of osteoblasts and chondrocytes, reduction of

inflammatory cytokines and chemokines, increase of anti-inflammatory cytokines and reduction of nerve stimulation, promoting the release of endogenous opioids, improving tissue healing, increase angiogenesis, muscle tensile strength, pain threshold by affecting cell membrane potential and decreasing inflammation.

Despite this, there are no pre-established protocols for all cases, and it is necessary to individually analyze the treatment for each patient, since treatment with LLLT, despite being non-invasive, has many details that can influence the results, such as the patient, device, operator.

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