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The use low laser therapy on oral nerve injuries in dental specialities: Literature review

O uso da laserterapia de baixa intensidade nas lesões de nervos orais em especialidades odontológicas: Revisão de literatura

El uso de la terapia con láser bajo en lesiones del nervio bucal en especialidades odontológicas: Revisión de la literatura

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Abstract
Objective: The objective of this study was to carry out a literature review that addresses the use of low-level laser applied to oral lesions. Methodology: The searches were carried out on the websites: Web of Science, LILACS, MEDLINE, PUBMED, BBO databases and Google scholar using the DeCS. To produce this literature review, we used the perspective of Mattos (2015), who has a study on the different types of reviews, which served as the basis for structuring this article and which provided guidance for the methodology used. Results: Low-level laser has great potential to stimulate nerve regeneration and alleviate symptoms in patients with oral neural injury, however it is a therapy that needs urgent research in order to provide solid scientific bases to establish clearer guidelines on its use in dentistry.
Keywords: Low intensity light therapy; Laser therapy; Soft tissue injuries; Dental injuries.

Resumo
Objetivo: O objetivo deste estudo foi realizar uma revisão de literatura que aborda sobre o uso do laser de baixa aplicada às lesões orais. Metodologia: As buscas foram realizadas nos sites: Web of Science, LILACS, MEDLINE, PUBMED, BBO databases e Google scholar using the DeCS. Para produzir essa revisão de literatura, utilizamos da perspectiva de Mattos (2015), que possui um estudo sobre os diversos tipos de revisões, que serviu de base na estruturação deste artigo e que deu norte para a metodologia usada. Resultados: O laser de baixa possui grande potencial de estimular a regeneração nervosa e aliviar os sintomas em pacientes com lesão neural oral, entretanto é uma terapia que precisa de

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urgentes pesquisas a fim de fornecer bases científicas sólidas para estabelecer diretrizes mais claras sobre o seu uso na odontologia.
Palavras-chave: Terapia com luz de baixa intensidade; Terapia a laser; Lesões dos tecidos moles; Lesões dentárias.

Resumen
Objetivo: El objetivo de este estudio fue realizar una revisión de la literatura que aborda el uso del láser de baja intensidad aplicado a las lesiones bucales. Metodología: Las búsquedas se realizaron en los sitios web: Web of Science, bases de datos LILACS, MEDLINE, PUBMED, BBO y Google Scholar utilizando el DeCS. Para realizar esta revisión de la literatura, utilizamos la perspectiva de Mattos (2015), quien cuenta con un estudio sobre los diferentes tipos de revisiones, que sirvió de base para estructurar este artículo y que orienta la metodología utilizada. Resultados: El láser de baja intensidad tiene un gran potencial para estimular la regeneración nerviosa y aliviar los síntomas en pacientes con lesión neural oral, sin embargo es una terapia que necesita investigación urgente con el fin de brindar bases científicas sólidas para establecer pautas más claras sobre su uso en odontología.
Palabras clave: Terapia de luz de baja intensidad; Terapia con láser; Lesiones de tejidos blandos; Lesiones dentales.

1. Introduction

The utilization of LASER technology in dentistry has gained substantial traction in recent years, attributable to its multifaceted benefits across various domains within the field. LASER, an acronym for "Light Amplification by Stimulated Emission of Radiation," represents a form of non-ionizing electromagnetic radiation, distinguished by its unique properties of monochromaticity, coherence, and directionality, setting it apart from conventional light sources such as fluorescent bulbs (Souza et al., 2021).

In parallel, the field of dentistry has been progressively incorporating less invasive procedures targeting oral nerves. This shift is driven by the imperative to account for the anatomical diversity and specific conditions of each patient seeking dental care. Nerve injuries in this context are categorized into three primary types: Neuropraxia, Axonotmesis, and Neurotmesis. Neuropraxia involves a temporary blockage of nerve conduction without axonal rupture, typically resolving spontaneously. In contrast, Neurotmesis signifies complete discontinuity of the nerve (Aquino et al., 2020; Moreira, 2020).

The prognosis for nerve injury recovery is contingent upon fiber regeneration or the elimination of secondary causative factors. While the majority of cases recover spontaneously or with conservative management, a minority necessitates surgical intervention to restore nerve integrity (Silva et al., 2021).

Low-level laser therapy (LLLT) emerges as a promising modality for the regeneration of injured nerve tissue. This therapy provides non-invasive, non-thermal benefits, including pain relief, reduction of inflammation, immunomodulation, wound healing, and tissue regeneration (Souza et al., 2021). LLLT is particularly efficacious in bio-stimulating nerve regeneration in cases of paresthesia, mitigating symptoms such as hypoesthesia, paresthesia, and anesthesia (Gasperini et al., 2014; Fernandes-Neto et al., 2020).

This study aims to review the scientific evidence regarding the efficacy of LLLT in the treatment of oral nerve injuries, with the objective of fostering the broader integration of photodynamic therapy within dentistry and its various specializations.

2. Methodology

For the construction of this narrative literature review, a detailed, non-systematic electronic search strategy was conducted in the Web of Science, LILACS, MEDLINE, PUBMED, BBO databases and Google scholar using the DeCS validated descriptors: Endodontics, Laser Therapy, Dentistry, Nerve Injuries, Parestesia. Books and periodicals concerning the theme were also consulted. The selection of the articles were carried out by using inclusion and exclusion criteria: Inclusion criteria encompassed articles published between 2010 and 2023, in Portuguese, English, and Spanish, within the categories of systematic and integrative review studies, literature reviews, and clinical cases. To carry out this literature review article, readings were made on the research by Mattos (2015), which addresses the different types of reviews, their differences, and what type of approach should be presented in the article giving a precise and safe methodology. Articles on the use of therapy on motor nerves and in vitro studies were excluded. Articles out of the scope were excluded. Rother's (2007) research was used to form this article, as it is a work that explains the constitution of a narrative literature review from its idealization to its construction, highlighting how its approach should be taken and the methodology to be followed during the search for information and descriptions that make up the work.

3. Results

3.1 Nerve Injuries Classifications and Regeneration

A prominent concern in the realm of dentistry pertains to nerve injuries that may occur directly or indirectly during various procedures. Such injuries, instigated by mechanical, chemical, or physical agents, can result from fractures, traction, electric shocks, lacerations by sharp objects, prolonged compression, crush injuries, or trauma induced by temperature changes. Seddon's classification (1943) delineates nerve injuries into three primary categories based on the extent of structural impairment and clinical manifestations: Neuropraxia, Axonotmesis, and Neurotmesis. This classification was later expanded by Sunderland to include five degrees of peripheral nerve injury (Dave et al., 2018; Silva et al., 2021).

Neuropraxia, classified as a grade I nerve injury, is characterized by a transient physiological blockade in nerve conduction due to compression without axonal rupture or structural alterations in the endoneurium, perineurium, or epineurium. Typically, this condition resolves spontaneously, leading to temporary motor and sensory deficits in the affected region (Silva et al., 2021).

Axonotmesis, corresponding to grade II, results from partial damage to the axons and myelin sheath (Schwann sheath), often caused by crushing, stretching, or percussion. Distal to the site of injury, Wallerian degeneration occurs, impeding nerve conduction. While recovery without sequelae is feasible, it may take longer than grade I injuries, contingent upon the extent of nerve fibre involvement (Silva et al., 2021).

Neurotmesis, classified as a grade III injury, involves significant disruption of the nerve's structural support, with the endoneurium ruptured while the epineurium and perineurium remain intact. Although spontaneous recovery is possible, surgical intervention may be required. Grade IV and V injuries denote more severe damage, including loss of axons and varying degrees of structural integrity, with grade V indicating complete nerve severance, necessitating surgical intervention for potential recovery (Silva et al., 2021).

Dental procedures posing a heightened risk of nerve injury include the administration of local anaesthesia, implicated in 37.5% of cases, leading to temporary paresthesia characterized by numbness, burning sensations, and tingling. The extraction of impacted third molars accounts for 25% of cases, particularly due to their proximity to the inferior alveolar and lingual nerves, thus escalating the risk of nerve injury. Endodontic procedures, bilateral sagittal split osteotomies, and mandibular interventions in implantology also contribute to these statistics, collectively accounting for an additional 12.5% of cases (Palmeira et al., 2021).

The process of nerve regeneration exhibits age-dependent characteristics, with older individuals generally experiencing less favourable outcomes compared to younger cohorts (Mafi et al., 2012). This phenomenon has been extensively documented by researchers and is attributed to the age-related decline in repair and regenerative mechanisms, coupled with a progressive reduction in the number of functional axons over time (Abbas et al., 2016; Hembd et al., 2017).

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3.2 Endodontic procedures that may lead to nerve injuries

Endodontic accidents may lead to the main types of nerve injuries, including the three mentioned above, contingent upon the severity of the trauma and the underlying mechanisms involved. Herein, we elucidate the scientific basis of how these accidents may manifest:

First, trauma during the administration of local anesthesia may induce transient pressure on the nerve, resulting in neuropraxia, which is relatively common in Endodontics. Additionally, excessive pressure during canal instrumentation, where improper use of endodontic instruments may play a temporary role in the compression on adjacent nerves, leading to such conditions. Furthermore, inflammation secondary to infections may also impose pressure on the nerves, causing a transient blockade in neural conduction (Hargreaves & Berman, 2015).

Another notable incident is the inadvertent extrusion of obturating materials beyond the dental apice, potentially damaging the axons of neighboring nerves. Mechanical trauma during the cleaning and shaping of the canal, where endodontic instruments might accidentally perforate or sever axons, is another significant cause. Additionally, surgical complications, such as those encountered during apicoectomy, may result in axonal damage due to improper handling or surgical techniques (Torabinejad & Walton, 2009).

Severe root fractures that extend beyond the apical region may lead to complete nerve rupture. Surgical endodontic procedures, such as hemisection or root resection, may inadvertently sever nerves if not meticulously performed. Moreover, overly aggressive and improper instrumentation techniques may cause complete nerve disruption, leading to neurotmesis. Similarly, endodontic sealers are easily overextended into the periapical region, and therefore and considering the possibility that such overextention may affect the inferior alveolar nerve, may lead to nerve injury (Siqueira & Rôças, 2008).

3.3 Low-Level Laser Therapy (LLLT)

Lasers are categorized into two main groups based on their power and interaction capabilities with biological tissues: high-power lasers, also known as surgical lasers or High Intensity Laser Therapy (HILT), and low-power lasers, referred to as non-surgical lasers or Low Intensity Laser Therapy (LILT) (Aquino et al., 2020).

High-power lasers function by generating heat and increasing tissue temperature, enabling applications such as cutting, vaporization, and hemostasis. In contrast, low-power lasers do not produce significant heat and are employed for their biostimulatory, analgesic, anti-inflammatory, and tissue healing effects. These characteristics make low-power lasers particularly beneficial for therapeutic purposes across a wide spectrum of medical conditions (Aquino et al., 2020; Tsai et al., 2023).

3.4 Biological Principles of Low-Level Laser Therapy

The biological principles of low-level laser therapy (LLLT) refer to the specific interactions between the light emitted by the laser and biological tissues, resulting in a series of responses from the organism. These principles are fundamental to understanding the functionality and efficacy of LLLT and its various applications (Moreira, 2020). Lasers interact with matter through optical processes such as reflection, transmission, scattering, and absorption. For a clinical effect to occur, the light must be absorbed by the tissue, with any reflected, transmitted, or scattered light being inherent to the organism. The absorption of laser light depends on the amount of chromophore (an element capable of absorbing the photons from the laser beam) present in the tissue, as well as the match between the absorption characteristics of the chromophore in the irradiated region and the wavelength used (Moreira, 2020).

Laser energy dispersion seems to be inversely related to wavelength, meaning that the longer the wavelength, the greater the penetration into the tissue. For instance, wavelengths between 300 and 400 nm disperse more and have less penetration capacity, whereas wavelengths between 1,000 and 1,200 nm disperse less and have greater penetration capacity. However, it is important to note that wavelengths in the mid to upper infrared range of the electromagnetic spectrum are absorbed superficially, as the main chromophore for these wavelengths is the water present in the tissue (Moreira, 2020).

When absorbed by the irradiated tissue, the light from Low-Level Laser Therapy (LLLT), whether used in the visible electromagnetic spectrum or the infrared spectrum, can directly enhance ATP production and improve cellular metabolism. The light is absorbed by various components of the cellular respiratory chain, such as the chromophores in cytochrome c oxidase (CCO) in mitochondria. CCO is the terminal enzyme unit IV in the mitochondrial electron transport chain, responsible for absorbing the irradiated light, transmitting photonic signals, and inducing increased ATP synthesis after receiving the light stimulus. The activity of CCO is inhibited by nitric oxide (NO), but laser irradiation can reverse this inhibition by photodissociating NO from its binding sites, thereby increasing the respiration rate (Souza et al., 2021).

Additionally, photobiomodulation therapy has the capability to reduce the levels of Reactive Oxygen Species (ROS) in injured cells and tissues, producing a change in the cell's reduction potential. This induces the activation of numerous intracellular signaling pathways, such as nucleic acid synthesis, protein synthesis, enzyme activation, and cell cycle progression. These pathways lead to the activation of transcription factors responsible for gene expression related to the proliferation of tissue repair cells (Souza et al., 2021).

LLLT also affects local blood flow. Tissue irradiation causes vasodilation, thereby increasing the blood supply to the treated area. This results in a greater delivery of oxygen and nutrients to the tissues, as well as facilitating the removal of metabolic waste and cellular debris, which contributes to reducing inflammation and accelerating wound healing (Olkoski et al., 2021).

The irradiation of low-level laser therapy can have an anti-inflammatory effect by reducing the levels of pro-inflammatory cytokines, increasing the expression of proteins related to proliferation and maturation (such as collagen), and inhibiting the production of prostaglandin E2 (PGE2). Additionally, it controls the process by increasing mediators and cells like macrophages, neutrophils, and lymphocytes (Moreira, 2020; Souza et al., 2021; Luna et al., 2023).

Low-level laser therapy is also capable of triggering nerve regeneration processes by stimulating the expression of growth factors essential for the growth and repair of damaged nerves. These factors are proteins that play crucial roles in promoting neural sprouting, forming new nerve connections, and regenerating myelin, the sheath that protects nerve fibers (Moreira, 2020).

3.5 Treatment Protocol for Nerve Injuries with Low-Level Laser Therapy

The protocol for nerve injuries is individualized and may vary depending on the severity of the injury, the affected area, and the specific needs of the patient. Therefore, before starting LLLT, it is essential to perform a comprehensive patient evaluation, including medical history, physical examination, and accurate diagnosis of the nerve injury. This evaluation will help determine the location and extent of the injury, as well as which nerves are affected (Benevides et al., 2018).

Based on the evaluation, the healthcare professional will determine the frequency of sessions, duration of treatment, and the appropriate wavelength for the specific nerve injury. The light used typically has a narrow spectral width between 600 nm and 1000 nm, which can be in the red or infrared light spectrum. It is often applied to the injury for about 30 seconds to a few minutes, several times a week for several weeks, depending directly on the degree of nerve injury (Souza et al., 2021).

In cases of paralysis and paresthesia, nerve biostimulation involves the use of low-level laser therapy in the infrared spectrum, with an energy density of 107 to 142 J/cm², to stimulate the regeneration and recovery of the affected nerves. The choice of the infrared spectrum is due to the fact that wavelengths in this range have a greater ability to penetrate biological tissues, which is essential for reaching the deep nerves that need to be stimulated (Moreira, 2020).

For each point, a specific dose of laser energy is applied, with a power between 3.0 and 4.0 J. The treatment protocol involves applying the laser to specific points along the path of the compromised nerve at the infraorbital and mental foramina, in addition to the paresthesia region (Moreira, 2020).

If the paresthesia affects the buccal, inferior alveolar, or mental nerves, or the gingival mucosa, jugal mucosa, lateral cheek, extending to the chin skin and lower lip region, LLLT should be applied to the pterygopalatine fossa, mandibular foramen, and mental foramen (chin skin and dry and wet lower lip mucosa). Conversely, if the paresthesia affects the lingual nerve, applications should be directed to the nerve's trajectory in the floor and lateral mucosa of the tongue (Aquino et al., 2020).

The treatment is performed 2 to 3 times a week, allowing for continuous and gradual stimulation of the affected nerves, contributing to the progressive improvement of the patient's condition. This therapeutic approach aims to promote nerve regeneration, increase the conduction of electrical impulses, and reduce symptoms of paralysis and paresthesia (Moreira, 2020).

The treatment consists of about 10 laser applications with intervals of 72 hours. However, the duration of the treatment and the frequency of sessions may vary depending on the degree of nerve injury and the patient's response to treatment. Additionally, monitoring the patient's progress during treatment is essential, adjusting the protocol if necessary, as regular clinical follow-up helps assess the therapy's effectiveness and make any adjustments to optimize the results (Moreira, 2020).

4. Discussion

Composed of bundles of nerve fibres, connective tissue, and Schwann cells, nerves are filamentous structures made up of axons and dendrites, playing a crucial role in transmitting electrical impulses throughout the human body. Through the Central Nervous System (CNS), they establish communication between organs, allowing for the coordination of motor functions and sensitivity to sensory stimuli. In the context of oral nerve injuries, the complexity of the innervation in the region makes these clinical occurrences even more delicate, potentially resulting in a wide range of symptoms including sensory, motor, and painful alterations. Similarly these injuries can be caused by various factors such as trauma, dental procedures, or even specific pathologies (Silva et al., 2021).

Nerve injuries can be classified as traumatic, iatrogenic, or pathological, depending on the underlying cause. Traumatic damage can occur due to accidents, falls, or sports injuries affecting the oral and craniofacial region, where direct impacts on the jaw, maxilla, or face can damage nerves and cause neurological problems. Pathological nerve injuries refer to damage or impairments to nerves occurring due to specific diseases or conditions such as infections, inflammations, and tumors (Souza et al., 2021).

Iatrogenic injuries are damages or complications occurring in the oral cavity as a result of dental procedures or treatments. (Souza et al., 2021). In this sense, endodontic procedures are prone to cause likewise incidents during biomechanical preparation of the root canals, as well as during the obturation step, especially those who use injectable sealers before the insertion of the main cone (Siqueira, 2008). Other endodontic procedures such as overinstrumentation of lower molars may also play important roles in nerve injuries. Periodontal surgeries, and oral biopsies as well. During tooth extractions, especially of lower third molars, there is a risk of damaging the inferior alveolar nerves, which can lead to numbness, tingling, or loss of sensitivity in the affected area (Matos et al., 2017; Bastos et al., 2021).

Benevides et al. (2018) claimed that this aspect manifests itself on several occasions due to improperly performed procedures, such as the use of improper incisions and overly vigorous curettage inside periodontal socket. Placement of implants, especially in the mandible, may also pose a risk of compromising the inferior alveolar nerve and the inferior dental nerve, resulting in potential neurosensory complications (Palmeira et al., 2021). In a similar sense, Palmeira et al. (2021) suggested in their study that orthognathic surgery procedures, aimed at correcting facial malformations, are also susceptible to nerve damage in the region, notably the inferior alveolar nerve and the lingual nerve. In endodontic treatments, such as root canal procedures, there is a possibility of oral nerve injuries, especially when the root canal is complex or located in the surrounding area very close to such delicate nerve elements. Furthermore, the author implied that surgical procedures aimed at treating periodontal diseases or performing bone grafts also involve risks of oral nerve damage.

In the same scientific direction, according to Castro et al. (2018), the most commonly affected oral nerves due to dental procedures are the inferior alveolar and the lingual nerves. The former runs a path close to the roots of the lower teeth, making it particularly susceptible to damage during extraction or implant procedures. The latter may be affected in procedures involving the tongue region, such as lower teeth extractions or surgeries to correct facial malformations. Last but not least, these mentioned nerves also have limited blood supply, increasing the risk of injury during surgical procedures.

Moreover, according to Silva et al. (2021), depending on the degree of nerve injury, the body has an autonomous recovery capacity. This allows milder injuries, such as neuropraxia, to heal naturally over time. In such situations, the nerve itself may regenerate and regain its normal functions, without requiring medical intervention. Nevertheless, in more severe cases, such as axonotmesis and neurotmesis, where there is a significant rupture of axons and the myelin sheath, the recovery process becomes more complex and may require surgical intervention under certain circumstances. Under some conditions, even when regeneration is possible, therapeutic interventions may be necessary to repair the affected nerve fibers and promote more effective recovery.

Currently, low-level laser therapy (LLLT) has been studied and used as a promising therapeutic approach for the treatment of oral nerve injuries. Studies have shown that applying low-level laser to the injured area can stimulate nerve regeneration, accelerate the healing process, and reduce inflammation, contributing to a faster and more effective recovery of patients. Despite the lack of in-depth research on the treatment of paresthesia with low-level laser therapy, existing studies validate the idea that there is a significant improvement in patients with oral nerve injuries undergoing this treatment (Souza et al., 2021).

Adding to the studies on the subject, Evangelista et al. (2019), in their comprehensive review, demonstrate that low-level laser therapy proves to be a bio-stimulating agent, whose influence on tissues does not solely rest on thermal effects, but instead lies in the interaction of electromagnetic waves of this radiation with cells. Consequently, the purposes underlying low-level laser therapy in the context of paresthesia treatment are multiple and relevant: to accelerate the regeneration of damaged nerve tissue, stimulate adjacent or contralateral nerve tissue, modulate nerve response, and normalize nerve threshold potential action.

Similarly, studies conducted by De La Torre and Alfaro (2016) provided a significant expansion to the field of low-level laser therapy, aiming to investigate its effectiveness in improving paresthesia, based on two clinical cases. The researchers highlight that in both occurrences, the therapy proved highly effective, achieving remarkable success by achieving 100% improvement in lingual nerve paresthesia in the first case and 80% improvement in mental nerve in the second case. These results underscore the approach of low-level laser therapy as a promising and effective technique, conferring high potential to benefit patients affected by such conditions.

Additionally, in their systematic review focused on orthognathic surgery, Bittencourt, Paranhos, and Martins-Filho (2017) came across evidence regarding the beneficial effects of low-level laser therapy in reducing pain and post-surgical paresthesia. Positive results found in the literature support the use of this therapeutic approach, providing scientific endorsement to enhance post-operative recovery and minimize discomfort experienced by patients.

Continuing with studies on surgical procedures, Gasperini et al. (2014) conducted research with 10 patients undergoing bilateral sagittal split osteotomy (BSSO) of the mandible, who presented with inferior alveolar nerve hypoesthesia. In this study, patients received low-level laser therapy on one side of the mandible, undergoing evaluations over a 60-day period. Data from treated and untreated sides were compared at different postoperative times - at 15, 30, and 60 days after surgery - when sensory recovery was noted on both sides. Remarkably, on the treated side, recovery was faster and nearly complete by the time of the last evaluation. Based on these results, it was suggested that the low-level laser therapy protocol may enhance tissue response and accelerate recovery from neurosensory disorders following BSSO.

However, it is worth noting the presence of multiple protocols, which are outlined by different scholars and employed in the management of neurosensory disorders. These approaches indeed relate to the severity of nerve injury and the specialist in charge; however, there is a convergence in the use of focalized irradiation through contact.

In this regard, according to the research of Fernandes Neto and Catão (2020), the application of lasers for nerve injury treatment should be carefully adjusted based on the degree of nerve involvement. It is recommended that the procedure be performed three times a week, with a 72-hour interval between each session, totaling a minimum of ten sessions. In contrast, other studies suggest that laser applications can be repeated at 48-hour intervals until symptoms disappear, covering the entire length of the affected nerve. These different approaches emphasize the need for an individualized and precise approach when using laser therapy for nerve injuries.

Additionally, a study conducted by Nogueira et al. (2017) conducted an in-depth analysis on the application of low-level laser therapy in a patient who suffered paresthesia due to a mental nerve injury after the extraction of a supernumerary tooth. In the context of this clinical case, researchers opted for a protocol that combined the use of red and infrared lasers. Immediately after surgery, red laser (660 nm) was used intraorally to stimulate healing, followed by the use of infrared laser (808 nm) extraorally, due to its notable penetration capacity and contribution to nerve regeneration. Remarkably, it was observed that neurosensory recovery was significantly faster due to low-level laser irradiation immediately after surgical intervention. This reinforces the importance of treatment protocols that incorporate innovative technologies, such as the use of laser, to achieve more promising and rapid results regarding post-operative nerve complications.

In addition to the previous research, the study implemented by Dias et al. (2020) aims to elucidate the underlying mechanism of low-level laser therapy (LLLT). In this context, it was found that wavelengths ranging from 600 to 900 nanometers exhibit notable penetration capacity into mucosal and skin tissues. When laser light interacts with tissues and cells at the appropriate dose, various cellular functions are stimulated, such as the activation of lymphocytes and mast cells, proliferation of different cell types, and increased mitochondrial ATP production. Thus, phototherapy through laser emerges as a potential bio-stimulating therapeutic approach to promote tissue repair, increase local circulation, cell proliferation, and collagen synthesis.

In this context, Moreira (2020) advocated in his studies that in cases of paralysis and paresthesia, nervous bio-stimulation reveals itself as a procedure that employs low-power laser with wavelengths in the infrared spectrum of 107 to 142 J/cm2, aiming to stimulate the regeneration and recovery of affected nerves. The choice of the infrared spectrum is based on its greater penetration capacity into biological tissues, thus reaching deeper nerves that need to be stimulated. For each specific point, a precise dose of laser energy is applied, with a power ranging from 3.0 to 4.0 J. The treatment protocol involves applying the laser to strategically selected points along the path of the affected nerve, including the infraorbital and mental foramens, as well as the area of paresthesia to be treated.

However, addressing the issue of treatment duration, studies have been dedicated to evaluating the efficacy of Low-Level Laser Therapy (LLLT) in the recovery of neurosensory disorders, primarily using general sensitivity tests based on the Visual Analog Scale (VAS). The analysis of results indicates that LLLT does not show immediate effectiveness (0 to 48 hours) shortly after surgery. However, it is observed that applying this therapeutic modality reveals significantly positive results after two weeks, one month, and two months post-surgery. Additionally, promising effects of LLLT are anticipated within 6 to 24 months post-surgery, as indicated by general sensitivity tests conducted (Firoozi et al., 2020; Eshghpour et al., 2017; Guarini et al., 2018).

Despite the absence of a specific protocol for using laser therapy in cases of oral nerve damage, LLLT has proven to be a promising alternative due to its minimally invasive nature and the benefits observed in existing studies. The ability of LLLT to stimulate injured nerves without the need for surgical intervention is highly desirable. Although there is a shortage of studies in the literature on the influence of LLLT on neural regeneration, some recent studies have reported positive effects of low-level laser treatment, resulting in objectively and subjectively verified improvements in sensory perception after nerve injuries.

5. Conclusion

The promising potential of low-level laser therapy in the treatment of nerve injuries seems to be interesting for odontology as a whole. Independently of which dental specialty is in focus, stimulating nerve regeneration and relieving symptoms in patients with oral neural damage is definitely the path to follow. Nevertheless, it is important to note that the absence of specific protocols for the application of this therapy, due to the diversity of each case and patient, poses a challenge to be overcome, due to the vast situations that may appear in the scenario. Under this point of view, the urgent need to deepen studies in this area is emphasized, in order to provide solid scientific foundation and establish clearer guidelines for the incorporation of low-level laser therapy into dental practice.

From this, it is seen that the low laser has several functions within dentistry, but that it needs more studies on its use, placing greater emphasis on its benefits and mainly on the harm that the laser can or cannot cause, aiming to prove through clinical reports, of day-to-day applications during procedures so that more practical confirmation of their usefulness and function can be obtained.

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