

Laser Therapy in the Treatment of patients with Oral Paresthesia: a Review of Clinical Trials

Laserterapia no Tratamento de Pacientes com Parestesia Oral: uma Revisão de Ensaios Clínicos

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Abstract

The aim of this article was to review the parameters and results of clinical trials about the use of laser therapy in the treatment of oral paresthesia. The search for the studies was performed using specific descriptors in February 2019 in the PubMed database, including articles published until February 2019, without restriction of language and country of study. The studies were selected from pre-established inclusion criteria and underwent a screening based on exclusion of duplicate studies, reading of the titles, abstracts and complete article. A total of 52 articles were found in the database, but only 7 randomized controlled trials were included according to the inclusion criteria. A variety of laser therapy protocols and assessment methods were used, however all studies reported improvement of sensorineural disorders to varying degrees and periods with the use of low intensity laser therapy. Despite the wide range of parameters found in the studies, the scientific literature has demonstrated that low intensity laser therapy is a useful therapy in the treatment of oral paresthesia. However, it is important to note that more research is still needed.

Keywords: Lasers. Paresthesia. Oral Surgery. Phototherapy. Low-Level Light Therapy.

Resumo

O objetivo desse artigo foi realizar uma revisão dos parâmetros e resultados encontrados de ensaios clínicos sobre o uso da laserterapia no tratamento da parestesia oral. A busca dos estudos foi realizada utilizando descritores específicos em fevereiro de 2019 na base de dados PubMed, incluindo artigos publicados até fevereiro de 2019, sem restrição de idioma e país de estudo. Os estudos foram selecionados a partir de critérios de inclusão preestabelecidos e passaram por uma triagem baseada em exclusão de estudos duplicados, leitura dos títulos, resumos e artigo completo. Um total de 52 artigos foi encontrado na base de dados, porém apenas 7 ensaios clínicos randomizados foram incluídos no presente estudo, por atenderem aos critérios de inclusão. Uma variedade de protocolos de laserterapia e métodos de avaliação foram utilizados, no entanto todos os estudos relataram melhora dos distúrbios neurossensoriais em diversos graus e períodos com o uso da laserterapia de baixa intensidade. Apesar da grande variedade de parâmetros encontrados nos estudos, a literatura científica tem demonstrado que a laserterapia de baixa intensidade é uma terapia útil no tratamento da parestesia oral. Porém, é importante pontuar que mais pesquisas ainda são necessárias.

Palavras-chave: Lasers. Parestesia. Cirurgia Bucal. Fototerapia. Terapia a Laser de Baixa Intensidade.

1 Introduction

Paresthesia is a localized condition of desensitization of a given region caused by an injury or sensitive nerve injury. Its main symptoms are the absence or partial loss of sensitivity in the affected region, but it may also present dormancy, tingling, itching or burning sensation¹⁻³

Oral paresthesia occurs when there is injury in one of the nerves in the region, usually the inferior alveolar and the lingual ones, in situations where they are affected because they are in contact with or in close proximity to the area involved in dental procedures³. Therefore, it may occur in situations such as: tooth extractions of lower third molars³⁻⁵, dental implant surgery²⁻⁶, local anesthesia^{1,7,8}, endodontic treatment⁹⁻¹¹ and orthognathic surgeries¹²⁻¹⁴.

Most cases of oral paresthesia reported after dental treatments are transient, receding within days, weeks or months, however, some patients may be affected with persistent

or permanent symptomatology. Persistent paresthesias are most commonly reported after surgical procedures¹.

Currently in the medical area, studies address protocols and recommendations for the use of laser for a series of clinical indications, including both the treatment and prevention of several disorders of the bucomaxilofacial complex. Among them, the use of low-intensity lasers in the treatment of oral paresthesia is noteworthy¹⁴⁻¹⁸.

According to Oliveira et al.¹⁶ the literature points out three main objectives for the use of low-intensity lasers in the treatment of paresthesia: acceleration of the regeneration of the damaged nervous tissue, stimulation of the adjacent or contralateral nervous tissue, causing them to play the role of the injured nerve and biomodulation of the nervous response to normality of the action potential threshold.

Despite the benefits already reported in the literature, Eshghpour et al.¹⁹ point out that more studies with larger

sample sizes, longer follow-ups and different evaluations should be developed to elucidate the effect of laser therapy on the treatment of sensorineural dysfunction. In addition, different irradiation protocols should also be compared to define ideal conditions and optimize therapy.

Recognizing the current importance of low-intensity laser therapy in medical and dental treatments, the main objective of this study was to perform a systematic review of the parameters and results found in clinical trials on the use of laser therapy in the treatment of patients with oral paresthesia.

2 Development

2.1 Methodology

The search for the articles was performed in February of 2019, at the base PubMed, including studies published until February 2019, without restriction of language and country of study. The descriptors used for the research were “Paresthesia”, “Laser”, “Laser Therapy” and “Neurosensory”, used in combination, and the “Clinical Trial” and “Humans” filters were selected to facilitate the search.

The studies were selected by the following inclusion criteria: 1) to be a clinical trial with humans, published in a fully available scientific article; 2) the evaluated participants were clearly diagnosed with oral paresthesia; 3) in at least one group of the study, the patient received laser therapy, not associated with any other local treatment; 4) or in case of “mouth-divided” clinical trials, one side of the patient received laser therapy, also not associated with any other local treatment.

After the identification of the studies in the database and the elimination of the duplicates, the first step in the selection process was a title-based screening. In order to be selected for a more detailed analysis in the next step, the study had to contain in its title one or more keywords, synonyms of these, or a word that was relevant to the topic of interest.

The second phase of the selection was performed based on the reading of the abstracts, where the inclusion criteria established were evaluated.

The articles that raised doubts during the screening phases based on the titles and abstracts were maintained for a more detailed evaluation during the next phase.

In the third stage, a screening was performed based on the complete reading of the articles. In addition, a survey was performed on the reference lists of all the articles that reached this stage to identify any studies lost during the search process.

In cases of doubt, they were referred to a second evaluator, *expert* on the subject.

In studies that met the inclusion criteria, a descriptive analysis of the results was performed.

2.2 Clinical trials on laser therapy in the treatment of oral paresthesia

A total of 52 articles were found in the database, according

to the pre-established search strategies (Chart 1). After the elimination of the duplicates, 32 studies followed for the title-based evaluation. Of these, only 8 went to the next stage, as 24 were not clearly related to the subject of interest or did not meet the inclusion criteria of the study.

Table 1 - result of the study survey carried out in the PubMed database.

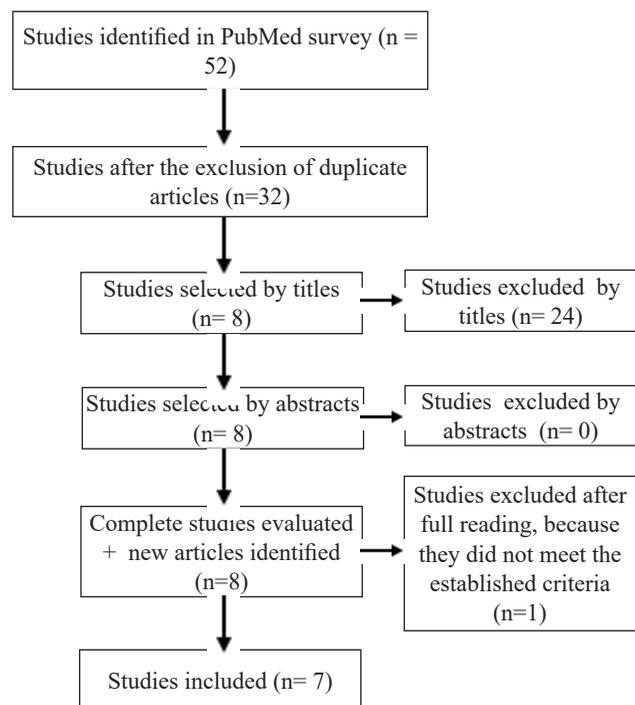
Search Strategy	Number of Studies
“Paresthesia” and “Laser”	21
“Paresthesia” and “Laser Therapy”	14
“Neurosensory” and “Laser”	9
“Neurosensory” and “Laser Therapy”	8
Total	52

Source: Research data.

After reading the abstracts, the 8 studies were selected for complete reading, where they could be analyzed in full and only 1 study was excluded by using laser and LED light together in the treatment of paresthesia.

Thus, data from 7 clinical trials were included and evaluated in this study and no other clinical trial of interest was found in the references of these articles (Figure 1).

Figure 1 – Flowchart with identification of studies, inclusions, and deletions in the different steps



Source: Research data.

The main aspects of the 7 studies that followed for final evaluation are laid out in Table 2. A variety of laser therapy protocols and assessment methods was observed, however all studies reported improvement of sensorineural disorders to varying degrees and periods with the use of low intensity laser therapy.

Table 2 – Summary of methodological characteristics and main results of each selected study

to be continued...

Study	Study design	Participants	Interventions	Evaluation Methods	Main Results
Khullar et al. ²⁰	Double-blind randomized clinical trial	13 patients with postoperative sensory abnormalities lasting more than 6 months in the distribution of the inferior alveolar nerve bilaterally or unilaterally, after the mandibular sagittal osteotomy and the surgical removal of impacted third molars, or mandibular fracture. The patients were divided into two groups at random: Laser (n=6) which received laser therapy and placebo group (n=7).	The patients in the Laser group received 20 laser therapy sessions (820 nm, 550 mW/cm ² , 70mW). In each of the 20 episodes of treatment, patients received 4 x 6J unilaterally or bilaterally, depending on whether both or only one side was affected. The treatment points were extracorporeal to the lower lip, intraoral in the region of the mental foramen, vestibular in the region of the 1st molar apices, and lingually in the region of the mandibular foramen. The treatment time per point was 85 seconds, giving an energy density of 48 J/cm ² . The treatments varied for a period between 33 and 69 days.	The degree of sensorineural deficit of mechanoreceptors was evaluated by Semmes Weinstein monofilaments and the degree of sensorineural deficit of the thermoreceptor was evaluated by a thermotester. The evaluations were made before and after the 20 sessions.	The group treated with laser showed a significant improvement in the sensory test of mechanoreceptors compared to the placebo group. In addition, the Laser group reported a subjective improvement in sensory function. There was no significant improvement in thermal sensitivity for groups treated with laser or placebo.
Khullar et al. ²¹	Double-blind randomized clinical trial	13 patients who underwent sagittal branch osteotomy, resulting in lower alveolar nerve compression or traction. The patients were divided into two groups at random: Laser (n=8) which received laser therapy and placebo group (n=5).	The patients in the Laser group received 20 laser therapy sessions (820 nm, 550 mW/cm ² , 70mW). In each of the 20 episodes of treatment, patients received 4 x 6J unilaterally or bilaterally, depending on whether both or only one side was affected. The treatment points were: lingual to mandibular foramen, vestibular in the apical region of the 2nd molar, vestibular in the region of the mental and extraoral foramen in the lateral third of the lower lip. The treatments were conducted over a period of time ranging from 20 to 63 days (mean of 31 days).	The degree of sensorineural deficit of mechanoreceptors was evaluated by Semmes Weinstein monofilaments and the degree of sensorineural deficit of the thermoreceptor was evaluated by a thermotester. The degree of subjective sensorineural deficit was assessed by means of an Analogue Visual scale (VAS). The evaluations were made before and after the 20 sessions.	Patients in the Laser group presented a subjective improvement on both lips and chin after the completion of the treatment. In addition, this group showed a significant decrease in the area of sensorineural deficit compared to no difference in the placebo group. The laser treatment group showed a strong trend of improvement in the sensorineural deficit of the mechanoreceptors in the areas of major damage both on the lip and on the chin. This improvement was especially pronounced in the region of the lips.

Führer-Valdivia et al. ¹³	Randomized, placebo-controlled, double-blind clinical trial	31 individuals who were surgically treated with bilateral sagittal osteotomy. Experimental group (n=17) which received laser therapy and a control group (n=14), placebo.	Each participant in the experimental group received 8 applications of low intraoral intensity laser (810 +/-20nm, 100mW, punctual, left and right sides in the mandibular and mental foramen and osteotomy site, 32J/cm ² , 9J per point, 90 seconds, in contact), on days 1, 2, 3, 5, 10, 14, 21 and 28 post-surgery. The control group received the same laser applications with laser light off, acting as placebo.	Sensorineural involvement was clinically evaluated with 5 tests: Analogue Visual scale (AVS) for pain and sensitivity, directional and 2-point discrimination, thermal discrimination. Each one performed before and after surgery on day 1 and 1, 2 and 6 months.	Clinical improvement in time, as well as in the magnitude of sensorineural return to the laser group: The AVS for sensitivity reached 5 (normal), 10 participants recovered the initial values for 2-point discrimination (62.5%) and 87.5% recovered the directional discrimination at 6 months after surgery. The general VAS for sensitivity showed 68.75% for the laser group, compared with placebo 21.43%.
Gasperini, Siqueira and Costa ¹⁵	Randomized, cross-sectional, double-blind study	10 submitted to bilateral sagittal osteotomy with Le Fort I osteotomy and submitted to low-intensity laser therapy on one side of the mandible.	the treated side, chosen randomly, received laser therapy at 4 intraoral points at 1 cm from the surgical wound immediately after and at 24, 48 and 72 h after surgery (660 nm, 5 J/cm ² , 10 s/point, 20 mW, 1.2 J/point) and at 8 extraoral points in the branch and the mandibular body immediately after at 24,48 and 72 hours after the surgery (789 nm, 30 J/cm ² , 20 s/point, 60 mW, 1.2 /point) Two points in the pre-auricular, jugular-digastric and submandibular areas the lymph nodes received the same exposure. The total energy used was 21.6 J per session. After the fourth day, with a 48-hour interval, 3 points at 1 cm from the surgical wound were irradiated and 10 points in the lower alveolar nerve pathway in the mandibular crest. In addition, 4 points in the inferior labial mucosa, 2 points in the lower lip and 9 points in the chin region at 1 cm from the surgical wound were radiated extrorally (780 nm 70 J/cm ² , 70 mW, 40 without point, 2.8 J/point). The total energy used was 50.4 J per session. On the other hand, untreated, the laser unit was positioned at the same points, but the laser was not activated	The two-point discrimination test and sensory test were performed immediately in the postoperative period, 15 days, 30 days and 60 days after the surgery. The data of the treated and untreated sides were compared in the postoperative period.	On the treated side, the recovery was faster and almost complete at the time of the last assessment. In 60 days, the difference between the sides in the two-point discrimination test increased and there were significant differences in sensitivity in the chin skin. The difference between the sides of the sensory test decreased but was still significant. The study suggests that this low-intensity laser therapy protocol can improve tissue response and accelerate the recovery of neurosensory disorders after bilateral sagittal osteotomy.

					conclusion
Eshghpour et al. ¹⁹	Randomized, double-blind study with a split-mouth design	16 patients submitted to bilateral sagittal osteotomy. After surgery, on one side of each patient performed to laser therapy was randomly assigned, and the other served as a placebo.	At 24, 48 and 72 hours after the surgery, the laser was intraoral at 4 points around the surgery site (660 nm, 200mW, 10s, 2J, 1.5J/cm ²), followed by extraoral irradiation at 8 points (810nm, 200 mW, 10 s, 2 J, 7 J/cm ² per point) along the distribution of the lower alveolar nerve. Then, the extraoral irradiation was repeated twice a week for 3 weeks along the path of the inferior alveolar nerve (8 points), lower lip (4 points) and chin (9 points). On the placebo side, the treatment was similar to the laser side, but without laser.	The 2-point discrimination test was applied before and immediately after the surgical procedure and also in 15, 30, 45 and 60 days later. The test was applied symmetrically at 6 points marked on the lower lip and on each side and the mean value was calculated separately for each side.	The comparison did not reveal a significant difference between the sides of the laser and the placebo before and immediately after the surgery and also at 15 and 30 days after the operation. However, the sensation of lower lip and mentum was significantly better in the laser than in the placebo side in the 45 and 60 days after the surgical process.
Guarini et al. ¹⁸	Randomized, placebo-controlled, double-blind clinical trial	42 patients who underwent sagittal branch osteotomy and exhibited neurosensory disturbances of the lower alveolar nerve. This study is a 2-year follow-up study with an experimental group (Laser) (n = 33) that received photo biomodulation, and a control group (n = 9), placebo.	All the participants of the Laser group received applications of low intraoral intensity laser (810 +/-20nm, 0.1W, punctual, left and right sides in the mandibular and mental foramen and osteotomy site, 31.8J/cm ² , 9J per point, 90 seconds, in contact), on days 1, 2, 3, 5, 10, 14, 21 and 28 post-surgery. The control group received the same applications, but the laser light was turned on and off immediately for treatment, so that the timer noise helped to confuse the patient if he or she was receiving laser light.	The neurosensorial involvement was clinically evaluated with 5 tests: Analogue Visual scale (AVS) for pain and sensitivity, sensitivity threshold test, 2-point discrimination and thermal discrimination. All tests were performed before (24 hours before surgery) and after surgery (24 hours, 28 days, 60 days, 6 months, 1 year and 2 years).	Clinical improvement was observed during the follow-up period for the Laser group; the general VAS for sensitivity was normal in 11 Laser group participants in 2 years after surgery (40.74%), while no control group participant achieved this. AVS for pain was normal in 31 patients of the Laser group after two years of follow-up (93.94%).
Santos et al. ²²	Randomized, double-blind study with a split-mouth design	20 patients were divided into two groups: Group 1 - patients in the short postoperative period (30 days) (n=10) and Group 2 - patients with persistent sensory abnormalities in the late postoperative period (6 months to 1 year) (n=10). All patients received laser therapy on one side of the mandible (the experimental side) and placebo treatment (control) on the other side.	An operator applied the active end of the laser (780nm, 157, 5 J/cm ² , 90 s per point) on the experimental side. The other operator applied the inactive end on the other side as placebo/ control. The irradiated points were distributed along the inferior alveolar nerve: Extraoral (mandibular branch and throughout the nerve for the mental region with 1 cm spaces between each point and intraoral (in the region of the mentonian foramen) totaling 29 unilateral points. Each patient received 5 laser/control sessions every 3 to 4 weeks among them.	The neurosensorial response was analyzed before the beginning of the treatment and after each session of laser therapy/control using the Semmes-Weinstein monofilament test.	The experimental side showed a significant improvement in sensorial recovery throughout the sessions in both groups, and Group 1 produces the better results

Source: Research data

2.3 Discussion

Current studies found in the scientific literature have demonstrated that low-intensity laser therapy brings benefits and considerable clinical improvement for patients with oral paresthesia, including for those affected for a long period of time^{14-16,18}. It should be noted that these disorders directly

affect the quality of life of patients, leading to emotional, socialization, esthetic, psychological and functional problems, therefore, the incorporation of a new treatment that results in positive outcomes is of extreme importance and social value.

Although current scientific literature contains case reports, literature reviews, series of clinical cases, laboratory research

and studies with other methodological designs on the subject, only a few developed studies are randomized clinical trials. Oliveira et al.¹⁶ point out that there are many differences between the results and parameters found and the literature still lacks double-blind controlled clinical protocols and trials, which should therefore be the focus of future research.

Despite studies by Khullar et al.²⁰ and Khullar et al.²¹ reported significant improvements in the neurosensory deficits of the mechanoreceptors, the authors stated that the treatments varied for a period of time among the patients and did not inform the exact interval time among the laser therapy sessions, different from the other studies. These data are essential for the replication of the methodology in future studies, in order to compare results, and determination of laser therapy protocols for clinical use. In addition, it is interesting that all patients, if possible, receive laser therapy on the same pre-determined post-surgery days in order to reduce the risk of research bias.

It should also be noted that the origin, degree and time of the patients' neurosensory damage vary among the studies, and this should be considered when evaluating the results found. Santos et al.²² when dividing the 20 study participants into two groups: Group 1 (patients in the short postoperative period of 30 days) (n=10) and Group 2 (patients with persistent sensory abnormalities in the late postoperative period from 6 months to 1 year), they observed that the experimental side that was irradiated showed a significant improvement in sensorineural recovery throughout the sessions in both groups, but group 1 presented the best results. Therefore, it is plausible that time is fundamental in the patient's response and that the professional should indicate laser therapy as soon as he or she notices or distrust of sensorineural damage.

A retrospective study by Oliveira et al.²³ whose objective was to evaluate the effectiveness of laser therapy for acceleration and recovery of nervous sensitivity after minor orthognathic or oral surgeries, by analyzing the medical records of 125 patients treated at a reference service of laser therapy in dentistry, they observed that sensitivity recovery was correlated with the patient's age and the interval between surgery and the beginning of laser therapy. Within the limits of a retrospective study, the authors concluded that low-intensity laser therapy in the infrared spectrum can positively affect sensitivity recovery after oral surgeries.

Other important limitations observed in some of the selected studies include the small sample size, the lack of follow-up after surgery for a long period of time and not considering the patient's satisfaction. For Mohajerani et al.¹⁷, further studies with larger samples and longer follow-up periods of at least 1 year are necessary to evaluate permanent neurosensory deficits.

Bittercourt et al.¹⁴ when assessing low-intensity laser therapy in the treatment of neurosensory disorders after orthognathic surgery, through a systematic review of randomized clinical data, they observed that individual

studies suggest a positive effect of low-intensity laser therapy on acceleration of improvement of paresthesia related to orthognathic surgery. However, due to the insufficient number and heterogeneity of the studies, a meta-analysis evaluating the outcomes of interest was not performed, and a pragmatic recommendation on the use of laser therapy is not possible. The authors recommend that more high-quality clinical studies are necessary to increase the strength of evidence and confirm the efficacy of low-intensity laser in the treatment of neurosensory disorders after orthognathic surgery.

It is important to point out that one of the great advantages of laser therapy is that its use does not present contraindications, the patient does not experience pain, has no side effects and most of the patients treated with this method have significant improvements. In addition, it can be used alone or as an adjunct to traditional treatments and should always be carried out safely by skilled and capable operators.

For Najeeb et al.²⁴ despite the benefits, lasers are not commonly used, particularly in developing countries and many factors contribute to this, such as high cost, technical sensitivity and lack of training among professionals. Considering continuous research and technological advancement, a notable increase in laser applications is expected in the near future.

Despite the positive results found this review, the small number of available studies added to the wide variety of laser therapy protocols used in the various studies makes it difficult to compare results. Different wavelengths were observed, ranging from 660nm (red laser) to 820 nm (infrared laser), strengths, doses, apparatuses and different forms and locations of irradiation. However, all studies have reported the use of infrared laser, which, due to its wavelength, reaches a greater depth and is therefore indicated in the treatment of neurosensory disorders.

4 Conclusion

Despite the wide range of parameters found in the studies, the scientific literature has demonstrated that low intensity laser therapy is a useful therapy in the treatment of oral paresthesia. However, it is important to point out that more research is needed, such as well-delineated randomized clinical trials and systematic reviews with meta-analysis, as a way of optimizing the treatment of patients affected by this type of disorder.

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