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Low-level laser therapy in carpal tunnel syndrome – systematic review

Abstract

Carpal tunnel syndrome is defined as a peripheral mononeuropathy, caused by mechanisms of compression of the median nerve. Among the modalities of treatment, the laser is distinguished by its analgesic, anti-inflammatory and healing action. The aim of this study was to conduct a systematic review of clinical trials on the effects of low-level laser therapy on carpal tunnel syndrome. The systematic review was conducted according to the PRISMA methodology, and the scientific articles, published in the last decade, were searched in the SciELO and PubMED databases. Two articles were included, women prevailing and right-side involvement. In the two studies, placebo groups were used, ten sessions were performed, five consecutive and with a two-day interval, and used Gallium and Aluminum Arsenide laser, the evaluations were the tínel test, palmar pain, nocturnal pain, paresthesias, daily and/ or working activities, and electromyography. There is a lack of clinical trials evaluating the effect of laser on carpal tunnel syndrome, and of those evaluated, although there are beneficial effects, there are methodological problems that compromise the results, making it necessary to carry out new studies to consolidate the effects of the use of this therapy in clinical practice.

Keywords: lasers, nerve crush, median neuropathy

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Introduction

Carpal tunnel syndrome (CTS) is defined as a peripheral mononeuropathy, caused by compression mechanisms and median nerve traction, characterized by reduced space in the carpal tunnel that may lead to disorders of the intraneural microcirculation, lesions in the myelin sheath, and axon, as well as changes in supporting connective tissue, resulting in neuromuscular injury. With this, there is alteration in nerve stimuli, generating paresthesia and pain in the affected segment.[1,2]

The loss of muscle strength is related to the hypotrophy of the tenar region, and in patients with exacerbated signs and symptoms there is loss of the tweezers movements and the opposition of the thumb, limiting the functionality of the affected hand. They also present a limitation of the range of motion of the wrist by the presence of pain, paresthesias and muscle strength deficit resulting in labor incapacity. In addition, there is shifted in electromyographic activity, due to the reduction of recruitment of motor units.[2,3]

CTS has a prevalence of 5% per year in American individuals, and can be due to a variety of forms, such as carpal tunnel abnormalities, trauma, inflammatory conditions, exposure to vibrations and occupational function. There are also factors that may influence the development of this disease, such as sex, age, genetic and anthropometric factors, being more common in women between 45 and 54 years of age and in obese women.[2,4] The diagnosis is done through the history of the disease, physical examination including provocative tests and complementary tests such as electroneuromyography, and imaging, radiography and ultrasonography.[2,5]

There are a variety of treatment options for CTS, including surgery, which consists of decompression of the carpal tunnel, or conservative administration of anti-inflammatory drugs, analgesics, steroid injections directly into the carpal tunnel, splints, oral corticosteroids, diuretics, vitamin B6, neural mobilization and low-level laser therapy (LLLT). Among these conservative treatment modalities, LLLT is a device that produces a beam of radiation, and can be used alone or as a coadjuvant of other treatments.[6–10]

There is evidence in clinical and experimental research that one of the effects of LLLT is the improvement of nerve function, increase metabolism and repair capacity of the myelin sheath. Because laser therapy is not invasive, the ability to radiate injured nerve is helpful. The absorption of light energy by nerve tissue increases microcirculation, cell proliferation and migration, increases axonal metabolism, improving tissue healing, thereby provoking the expression of neurotrophic factors and the rate of regeneration, performing analgesic, anti-inflammatory action and healing.[7,11] Although experimental studies show the effects of laser on peripheral nerve injury,[7,11] there is a need to demonstrate its effects in current clinical practice. Thus, this study aims to conduct a systematic, clinical-trial review of the effects of LLLT on CTS, and thereby provides a subsidy for its use in clinical practice.

Materials and methods

The present study is a systematic review, which was conducted according to the PRISMA methodology (Preferred Reporting Items For Systematic Reviewsand Meta-Analysis). The scientific articles on the subject were researched in the databases: SciELO and PubMED.

The following descriptors were used in the health sciences (DeCS): "laser", "nerve crush", "carpal tunnel syndrome" and "median neuropathy". In the articulation of the words, the expression "AND" was adopted allowing combinations of the "laser" descriptor with the others.

Two authors individually analyzed the abstracts of articles to verify which were pertinent to the subject of this systematic review.

As inclusion criteria, we selected articles available in full online, classified as clinical trials, from 2006 to 2018, in the Portuguese and English languages, which used a LLLT.

A flowchart (Figure 1) with the descriptions of the processes of identification and selection of the researched articles was elaborated, subdividing in the following stages: identification, sorting, eligibility and included studies. From this, the PEDro (Physiotherapy Evidence Database) scale was applied, consisting of 11 criteria to identify which of the randomized controlled studies, obtained internal validity (criteria 2-9), and had sufficient statistical information so that their results could be interpreted (criteria 10-11).[12] Table 1 was also prepared to characterize the selected studies, which covered the following topics: sample, LLLT dosimetry, evaluations and results.

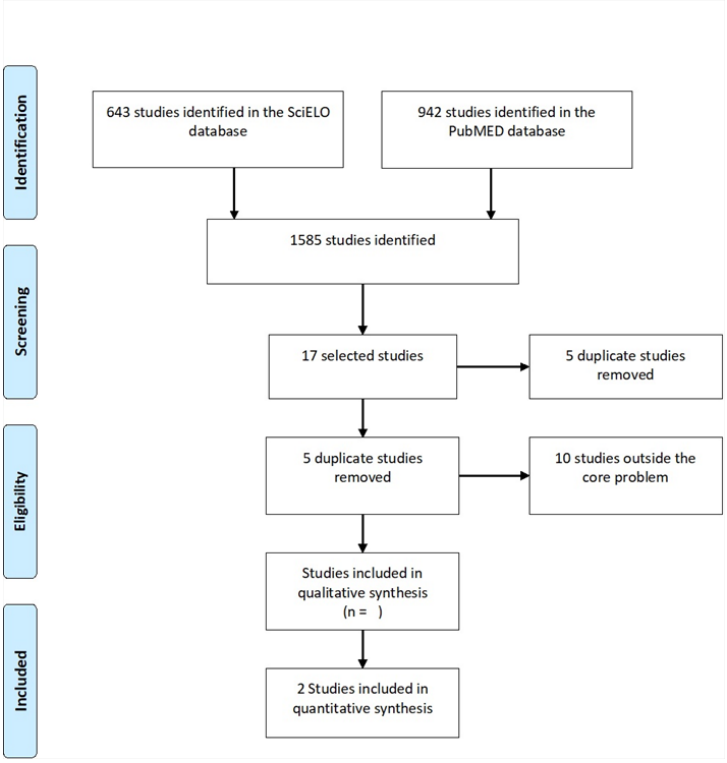

Figure 1 Identification of articles according to PRISMA criteria.

Table 1 Description of selected studies

Authors	Sample	LLLT dosimetry	Assessments	Results
Ekim et al.[14]	19 individuals with CTS and rheumatoid arthritis (18 women and 1 man)	Ga-Al-As Laser λ: 730 nm Power: 50 mW Energy: 1.5 J, in 5 point Time: 2 min 10 sessions: for 2 weeks–5x / week	Assessment of signs and symptoms, and function (ENMG) before, at the end of the protocol and 3 months after treatment	There was a marked improvement with LLLT irradiation in the evaluation of ENMG, a significant improvement in pain score and score in the functional status scale
Alves & Araújo[13]	58 individuals with CTS undergoing carpal tunnel decompression surgery (12 men and 46 women)	Ga-Al-As Laser λ: 830 nm Power: 30 mW Energy: 3 J, in 3 points 10 sessions: for 2 weeks–5x / week	Assessment of signs and symptoms, and function (ENMG) prior to surgery and on discharge / 6 months after surgery. In addition, clinical signs were assessed 1, 2 and 3 months after surgery	LLLT irradiation promoted the reduction of clinical signs more rapidly and there were more patients without neurofunctional alterations

CTS, carpal tunnel syndrome; λ, wavelength; nm, nanometers; W, miliWatts; J, joules; Ga-Al-As, gallium and aluminum arsenide; LLLT, low-level laser theray; ENMG, electroneuromyography.

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Results and discussion

Two articles were included in this review, and the process of identification, screening, eligibility and inclusion of the articles is described in the flow chart and the synthesis of the articles included in Table 2. The studies were evaluated for the PEDro scale (Table 2) and the results of the present study were presented and discussed according to the sample, PEDro scale criteria, methods and results of included articles.

Table 2 Methodological quality of articles analyzed according to PEDro scale (Y – yes; N – not).

Criteria \ Articles		Ekim et al.[15]	Alves & Araújo[14]
1.	Elegibility criteria were specified	Y	Y
2.	Subjects were randomly allocated to groups	Y	Y
3.	Allocation was concealed	N	N
4.	The groups were similar at baseline regarding the most important prognostic indicators	N	N
5.	There was blinding of all subjects	Y	Y
6.	There was blinding of all therapists who administered the therapy	Y	N
7.	There was blinding of all assessors who measured at least one key outcome	Y	N
8.	Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups	Y	Y
9.	All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by "intention to treat"	Y	Y
10.	The results of between-group statistical comparisons are reported for at least one key outcome	Y	N
11.	The study provides both point measures and measures of variability for at least one key outcome	Y	N
Score		8	5

Sample

In both studies, the groups were the same in relation to the number of men and women, and on the side of the affection, prevailing in women and the right side as found in the literature.[2,9] The mean age of the samples was 44 to 52 years, data also found according to the literature,[4] but in both studies, the LLLT group had a mean age seven years younger than the group submitted to sham, which may have influenced the beneficial results found, since age is one of the factors that influence the development of this disease.[2]

In the study by Alves and Araújo[13] the sample consisted of individuals affected only by CTS, whereas in the work of Ekim et al.[14] in addition to CTS, individuals had arthritis-rheumatoid factor, which may predispose to the development of this disease,[4] and may have influenced the partial recovery of the parameters evaluated. In addition, in the studies, there was a difference of two months in the mean time of CTS development between the laser group and placebo, and this is a factor that may influence recovery.[8,15] In spite of being a small difference, the evolution time of the disease may have influenced the results, since in the study by Alves & Araújo,[13] who presented better results, the group submitted to LLLT presented the CTS at a shorter time than the placebo, while in the work of Ekim et al.[14] this time was lower. And among these studies the mean evolution time was similar.

PEDro scale criteria

In both studies the eligibility criteria (criterion 1) were specified; the subjects were randomly assigned to the groups (criterion 2), which ensures the comparison between the group submitted to LLLT and placebo; all subjects blindly participated in the study (criterion 5), which ensures that the subjects were unable to distinguish whether or not they received the treatment and thus it is possible to delimit the effects of the therapy; and measurements of at least one key outcome were obtained in more than 85% of the subjects, which occurred in the study by Ekim et al.[14] on the visual scale of pain and functional scale, and in the study by Alves & Araújo,[13] on clinical signs, pain and paresthesia; and both underwent intention-to-treat analysis (criterion 9), which reduces the risk of bias.

However, in these studies the subjects' distribution was not performed in a "blind" way (criterion 3); the groups presented differences at the beginning of the study (criterion 4) that were mentioned above in the sample topic, being different in the mean age and time of CTS development. These biases can produce systematic deviations in random distribution.

What differentiated these studies was that in the research by Ekim et al.[14] all physiotherapists who administered the therapy (criterion 6) and the evaluators were "blind" (criterion 7), ie they did not discriminate the groups that the samples were part of, ensuring that they applied the therapy and the evaluation of equal form; in addition, the statistical comparison between groups (criterion 10) was performed, showing the results in difference in proportions and their confidence interval; the study presented both precision measurements and measures of variability (criterion 11). While in the study by Alves

& Araújo,[13] these criteria were not followed, leading to a decrease in the reliability of the results.

Methods

In both studies, placebo groups were used, being another positive aspect, since it delimited the effects of LLLT. Both performed ten sessions, five consecutive and with a two-day interval, corresponding to the weekend, and used Ga-Al-As laser, but Ekim et al.[14] used higher parameters of power, energy per point and number of points, but smaller wavelength, still remaining with infrared laser. Although there is no consensus in the literature about LLLT parameters on peripheral nerve regeneration, experimental studies show its beneficial effects,[7,12] as in the study of Santos et al.[16] which showed increased nerve fiber diameter and functional return with the use of infrared LLLT during the same period as the cited clinical trials, ie five days a week, for two weeks.

In the article by Alves & Araújo,[13] a greater number of evaluations were carried out, followed by a period of three months more than the work of Ekim et al.[14] or until discharge from the patients. The evaluations performed in both studies consisted of: Tinel test, palmar pain, night pain, paresthesia, daily and/or work activities, and ENMG, parameters frequently used in the diagnosis and evaluation of the evolution of CTS.[17,18] Alves & Araújo,[13] evaluated only the presence or absence of these parameters, which may represent a superficiality of results. While Ekim et al.[14] quantified the pain, severity of symptoms, and nerve and motor function. In addition, they performed a Phalen test and palmar grip strength,[17,18] denoting a more precise and complete evaluation, which may also have interfered with the result.

Results

In the study by Alves & Araújo,[13] there was improvement in the parameters evaluated at the end of 6 months, but in the group irradiated with LLLT this effect occurred in a shorter period and presented a larger number of patients without alterations in the ENMG examination. While in research by Ekim et al.[14] there was significant improvement only in pain score and functional status scale and a more evident improvement in the ENMG test with LLLT irradiation.

The main parameter that may have influenced the difference of the results among the articles was that in the work of Alves & Araújo,[13] a surgical procedure of carpal tunnel decompression was performed, and the LLLT irradiation performed after the surgery as an adjuvant therapy, since regardless of whether or not this therapy was performed, there was an improvement in the parameters analyzed and LLLT only accelerated this process, since the procedure leads to relief of symptoms and improvement of strength and function, but in 41-90% of cases the symptoms persist, requiring other therapies such as LLLT.[19–21] While Ekim et al.[14] used LLLT as main therapy, obtaining more pure results regarding the effects of this therapy.

It was possible to evidence the lack of clinical trials evaluating the effect of LLLT on CTS, although there are several experimental studies with this resource used as a form of treatment in peripheral nerve injury,[22–32] as well as projects[33] demonstrating the interest in this form of therapy for this disease, thus denoting the importance of new studies. However, this small number of studies can also be justified due to the fact that the search is performed in only two databases and in only two languages, being one of the limitations of this study.

Conclusion

There is a lack of clinical trials evaluating the effect of LLLT on CTS, and of these existing studies, although they have beneficial effects of LLLT applied five days a week for two weeks, promoting pain reduction and functional improvement, there are several problems methodological studies that compromise these results, making it necessary to carry out new studies to consolidate the effects of the use of this therapy in clinical practice.

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None

Conflicts of interest

The authors declare no conflicts of interest.

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