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LOW-INTENSITY LASER THERAPY AS A THERAPEUTIC RESOURCE IN CARPAL TUNNEL SYNDROME: A SYSTEMATIC REVIEW

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Abstract: Introduction: Carpal Tunnel Syndrome (CTS) is a compressive syndrome. It is characterized by compression and/or traction of the median nerve. The most common clinical symptoms are: pain, hypoesthesia and paresthesia in the region of innervation of the median nerve, with nocturnal worsening of these symptoms. The treatment of the syndrome can be performed surgically or conservatively. **Goal:** To study low-level laser therapy as a therapeutic resource in Carpal Tunnel Syndrome. **Methodology:** The present research as to the objective was classified as exploratory. As for the modality, it was classified as a systematic review. As for the approach, it was classified as quantitative. Articles published between 1999 and 2019, available in full and in Portuguese and English, of the randomized clinical trial type that used laser therapy as a treatment for CTS were included in the search. **Results:** Laser therapy as a therapeutic resource in CTS applied with a dose of 3J/cm² showed a significant reduction in pain in addition to shortening the sensory and motor latency time of the nerve. Studies that used a dosage of 5J/cm² showed a reduction in pain and CTS symptoms, as well as an improvement in handgrip and thumb pinch strength. **Conclusion:** It is concluded that among the protocols found, the ones with the best results were those that used dosage between 3 to 5J/cm², applied with a punctual technique.
Keywords: Carpal Tunnel Syndrome, Laser Therapy, Therapeutic Resource.

INTRODUCTION

Carpal Tunnel Syndrome (CTS) is a compressive syndrome, being the most frequent of this group of syndromes. It is characterized by compression and/or traction of the median nerve, a structure that passes through the carpal tunnel (a compartment composed of carpal bones, ligaments, and fibrous retinaculum of the flexor muscles) and is responsible for partial innervation of the hand, with motor and sensory function. (CHAMMAS, et al. 2014). The etiology is idiopathic. Currently, it is known that any factor that generates a reduction in volume or increases the pressure of this compartment can precipitate or cause compression of the median nerve, generating the symptoms of CTS (MIDDLETON, ANAKWE, 2014). The most common clinical symptoms in the syndrome are: pain, hypoesthesia and paresthesia in the region of innervation of the median nerve (thumb, index finger, middle and radial surface of the ring finger), with nocturnal worsening of these symptoms with exacerbation of the inflammatory condition (OLIVEIRA FILHO, OLIVEIRA, 2017).

CTS has an overall prevalence of 8%. This pathology affects more women than men, in a ratio of 2:1. It most often affects people over 50 years of age, as well as a large part of the economically active population. The incidence, when confirmed with clinical examination and imaging, is about 23 per 1000 people per year (ORRÚ, 2019).

Laser therapy has been used to treat inflammation. The effects of this resource can be observed in the increase in proliferation and activation of lymphocytes, increase in phagocytosis of macrophages; increasing secretion of fibroblast growth factors and activating the reabsorption of fibrin and collagen. They also contribute to increase the motility of epithelial cells, the amount of granulation tissue and may decrease the synthesis of mediators of the inflammatory process (ANDRADE, CLARK, FERREIRA, 2014). Although there is no consensus in the literature on the effects of laser therapy on CTS, Chang, et al. (2008) evaluated the effects of low-level diode laser therapy at 830 nm in 18 patients with CTS, finding a reduction in pain, improvement in functional capacity and handgrip strength when compared with the placebo group.

Taking into account the large number of cases, including the involvement of people who contribute financially to the country's economic development, in addition to the various types of lasers and protocols that are used as a therapeutic approach, it is necessary to carry out studies that analyze the effect of laser therapy on CTS in order to know which type of laser is effective, as well as its respective parameters. Thus, making possible the reintegration of this population to work and their daily activities through the use of a conservative treatment.

In view of these statements, the research aimed to study low-level laser therapy as a therapeutic resource in Carpal Tunnel Syndrome, analyzing its pathophysiological mechanism and the effectiveness of the use of laser in the rehabilitation of CTS patients, as specific objectives.

METHODOLOGY

This is a systematic review. To carry out the research, the following databases were consulted: SciELO; PUBMED; LILACS; SpringerLink and ScienceDirect. In these databases, descriptors in two different languages were used – which guided the search for articles. In Portuguese, the search was performed using two descriptors simultaneously: carpal tunnel syndrome, laser therapy. And later, the descriptors in English: carpal tunnel syndrome, laser therapy. To calculate the total number of studies, it was found that the studies were not duplicated, and each article was considered only once. All studies found with the search strategy and that met the inclusion criteria, from March to April 2020, were included.

Articles published between 1999 and 2019, available in full and in Portuguese and English, studies of the randomized clinical trial type that used laser therapy as a treatment for CTS were included in the search. Articles that used the Systematic Review as a research method, incomplete articles, studies that performed combined treatments of laser therapy and another therapeutic resource, repeated studies and animal studies were excluded.

The procedure for the preparation of this study was divided into the following steps: a) bibliographic survey of materials already published, such as scientific articles, books and periodicals, related to the proposed theme; b) previous reading of studies found in electronic databases (internet), which address the topic in question; c) reading for the selection of studies, this being detailed and more in-depth of the content necessary for the work of the main ideas of each author, differentiating them from each other and from the secondary ones; d) interpretive reading, in which the researcher sought to identify repetitive, emphasized and divergent information from the authors about the keywords mentioned above.

The search was performed independently by two reviewers. The analysis of interobserver agreement was performed using the Kappa test (BioEstat V 5.0), according to the method of Landis and Koch (1977). The value found was K = 0.78 (Substantial agreement).

The articles were critically analyzed using an interpretation guide, used to assess their individual quality, based on studies by Greehalgh (1997) and adapted by MacDermid et al (2009). Items for evaluating the quality of articles are expressed by scores in Table 1, where 0 = absent; 1 = incomplete; and 2 = complete. The percentage calculation in Table 1 was performed by the sum of the points achieved in each evaluation criterion divided by the maximum expected in each item.

RESULTS

A summary of the electronic search in the selected databases is presented in figure 1. Initially, 719 articles were identified, of which 686 were excluded, 633 of which were not relevant, such as descriptions of laser therapy and carpal tunnel syndrome, and 53 because they were duplicates; the remaining 33 underwent analysis and verification of titles and abstracts according to the inclusion and exclusion criteria. Of these, all 43 were read in full, of which only 14 articles adequately met all inclusion criteria and were therefore selected for this integrative review in Table 2.

The results showed that laser therapy as a therapeutic resource in CTS applied at a dosage of 3J/cm² showed a significant reduction in pain in addition to shortening the sensory and motor latency time of the median nerve. In studies that used a dosage of 5J/cm², a reduction in pain and CTS symptoms was observed, in addition to an improvement in handgrip and thumb pinch strength. The use of the therapeutic resource applied with a dosage of 6J/cm² demonstrated a decrease in daytime and nighttime pain as well as a reduction in symptoms when performing the Phalen test after the application of the resource. On the other hand, laser application with a dose of 7J/cm² resulted in a decrease in pain, improvement in fine forceps and functional capacity, a finding similar to studies that used a dose of 9J/cm². The use of low dosages, between 0.6 - 1.8J/cm/², in only one study was found a beneficial response, reporting improvement in nerve conduction and a decrease in symptoms, with the chosen dosage of 1.8J/cm². The study that chose to use high doses, 24J/cm², observed a decrease in symptoms, through the application of a questionnaire. In all selected studies, the application of the resource was carried out with a punctual

Studies	Rating criteria												
	1	2	3	4	5	6	7	8	9	10	11	12	Total (%)
Juan, *et al.* (2019)	1	2	2	0	2	2	2	2	2	2	2	2	87,50%
Guner, *et al.* (2018)	1	1	2	0	2	2	2	2	2	2	2	1	79,16%
Ahmed, *et al.* (2017)	1	2	1	0	2	2	2	2	2	2	2	1	79,16%
Pratelli, *et al.* (2015)	1	2	2	0	2	2	2	2	2	2	2	2	87,50%
Lazovic, *et al.* (2014)	1	2	2	0	2	2	2	2	2	1	1	1	75,00%
Dakowicz, *et al.* (2011)	1	1	2	0	2	2	1	2	2	1	1	1	66,66%
Tascioglu, *et al.* (2012)	1	1	2	0	2	2	2	2	2	2	2	1	79,16%
Chang, *et al.* (2008)	1	2	1	0	2	2	2	2	2	2	2	1	79,16%
Shooshtari, *et al.* (2008)	1	1	1	0	2	2	1	2	2	2	2	1	70,83%
Evick, *et al.* (2007)	1	1	2	0	2	2	2	2	2	2	2	1	79,16%
Elwakil, *et al.* (2007)	1	1	1	0	2	2	1	2	2	1	1	2	66,66%
Bakhtiary, *et al.* (2004)	1	2	2	0	2	2	2	2	2	2	2	1	83,33%
Irvine, *et al.* (2004)	1	2	2	0	1	2	2	2	2	1	1	1	70,83%
Pádua, *et al.* (1999)	1	1	1	0	2	2	1	2	2	2	2	1	70,36%

Abbreviations: N.A., not applicable to paper.

* Evaluation criteria: 1. Thorough literature review to define the research question; 2. Specific inclusion/exclusion criteria; 3. Specific hypotheses; 4. Appropriate range of psychometric properties; 5. Sample size; 6. Follow-up; 7. The authors referenced specific procedures for administering, scoring, and interpreting procedures; 8. Measurement techniques have been standardized; 9. Data were presented for each hypothesis; 10. Appropriate statistics - point estimates; 11. Appropriate statistical error estimates; 12. Valid conclusions and clinical recommendations.

Table 1: Analysis of the quality of the articles found on low-level laser therapy as a therapeutic resource in Carpal Tunnel Syndrome.

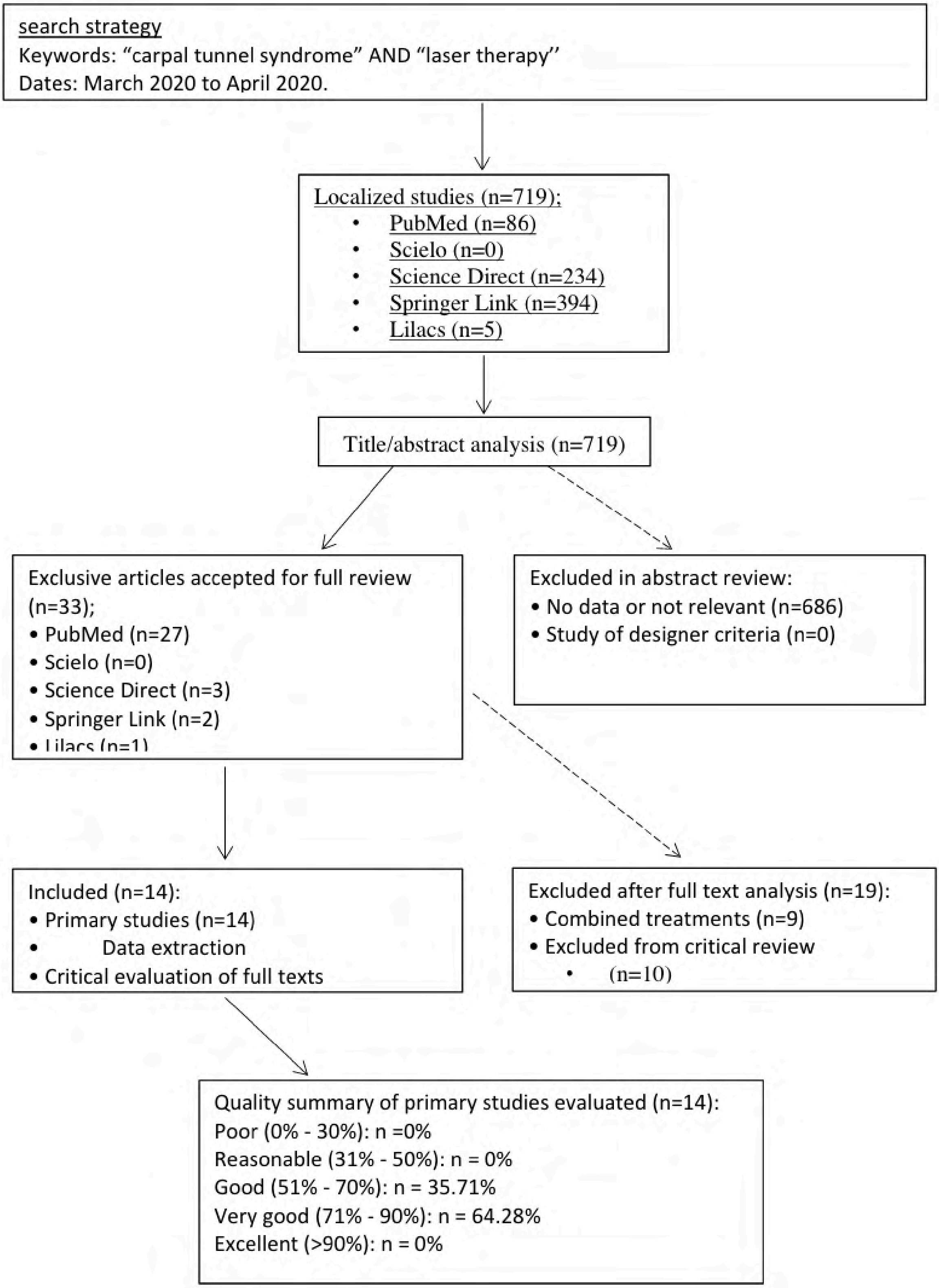

Figure 1: Studies included and excluded in the review of low-level laser therapy as a therapeutic resource in Carpal Tunnel Syndrome.

technique. The time of laser application in each patient ranged from 15 seconds to 10 minutes (Table 2).

DISCUSSION

CTS is the most common and widely studied nervous entrapment syndrome. It is caused by compression and/or traction of the median nerve, a structure that passes through a channel in the wrist and is responsible for partial innervation of the hand, with motor and sensory function. This channel, known as the carpal tunnel, is made up of bones, transverse carpal ligament, median nerve and digital flexor tendons (PADUA, et al. 2016).

The carpal tunnel is an osteofibrous outlet, which is located between the flexor retinaculum and the carpal bones. The upper region of this tunnel is composed of the fibrous transverse carpal ligament. The structures that cross the carpal tunnel are: nine flexor tendons, their sheath, and the median nerve. This nerve enters the tunnel in the midline or slightly in the radial region. The median nerve supplies sensory branches to supply the 3 radial digits and half of the 4th radial digit. It also gives palmar sensory cutaneous branches, which innervate the cutaneous region of the palm and the (recurrent) thenar motor branch (MACDERMID, DOHERTY, 2004).

Occupational activities that require repetitive movements, strength, posture and vibration in the carpal tunnel region were cited as a significant extrinsic risk factor for the development of CTS. Also, many intrinsic factors that can trigger the syndrome, some of which are: menopause, pregnancy, kidney failure, obesity, hypothyroidism, congestive heart failure and use of oral contraceptives. These are factors that generate a potential risk by increasing the volume of the synovial sheath within the tunnel (WERNER, 2006).

The histopathological features of CTS include tendon sheath thickening, edema, fibrosis of the tendon sheath lining with thickening of the vessel walls, intimal hyperplasia, and thrombosis, all of which decrease the median nerve passage space leading to compression. (TEZCAN, et al. 2018).

The exact pathogenesis of CTS is not well defined. There are a few theories that try to explain the symptoms and impaired nerve conduction. The most highly regarded are mechanical compression, microvascular insufficiency and vibration theories.

Trapping of a peripheral nerve occurs as a result of its passage through an anatomical compartment that has become too tight, resulting in altered function within the nerve and damage to the nerve at the site of compression. Trapping neuropathy combines compression and traction phenomena. Nerve compression and traction can cause disturbances of intraneural microcirculation, damage to the myelin sheath and axon, as well as changes in connective tissue. These mechanisms are interacting and include increased tunnel pressure, damage to the median nerve microcirculation, compression of median nerve connective tissue, and synovial tissue hypertrophy.

The theory of microvascular insufficiency explains that the scarcity of blood supply results in the reduction or even total depletion of nutrients and oxygen to the nerve, generating a slow process of losing its ability to transmit nerve impulses (AROORI, SPENCE, 2008). The blood-brain barrier is made up of the inner cells of the perineurium and the endothelial cells of the endoneural capillaries that accompany the median nerve through the carpal tunnel. These endoneural microvessels are formed by branches of nutrients that originate from the radial and ulnar arteries, in the region proximal to the flexor retinaculum (ABOONQ, 2015). An increase in pressure within the tunnel can

Author (year)	Sample	Methods	Dosage	Technique	Main results
Juan, *et al.* (2019)	84 individuals. Group (1): 43 individuals; Group (2): 41 individuals	Treatment group (1): infrared laser; Placebo group (2): infrared laser device turned off. Applied 5 days a week for 4 weeks	24J/cm², 1 minute	Punctual, applied to traditional Chinese acupuncture points.	A decrease in the Global Symptom Questionnaire score, applied before and after the intervention, was observed in the Treatment Group and the Nervous Conduction Study showed no significant difference between the groups.
Guner, *et al.* (2018)	64 hands. Group (1): 21 hands; Group (2): 21 hands; Group (3): 22 hands	Group (1): application of 685nm gallium arsenide laser. Group (2): kinesiotherapy in the wrist flexor muscles and application of low power laser; Group (3): simulated laser therapy. Applied 5 days a week for 3 weeks	5J/cm², 4 minutes	Punctual	Group 1 showed a greater reduction in pain and CTS symptoms, in addition to improvement in handgrip and thumb pinch strength. Thus, the application of low-level laser proved to be effective and the application of associated kinesiotherapy did not demonstrate any additional benefit.
Ahmed, *et al.* (2017)	50 individuals. Group (A): 25 individuals, Group (B): 25 individuals	Group (A): 904 nm gallium arsenide laser. Group (B): Therapeutic ultrasound 1MHz. Applied 3 days a week for 6 weeks.	4.8J/cm², 6 minutes	Punctual	Patients in both groups showed improvement in handgrip and fine pinch strength as well as improvement in nerve conduction, with no statistically relevant difference between the groups. Therefore, the use of low power laser and 1MHz ultrasound were considered effective for the treatment of moderate CTS.
Pratelli, *et al.* (2015)	42 subjects, 70 symptomatic hands. Group (A): 35 hands; Group (B): 35 hands	Group (A): Fascial Manipulation. Group (B): Infrared Diode Laser Therapy. Applied 3 days a week for 3 weeks	3J/cm², 10 minutes	Punctual	Patients who received fascial manipulation as treatment showed a reduction in pain level and an increase in function and those who received laser treatment had an improvement in function, but this improvement regressed before completing 3 months of the end of the study.
Lazovic, *et al.* (2014)	79 individuals. Experimental Group (EG): 40 individuals; Placebo Group (GP): 39 individuals.	Experimental Group (EG): GaAlAs 780 nm diode laser; Placebo Group (GP): sham laser therapy. Applied 5 days a week for 2 weeks	3,4J/cm², 1 minute and 30 seconds	Punctual	In the experimental group, in which the laser was applied, there was a significant reduction in pain, a reduction in the number of patients with positive Tinel's sign as well as a shortening of the sensory and motor latency time of the median nerve in the examination of nerve conduction. These findings were not observed in the placebo group.
Dakowicz, *et al.* (2011)	38 individuals. Group (L): 18 individuals, Group (M): 20 individuals	Group (L): 904nm Gallium Arsenide Laser. Group (M): Pulsed Magnetic Field Therapy. Applied 5 days a week for 4 weeks.	6J/cm², 5 minutes	Punctual	A decrease in daytime and nighttime pain was observed in both groups, but Group (L) reported this improvement in the initial phase of treatment. There was a reduction in symptoms when performing the Phalen test in both groups, with the improvement in Group (L) being more significant.
Tascioglu, *et al.* (2012)	60 individuals. Group (1): 20 individuals; Group (2): 20 individuals; Group (3): 20 individuals	Group (1): 830 nm Gallium Arsenide Low Power Laser. Group (2): 830 nm gallium arsenide low power laser, Group (3): simulated laser therapy. Applied 5 days a week for 3 weeks.	Group (1):1.2J/cm², 10 minutes; Group (2): 0.6J/cm², 1 minute	Punctual	There was no statistically significant difference in pain reduction, increase in handgrip strength, decrease in symptoms, or functional improvement in the three groups. An improvement in the velocity of nerve transmission of the median nerve was observed in Group (1) compared to Group (2). Thus, the application of active laser was not considered more effective than placebo.

Chang, *et al.* (2008)	36 individuals. Laser Group (L): 18 individuals. Placebo Group (P): 18 individuals	Laser Group (L): 830nm diode laser. Placebo Group (P): simulated laser. Applied 5 days a week for 2 weeks.	9.7J/cm², 10 minutes	Punctual	Patients in the Laser Group (L) showed greater relief of pain and symptoms and an improvement in functional capacity and handgrip strength without side effects, compared to the Placebo Group (P).
Shooshtari, *et al.* (2008)	80 individuals. Test Group (A): 40 subjects; Control Group (B): 40 individuals	Test Group (A): Low-level laser therapy. Control Group (B): Simulated laser therapy. Applied 5 days a week for 3 weeks.	9J/cm²	Punctual	There was a significant improvement in clinical symptoms, increased handgrip and decreased median nerve sensory and motor latency in patients who received laser therapy application compared with the sham laser therapy group.
Evcik, *et al.* (2007)	81 individuals. Group (1): 41 individuals, Group (2): 40 individuals	Group (1): 830nm gallium arsenide diode laser therapy. Group (2): Simulated laser therapy. Applied 5 days a week for 2 weeks.	7J/cm², 10 minutos	Punctual	After therapy, there was a decrease in pain, improvement in fine forceps and functional capacity in both groups. Group (1) showed improvement in hand grip and in the sensory and motor latency of the median nerve. Sensory nerve velocity improved in Group (2).
Elwakil, *et al.* (2007)	54 individuals, 60 hands. Group (A): 27 individuals, 30 hands; Group (B): 27 individuals, 30 hands	Group (A): Helium Neon 632nm laser therapy, Group (B): carpal tunnel release surgery. Applied 2 days a week for 6 weeks.	3J/cm²	Punctual	Laser therapy showed significant results in all subjective complaints except muscle weakness and thenar atrophy. After analyzing the results, the two treatments expressed the same statistical significance. Thus, laser therapy has proven to be an effective and non-invasive treatment modality for CTS, especially in early and mild to moderate cases.
Bakhtiary, *et al.* (2004)	50 individuals. A group): 25 individuals, Group (B): 25 individuals	Group (A): 1MHz ultrasound, Group (B): Infrared laser 830nm. Applied 5 days a week for 3 weeks.	9J/cm²	Punctual	Patients in the ultrasound group demonstrated better results in motor nerve latency, range of motor action, finger pinch strength, and pain relief when compared to the laser therapy group.
Irvine, *et al.* (2004)	15 individuals. Control Group: 8 individuals. Treatment Group: 7 individuals	Control Group: Simulated laser therapy. Treatment Group: 830nm gallium arsenide laser. Applied 3 days a week for 5 weeks.	6J/cm², 15 seconds	Punctual	There was significant symptomatic improvement in the control and treatment groups. However, there was no significant difference in any of the outcome measures between the two groups. Thus, laser therapy was not more effective in reducing the symptoms of Carpal Tunnel Syndrome than sham treatment.
Pádua, *et al.* (1999)	40 individuals. Treatment Group: 10 individuals; Control Group: 30 individuals	Treatment Group: Lasertherapy with 830nm gallium arsenide diode probe; Control Group: Patients without therapy. Applied 2 days a week for 3 weeks.	1,08J/cm², 10 minutes	Punctual	Patients who received the laser application had a better response in nerve conduction and a decrease in symptoms that had pre-treatment, compared to patients in the control group.

Table 2. Characteristics of the studies that evaluated the effectiveness of low-level laser therapy as a therapeutic resource in Carpal Tunnel Syndrome.

cause microvessels located within this barrier to break down, causing a buildup of proteins and inflammatory cells. This process can cause a miniature closed compartment syndrome, increasing permeability, contributing to increased endoneural fluid pressure and development of an intrafascicular edema, leading to a shortage of blood supply to the nerve).

According to vibration theory, CTS symptoms may be due to the effects of prolonged use of vibrating tools on the region of the carpal tunnel where the median nerve passes. Lundborg et al. (1987) observed that within a few days after exposure to vibrating hand tools, epineural edema forms in the median nerve, leading to reduced microvascular flow to the nerve, leading to rupture of its myelin sheath and decreased conduction velocity. motor.

Another etiological reason also widely accepted by researchers to explain the increased susceptibility to compression of the median nerve, especially in diabetic patients, is changes in the microvascular structure of the nerve that are exacerbated by biochemical disorders, which can lead to reduced endoneural blood flow and of oxygen tension. Focal compression leads to localized intraneural circulatory changes generating increased permeability of endoneural vessels, in addition to providing the formation of edema of the endoneural space. The development of edema can lead to an increase in the diffusion distance of oxygen from the capillaries, which can lead to hypoxia of the neural cells (DAHLIN, 1991).

Despite the existence of more than one theory to explain the pathophysiology of the syndrome, they all have one point in common: median nerve entrapment. The entrapment neuropathy is the combination of compression and traction phenomena. Nerve compression and traction can cause disturbances of intraneural microcirculation, damage to the myelin sheath and axon, as well as changes in the supporting connective tissue. The entrapment of a peripheral nerve occurs as a result of its passage through an anatomical compartment that has become too tight, generating altered function within the nerve and its dysfunction, generating repercussions at the compression site and its innervation path (MILLESI, ZOCH, RATH, 1990).

According to carpal tunnel anatomy, there are 2 most likely sites for median nerve compression: 1) At the proximal edge of the carpal tunnel, caused by wrist flexion and due to the change in thickness and stiffness between the antebrachial fascia and the proximal portion of the flexor retinaculum; and 2) In the narrowest part of the hook of the hamate bone (ABOONQ, 2015). Werner, Andary (2002) carried out a study to measure the pressure in the intracarpal tunnel and found values in the range of 2 to 10 mmHg. The authors observed that large changes in fluid pressure in the carpal tunnel occurred during wrist movement, with wrist extension increasing pressure 10-fold and flexion increasing 8-fold.

Compression of the median nerve occurs by an increase in pressure in the carpal tunnel. The increased pressure within the carpal tunnel added to the continuous shear generates an invasion of fibroblasts, which gradually increases fibrosis in the median nerve. In addition, an ischemic injury caused by chronic compression produces focal demyelination and axonal degeneration in the median nerve, and these degenerative changes lead, over time, to an increase in nerve stiffness, leading to a worsening of symptoms. al. 2018).

Pratelli, et al (2015) conducted a study with 42 individuals totaling 70 symptomatic hands, dividing them into two groups. Fascial manipulation was used in the 35 hands of group A and in group B laser therapy with an intensity of 3J/cm² as a therapeutic resource. In their research, Elwakil, et al (2007) used laser at the same dose in 30 symptomatic hands and surgery for carpal tunnel release in another 30 hands, totaling 60 hands in their study. Lazovic et al (2014) in their study divided 79 subjects into two groups, performing laser therapy with 3.4 J/cm² intensity in the first group and sham laser therapy in the second group. The authors observed a reduction in the level of pain and improvement in function in both studies, as well as a shortening of the sensory and motor latency time of the median nerve in the nerve conduction exam, concluding that the laser, when applied at this dosage, is a resource effective therapeutic for the treatment of carpal tunnel syndrome, especially in initial mild to moderate cases. Previous studies showed that low-level laser therapy had some potential benefits, including anti-inflammatory and anti-edematous effects, increased adenosine triphosphate production and cellular respiration, and improved vascular supply to the median nerve, in the treatment of CTS. Furthermore, low-level laser therapy leads to an increase in myelin production, which results in nerve regeneration (LI. et.al, 2016).

In a study carried out by Guner et al (2008), 64 hands were divided into three groups, in which group (1) received the application of a 685nm gallium arsenide laser with an intensity of 5J/cm², group (2) the application of kinesiotherapy in the wrist flexor muscles associated with the application of low power laser and the group (3) simulated laser therapy. Ahmed et al (2017) divided 50 individuals into two groups, in which group (A) received 904nm gallium arsenide laser as a therapeutic resource, being applied with a dosage of 4.8J/cm² and group (B) received the application of therapeutic ultrasound 1MHz. The studies showed a result of a reduction in the pain and symptoms of CTS, in addition to an improvement in handgrip and thumb pinch strength, as well as an improvement in nerve conduction. Forootan et al (2015) observed in their study the recovery of motor function in patients after application of low-level laser therapy in the distal half of the median nerve. They attributed this acquisition to the increase in fiber diameter, number of axons and nerve growth velocity, observed by the authors after the application of the therapeutic resource.

Research carried out by Chang et al. (2008) in which the authors divided 36 patients into two groups, performing the application of laser therapy with an intensity of 9.7 J/cm² in the first group and simulated laser therapy in the second group. application of laser therapy when compared to the placebo group. The results corroborate a study carried out by Shooshtari, et al. (2008), in which 80 patients were divided into two groups, in which Group (A) applied low-level laser therapy with 9J/cm² and in Group (B) simulated laser therapy. In addition to the improvement in handgrip, a decrease in sensory and motor latency of the median nerve was observed in Group (A) compared to Group (B). In a research carried out by Macagnan et al. (2018), in which the authors used laser therapy in the region of the flexor muscles of the patients' fingers during hemodialysis, an improvement in their handgrip strength was observed. According to the authors, this gain can be explained by the increase in intracellular ATP synthesis caused by the application of laser therapy in the region. Even though handgrip strength is highly dependent on anaerobic metabolism, ATP production is responsible for reducing metabolic disturbances and increasing resistance during submaximal exercise, potentiating muscle action during movement execution. Furthermore, ATP generates an energy boost and promotes an increase in oxidative metabolism.

A research carried out by Dakowicz et al. (2011) in which 38 individuals were divided into two groups, Group (L) which was applied gallium arsenide laser with an intensity of 6J/cm² in 18 individuals and Group (M) with the application of pulsed magnetic field therapy in 20 individuals. As a result, there was a decrease in daytime and nighttime pain in both groups, but Group (L) reported this improvement in the initial phase of treatment. In the study by Evick et al. (2007) in which 81 individuals were subdivided into two groups: Group (1) with 41 individuals who received 830nm gallium arsenide diode laser with an intensity of 7J/cm² as a therapeutic resource and Group (2) with 40 individuals who received the application of simulated laser therapy. After therapy, there was a decrease in pain, improvement in fine forceps and functional capacity in both groups. In both studies, the authors reported a decrease in pain, a very recurrent inflammatory sign in the symptoms of carpal tunnel syndrome. Oliveira Júnior, et al. (2014) explain that the application of laser therapy in a region with an inflammatory process is responsible for reducing the migration of neutrophils to the site, generating the anti-inflammatory effect, which reduces inflammatory signs.

Other studies such as those by Tascioglu, et al. (2012), Irvine, et al. (2004) showed no efficacy in the application of laser therapy when compared with other resources or even with simulated laser therapy. According to Cardozo et al. (2009) the action of the laser is not equally positive in all patients. The individuality factor is decisive in the results of its use. People have different amounts of absorbent cells, in addition to their spatial arrangement. Even if we consider a single person, their different body regions have different absorption rates. Another additional factor is the skin tone of the patients. Darker-skinned individuals absorb a greater amount of radiation due to the greater amount of pigments; therefore, the presence of such information in the studies is of great importance, since it is a factor of great influence on the final results.

CONCLUSION

It was observed that among the protocols found, those with the best results were those that used a dosage between 3 to 5J/cm², applied with a punctual technique. In these studies, the main effects observed after the application were: decrease in pain, improvement in handgrip, improvement in sensory and motor latency, in addition to improvement in the speed of nerve transmission of the median nerve. The reduction of symptoms in these patients occurs as a result of tissue changes observed after the application of laser therapy, which are: anti-inflammatory and anti-edematous effect, as a result of increased production of adenosine triphosphate and improved vascular supply to the nerve, in addition to the increase in myelin production, which results in nerve regeneration and consequently an improvement in the syndrome.

It is believed that the knowledge of the use of this therapeutic resource in the syndrome is extremely important for its conservative treatment, expanding the possibilities of treating the syndrome, thus helping physiotherapists and other health professionals in the best choice for each case.

REFERENCES

ABOONG, M.S. Pathophysiology of carpal tunnel syndrome, **Neurosciences Journal**, v. 20, n. 1, p. 4-9, 2015

ABOONQ, M.S. Pathophysiology of carpal tunnel syndrome. **Neurosciences**. v.20, n.1., p.4-9, 2015

AHMED, O.F., ELKHARBOTLY, A.M., TAHA, N., BEKHEET, A.B. Treatment of mild to moderate carpal tunnel syndrome in patients with diabetic neuropathy using low level laser therapy versus ultrasound controlled comparative study, **BBA Clin**, v. 20, n. 8, p. 43-47, 2017

ANDRADE, F.S.S.D.; CLARK, R.M.O.; FERREIRA, M.L. Efeitos da laserterapia de baixa potência na cicatrização de feridas cutâneas, **Revista do Colégio Brasileiro de Cirurgiões**, v. 41, n.2, p.129-133, 2014

AROORI, S., SPENCE, R.A. Carpal tunnel syndrome, **Ulster Medical Journal**, v. 7, n. 1, p. 6-17, 2008

BAKHTIARY, A.H., RASHIDY-POUR, A. Ultrasound and laser therapy in the treatment of carpal tunnel syndrome, **Aust J Physiother**, v. 50, n. 3, p. 147-151, 2004

CARDOZO, J.P.C., DAVID FILHO, L.S., SOUZA, H.A., DUMAS, F.L.V. Aplicações do laser de baixa intensidade no tratamento da síndrome do túnel do carpo, **Universitas: Ciências da Saúde, Brasília**, v. 7, n. 2, p. 85-96, 2009

CHAMMAS, M.; BORETTO, J.; BURMANN, L.M.; RAMOS, R.M.; SANTOS NETO, F.C.; BRAGA SILVA, J. Síndrome do túnel do carpo – Parte I (anatomia, fisiologia, etiologia e diagnóstico), **Revista Brasileira de Ortopedia**, v.49, n.5, p.429-436, 2014

CHANG, W., WU, J., JIANG, J., YEH, C., TSAI, C. Carpal tunnel syndrome treated with a diode laser: a controlled treatment of the transverse carpal ligament, **Photomed Laser Surg**, v.26, n.6, p.551-557, 2008

DAHLIN L.B. Aspectos sobre a fisiopatologia das compressões nervosas e lesões por compressão nervosa. **Neurosurg Clin N Am.** v.2, p.21–29, 1991.

DAKOWICZ, A., KURYLISZYN-MOSKAL, A., KOSZTYLA-HOJNA, B., MOSKAL, D., LATOSIEWICZ, R. Comparison of the long-term effectiveness of physiotherapy programs with low-level laser therapy and pulsed magnetic field in patients with carpal tunnel syndrome, **Adv Med Sci**, v. 56, n. 2, p. 270-274, 2011

ELWAKIL, T.F., ELAZZAZI, A., SHOKEIR, H. Treatment of carpal tunnel syndrome by low-level laser versus open carpal tunnel release, **Lasers Med Sci**, v. 22, n. 4, p. 265-270, 2007

EVCIK, D., KAVUNCU, V., CAKIR, T., SUBASI, V., YAMAN, M. Laser therapy in the treatment of carpal tunnel syndrome: a randomized controlled trial, **Photomed Laser Surg**, v. 25, n. 1, p. 34-39, 2007

FOROOTAN, K.S., FORGHANI, S.F., MADANI, S.P., ESTAHBANATI, H.K., FOROOTAN, N.S.S. Laser Therapy After Repair of the Distal Half of the Median Nerve; a Comparative Study, **Trauma Monthly**, v. 20, n.2, 2015

GERHARDT, T. E.; SILVEIRA, D.T. **Métodos de Pesquisa**, 1. ed. Rio Grande do Sul, 2009

GREENHALGH T. Assessing the methodological quality of published papers. **BMJ**. v. 315, n. 7103, p. 305-308, 1997

GUNER, A., ALTAN, L., AKSOY, M.K. The effectiveness of the low-power laser and kinesiotaping in the treatment of carpal tunnel syndrome, a pilot study, **Rheumatol Int,** v.38, n. 5, p. 895-904, 2018

IRVINE, J. CHONG, S.L., AMIRJANI, N., CHAN, K.M. Double-blind randomized controlled trial of low-level laser therapy in carpal tunnel syndrome, **Muscle Nerve**, v. 30, n. 2, p. 182-187, 2004

JUAN, C., CHANG, M., LIN, T., HWANG, K., FU, T., SHIH, P., CHANG, C., YANG, C. Laser Acupuncture for Carpal Tunnel Syndrome: A Single-Blinded Controlled Study**, J Altern Complement Med**, v.25, n.10, p. 1035-1043, 2019

LANDIS J.R., KOCH G.G. The measurement of observer agreement for categorical data. **Biometrics**. v. 33, n.1, p.159-174, 1977

LAZOVIC, M., ILIC-STOJANOVIC, O., KOCIC, M., ZIVKOVIC, V., HRKOVIC, M., RADOSAVLJEVIC, N. Placebo-controlled investigation of low-level laser therapy to treat carpal tunnel syndrome, **Photomed Laser Surg**, v. 32, n. 6, p. 336-344, 2014

LI Z.J., WANG Y., ZHANG H.F., MA X.L., TIAN P., HUANG Y. Effectiveness of low-level laser on carpal tunnel syndrome: a meta-analysis of previously reported randomized trials. **Medicine (Baltimore)**, 2016

LUNDBORG G., DAHLIN L.B., DANIELSEN N., HANSSON H.A., NECKING L.E., PYYKKO I. Intraneural edema following exposure to vibration. **Scand J Work Environ Health**, v.13, n.4, p. 326–329, 1987

MACAGNAN, F.E., BARONI, B.M., CRISTOFOLI, E.Z., GODOY, M., SCHARDONG, J., PLENTZ, R. D.M. Acute effect of photobiomodulation therapy on handgrip strength of chronic kidney disease patients during hemodialysis, **Lasers in Medical Science**, v. 34, p. 835-840, 2018

MACDERMID J.C., DOHERTY T. Teste clínico e eletrodiagnóstico da síndrome do túnel do carpo: uma revisão narrativa. **J Orthop Sports Phys Ther**. v.34, p.565–588, 2004

MACDERMID J.C., WALTON D.M., AVERY S., BLANCHARD A., ETRUW E., MCALPINE C. Measurement properties of the neck disability index: a systematic review**. J Orthop Sports Phys Ther**. v. 39, n.5, p. 400-417, 2009

MIDDLETON, S.D., ANAKWE, R.E. Carpal tunnel syndrome, **The BMJ**, v.1, n.1, p. 1-7, 2014

MILLESI H., ZOCH G., RATH T. O aparelho de deslizamento do nervo periférico e seu significado clínico. **Ann Chir Main Memb Super**. v.9, p.87–97, 1990

OLIVEIRA FILHO, J.R.; OLIVEIRA, A.C.R. Síndrome do túnel do carpo na esfera trabalhista, **Revista Brasileira de Medicina do Trabalho**, v.15, n.2, p.182-192, 2017

OLIVEIRA JÚNIOR, M.C., GREIFFO, F.R., RIGONATO-OLIVEIRA, N.C., CUSTÓDIO, R.W.A., SILVA, V.R., DAMACENO-RODRIGUES, N.R., ALMEIDA, F.M., ALBERTINI, R., LOPES-MARTINS, R.A.B., OLIVEIRA, L.V.F., CARVALHO, P.T.C., OLIVEIRA, A.P.L., LEAL JÚNIOR, E.C.P., VIEIRA, R.P. Low level laser therapy reduces acute lung inflammation in a model of pulmonary and extrapulmonary LPS-induced ARDS, **Journal of Photochemistry and Photobiology**, v. 134, n. 5, p. 57-63, 2014

ORRÚ, C. **O que sabemos sobre Síndrome do Túnel do Carpo?** São Paulo, 2019. Disponível: https://pebmed.com.br/o-que-sabemos-sobre-sindrome-do-tunel-do-carpo/. Acesso em: 18 maio 2020

PADUA, L., CORACI, D., ERRA, C., PAZZAGLIA, C., PAOLASSO, I., LORETI, C., CALIANDRO, P., HOBSON-WEBB, L.D. Carpal tunnel syndrome: clinical features, diagnosis, and management, **Lancet Neurology,** v.15, n.12, p. 1273-1284, 2016

PADUA, L., PADUA, R., MORETTI, C., NAZZARO, M., TONALI, P. Clinical Outcome and Neurophysiological Results of Low-Power Laser Irradiation in Carpal Tunnel Syndrome, **Lasers in Medical Science**, v. 14, p. 196-202, 1999

PIOVESAN, A.; TEMPORINI, E.R.Pesquisa exploratória: procedimento metodológico para o estudo de fatores humanos no campo da saúde pública, **Revista de Saúde Pública**, v.29, n.4, p.318-325, 1995

PRATELLI, E., PINTUCCI, M., CULTRERA, P., BALDINI, E., STECCO, A., PETROCELLI, A., PASQUETTI, P. Conservative treatment of carpal tunnel syndrome: comparison between laser therapy and Fascial Manipulation, **J Bodyw Mov Ther**, v. 19, n. 1, p. 113-118, 2015

SAMPAIO, R.F.; MANCINI, M.C. Estudos de revisão sistemática: um guia para síntese criteriosa da evidência científica, **Revista Brasileira de Fisioterapia**, v.11, n.1, 2007

SHOOSHTARI, S.M.J., BADIEE, V., TAGHIZADEH, S.H., NEMATOLLAHI, A.H., AMANOLLAHI, A.H., GRAMI, M.T. The effects of low level laser in clinical outcome and neurophysiological results of carpal tunnel syndrome, **Electromyogr Clin Neurophysiol,** v.48, n.5, p.229-231, 2008

TASCIOGLU, F., DEGIRMENCI, N.A., OZKAN, S., MEHMETOGLU, O. Low-level laser in the treatment of carpal tunnel syndrome: clinical, electrophysiological, and ultrasonographical evaluation, **Rheumatol Int.,** v. 32, n.2, p. 409-415, 2012

TEZCAN, S., OZTURK, F.U., USLU, N., NALBANT, M., YEMISCI, O.U. Carpal Tunnel Syndrome: Evaluation of the Effects of Low-Level Laser Therapy With Ultrasound Strain Imaging, **Journal of Ultrasound in Medicine**, v. 38, n.1, 2018

WERNER R.A. Avaliação da síndrome do túnel do carpo relacionada ao trabalho. **J Occup Rehabil**. v.16, p.207–222, 2006

WERNER R.A., ANDARY M. Carpal tunnel syndrome: pathophysiology and Clinical Neurophysiology. **Clin Neurophysiol**. v.113, p.1373–1381, 2002