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Use of low level laser therapy to control neuropathic pain: A systematic review

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ABSTRACT

Neuropathic pain can be defined as pain initiated or caused by a primary lesion or dysfunction in the central or peripheral nervous system. The low level laser therapy (LLLT) has gained great prominence as a treatment in this type of pain; however, the application parameters are still controversial in the literature. This study aimed to review the literature on the use of LLLT in neuropathic pain with the goal of establishing a "therapeutic window" for the effective use of this treatment. We analyzed 14 articles, 10 in experimental animals and 4 in humans. The results are presented in three tables, the first being for comparison of the studies' application parameters, the second showing the average and median parameters experimental studies and third showing the clinical studies embodiment. The experimental studies revealed better results for LLLT and infrared laser powers above 70 mW. Clinical studies are inconclusive as to the application parameters, due to the discrepancy; however all demonstrate the effectiveness of LLLT. According to the data presented, it was concluded that LLLT has positive effects on the control of analgesia for neuropathic pain, but further studies with high scientific rigor are needed in order to define treatment protocols that optimize the action LLLT in neuropathic pain.

1. Introduction

Science describes pain as an evolutionary reaction whose main function is the communication of the bodily structural and functional damage through information concerning location and intensity of harmful and potentially damaging stimuli [1]. Lesion in the central or peripheral nervous system triggers a special type of pain, which is characterized by the absence of nociception, and this type of pain is named neuropathic pain [2]. Whereas the physiological or nociceptive pain is fundamental for the preservation of one's integrity because it warns for the occurrence of lesions in several bodily tissues, the neuropathic pain is maladaptive and is an important cause of permanent disability, especially when it is chronic [3].

According to the international Association for the Study of Pain (IASP), neuropathic pain can be defined as "pain caused by a lesion or disease of the somatosensory system" (www.iasp-pain.org/resources/pain definition). This definition replaces that appeared in the Classification of Chronic Pain published by IASP in 1994, which defined neuropathic pain as the pain triggered or caused by a lesion or primary dysfunction of the nervous system, or may occur due to peripheral nerve lesion (amputation), infection (post herpetic neuralgia), nerve compression (accidents, surgeries, tumor), infarction, metabolic (diabetic neuralgia) or could even be idiopathic [4]. Neuropathic pain is classified according to its intrinsic cause or by the location of the nervous lesion - central or peripheral - but the physiopathology and its biological mechanisms are not yet fully understood [5,6]. In order to better understand the human neuropathic syndrome, a great variety of experimental models has been developed, among which partial or total nerve transection, perineural inflammation, experimental diabetes and chronic sciatic nerve compression [7–12].

Nowadays, painkillers are the most commonly used techniques to treat. However, they have shown only 30% effectiveness in patients with neuropathic pain [13–15]. Therefore, several researchers have been seeking for alternative treatments, other than pharmacological, for the treatment of this type of pain, such as anesthetics and neurosurgical procedures, psychotherapy and physiotherapeutic resources [16–19].

Among the physiotherapy resources, LLLT has been widely used in investigations on tissue regeneration and pain reduction. This therapy has been highlighted due to its low cost, to the fact that it is non- invasive and that it presents few contraindications as well as rare side effects [20–23]. LLLT has effects on the reduction of fibrinogen levels, reduction of the edema and the quantity of inflammatory cells, which suggests analgesia by the reduction of the inflammatory process [23,24]. During the inflammatory process, LLLT acts modulating chemical mediators, vasodilation, increase on protein and cortisol synthesis [23,25], besides producing an increase in the synthesis of endorphins [26,27].

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The first work found in the literature that approaches LLLT for the control of neuropathic pain was described by Gustafsson et al., (2003) [28]. In this study, the authors used 532 nm laser, with 70 mW power and energy densities of 263 J/cm^2, 656 J/cm^2 and 1312 J/cm^2. Other works such as the one by Cidral-Filho et al., (2012) [29] approached LLLT for the treatment of neuropathic pain with much lower energy density values than the ones used by Gustafsson et al., (2003) [28]. They used the energy densities of 1 J/cm^2, 2.5 J/cm^2 and 4 J/cm^2. In both studies LLLT was effective and applied energy. The literature shows many studies in which LLLT is used in the treatment of neuropathic pain using energy densities ranging from 1 J/cm^2 to 1312 J/cm^2, and, in most studies, the results are positive despite the discrepant energy densities as well as other parameters, such as power and total energy, which also had divergent values. Therefore, it was necessary to perform a systematic review with the purpose of establishing a "therapeutic window" for the treatment of neuropathic pain with LLLT, aiming a more effective treatment and a better understanding of the mechanism of action of this therapeutic resource.

2. Materials and Methods

A systematic review of the literature was carried out after a bibliographical search on the database Medilane/PubMed, Lilacs, Embase, Scielo, Scopus and active search lists of bibliographical references of articles selected up to April 2016. The search was carried out according to the orientations in PRISMA [32] (Preferred Reporting Items for Systematic Reviews and Meta-Analysis). The database search was performed using the following terminology for laboratory tests: low level laser therapy and chronic nerve lesion and neuropathic pain and pain. For the clinical studies, the terminologies used were: low level laser therapy or laser therapy and neuropathic pain and clinical studies.

2.1. Inclusion Criteria

We selected full articles published in national and international periodicals, in English, Spanish and Portuguese, from the first publication on the subject until April 2016, which addressed the use of low intensity laser therapy in controlling neuropathic pain.

2.2. Study Type

We selected randomized clinical trials and experimental studies published in complete articles that used low level laser therapy as the main resource for the treatment of neuropathic pain.

2.3. Type of Participants

We included only those studies that reported results on people suffering from neuropathy and results experimental studies in an experimental model of neuropathic pain in rodents.

2.4. Intervention Type

We selected studies investigating the action of low level laser therapy as primary treatment resource for neuropathic pain.

2.5. Types of Reported Results

We included studies that investigated variables related neuropathic pain.

Clinical articles included in this review had their methodological quality assessed by the PEDro scale Physiotherapy Evidence Database.

Due to the heterogeneity of the primary studies, it was not possible to perform a meta-analysis. In order to compare the effect size (ES) of each MT technique, standardized mean difference was calculated for each comparison group separately, considering the values before and after intervention. They were further classified as small (<0.20), moderate (around 0.50) or large (>0.80), according to Cohen's criteria.

3. Results

We identified 34 works in the search for clinical studies (PubMed: 11; Lilacs: 5; Scopus 18), and for the laboratory studies we found 218 works (PubMed: 111; Lilacs: 50; Scopus 55, Scielo:1; whereas 1 study has been found by active search in bibliographical references), totaling 252 studies. After removing duplicated studies, the count was of 192 and after excluding articles whose title and abstract did not match with the proposal of this review, the final count was of 15 articles (Fig. 1).

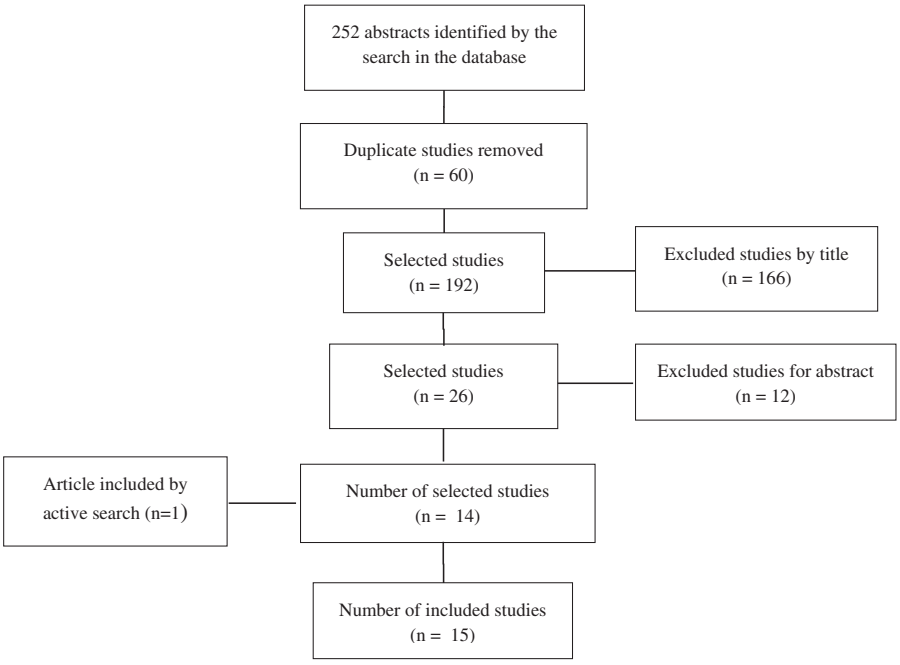

Fig. 1. Flow diagram of the different phases of the systematic review recommended by PRISMA [32].