Effectiveness of Laser Therapy in the Treatment of Myofascial Pain

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Abstract

Myofascial pain is a regional neuromuscular dysfunction of multifactorial etiology that is characterized by the presence of trigger points. It is a common cause of chronic pain and a frequent finding in clinical medicine. The proposed therapeutic procedures aim to reduce pain intensity, inactivate trigger points, rehabilitate muscles and preventively eliminate perpetuating factors. The search for effective treatments and non-invasive options is a topic of ongoing study and, among the proposed therapeutic modalities, laser therapy remains controversial. ***Objective:*** *To analyze the history of laser therapy in the treatment of myofascial pain, the evolution of research on its effectiveness and the establishment of treatment protocols.* ***Methodology:*** *Analytical study of randomized and controlled clinical trials, double-blinded or single-blinded, describing the effects of laser therapy for myofascial pain or myofascial trigger points, published between 2009 and 2013, and available in the databases PUBMED, MEDLINE, LILACS, IBECS, Cochrane Library, KSCI and SciELO.* ***Results:*** *Regarding the effectiveness of laser therapy for the treatment in question, both positive results and results at the same level as the placebo were observed in the studies. The heterogeneity of the trials does not allow the determination of optimal laser parameters for treatment.* ***Conclusion:*** *According to the data from clinical trials conducted in the last five years, it is still not possible to provide definitive conclusions about the effects of laser therapy for myofascial pain or to establish correlations between the observed results and the parameters employed.*

Keywords: myofascial pain syndrome; trigger points; laser therapy.

Introduction

Pain related to the musculoskeletal system represents two thirds of the algesic conditions treated in primary care. Myofascial pain is a common muscle dysfunction that causes chronic pain (1). Its chronic nature can cause serious health problems once quality-of-life is severely compromised. The prevalence of myofascial pain among patients seen in general medical practices varies from 30% to 95%. It is commonly identified in the diagnostic investigation of headache, lumbar, neck, and shoulder pain (2, 3) and frequently found in the head and neck region (4, 5, 6, 7, 8).

Myofascial pain syndrome (MPS) is a regional neuromuscular dysfunction associated with the presence of trigger points (TPs) in one or more muscle groups that generate variable pain patterns. The diagnostic criteria include the presence of a palpable taut band in the muscle, the presence of a hypersensitive palpable nodule in the taut band, a local contractile response (twitch) to palpation of the taut band, the reproduction of a typical pattern of referred pain in response to the compression of the nodules, i.e., of the TPs, and the spontaneous presence of a typical pattern of referred pain and/or the acknowledgment of this pain as familiar (9). There are still gaps regarding the specificity of the criteria (10, 11); thus, diagnosis is based exclusively on the clinical history and findings from the physical examination, which must be accurate to avoid confusion with other diseases that also occur with the presence of TPs (2, 8, 12).

With its multifactorial etiology, MPS presents a complex pathophysiology with possible involvement of the peripheral and central nervous systems (13), which, in particular, can contribute to difficulty in the treatment of chronic conditions (11, 12). Thus, MPS can be related to movement limitations, autonomic effects (e.g., tearing and redness of the eyes, nasal discharge, pilomotor activity and tinnitus), motor effects (protective co-contraction), and sensory effects (referred pain, secondary hyperalgesia and allodynia).

The factors possibly involved in MPS development and/or perpetuation include trauma, oral parafunctional habits, postural imbalances, sleep disorders, psychosocial stress and inadequate nutrition (9, 14, 15). The proposed therapeutic approaches have variable aims, ranging from the reduction of pain intensity, inactivation of TPs and muscle rehabilitation to the preventive elimination of perpetuating factors. Reviews of treatments for MPS cite pharmacological treatments, such as the use of anti-inflammatory agents, muscle relaxants (tizanidine, cyclobenzaprine, thiocolchicoside) and antidepressants (amitriptyline, duloxetine), botulinum toxin injection, dry needling and anesthetic injection, manual therapies, ultrasound, transcutaneous electrical nerve stimulation (TENS), magnetic stimulation, and laser therapy (11, 12).

A systematic literature review on the effectiveness of non-invasive treatments for active myofascial TP pain assembled the following conclusions about the proposed treatments: a) there is significant evidence that laser therapy can be effective as an intervention that, in the short term**,** reduces pain intensity, but studies are needed on the long-term effects and the definition of laser parameters and treatment protocols; b) TENS seems to have an immediate effect on the reduction of pain intensity, but the existing data are insufficient to demonstrate its effectiveness; c) there is moderate evidence that ultrasound is no more effective than placebo; d) there is preliminary evidence suggesting that magnetic therapy may be effective, but further studies are required to support the findings; and finally, e) trials evaluating manual therapies suggest that they may be effective, but their efficacy and effect compared to placebo remain inconclusive (4).

Also referred to as low intensity laser therapy (LILT), low level laser therapy (LLLT), soft laser and cold laser, among other names, laser therapy is a form of non-invasive alternative therapy. This therapy uses LASER (light amplification by stimulated emission of radiation) transmission equipment with a wavelength (λ) between 600 and 1000 nm, in which the following characteristics are highlighted: no emission of ionizing radiation, emission of light beam of exceptional collimation and potency, or laser parameters limited to values that do not produce a significant increase in temperature in the irradiated tissues (<0.5°C). The penetration depth of the laser light is influenced by several factors, which may be related to the characteristics of the target tissue, such as skin color (melanin is a major biological tissue photoreceptor, and increased melanin pigmentation may lead to higher absorption and lower transmission), to the wavelength used (different λ values may behave differently toward the same target tissue), to technical issues, such as the angle of incidence or mode of treatment (contact or noncontact, resulting in differences in the energy delivered), or even to technical aspects of the equipment used (compatibility of actual irradiated light values with the values displayed on the equipment) (16, 17).

Laser therapy has been studied and applied in several areas of healthcare because of its effects, which include the following: a) biochemical effects, involving control of the production of substances released during pain and inflammation phenomena and modifying enzymatic reactions; b) bioelectrical effects, occurring during the return to normalcy of the membrane potential; and c) bioenergetical effects, by providing energy to stimulate tropism, normalizing deficiencies and balancing inequalities. Laser therapy can result in increased local microcirculation, analgesia, and modulation of the inflammatory process as a possible adjuvant in reducing edema and tissue repair (16, 17, 18).

A study that evaluated the effects of laser therapy in MPS patients by measuring the intensity of pain through a visual analog scale (VAS) and by researching the levels of serotonin degradation products, specifically 5-hydroxyindoleacetic acid (5-HIAA) and serotonin + 5-hydroxytryptophan (5-HT + 5-HTP) in urine, established a correlation between the significant increase in the levels of these excreted products and the significant reduction in pain intensity observed in the treatment group in contrast with the control group (placebo treatment). The authors concluded that the increase in the excretion of a metabolite and a serotonin precursor due to infrared laser therapy reflects an increase in body serotonin that may partially explain the analgesia caused by laser therapy (19).

A systematic review of laser therapy in the treatment of cervicalgia from several causes, excluding conditions such as fibromyalgia and conditions related to systemic inflammation, analyzed prospective, randomized, and controlled clinical trials published in the English language, excluding crossover studies or studies that used the opposite side of the body as the control. The authors concluded that infrared laser therapy might be effective for cervicalgia treatment with a small probability of side effects (considered mild and transient, but not described). Due to the heterogeneity of the trials, however, it was not possible to determine the optimal energy density or the ideal anatomical site for laser irradiation (20).

In a meta-analysis of laser phototherapy for the relief of pain resulting from diverse etiologies, it was found that the number of articles addressing this issue had more than doubled since the year 2000, reflecting an increase in the acceptance of phototherapy as a clinical procedure to relieve pain. The authors observed that, based on the effect size of the analysis, phototherapy is highly effective for the relief of pain. The authors also reported that the exact mechanism of action of laser therapy is still being studied and emphasized its use not only as a substitute for other pain relief treatments but also as an adjuvant to be considered within multidisciplinary approaches (21).

Methodology

This review on laser therapy in the treatment of TPs and myofascial pain sought to analyze prospective, randomized, and controlled double-blinded or single-blinded clinical trials, regardless of muscle group, published in English. Studies published between 2009 and 2013 were analyzed, as data through 2008 had already been compiled (22), and the studies for analysis were selected from the databases PUBMED, MEDLINE, LILACS, IBECS, Cochrane Library, KSCI and SciELO using the following keywords: myofascial pain, myofascial pain syndrome, trigger points, laser, laser therapy, and low intensity laser therapy.

During the analysis process, crossover studies or studies that used the opposite side of the body as a control were judiciously excluded due to the potential cumulative systemic effect of laser therapy and evidence of effects distant from the treated area, respectively (17, 20). Studies that used only the RDC/TMD (Research Diagnostic Criteria for Temporomandibular Disorders) questionnaire for the diagnosis of myofascial pain were also excluded because it has been established in the literature that the diagnosis of myofascial pain in the orofacial region based on the RDC/TMD, which includes myofascial pain as one of its diagnostic subgroups, is flawed (23, 24). The RDC/TMD contains questions on the presence of muscle pain in the face or temples, measurement of mouth opening to assess the presence or absence of movement limitation, and assessment of levels of pressure-pain in masticatory muscle groups. However, the questionnaire does not investigate the presence of taut bands, TPs, twitch, referred pain upon the compression of nodules, or recognition of the pattern of pain as familiar, which are aspects that characterize myofascial pain by definition.

Results

Five articles were found in the databases cited that were in accordance with the criteria defined for the treatment of myofascial pain with laser therapy. Their parameters and results are shown in Table 1.

Table 1: Parameters and results of selected articles

ARTICLES / INFORMATION	Carrasco et al. (2009) [25]	Shirani et al. (2009) [6]	Jung-hoon Lee, Sun-min Lee (2011) [26]	Kannan (2012) [27]	Uemoto et al. (2013) [28]
N	60 patients 6 groups (3 G laser)	16 patients 2 groups	30 patients 2 groups	45 patients 3 groups	21 patients 3 groups
Placebo group	Yes	Yes	Yes	No	Yes
Muscle groups	Anterior masseter Anterior temporal	Suggests masticatory muscles	Upper trapezius	Upper trapezius	Masseter
λ (nm) and (laser)	780 (GaAlAs)	660 (InGaAlP) 890 (GaAs)	830 (GaAlAs)	904 (NR)	795 (NR)
Emission	Continuous	Continuous Pulsed	Continuous	Pulsed	NR
Irradiation method	Contact	Contact with light pressure	Contact	NR	NR
Irradiation method (spot or scanning)	NR	NR	Spot	NR	NR
***SPOT SIZE* (cm^2)**	NR	0.6 0.6	0.07	NR	NR
P(mW)	G1 50 G2 60 G3 70	17.3 1.8 (AP)	450	NR	80
Pulse frequency/ repetition rate (Hz)	Not applicable (or = 0)	0 1500	0	NR	NR
No. of SESSIONS and	2 times per week for 4	2 times per	Only 1 session (?)	5 sessions on	4 sessions at

TIMES per week	weeks	week for 3 weeks		consecutive days	intervals of 72, 48, and 72 hours
TOTAL energy (J)	NR	NR NR	#	NR	NR
PD(W/cm^2)	NR	# #	6.4	NR	NR
ED (J/cm^2)	G1 25 G2 60 G3 105	6.2 1	128.6	74 mJ/cm^2 (= 0.074)	4 (right side) 8 (left side)
Tested with power meter	NR	Yes	NR	NR	NR
Time (s)	NR	360 600	20	30	NR
E per point (J)/ no. of points	NR	NR	9 1 point	NR	NR
Evaluation method	VAS	VAS	Numerical scale Algometer	VAS Pain inducing test Cervical lateral flexion	VAS Algometer EMGs
Monitoring	- Before the 1st session - After the 4thsession - After the 8thsession - 15 days after treatment - 30 days after treatment	- Before treatment - After treatment - 1 week after treatment - On the day of complete pain relief - 30 days after treatment, only in the laser group	- Before treatment - After treatment	- Before treatment - After treatment	- Before treatment - After treatment
Result	No difference	Laser was better	No difference	Ultrasound, laser and ischemic compression obtained positive results, with preponderance of the laser group.	VAS: only placebo showed no improvement Algometer: improvement in the 4J/cm^{2}laser group and in the anesthetic injection group sEMG: no difference
Adverse effects	NR	No	NR	NR	NR
Association	No	No	No	Associated with stretching exercises	Associated with stretching exercises

NR = not reported, # = calculable, λ = wavelength, spot size = cross sectional area of the laser beam, P = power, AP = average power, PD = power density, ED = energy density, E = energy, VAS = visual analog scale, sEMG = surface electromyography, and G = group

Discussion

A critical analysis reviewing the literature on the use of LILT in the treatment of myofascial TPs up to 2008 draws attention to the lack of information on the laser parameters, methodology, and even the diagnostic criteria used, which precludes the reproduction of many of the published trials and the establishment of optimal parameters and methodologies for certain treatments based on scientific evidence (22). It can be observed from Table 1 that studies with insufficient information for replication are still being published, thus contributing only in a limited manner to the establishment of treatment protocols.

It can also be observed that the sample sizes ranged from 16 to 60 individuals, divided into groups of 7 to 15 patients, reflecting the difficulty of establishing inclusion/exclusion criteria. Only one trial did not employ comparison with a placebo group, and only one trial reported checking the parameter used with a power meter. In short, the effectiveness of laser therapy for myofascial pain treatment is still a controversial issue. Carrasco et al. (2009) subjected patients with a single active anterior masseter or anterior temporal TP to laser therapy with three different power densities for 4 weeks (2 weekly sessions) and compared them with the placebo groups. The evaluation was performed using a VAS, and the data were collected before, during, and 15 and 30 days after the end of therapy, with no significant difference found between the groups (25).

The clinical trial conducted by Shirani et al. (2009) evaluated a group treated with both red and infrared lasers compared to a placebo group. The patients were diagnosed with myofascial pain in temporomandibular disorder (TMD) through physical examination, and patients with other forms of associated TMDs were excluded. The article was not clear about the irradiated muscle groups or the irradiation method, but the authors mentioned the masseter as the most painful muscle and the non-involvement of the lateral pterygoid in the study. The results showed that the laser treatment employed in the trial for the reduction of pain was significantly superior to the placebo (6).

Lee and Lee (2011) studied the immediate effect of laser therapy on myofascial TPs in the upper trapezius. After a single irradiation at one point, the authors observed no significant difference between the laser and placebo groups in the pressure-pain threshold and sensitivity to 3 Kg measurements taken before and after treatment. The authors consider the non-observation of positive results to be possibly due to the use of inadequate laser parameters and point to the small sample size, the short evaluation time, the lack of evaluation of different parameters, and the lack of treatment of multiple TPs as limitations of the study (26).

In 2012, Kannan compared laser therapy, ultrasound, and ischemic compression treatments for myofascial pain in the upper trapezius, performed for a period of five consecutive days. The patients belonging to the three groups were advised to simultaneously follow a home program of muscle stretching, which was not described. All three groups showed improvement, with a trend toward better results in the laser group. The author noted the absence of a control group (placebo), the small sample size, and the short follow-up time as study limitations (27). Uemoto et al. (2013) evaluated the deactivation of myofascial TPs in the masseter muscle using laser therapy and dry needling or anesthetic injection. With regard to laser therapy, one group was irradiated with an infrared laser at 4 J/cm^2 in the right masseter and 8 J/cm^2 in the left masseter. In the control group, sham laser therapy (placebo) was performed on the right and left masseter muscles. Four treatment sessions were performed at intervals of 72, 48, and 72 hours between sessions. At the end of each session, the patients performed three sets of 10 seconds of active muscle stretching, consisting of maximum mouth opening. Based on an assessment using a visual analog scale, only the control group showed no significant reduction in pain. In the evaluation using a digital algometer, significant improvement was observed only in the anesthetic injection and laser therapy with 4 J/cm^2 groups. In the evaluation by surface electromyography, no significant changes in the signals captured during maximal voluntary contraction before and after treatment were observed (28).

The following should therefore be asked: what information is required for an adequate description of the trials, or how can the studies be made reproducible and provide definitive information on appropriate or inappropriate parameters for laser therapy treatment? In addition to detailed physical examination performed according to diagnostic criteria for myofascial pain (2, 9) and the history of the disease, the duration of symptoms should also be reported because a chronic condition lasting many years may be associated with central sensitization, which can hinder treatment response (11, 30). With respect to the criteria related to trials with laser therapy, a consensus was reached by the World Association for Laser Therapy (WALT) (29) resulting in the guidelines summarized here as follows: the trial must include a control group with a placebo laser or other reference treatment, randomization procedures, and "blind" patients; must present a specific description of the intervention (irradiation method, wavelength, output power, treatment length, energy, power density, cross-sectional area of the laser beam, and total energy); must measure emission using a powermeter (at least at the beginning and end of the trial); must avoid interventions in conjunction with steroids; and must clarify the site of laser exposure.

Verified information on the energy delivered, ensuring that the laser emission in the equipment is within the disclosed parameters and within the therapeutic ranges, will avoid, for example, the delivery of under dosages, allowing the professional to compare the methodologies and protocols used and thus giving greater credibility to the results of the studies.

In addition, it is important to report the characteristics of the target tissue, such as skin color, because of the presence of the photo-absorber melanin, as the established parameters (29) use Caucasians as a reference. Finally, because laser therapy is a sensitive technique, non-compliance with criteria ranging from technical problems, such as a dirty lens, to the use of sunscreen by the patient in the area to be irradiated can interfere with the effects of its application.

Conclusion

According to the results of the scientific studies found in the cited databases following the criteria described, it is still not possible to draw definitive conclusions about the effects of laser therapy in patients with myofascial pain or to establish correlations between the parameters used, reduction in pain intensity, and possible benefits in the treated region.

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