The effects of low-level laser in the treatment of myofascial pain syndrome: systematic review

Os efeitos do laser de baixa intensidade no tratamento da síndrome da dor miofascial: revisão sistemática

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ABSTRACT

BACKGROUND AND OBJECTIVES: Among the approaches inherent to conservative treatment, the low-level laser therapy (LLLT) is one of the most used resources in the treatment of myofascial pain. This research sought to search the literature for the available evidence on the treatment of myofascial pain syndrome with LLLT in order to analyze the reported effects of this intervention.
CONTENTS: Medline/PubMed, SCOPUS, Web of Science, Cochrane Central Registry of Controlled Trials (CENTRAL) and the Cumulative Index to Nursing and Allied Health Literature (CINAHL) by Ebsco was used to search for articles on randomized clinical trials that related myofascial pain syndrome with LLLT. Studies were systematically selected by two reviewers independently, through title, abstract and, later, full text. Ten articles that met the criteria were included in this integrative review. In six of these articles, the improvement in pain compared to placebo group was presented right after LLLT session, although these results did not remain in the follow-ups of the studies that performed follow ups.
CONCLUSION: LLLT seems to be a resource that decreases pain in patients with myofascial pain syndrome. Despite the positive results in reducing pain with the use of LLLT in some studies, this review admits the heterogeneity of studies with conflicting results related to the effectiveness of LLLT. Research that defines the parameters and adequate therapeutic dosages are necessary for a better understanding of the real effects of LLLT on this clinical condition.
Keywords: Pain, Trigger-points, Low-level laser therapy.

RESUMO

JUSTIFICATIVA E OBJETIVOS: Das abordagens inerentes ao tratamento conservador, o laser de baixa intensidade (LBI) é um dos recursos mais utilizados no tratamento da dor miofascial. Esta pesquisa buscou avaliar na literatura as evidências disponíveis sobre o tratamento da síndrome da dor miofascial com o LBI para analisar os efeitos reportados dessa intervenção.
CONTEÚDO: Foram utilizadas as bases de dados Medline/Pubmed, SCOPUS, *Web of Science*, Registro Central Cochrane de Ensaios Controlados (CENTRAL) e *Cumulative Index to Nursing and Allied Health Literature* (CINAHL), da Ebsco, para busca de artigos de ensaios clínicos randomizados que relacionassem síndrome da dor miofascial com LBI. Os estudos foram selecionados sistematicamente por dois revisores, independentemente, por meio do título, resumo e, posteriormente, texto completo. Dez artigos que se adequaram aos critérios foram incluídos nessa revisão sistemática. Em seis destes artigos, foi apresentada a melhora da dor comparada ao grupo placebo logo após a sessão de LBI, embora esses resultados não tenham permanecido nos acompanhamentos dos estudos que realizaram *follow-ups*.
CONCLUSÃO: O LBI parece ser um recurso que diminui a dor em pacientes com síndrome da dor miofascial. Apesar dos resultados positivos na diminuição da dor com o uso do LBI em alguns estudos, esta análise admite a heterogeneidade dos estudos com resultados conflitantes relacionados à efetividade do LBI. Pesquisas que definam os parâmetros e dosagens terapêuticas adequadas são necessárias para um melhor entendimento sobre os reais efeitos do LBI sobre essa condição clínica.
Descritores: Dor, Pontos-gatilho, Terapia com luz de baixa intensidade.

INTRODUCTION

The pain of specific location associated with muscle structure, usually associated with trigger-points (TP) and pain complaint, is commonly referred to as myofascial pain of multifactorial cau-

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HIGHLIGHTS
- Low-level laser therapy (LLLT) is one of the most used resources in clinical practice for pain relief. Therefore, it is important to comprehend its real effects in the treatment of this symptom.
- LLLT seems to show good results for pain relief, however there is heterogeneity among studies that makes it difficult to really understand these effects.
- More robust clinical trials are needed to achieve a better comprehension of the LLLT effectiveness in reducing pain.

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se. This is a condition that affects mostly females, with an age range of 30 to 45 years. The presence of myofascial pain and trigger points is associated with decreased range of motion, muscle strength and changes in functionality and quality of life[1,2].

The predominant muscles affected in myofascial pain syndrome are the posterior cervical, trapezius and levator scapulae; although it is believed that the prevalence is high, studies show prevalence data ranging from 28% to 65% of involvement[3]. The recurrence, commonly observed by clinicians, is also reported in literature, but little is investigated about the effects of therapeutic resources on the periodicity of crises[4,5].

Several conservative treatment resources are used in the management of myofascial pain syndrome, from the physiotherapeutic approach and its variety of interventions to the pharmacological treatment, either oral or injectable, such as anesthetics or corticoids[6,7]. However, there is no consensus on a type of treatment or resource that is considered the gold standard in treating patients with myofascial pain syndrome.

Low-level laser therapy (LLLT) is one of the most investigated treatments due to the photobiomodulation effect on the body[8,9]. There is evidence of the therapeutic use of LLLT in musculoskeletal conditions that are related to its effects in reducing pain and inflammation due to collagen stimulation and wound healing[10], as well as its effects directed to the rheumatologic area, as in arthritic conditions[11]. LLLT acts in pain reduction from the modulation of neurotransmitters that will relieve pain, such as serotonin and endorphin. In addition, it inhibits action potentials that will reduce painful stimuli and inflammatory cells[5,12]. Recent researches have presented the use of LLLT in the management of myofascial pain syndrome, however the results have been controversial and with great heterogeneity regarding the parameters used.

It is necessary to investigate the effect of LLLT on the reduction of pain in patients with myofascial pain syndrome, as well as on improvement of functionality and quality of life of these individuals. In addition, it is necessary to analyze the potentiation of the effects of LLLT associated with other interventions and its long-term effects. Therefore, this research has as main objective to search and evaluate in the literature the available evidence on the treatment of myofascial pain syndrome with LLLT and to analyze the reported effects of this intervention.

METHODS

This is a systematic review type of research that followed the recommendations established by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 Checklist. Data search was performed in the following databases: Medline/Pubmed, SCOPUS, Web of Science, Cochrane Central Register of Controlled Trials (CENTRAL) and Ebsco's Cumulative Index to Nursing and Allied Health Literature (CINAHL). The systematic search of the studies was performed without restriction on year of publication. Search terms were derived from the keywords "myofascial pain syndrome", "trigger-points", "low level laser", "laser therapy", "laser therapie" e "low-level light therapy", using the Boolean operators "AND" and "OR" for their combinations, and there were no restrictions as to the year of publication.

Eligibility criteria

Inclusion and exclusion criteria were chosen according to PICOS strategy. This review included randomized clinical trials (RCT) that investigated the effect of any low-intensity laser intervention on pain in individuals with myofascial pain syndrome. Pain had to be one of the outcomes analyzed for the study to be included, regardless of whether it was acute or chronic pain and the type of measurement performed. The evaluator should verify the diagnosis of myofascial pain syndrome by clinical evaluation or tests performed.

The exclusion criteria were studies that focused on generalized musculoskeletal pain or systemic inflammatory condition of rheumatic origin, and studies associated with temporomandibular dysfunction (TMD) linked to dentistry. Non-randomized clinical trials that did not have a placebo or control group and those that were not in English or Portuguese were excluded. Control group should be composed of individuals with the same disorder as those included in treatment group.

Selection of studies

The studies found from the search strategy were exported to EndNote X9.3.3 software. Then, cross references and duplicates were excluded by two researchers independently (M.G.F; J.R.S.A). In the same way, these researchers performed the following steps: selection of studies by titles and abstracts. Later, the selected articles were read in their entirety, determining which ones were included in this review. All steps mentioned above were carried out taking into account the eligibility criteria. Disagreements were resolved through meetings to reach consensus, and a third reviewer was available if necessary.

Methodological quality analysis

The methodological quality of the studies was performed by two reviewers independently. For this analysis, PEDro scale[13] was used, that contains 11 items, which are: eligibility criteria, sample randomization, allocation confidentiality, similarity of groups at baseline, blinding of participants, blinding of therapists, blinding of evaluators, measurement of at least one key outcome obtained in more than 85% of subjects, intention-to-treat analysis, intergroup comparison, effect measurement, and treatment variability. The total score ranged from zero to 10 points, with the higher the score, the better the methodological quality. Item 1 was not considered for score calculation.

Data collection

Data were collected regarding authors and year, age, gender, body mass index (BMI), number of participants in each group, study design, laser intervention parameters, outcome measures analyzed, intervention group and control group, and the main findings of each included study.

The data were analyzed qualitatively and categorized for discussion according to findings' relevance regarding the theme.

According to the established methods and criteria, 10 scientific articles were included in this review for analysis. Search results and verification steps are presented in figure 1.

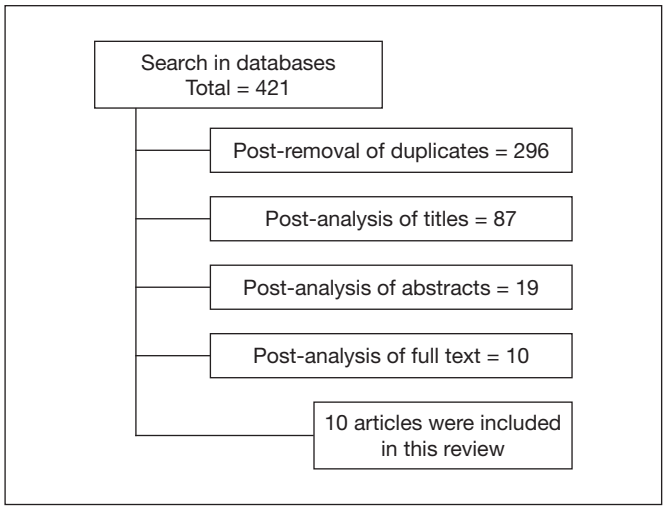

Figure 1. Search model flowchart

RESULTS

Characteristics of the studies

The selected articles were systematized based on collected data, including title, author, year of publication, sample size, intervention and comparison groups, and sample characteristics, such as gender and mean age. The results are shown in table 1. Most of the sample was female, and the age range was 23 to 47 years. Only two studies[14,15] presented data regarding weight and height of the participants. Only one article[16] used a crossover research design. 5 studies[4,17-20] compared laser application with an intervention other than placebo.

Quality of the studies

The selected studies had a mean score of 7.9 points on the PEDro scale and a range of 5-9 points. The questions regarding random allocation and specification of eligibility criteria were

Table 1. Study population and parameters used in the low-intensity laser intervention

Authors	Population	Laser Type	Wavelength	Parameters	Periodicity	Follow-up
Thorsen et al.[16]	n=41 with myofascial pain and age between 23 and 65 years	GaALAS	830 nm	Continuous and pulse mode Power 30 mWatt Energy/spot 0.9 J (max 9 J/treatment) Probe head area 2.5 mm^2	6 times/week 2 weeks 12 sessions	
Gur et al.[14]	n=60 (13 men and 47 women) with myofascial pain Intervention group: 30 Placebo group: 30	GaAs infrared laser	904 nm	Duration 200 ns Frequency 2.8 kHz Average power 11.2 mW Power density/spot: 2 J/cm2 (max 20 J/cm^2) Max output 20 W/pulse 1 cm surface Time 3 min on each spot	Daily for 2 weeks, except weekends. 10 sessions	2, 3 and 12 weeks
Ceylan et al.[17]	n=39 with myofascial pain Intervention group: 19 Placebo group: 20	Gymna 200 laser	904 nm	Duration 200 ns Frequency 4 kHz Energy/spot 1.44 J Laser probe tip length 5 mm Time 3 min at each spot	1 time a day for 10 consecutive days.	
Ilbuldul et al.[12]	n=60 subjects with myofascial pain Laser group: 20 Dry needling group: 20 Laser placebo group: 20	HeNe Laser	632.8 nm	Energy/spot 2 J	3 times a week 12 sessions	6 months
Altan et al.[19]	n=53 (18 men and 35 women) with myofascial pain Intervention group: 23 Placebo group: 25	GaAs laser	904 nm	Maximum power 27 W, 50 W or 27 • 4 W Frequency 1 kHz Time 2 min at each spot	1 time/day for 10 weekdays 2 weeks	2, 12 and 14 weeks
Dundar et al.[5]	n=64 (9 men and 55 women) with myofascial pain Intervention group: 32 Placebo group: 32	GaAsAl laser	830 nm	Power 42 J Frequency 1 kHz Time 2 min in each spot	1 time/day for 15 weekdays 3 weeks	4 weeks
Lee and Han[15]	n=24 (10 men and 14 women) with myofascial pain. Intervention group: 12 Placebo group: 12	GaALAs	830 nm	Power 450 mW Energy density 35.71 W/cm^2 Spot diameter 0.3 cm Spot size 0.07 cm^2	Intervals of 1 week for 1 min, 2 min, and 5 min, respectively.	

Continue...

Table 1. Study population and parameters used in the low-intensity laser intervention – continuation

Authors	Population	Laser Type	Wavelength	Parameters	Periodicity	Follow-up
Rayegani et al.[20]	n=63 (17 men and 46 women) with myofascial pain Laser Group: 17 Ultrasound group: 16 Laser placebo group: 16		880 nm	Continuous mode 880 nm/pulsed 905 nm Peak power 1100 mW Frequency 700 Hz with variable duty cycle Energy density 39,7 J/cm^2 Time 2 minutes each spot	5 times/week 2 weeks 10 sessions	
Manca et al.[21]	n=60 (32 men and 28 women) with myofascial pain Laser group: 11 Laser placebo group: 11 Ultrasound group: 12 Ultrasound placebo group: 12 No therapy group: 11	GaAs	904 nm	Pulse duration 200 ns Pulse frequency 1953 Hz Peak power 90 mw Average output 30 mw Power density 22.5 mw/cm^2 Energy dose 18 J/session Spot size 4 cm^2 Laser probe 4 cm^2 Time 600 seconds	5 times/week 2 weeks 10 sessions	12 weeks
Momenzadeh et al.[4]	n=30 with myofascial pain Laser intervention group: 10 Intravenous laser intervention group: 10 Placebo group: 10	GaALAs	810 nm	Continuous mode Power 60 mw Energy density 20.35 J/cm^2 Time 300 seconds each point	1 every 2 days except friday 12 sessions	1 and 3 months

nm = nanometer; J = joule; cm = centimeter; Hz = hertz; W = watt; kHz = kilohertz; mm = millimeter; min = minutes; mW = milliwatts.

the most satisfied among those evaluated by the scale. The least complied requirements were those related to blinding of assessors and therapists (Table 2).

Characteristics of the intervention protocols

Regarding the interventions performed, the studies presented a great variety in type of laser, wavelength, and parameters used in the interventions, as well as in frequency and number of sessions, and also in frequency of follow-up, when performed. Due to this disparity, these data were systematized in table 1.

Pain outcome

All the selected studies investigated the individuals' intensity or pain threshold, the intensity being evaluated by means of visual analog scale (VAS) and the threshold verified by an algometer. The results of most studies were statistically significant for post-session pain improvement compared to placebo, except in four[5,16,19,21]. The improvement in pain did not remain at the follow-ups performed.

The main results found in the included studies are summarized and inserted in table 3, as well as the instruments used for pain assessment in each study.

Other outcomes

Four selected articles[4,5,14,21] reported that there were no adverse effects in LLLT interventions. In addition to pain, the studies investigated function and quality of life through different questionnaires, range of motion (ROM) through a goniometer, the consumption of analgesics during treatment and a single study investigated the urinary excretion of 5-HIAA in 24 hours[17].

Table 2. Evaluation of methodological quality using PEDro scale

Authors	Criteria											Total score
	1	2	3	4	5	6	7	8	9	10	11	
Thorsen et al.[16]	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Alltan et al.[13]	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6
Ilbuldu et al.[12]	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	7
Rayegani et al.[20]	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	8
Ceylan et al.[17]	Yes	Yes	No	No	No	No	No	Yes	Yes	Yes	Yes	5
Lee and Han[15]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	9
Dundar et al.[5]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	9
Momenzadeh et al.[4]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	9
Gur et al.[14]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	9
Manca et al. [21]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	9

Table 3. Pain assessment tools and main findings

Autores	Pain assessment tools	Main findings
Thorsen et al.[16]	Visual Analog Scale (VAS)	No difference was found between laser group and placebo group with regard to pain reduction.
Gur et al.[14]	VAS	There was a significant decrease in pain in active laser group compared to placebo group at the end of treatment, and at 1 and 10 weeks after completion of treatment.
Ceylan et al.[17]	VAS	There was a significant decrease in pain in active laser group compared to placebo group at the end of treatment.
Ilbuldul et al.[20]	VAS and algometer	There was a significant decrease in pain at rest and pain on activity in laser group compared to placebo. However, there was no difference in any of the parameters between the groups at the 6-month follow-up.
Altan et al.[19]	VAS and algometer	There was no difference between the intervention and control group regarding the pain outcome.
Dundar et al.[5]	VAS	There was no difference between the intervention and control group regarding the pain outcome.
Lee e Han[9]	Algometer	There was a significant decrease in pain in active laser group compared to placebo group after 5 minutes of application.
Rayegani et al.[14]	Algometer	There was a significant decrease in pain at rest and pain on activity in laser group compared to placebo.
Manca et al.[21]	VAS and algometer	No difference was found between laser group and placebo group with regard to pain reduction.
Momenzadeh et al.[4]	Pain Disability Index (PDI) and VAS	There was a significant decrease in pain in active laser group compared to placebo group at the end of treatment.

One study[18] noticed a significant increase in the improvement of range of motion in extension for the laser group, compared to placebo and dry needling, right after the session. The improvement in quality of life measured in another study[4] using the SF-12 questionnaire, was not statistically significant.

DISCUSSION

Six of the 10 articles included in this review showed pain improvement in the intervention group compared to the placebo group immediately after the LLLT session, although the improvement seemed to last only a short time, since these results did not remain in the studies that performed follow-ups. Verifying LLLT effects on the upper trapezius, one study[15] used an evaluation method at one, two and five minutes after laser application. The intervention group did not show significant changes in pressure pain threshold after one and two minutes, however a significant change in pressure pain threshold was observed after five minutes in the LLLT group ($p<0.05$). Still using LLLT in the treatment of chronic neck pain, another study[14] found significant improvements in LLLT group patients with respect to all parameters such as pain, number of TPs, depression scores, functioning and quality of life measures, although there were improvements in placebo laser group patients with respect to resting pain intensity one week after the end of treatment. The authors of the aforementioned study make a strong recommendation for the use of LLLT in myofascial pain management from these results.

A systematic review[22] examined LLLT efficacy in treatment of acute or chronic neck pain patients, and the meta-analysis seemed to favor the group treated with laser. However, despite methodological rigor in conducting the review, the included studies had a large heterogeneity and some signs of publication bias were described. The authors consider the results inconclusive due to these divergences. These results corroborate with the present systematic review, in which the sample characteristics were unclear, such as description of habits, weight information, height, inequality in male/female ratio per group, and despite similar mean ages, the limits of standard deviation were unequal. The findings related to LLLT effects in the present systematic review may be masked because the volunteers in two studies[19,20] associated laser therapy with exercise. A large variability in laser parameters used was also present, decreasing clarity in comparing the results and increasing the likelihood of the effects being conflicting.

The most recent randomized clinical trial using LLLT for myofascial pain syndrome compared the results of percutaneous laser with intravenous laser application[4]. The results of this research related to quality of life questionnaire (SF-12) scores indicated improvement from low to high quality of life and remained constant in the high quality of life range until the end of the follow-up period in both groups, intravenous and percutaneous LLLT. When compared to placebo laser group, the improvements in quality of life that were observed in the other two groups were statistically significantly greater ($p<0.0001$). The mean maximum pain intensity during the day and night at the end of treatment and at the follow-up sessions one and three months after treatment showed a significantly ($p<0.0001$) greater reduction in intravenous LLLT and percutaneous LLLT groups compared to placebo laser group, but although the reduction in pain intensity was more pronounced in the intravenous LLLT group compared to the percutaneous LLLT group, this difference was not statistically significant ($p= 0.2$)[4].

An experimental research[19] that compared laser and placebo groups regarding cervical myofascial pain in percentage changes immediately after and 12 weeks after treatment, in relation to pre-treatment values, did not show a significant difference between the two groups, although an improvement was obser-

ved. Another study[5] analyzed the effects of LLLT application on cervical spine and found no statistically significant differences in pre-treatment parameters between the two groups (p>0.05). The comparison of percentage changes at four weeks after treatment compared with pre-treatment values also showed no significant difference between the two groups, although a significant improvement was recorded for all parameters in both groups at the end of therapy (week four). A study[16] that presented a crossover design, using the laser for neck and shoulder disorders, showed a result with significant difference in favor of the placebo group (p=0.04), in the patients' report on the treatment beneficial effects.

The differences between results found in the studies, regarding laser effects on myofascial pain syndrome, may be related to differences between the parameters used, such as dosage, mode of application and frequency[23,24]. One study[25] performed a randomized clinical trial involving patients with plantar fasciitis in which the objective was to compare LLLT application with high and low intensity. The research concluded that there was no difference regarding pain between these groups. However, it is important to point out that the pathophysiology of plantar fasciitis and myofascial pain syndrome are different.

A research[26] carried out a systematic review on the LLLT effects in patients with nonspecific chronic low back pain. Only studies that used LLLT with high doses were included and it was observed that there is a decrease in pain with the use of this type of treatment, since using a higher intensity it is possible to promote a decrease in pain from the photobiomodulation effects. There are reports in the literature of a minimum dose needed to achieve these effects[27,28] and this may explain why some studies included in this review did not show a significant effect on pain reduction. It is important to conduct further studies that compare the effects of small and high LLLT doses in patients with myofascial pain syndrome in order to have a better understanding of its effects, especially on pain.

The limitations of this study are the non-performance of a meta-analysis due to the heterogeneity of the studies and data used, in addition to the inclusion of studies written only in English and Portuguese. However, LLLT is a resource widely used in patients with pain symptoms and this review becomes important to elucidate its real effects in subjects with myofascial pain syndrome. Although there were no new randomized clinical trials published with this subject in the last four years, from the results found, it can be identified that the findings seem controversial for the use of LLLT in the management of this muscular condition. The studies analyzed seem to have some biases, which may generate uncertain results about the outcomes investigated. Based on that, there is a need for well-conducted clinical trials with better standardization of the parameters to be used in the treatment of this syndrome.

CONCLUSION

This study gathered results regarding the low intensity laser in the management of myofascial pain syndrome, understanding that this resource is widely used in physical therapists clinical practice, in the treatment of musculoskeletal disorders. Although some authors guarantee the effects of LLLT in reducing pain and improving the individuals' quality of life, the results of this qualitative analysis lead to questioning LLLT effectiveness, due to the variety of studies with conflicting results, and also the superiority of other resources in myofascial pain syndrome treatment. Researches that define the parameters and adequate therapeutic dosages are necessary to achieve a better comprehension of the real effects of LLLT on this clinical condition.

AUTHORS' CONTRIBUTIONS

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Data Collection, Conceptualization, Project Management, Writing - Preparation of the Original, Writing - Review and Editing
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Data Collection, Conceptualization, Project Management, Methodology, Writing - Preparation of the Original, Writing - Review and Editing, Supervision

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