



The Effects of High-Power Laser Therapy on the Treatment of Patients with Myofascial Trigger Points in the Upper Trapezius Muscle: A Randomized Controlled Trial

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Abstract

Introduction: This study aims to evaluate the effectiveness of high-power laser therapy (HPLT) in treating myofascial trigger points (MTrPs) in the upper trapezius muscle, a key contributor to myofascial pain syndrome.

Methods: This randomized controlled trial enrolled 40 participants with clinically confirmed active MTrPs in the upper trapezius muscle. Participants were randomly allocated to either the HPLT group or the control group. Both groups received ten treatment sessions over a two-week period. The high-power laser group was treated using a 15-watt laser device (810/980 nm wavelengths), while the control group received routine physiotherapy. Outcomes (Visual Analog Scale, neck disability, cervical range of motion) were assessed before and after the intervention.

Results: Significant improvements were observed in both groups, with the HPLT group showing superior outcomes. Pain intensity in the laser group declined by 4.06 points (6.39 ± 1.65 and 2.23 ± 1.24 before and after the intervention, respectively) compared to 2.33 (7.11 ± 1.88 and 4.78 ± 2.18 before and after the intervention, respectively) in the control group ($P < 0.001$). The Neck Disability Index also showed a more pronounced reduction in the laser group (18.35 ± 6.19 and 6.15 ± 3.64 before and after the intervention, respectively) compared to the control group (21.90 ± 7.49 and 15.50 ± 9.09 before and after the intervention, respectively) ($P < 0.001$). Although both groups showed improved cervical side-bending range of motion (ROM), no significant difference was noted ($P > 0.05$).

Conclusion: High-power laser therapy provided significant pain relief and functional neck improvement for individuals suffering from upper trapezius MTrPs. These findings contribute to the growing body of evidence supporting the use of HILT as a viable therapeutic modality for musculoskeletal pain, particularly MTrPs.

Keywords: Myofascial pain syndrome; Trigger points; High-power laser therapy; Upper trapezius; Physiotherapy.

Introduction

Myofascial pain syndrome (MPS) is a common musculoskeletal disorder, notable for its hallmark feature: myofascial trigger points (MTrPs). These sensitive palpable nodules form within tight muscle bands. Muscle tightness can result in radiating pain either spontaneously or when pressure is applied to the fingers.^{1,2} The formation of MTrPs typically stems from excessive strain, acute or repetitive overload, and mechanical stress.³

MTrPs frequently develop in the postural muscles, particularly in the shoulder and pelvic girdles, neck, and lumbosacral area.⁴ These muscle trigger points can be categorized as either active or latent. Active MTrPs cause pain even during muscle activity or at rest. In contrast,

latent points, as noted by Simons and Travell, do not produce pain unless direct firm pressure is applied, potentially leading to limited movement or muscle weakness.⁵ The prevalence of myofascial pain syndrome varies significantly, with reported rates in American pain clinics ranging from 30% to 85%.^{4,6}

In the neck region, the upper trapezius is especially susceptible to the development of MTrPs due to its exposure to constant stress and micro-trauma from minor shocks. This issue leads to the onset of myofascial pain syndrome, which can severely affect quality of life and create significant financial strain on healthcare systems.^{7,8} Therefore, it should be considered an important treatment part of the comprehensive neck physiotherapy program.

Treatment approaches for MTrPs include both invasive and non-invasive methods. Invasive treatments may involve injections of corticosteroids, anesthetics, or the use of dry needling. At the same time, non-invasive treatments range from medicinal applications to traditional physiotherapy methods such as muscle stretching, cooling sprays, laser therapy, and ultrasound.⁹

Exercise and stretching are integral components of non-invasive treatment strategies for managing MPS. Research supports that stretching the neck and shoulder muscles regularly leads to notable pain reduction, greater cervical mobility, and improved daily functioning.¹⁰⁻¹³ These exercises help lengthen shortened muscle fibers, reduce muscle tension, and promote flexibility, thereby addressing the biomechanical imbalances related to MTrPs. Resisted exercises, particularly for the neck extensors, have also proven effective in strengthening weakened muscles, alleviating pain, and restoring function.^{12,14,15} When combined with other therapeutic modalities, such as laser therapy or dry needling, exercise and stretching regimens contribute to holistic and sustained improvements in patients with MPS.¹⁶ Importantly, adherence to a structured home exercise program ensures long-term management of symptoms, highlighting the role of patient education and compliance in successful outcomes.¹⁷

Traditional treatments typically include electrotherapy, manual therapy, heat and cold applications, local anesthetics, needle injections, stretching, and exercise.¹⁸ Stretching, a commonly utilized technique, involves applying a sustained external elongation force, either manually or through mechanical devices, to extend a shortened muscle-tendon unit and surrounding connective tissues. This technique helps restore mobility by gently moving a hypomobile joint slightly beyond its limited range of motion, which may be restricted by adhesions, contractures, or scar tissue in the surrounding soft tissues.¹⁹

Recent studies have investigated various treatment approaches for managing MPS, particularly in the neck and upper back regions. A comprehensive systematic review and meta-analysis examined the comparative efficacy of dry needling versus manual trigger point therapy in managing myofascial pain syndrome. The findings demonstrated the comparable effectiveness of both interventions in pain reduction and functional improvement during short- to medium-term follow-up, with neither modality showing clear superiority.²⁰ These findings emphasize the need for personalized treatment approaches and support integrating both techniques into comprehensive management strategies for MPS.

Laser therapy, a non-pharmacological treatment for skeletal muscle conditions, encompasses both low-power (Class 3) and high-power (Class 4) lasers.^{21,22} The former utilizes limited energy at a single wavelength,

with research showing that it enhances cellular activity, anti-inflammatory responses, and collagen production.²¹ Numerous studies have demonstrated the benefits of cold lasers in enhancing the range of motion and alleviating pain.^{21,23}

The high-power laser, characterized by multi-wavelength emission and power outputs exceeding 500 milliwatts, has emerged in the field of laser therapy over the last decade. By delivering multiple wavelengths that target different tissue layers concurrently and providing greater energy output than low-power lasers, it is expected to provide a deeper penetration and more effective treatment.²⁴ So far, limited studies have been conducted in the clinical evaluation of high-power lasers. However, they have confirmed the positive therapeutic effect of this laser as a low-power laser.²⁴

Parandnia et al²⁵ found that both high-power laser therapy (HPLT) and dry needling effectively treat upper trapezius muscle MTrPs. Dundar et al²⁶ similarly demonstrated the clinical efficacy of HPLT for the management of upper trapezius myofascial pain syndrome. A systematic review by Arroyo-Fernández et al²⁷ demonstrated that HPLT produces clinically significant improvements in pain levels, joint mobility, and life quality for patients with musculoskeletal disorders. The results showed that due to the high risk of bias in the studies, the results of these studies should be used with caution, and more clinical trials are needed to reduce the risk of bias. Despite the growing body of literature on laser therapy for MTrPs, there is heterogeneity in the methodology of previous studies, especially in the field of laser parameters, participant characteristics, and study quality. Therefore, more clinical trial studies are necessary to determine the most optimal laser parameters for treating MTrPs and to increase the generalizability of study results. Therefore, this investigation aims to determine whether HPLT effectively reduces pain, increases neck mobility, and decreases functional disability in patients with upper trapezius MTrPs.

Methods

Subjects

Forty patients with MTrPs in the upper trapezius muscle were selected from patients referred to the Physiotherapy Clinic of Hamadan University of Medical Sciences. The diagnosis of MTrPs was based on the criteria established by Simons et al. These criteria include a palpable taut band in the upper trapezius muscle, elicited referred pain upon compression on MTrPs, pain, tenderness, or autonomic phenomena referred from active MTrPs.² The participants were randomly allocated into two study groups using a block randomization method: the HPLT group and the control group (n = 20 per group) (Figure 1). The randomization process utilized block randomization with two groups and a block size of 4. An independent

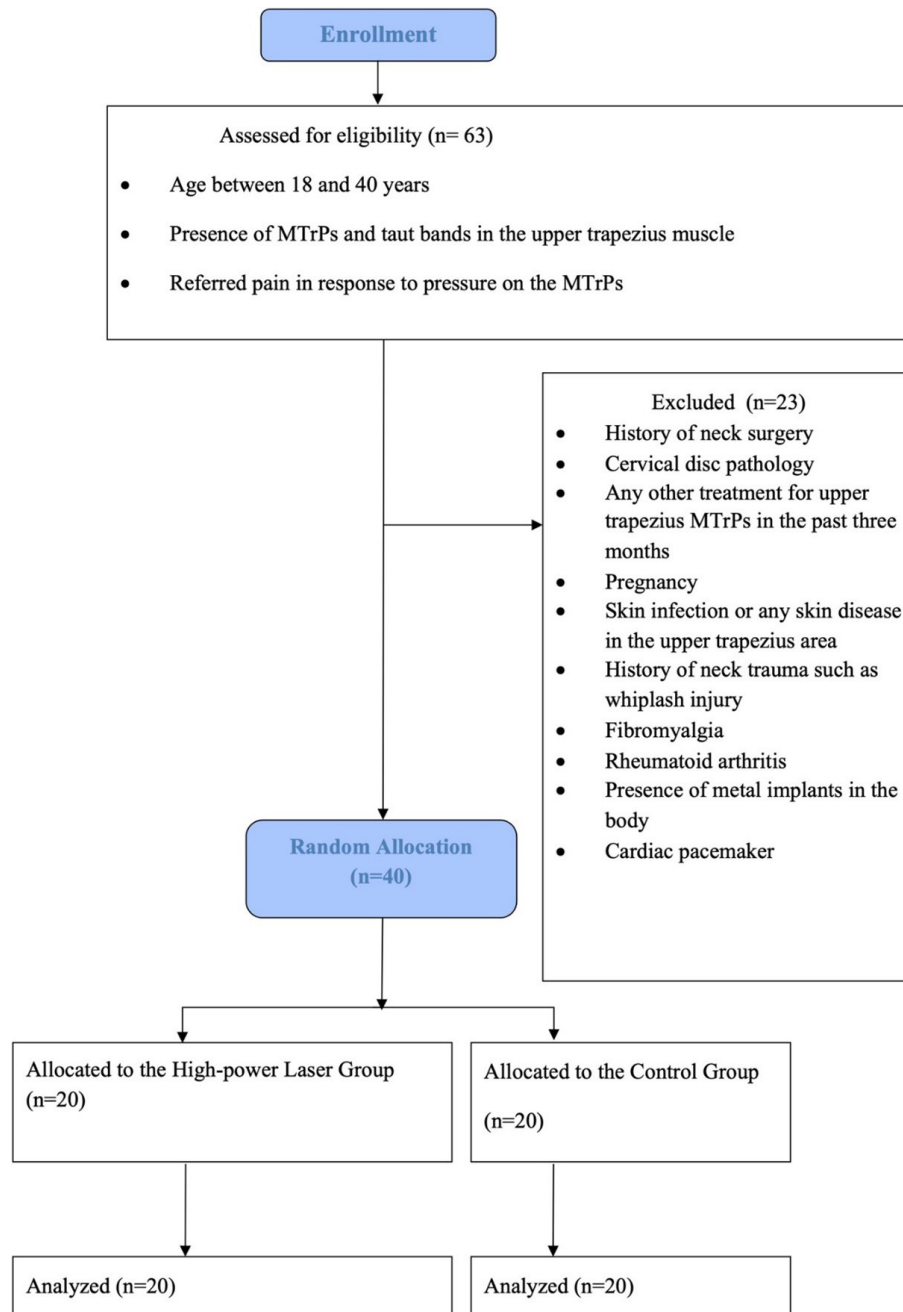


Figure 1. Flowchart of the Study Design

researcher uninvolved in participant screening, treatment delivery, or outcome assessment performed the randomization. The randomization sequences were contained in a set of sealed envelopes before allocation. The treating physiotherapist remained blinded to group allocation until immediately before the intervention, when the sealed envelope was opened to reveal the assignment. The sample size was determined using the formula for comparing the means of two groups, following the study by Dundar et al.²⁶ Based on the observed mean visual analog scale (VAS) scores (high-power laser: 2.7 ± 1.2 ; placebo: 4.2 ± 1.6) after the intervention, with a confidence level of 95% and a power of 90%, the sample

size was determined to be 20 participants in each group, totaling 40 participants.

$$n = \frac{(z_{1-\frac{\alpha}{2}} + z_{1-\beta})^2 (S_1^2 + S_2^2)}{(\mu_1 - \mu_2)^2}$$

Blinding was implemented as follows: Outcome assessors and data analysts remained blinded to group allocation throughout the study; meanwhile, patients and physiotherapists delivering the HPLT, due to the nature of interventions, could not be blinded. The outcome assessment and data analysis were performed by two

additional investigators who were blinded to treatment allocation by coding.

Inclusion Criteria

Eligible participants met all of the following criteria: (1) Age between 18-40 years; (2) diagnosed with active MTrPs in the upper trapezius muscle, confirmed by the presence of a palpable taut band and referred pain upon pressure, as per Simons et al²; (3) reported minimum pain intensity of 4 on the VAS at baseline; and 4) provided informed consent and agreed to comply with the study protocol. Additionally, participants had no contraindications to HPLT, such as active skin infections, lesions, or dermatological conditions in the upper trapezius area, and no metal implants or cardiac pacemakers.

Exclusion Criteria

Participants were excluded if they: (1) had prior cervical spine surgery or cervical spine pathology (e.g., cervical disc herniation, radiculopathy, or myelopathy), (2) had acute neck trauma (e.g., whiplash injuries) within the past 6 months, (3) had a diagnosis of fibromyalgia, rheumatoid arthritis, or any other systemic inflammatory or autoimmune condition, (4) had metal implants or cardiac pacemakers, (5) had received any treatment for MTrPs (e.g., dry needling, corticosteroid injections, or physiotherapy) within the past 3 months, (6) were pregnant or lactating, or (7) had active trigger points in other muscles of the shoulder girdle.

Written informed consent was obtained from all participants prior to enrollment. Confidentiality was strictly maintained, and participants could withdraw freely at any time.

Procedure

All patients received 10 treatment sessions across a 2-week duration (5 sessions/week). Pain intensity, Neck Disability Index scores, and cervical range of motion were assessed in all participants before and after the intervention.

Control Group: Routine Physiotherapy

The control group received routine physiotherapy treatments, which included:

1. Transcutaneous electrical nerve stimulation (TENS): TENS was delivered for 20 minutes using a low-frequency setting of 5 Hz and a pulse duration of 300 μ s (Novin Company, Iran). Two electrodes were used and secured with straps to maintain contact with the skin. The electrodes were placed bilaterally over the upper trapezius muscle, ensuring even coverage of the MTrPs.
2. Infrared therapy: A therapeutic infrared lamp was applied for 15 minutes, targeting the upper trapezius muscle. The lamp was positioned 30 cm away from the skin, ensuring consistent heat delivery.

3. Exercise Therapy: Participants performed cervical stabilization exercises that focused on activating and strengthening the deep neck flexors. This exercise was followed by passive stretching of the upper trapezius muscle, which involved slow and controlled movements to achieve a gentle stretch, held for 30 seconds and repeated three times on each side.

These treatments were designed to mirror standard physiotherapy practices for managing MTrPs and provide a comprehensive approach to pain relief and functional improvement.

High-Power Laser Therapy Group

In addition to the interventions undertaken by the control group, the HPLT group received treatment using a Novin 885G device (Novin Company, Iran). Treatment parameters included wavelengths of 810 nm and 980 nm, power of 15 W, frequency of 30 kHz, and duty cycle of 20-50%. The laser probe was held perpendicular to the skin and applied using a scanning method in both longitudinal and transverse directions over the upper trapezius muscle, corresponding to the location of the MTrPs.

Outcome Measures

Three primary outcome measures were used to assess the effectiveness of the interventions: pain intensity, neck disability index (NDI), and cervical range of motion. These measures were assessed before the first session and after the fifth and tenth sessions. The rationale for selecting these measures is based on their widespread use and validated reliability in assessing MPS.

Pain intensity was quantified using the VAS, which consists of a line from 0 (no pain) to 10 (most severe pain imaginable). Patients marked their evaluation of the existing pain on this graduated line, with higher scores indicating greater pain intensity.²⁸

The NDI was used to assess the impact of neck pain on daily activities and function. The NDI consists of ten sections that show the effect of neck pain on an individual's daily activities, including pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleep, and recreation. Each section is scored from 0 to 5, with a total possible score ranging from 0 to 50. The scores are interpreted as follows: 0-4 indicates no disability, 5-14 mild disability, 15-24 moderate disability, 25-34 severe disability, and 35-50 complete disability. The reliability and validity of this survey have been verified.^{29,30}

The cervical lateral flexion range of motion was quantitatively assessed using standardized manual goniometry. The patient sits on a chair with arms at the sides, both feet on the ground, and face forward so that the nose is vertical and the mouth is horizontal. The goniometer's pivot is aligned with the spinous process of the first thoracic vertebra, and the center of the movable arm is placed on the occipital protuberance.

The goniometer's fixed arm was precisely aligned parallel to the horizontal plane during all measurements. Participants were instructed to perform contralateral cervical lateral flexion while maintaining shoulder depression, with the goniometer's movable arm tracking the maximal achievable range. The range of motion was measured actively and without pain. Three measurements were recorded at 30-second intervals, and the mean value was calculated. All assessments were performed by the main researcher before and after the intervention.³¹ The study employed a dual-therapist design: one physiotherapist administered interventions while a separate, blinded evaluator assessed outcomes. For trigger point localization, participants assumed a supine position with their hands positioned beneath the forehead. Therapists identified taut bands in the upper trapezius via pincer palpation between the acromion and C7 spinous process.³² The trigger point demonstrating the highest visual analog scale (VAS) score upon palpation was designated as the primary treatment target for both assessment and therapeutic intervention.

Statistical Analysis

The Shapiro-Wilk test confirmed normal distribution ($P > 0.05$) for all measured variables across both treatment groups. Data were analyzed using the independent-samples t test, paired-samples t test, and chi-square test with SPSS 16 (IBM, SPSS Inc, Chicago, Illinois, USA). Statistical significance was set at $p < 0.05$ for all analyses.

Results

Demographic Variables

Demographic data showed no significant differences between the control and laser groups regarding age, history of pain, or BMI, confirming that the groups were comparable from the outset (Table 1).

The normality of the data was assessed using the Shapiro-Wilk test, with the results presented in Table 2. The test confirmed that all the variables under study had a normal distribution ($P > 0.05$), which justified the use of the parametric tests described. As shown in Table 3, pain

intensity, measured by the VAS, significantly decreased in both groups over time, indicating a difference between measurements taken before and after the intervention. The HPLT group exhibited a more substantial reduction in pain compared to the control group.

Significant pain reduction occurred in both groups after the treatment (both $P < 0.001$), although the HPLT group showed superior outcomes, with approximately 2.5 units greater improvement on the VAS compared to the controls ($P < 0.001$; Table 3).

Both groups showed a significant improvement in the side-bending range of motion post-intervention ($P < 0.05$ for within-group changes), though no significant between-group difference emerged ($P > 0.05$; Table 3).

NDI improved significantly in both groups over time ($P < 0.001$), with the HPLT group demonstrating a significantly greater improvement compared to controls ($P = 0.002$; Table 3).

Discussion

This study divided participants into two groups (i.e., control and HPLT) to ensure comparability, analyzing demographic variables such as age, pain history, and BMI. Baseline characteristics demonstrated no statistically significant intergroup differences, confirming equivalent starting parameters between the groups (Table 1). Random allocation was used to distribute participants equally, and strict inclusion and exclusion criteria helped ensure a homogeneous sample, reducing potential confounding factors. Standardized assessment tools, such as the VAS for pain intensity and the NDI for neck function, ensured consistent outcome measurements. Additionally, treatment protocols were followed rigorously, with the HPLT administered using precise parameters to ensure reproducibility.

Our findings demonstrate that HPLT significantly reduces pain intensity and improves functional outcomes in patients with upper trapezius MTrPs, outperforming the control group. This finding was supported by the more pronounced reductions in VAS scores and NDI results in the high-power laser group, reflecting both better pain relief and improved functional recovery.

Our results are consistent with prior clinical

Table 1. Comparison of Demographic Variables Between Control and High-power Laser Groups

Variables	Control (n=20)	High-Power Laser (n=20)	P Value
Age (year); Mean $\pm$ SD Range (Min, Max)	42.22 $\pm$ 12.26 42 (22, 64)	41.44 $\pm$ 9.54 34 (27, 61)	0.838*
History of pain (months); Mean $\pm$ SD Range (Min, Max)	10.61 $\pm$ 8.12 22.5 (1.5, 24)	6.50 $\pm$ 4.76 11 (1, 12)	0.072*
BMI; Mean $\pm$ SD Range (Min, Max)	23.83 $\pm$ 1.91 6.18 (19.38, 25.56)	25.19 $\pm$ 2.82 10.15 (19.97, 30.12)	0.109*
Gender (Male); n (%)	6 (30%)	2 (10 %)	0.235**

* Independent-samples t test; **Chi-square test.

Table 2. Result of the Kolmogorov–Smirnov Test for the Normality of Variables

Variables		Control		High-power Laser	
		Statistic	P Value*	Statistic	P Value*
Visual analog scale	Before	0.174	0.181	0.124	0.301
	After	0.141	0.200	0.155	0.140
Cervical range of motion (side bending)	Before	0.129	0.204	0.170	0.179
	After	0.212	0.053	0.195	0.167
Neck disability index	Before	0.191	0.153	0.136	0.202
	After	0.170	0.190	0.199	0.088

* Kolmogorov–Smirnov test.

Table 3. Comparison of the Visual Analog Scale, Side-Bending Range of Motion, and Neck Disability Index Between the Two Groups at Baseline After the Intervention

Variables	Group	Mean $\pm$ SD			CI (95%) **** P-value** (Effect Size)
		Before	After	Diff	
Visual analog scale	Control Range (Min, Max)	7.11 $\pm$ 1.88 6(4,10)	4.78 $\pm$ 2.18 7 (1,8)	-2.33 $\pm$ 0.77 2(-3, -1)	(-2.71, -1.95) <0.001 (3.02)
	High-power laser Range (Min, Max)	6.39 $\pm$ 1.65 4 (4,8)	2.23 $\pm$ 1.24 4 (1,5)	-4.06 $\pm$ 1.39 4 (-6, -2)	(-3.36, -12.36) <0.001 (2.92)
	CI (95%) ***	(-0.47,1.91)	(1.23,3.65)	(0.95,2.49)	
	P value* (effect size)	0.228 (0.40)	<0.001 (1.43)	<0.001 (1.53)	
Cervical range of motion (side bending)	Control Range (Min, Max)	23.75 $\pm$ 8.25 25 (10,35)	27.63 $\pm$ 9.48 35 (10,45)	4.47 $\pm$ 4.68 15 (0,15)	(2.21,6.73) <0.001(0.95)
	High-power laser Range (Min, Max)	28.25 $\pm$ 7.99 30 (15,45)	32.25 $\pm$ 7.69 30 (15,45)	4.00 $\pm$ 5.28 15 (0,15)	(1.52,6.47) 0.003 (0.75)
	CI (95%) ***	(-9.70,0.70)	(-10.20,0.97)	(-2.77,3.71)	
	P value* (effect size)	0.088 (0.55)	0.102 (0.53)	0.769 (0.09)	
Neck disability index	Control Range (Min, Max)	21.90 $\pm$ 7.49 20 (9,29)	15.50 $\pm$ 9.09 26 (3,29)	-6.40 $\pm$ 4.16 11 (-11,0)	(-8.34, -4.45) <0.001 (1.53)
	High-power laser Range (Min, Max)	18.35 $\pm$ 6.19 19 (10,29)	6.15 $\pm$ 3.64 12 (1,13)	-12.20 $\pm$ 6.38 19 (-22, -3)	(-15.18, -9.21) <0.001 (1.91)
	CI (95%) ***	(-0.84,7.94)	(4.84,13.85)	(2.35,9.24)	
	P value* (effect size)	0.111 (0.51)	<0.001 (1.35)	0.002 (1.07)	

Independent-samples *t* test; **Paired-samples *t* test.

***95% confidence interval for the mean difference between the two groups .

****95% confidence interval for the mean difference before and after .

investigations reporting positive outcomes following high-power laser application for MTrPs, reinforcing its therapeutic value in myofascial pain management. For example, Yassin et al³³ conducted a comparative study between high-intensity laser therapy and dry needling for treating MTrPs in the upper trapezius. Their findings from 32 female participants demonstrated that both modalities significantly improved pain scores, functional disability measures, and cervical range of motion. They found no significant differences between the two treatments, suggesting that both HPLT and dry needling are equally effective for managing MTrPs. However, unlike Yassin et al, who reported superior outcomes in the side bending range of motion for the laser group, our results showed no statistically significant between-group differences in this outcome measure.

Our findings are further supported by Dundar et al,²⁶ who evaluated the therapeutic effectiveness of HPLT for trapezius MTrPs. In their study, which included 76 female patients, HPLT combined with exercise showed superior outcomes compared to sham laser therapy combined with exercise. The HPLT group exhibited significant improvements in pain reduction, neck disability, and various aspects of quality of life. These results are consistent with those in our high-power laser group. The enhanced efficacy of high-intensity laser therapy is likely attributed to its ability to deliver higher energy levels, allowing deeper penetration and more effective targeting of deeper tissues, which could explain the superior outcomes in pain and functional measures.

In 2020, Shahimoridi et al³⁴ investigated the effects of

polarized low-power laser therapy and standard low-power laser therapy on MTrPs in the trapezius muscle. They included 64 patients, randomly divided into two groups: one receiving polarized low-power laser therapy and the other receiving standard low-power laser therapy, with both of the groups receiving ten sessions of laser therapy over a two-week period. Patients were treated with laser beams at an intensity of 6 J/cm², and pain intensity was measured using a VAS at baseline, after the 5th treatment session, and immediately after the 10th session. Both therapeutic modalities demonstrated analgesic effects, with standard low-power laser therapy exhibiting superior outcomes in pain reduction and functional improvement compared to polarized low-power laser therapy.

Building on the existing research, de la Barra Ortiz et al¹⁶ conducted a systematic review and meta-analysis examining the combined efficacy of HPLT and physical therapy interventions in treating myofascial pain syndrome. Their analysis included three RCTs (N = 176), with a focus on the upper trapezius muscle. The meta-analysis revealed that HPLT groups showed greater pain reduction compared to control groups, with a mean difference of -1.90 cm on the visual analog scale (95% CI: -2.58, -1.22; *P* < 0.01). While individual studies reported improvements in the cervical range of motion, the meta-analysis showed no significant differences between high-intensity laser therapy and control groups.

As highlighted in a systematic review by Ezzati et al,²⁴ HPLT has demonstrated promising results in managing chronic pain, especially when combined with exercise

or other therapeutic interventions. The review found that HPLT, with higher energy levels and long-term application, significantly reduces pain in conditions such as lumbar disc protrusion, plantar fasciitis, and juvenile rheumatoid arthritis. Nevertheless, the variability in study methodologies and the influence of confounding factors, such as the concurrent use of non-steroid anti-inflammatory drugs, necessitate further research. Long-term, randomized, controlled trials with rigorous methodological designs are essential to fully establish the HPLT's therapeutic potential in diverse musculoskeletal conditions.

In our research, both groups experienced significant pain reduction, indicating that HPLT enhances therapeutic outcomes. The deeper penetration and multi-wavelength capabilities of high-power lasers likely contribute to superior pain relief and functional improvement. This consistency aligns with findings from studies on low-level laser therapy, such as those by Shahmoridi et al.³⁴ and Uemoto et al.,³⁵ confirming the effectiveness of laser therapy in reducing MTrP-related pain and disability. However, in our study, the range of motion of lateral neck flexion did not differ significantly in the HPLT group compared to the control group. The explanation is that we only focused on the upper trapezius muscle. In contrast, several other muscles involved in side bending, such as the scalenes, sternocleidomastoid, and splenius capitis, were not targeted. By working on only one of the muscles, we may not have captured the full extent of side bending improvement that a more comprehensive treatment involving all relevant muscles might achieve.

The exact mechanism of the therapeutic effect of HPLT for MTrP remains unknown. HPLT may exert its analgesic effects through multiple neuromodulatory pathways: (1) direct inhibition of nociceptive signals in MTrP afferents, (2) suppression of A δ and C fiber transmission, and (3) activation of endogenous opioid release (enkephalins/endorphins).^{36,37} Regarding its photochemical and photothermal effects, HPLT can be used to promote muscle tissue repair and remove painful stimuli by increasing blood flow, vascular permeability, and cell metabolism.³⁸ Also, HPLT demonstrates therapeutic potential for relieving muscle spasms and reducing taut band tension in myofascial pain syndromes by stimulating sensory receptors and decreasing the perception of localized pain.³⁹

Several methodological limitations should be considered when interpreting these results. First, the modest sample size in this investigation constrains both the statistical power and generalization to broader populations. Future studies with larger and more diverse populations are needed to confirm the efficacy of HPLT in treating MTrPs. Second, the short follow-up period restricted the ability to evaluate the long-term effects of the intervention. Longer follow-up durations would provide

more comprehensive insights into the durability of the observed benefits. In this respect, Future investigations should incorporate musculoskeletal ultrasound imaging to objectively evaluate structural tissue modifications following HPLT interventions. Additionally, the absence of detailed baseline characteristics such as smoking status, activity level, and other relevant factors is a limitation.

Moreover, the study focused exclusively on the upper trapezius muscle, while other muscles involved in cervical function, such as the scalenes, sternocleidomastoid, and splenius capitis, were not targeted. Finally, the study employed specific laser parameters and treatment protocols, which may not fully represent the potential of HPLT. Exploring different dosages, frequencies, and combinations with other treatment modalities, such as exercise or manual therapy, could further optimize therapeutic outcomes in future research.

By addressing these limitations, future studies can build on the current findings and provide a more comprehensive understanding of the role of HPLT in managing myofascial pain syndrome.

While HPLT offers significant promise in pain reduction and functional recovery in individuals with myofascial pain syndrome, several practical applications must be considered. One major factor is the cost of HPLT, which can vary depending on the equipment used and the duration of treatment. This variability could potentially limit the accessibility of HPLT for some patients, particularly in resource-constrained settings. However, the potential for sustained pain relief and improved functionality, especially for individuals with chronic pain conditions unresponsive to other treatments, may justify the expense. In such cases, HPLT could offer a valuable alternative or adjunct to more conventional therapies.

Furthermore, accessibility to HPLT is also influenced by the availability of specialized equipment and trained professionals, which may not be widespread in all regions. Expanding access to these resources through a broader distribution of equipment and enhanced training for healthcare professionals could help increase the accessibility of this therapy, particularly in underserved areas.

Regarding long-term benefits, although our study demonstrated significant improvements in pain and function in the short term, the sustained outcomes and durability of these benefits remain unclear. Accordingly, Future studies incorporating extended follow-up periods are required to comprehensively evaluate the sustained therapeutic benefits of HPLT for myofascial pain syndrome.

In conclusion, HPLT presents a promising, non-invasive treatment option that could be effectively integrated into comprehensive pain management programs. If these practical barriers can be addressed, HPLT could emerge as a treatment modality, offering both high efficacy and

practical accessibility, for myofascial pain and related chronic pain disorders.

Conclusion

This study highlights the effectiveness of HPLT as a non-invasive intervention for managing upper trapezius MTrPs, offering both analgesic benefits and functional restoration. The findings contribute to the expanding body of evidence supporting HPLT's role in managing myofascial pain syndrome and its potential application in a wider range of musculoskeletal conditions. With the ability to address key challenges such as cost, accessibility, and training, HPLT could become a valuable component of comprehensive pain management programs. By overcoming these barriers, HPLT holds the promise of significantly enhancing patient care, offering a highly effective and accessible treatment option for individuals suffering from chronic pain conditions.

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Competing Interests

The authors declare that they have no conflict of interest.

Ethical Approval

The research protocol was approved by the Ethics Committee of Hamadan University of Medical Sciences (IR.UMSHA.REC.1401.474) and was registered in the Iranian Registry of Clinical Trials (identifier: IRCT20190202042581N4).

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References

- Chaitow L, Crenshaw K. *Muscle Energy Techniques*. New York: Churchill Livingstone; 1997.
- Simons DG, Travell JG, Simons LS. *Travell and Simons. Myofascial Pain and Dysfunction: The Trigger Point Manual*. Baltimore, MD: Lippincott Williams & Wilkins; 1999.
- Travell JG, Simons DG. *Apropos of all muscles*. In: *Myofascial Pain and Dysfunction*. Baltimore, MD: Lippincott Williams & Wilkins; 1992.
- Tough EA, White AR, Cummings TM, Richards SH, Campbell JL. Acupuncture and dry needling in the management of myofascial trigger point pain: a systematic review and meta-analysis of randomised controlled trials. *Eur J Pain*. 2009;13(1):3-10. doi: [10.1016/j.ejpain.2008.02.006](https://doi.org/10.1016/j.ejpain.2008.02.006).
- Rickards LD. The effectiveness of non-invasive treatments for active myofascial trigger point pain: a systematic review of the literature. *Int J Osteopath Med*. 2006;9(4):120-36. doi: [10.1016/j.ijosm.2006.07.007](https://doi.org/10.1016/j.ijosm.2006.07.007).
- Rickards LD. Therapeutic needling in osteopathic practice: an evidence-informed perspective. *Int J Osteopath Med*. 2009;12(1):2-13. doi: [10.1016/j.ijosm.2009.01.003](https://doi.org/10.1016/j.ijosm.2009.01.003).
- Sciotti VM, Mittak VL, DiMarco L, Ford LM, Plezbert J, Santipadri E, et al. Clinical precision of myofascial trigger point location in the trapezius muscle. *Pain*. 2001;93(3):259-66. doi: [10.1016/s0304-3959\(01\)00325-6](https://doi.org/10.1016/s0304-3959(01)00325-6).
- Alvarez DJ, Rockwell PG. Trigger points: diagnosis and management. *Am Fam Physician*. 2002;65(4):653-60.
- Hertling D, Kessler RM. *Management of Common Musculoskeletal Disorders: Physical Therapy Principles and Methods*. Philadelphia, PA: Lippincott Williams & Wilkins; 2006.
- Tunwattanapong P, Kongkasuwan R, Kuptniratsaikul V. The effectiveness of a neck and shoulder stretching exercise program among office workers with neck pain: a randomized controlled trial. *Clin Rehabil*. 2016;30(1):64-72. doi: [10.1177/0269215515575747](https://doi.org/10.1177/0269215515575747).
- Maicki T, Trąbka R, Wilk-Frańczuk M, Krzepkowska W. Proprioceptive neuromuscular facilitation therapy versus manual therapy in patients with neck pain: a randomised controlled trial. *J Rehabil Med*. 2024;56:jrm40002. doi: [10.2340/jrm.v56.40002](https://doi.org/10.2340/jrm.v56.40002).
- Rosenfeldt M, Stien N, Behm DG, Saeterbakken AH, Andersen V. Comparison of resistance training vs static stretching on flexibility and maximal strength in healthy physically active adults, a randomized controlled trial. *BMC Sports Sci Med Rehabil*. 2024;16(1):142. doi: [10.1186/s13102-024-00934-1](https://doi.org/10.1186/s13102-024-00934-1).
- Hashem M, Almohaini RA, Alharbi TM, Aljurfi MM, Alzmamy SA, Alhussainan FS, et al. Impact of neck and shoulder pain on health-related quality of life in adults in Saudi Arabia. *Cureus*. 2024;16(4):e59252. doi: [10.7759/cureus.59252](https://doi.org/10.7759/cureus.59252).
- Schomacher J, Petzke F, Falla D. Localised resistance selectively activates the semispinalis cervicis muscle in patients with neck pain. *Man Ther*. 2012;17(6):544-8. doi: [10.1016/j.math.2012.05.012](https://doi.org/10.1016/j.math.2012.05.012).
- Schomacher J, Falla D. Function and structure of the deep cervical extensor muscles in patients with neck pain. *Man Ther*. 2013;18(5):360-6. doi: [10.1016/j.math.2013.05.009](https://doi.org/10.1016/j.math.2013.05.009).
- de la Barra Ortiz HA, Liebano R, Vera M, Cancino J. Effectiveness of high-intensity laser therapy added to a physical therapy program for the treatment of myofascial pain syndrome-a systematic review and meta-analysis. *Adv Rehabil*. 2022;36(3):35-48. doi: [10.5114/areh.2022.119498](https://doi.org/10.5114/areh.2022.119498).
- Alayat MS, Battecha KH, Elsodany AM, Ali MI. Pulsed ND:YAG laser combined with progressive pressure release in the treatment of cervical myofascial pain syndrome: a randomized control trial. *J Phys Ther Sci*. 2020;32(7):422-7. doi: [10.1589/jpts.32.422](https://doi.org/10.1589/jpts.32.422).
- Hou CR, Tsai LC, Cheng KF, Chung KC, Hong CZ. Immediate effects of various physical therapeutic modalities on cervical myofascial pain and trigger-point sensitivity. *Arch Phys Med Rehabil*. 2002;83(10):1406-14. doi: [10.1053/apmr.2002.34834](https://doi.org/10.1053/apmr.2002.34834).
- Kisner C, Borstad J, Colby LA. *Therapeutic Exercise: Foundations and Techniques*. 8th ed. Philadelphia, PA: FA Davis Company; 2023.
- Lew J, Kim J, Nair P. Comparison of dry needling and trigger

- point manual therapy in patients with neck and upper back myofascial pain syndrome: a systematic review and meta-analysis. *J Man Manip Ther.* 2021;29(3):136-46. doi: [10.1080/10669817.2020.1822618](https://doi.org/10.1080/10669817.2020.1822618).
21. Cotler HB, Chow RT, Hamblin MR, Carroll J. The use of low-level laser therapy (LLLT) for musculoskeletal pain. *MOJ Orthop Rheumatol.* 2015;2(5):00068. doi: [10.15406/mojor.2015.02.00068](https://doi.org/10.15406/mojor.2015.02.00068).
 22. Ezzati K, Fekrazad R, Raoufi Z. The effects of photobiomodulation therapy on post-surgical pain. *J Lasers Med Sci.* 2019;10(2):79-85. doi: [10.15171/jlms.2019.13](https://doi.org/10.15171/jlms.2019.13).
 23. Chow RT, Johnson MI, Lopes-Martins RA, Bjordal JM. Efficacy of low-level laser therapy in the management of neck pain: a systematic review and meta-analysis of randomised placebo or active-treatment controlled trials. *Lancet.* 2009;374(9705):1897-908. doi: [10.1016/s0140-6736\(09\)61522-1](https://doi.org/10.1016/s0140-6736(09)61522-1).
 24. Ezzati K, Laakso EL, Salari A, Hasannejad A, Fekrazad R, Aris A. The beneficial effects of high-intensity laser therapy and co-interventions on musculoskeletal pain management: a systematic review. *J Lasers Med Sci.* 2020;11(1):81-90. doi: [10.15171/jlms.2020.14](https://doi.org/10.15171/jlms.2020.14).
 25. Parandnia A, Yassin M, Sarrafzadeh J, Salehi R, Navaei F. Comparison of the effects of dry needling and high-intensity laser therapy on pain intensity and pain pressure threshold in females with active trigger points in upper trapezius muscle: a single-blind randomized clinical trial. *Funct Disabil J.* 2020;3(1):111-22. doi: [10.32598/fdj.3.16](https://doi.org/10.32598/fdj.3.16).
 26. Dundar U, Turkmen U, Toktas H, Solak O, Ulasli AM. Effect of high-intensity laser therapy in the management of myofascial pain syndrome of the trapezius: a double-blind, placebo-controlled study. *Lasers Med Sci.* 2015;30(1):325-32. doi: [10.1007/s10103-014-1671-8](https://doi.org/10.1007/s10103-014-1671-8).
 27. Arroyo-Fernández R, Aceituno-Gómez J, Serrano-Muñoz D, Avendaño-Coy J. High-intensity laser therapy for musculoskeletal disorders: a systematic review and meta-analysis of randomized clinical trials. *J Clin Med.* 2023;12(4):1479. doi: [10.3390/jcm12041479](https://doi.org/10.3390/jcm12041479).
 28. Melzack R. The short-form McGill pain questionnaire. *Pain.* 1987;30(2):191-7. doi: [10.1016/0304-3959\(87\)91074-8](https://doi.org/10.1016/0304-3959(87)91074-8).
 29. Mousavi SJ, Parnianpour M, Montazeri A, Mehdian H, Karimi A, Abedi M, et al. Translation and validation study of the Iranian versions of the Neck Disability Index and the Neck Pain and Disability Scale. *Spine (Phila Pa 1976).* 2007;32(26):E825-31. doi: [10.1097/BRS.0b013e31815ce6dd](https://doi.org/10.1097/BRS.0b013e31815ce6dd).
 30. Vernon H, Mior S. The Neck Disability Index: a study of reliability and validity. *J Manipulative Physiol Ther.* 1991;14(7):409-15.
 31. Unalan H, Majlesi J, Aydin FY, Palamar D. Comparison of high-power pain threshold ultrasound therapy with local injection in the treatment of active myofascial trigger points of the upper trapezius muscle. *Arch Phys Med Rehabil.* 2011;92(4):657-62. doi: [10.1016/j.apmr.2010.11.030](https://doi.org/10.1016/j.apmr.2010.11.030).
 32. Simons DG, Travell JG, Simons LS. Travell & Simons' Myofascial Pain and Dysfunction: The Trigger Point Manual. 2nd ed. Baltimore, MD: Lippincott Williams & Wilkins; 1999.
 33. Yassin M, Parandnia A, Sarrafzadeh J, Salehi R, Navaee F. The effects of high intensity laser therapy and dry needling on clinical signs in females with upper trapezius muscle active trigger points: a single blinded randomized clinical trial. *J Bodyw Mov Ther.* 2024;40:1381-7. doi: [10.1016/j.jbmt.2024.07.031](https://doi.org/10.1016/j.jbmt.2024.07.031).
 34. Shahimoridi D, Shafiei SA, Yousefian B. The effectiveness of the polarized low-level laser in the treatment of patients with myofascial trigger points in the trapezius muscles. *J Lasers Med Sci.* 2020;11(1):14-9. doi: [10.15171/jlms.2020.04](https://doi.org/10.15171/jlms.2020.04).
 35. Uemoto L, Garcia MA, Gouvêa CV, Vilella OV, Alfaya TA. Laser therapy and needling in myofascial trigger point deactivation. *J Oral Sci.* 2013;55(2):175-81. doi: [10.2334/josnusd.55.175](https://doi.org/10.2334/josnusd.55.175).
 36. Chow R, Armati P, Laakso EL, Bjordal JM, Baxter GD. Inhibitory effects of laser irradiation on peripheral mammalian nerves and relevance to analgesic effects: a systematic review. *Photomed Laser Surg.* 2011;29(6):365-81. doi: [10.1089/pho.2010.2928](https://doi.org/10.1089/pho.2010.2928).
 37. Zati A, Valent A. Laser therapy in medicine. In: *Physical Therapy: New Technologies in Rehabilitation Medicine*. Torino, Italy: Edizioni Minerva Medica; 2006. p. 162-85.
 38. Kujawa J, Zavodnik L, Zavodnik I, Buko V, Lapshyna A, Bryszewska M. Effect of low-intensity (3.75-25 J/cm²) near-infrared (810 nm) laser radiation on red blood cell ATPase activities and membrane structure. *J Clin Laser Med Surg.* 2004;22(2):111-7. doi: [10.1089/104454704774076163](https://doi.org/10.1089/104454704774076163).
 39. de Sousa MV, Kawakubo M, Ferraresi C, Kaippert B, Yoshimura EM, Hamblin MR. Pain management using photobiomodulation: Mechanisms, location, and repeatability quantified by pain threshold and neural biomarkers in mice. *J Biophotonics.* 2018;11(7):e201700370. doi: [10.1002/jbio.201700370](https://doi.org/10.1002/jbio.201700370).