



Research Paper:

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



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Conflict of interest

The authors declared no conflict of interest.

ABSTRACT

Background & Objectives: Myofascial Trigger Point (MTrP) is one of the most common musculoskeletal disorders. The MTrP includes highly sensitive points within a taut band, is painful to palpation, and causes pain in a specific pattern. The MTrP is more prevalent in the upper trapezius muscle because this muscle plays an important role in maintaining the posture of the head and neck.

This study aimed to compare the effects of dry needling and high-intensity laser therapy on the clinical signs of females with active trigger points in the upper trapezius muscle.

Methods: Thirty females with the active MTrP of the upper trapezius muscle were randomly assigned into two groups: high-intensity laser therapy group (n=15) and dry needling group (n=15); they received the interventions in five sessions for three weeks. The outcome measures included pain intensity and pain pressure threshold, which were assessed before and two days after the interventions.

Results: In both study groups, the scores of the visual analogue scale of pain were significantly decreased, also, the pain pressure threshold was significantly increased (P=0.001), after the treatment. However, the two groups did not significantly differ in any of the outcome measures (P>0.05).

Conclusion: Both high-intensity laser therapy and dry needling can be employed to treat the MTrP of the upper trapezius muscle. Considering the effectiveness of the two treatments, each of the methods can be alternatively selected for these patients.

Keywords: Myofascial pain syndrome, Myofascial trigger point, Dry needling, High-intensity laser therapy, Upper trapezius muscle



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↑ *What is “already known” in this topic:*

The MTrP in Upper Trapezius muscle causes symptoms such as neck pain and shoulder pain. DN and HILT are invasive and non-invasive methods for treatment MTrP, respectively. no study has compared DN and HILT in the treatment of active TrPs of UT muscle.

→ *What this article adds:*

After five sessions of treatment, there was no significant difference in pain intensity and the PPT between DN and HILT. considering the effectiveness of the two treatments, each of methods can be alternatively selected for these patients.

1. Introduction

The Myofascial trigger point (MTrP) is one of the main causes of musculoskeletal pains [1]. Approximately, 30% to 85% of the population with musculoskeletal disorders would experience MTrP in their life [2, 3]. Also, the prevalence of MTrP has been reported as 21%, 30%, and 93% in the patients of a general orthopedic clinic, general medical clinic, and specialty pain management centers, respectively [8].

Travell and Simons have defined MTrP as highly sensitive and irritable spots in the palpable taut band of skeletal muscle [4]. Clinically, MTrPs are classified as active and latent in the musculoskeletal system and can be differentiated by manual assessment. The active trigger point can cause spontaneous pain and produce familiar referral pain on palpation, whereas the latent trigger point does not cause spontaneous and familiar pain [5-7].

Previous studies have related the etiology of trigger points to trauma, overuse, postural fault, muscle imbalance, and limbic system dysfunction [2, 9]. These points are painful on palpation or compression and can cause local and/or referred pain, tenderness, and autonomic response to a remote area [5].

The MTrPs are more commonly observed in the postural muscles, especially the upper trapezius (UT) muscle [10, 11]. The MTrP in the UT muscle causes symptoms, such as neck pain, tensional headache, dizziness or vertigo, and a limited range of motion of the neck and shoulder [9, 12].

Types of treatment in trigger point include noninvasive (manual therapy, phonophoresis, massage, tapping, ultrasound, shock wave, low-level laser, and high-intensity laser) and invasive techniques (injection, dry needling,

and acupuncture) [13, 14]. Overall, the mechanism of treating MTrP includes the inactivation of the trigger point [15].

Moreover, dry needling (DN) is a common therapeutic technique for patients with MTrP [16, 17]. The therapeutic effects of DN act through mechanical, neurophysiological, chemical, and microcirculation mechanisms, and improve sensory, motor, and autonomic symptoms caused by MTrP [18, 19]. Although studies have shown that DN is an effective treatment that decreases pain and improves pain threshold, it may not be accepted by all patients, because of its invasive nature, such as the fear of the needle, pain, tenderness, soreness, and local hemorrhage [20, 21].

High-intensity laser therapy (HILT) is a noninvasive technique, the beneficial clinical effects of which have been shown in the management of musculoskeletal disorders [22, 23]. It utilizes a particular waveform to reduce pain and inflammation with photochemical and photothermic effects [24-26].

However, no research has compared DN and HILT in the treatment of the active trigger points of the UT muscle. Therefore, this study aimed to compare the effects of these two treatments on pain intensity and pain threshold in females with active trigger points in the UT muscle.

2. Materials and Methods

2.1. Study design

This study was an experimental single-blind (evaluator) randomized clinical trial (IRCT20191208045652N2) performed in the Physiotherapy Clinic of the Faculty of Rehabilitation at Iran University of Medical Sciences. All the outcomes were measured by a physiotherapist who was blind to the method of intervention. All of the



Figure 1. Dry needling in the UT muscle

participants completed the written consent form, before receiving the intervention. This study was conducted from December 22, 2019, to September 5, 2020 (because of the prevalence of COVID-19 the implementation of the study was postponed for six months). Also, the study was approved by the ethical committee at the Iran University of Medical Sciences (No. IR.IUMS.REC.1398.1044).

2.2. Participants

This study included 30 females Mean±SD age: 26.46±4.69 years) with active trigger points in the UT muscle.

The inclusion criteria were as follows: (1) female aged 18 to 35 years; (2) the presence of the maximum number of three active trigger points in the UT muscle; based on Simons et al., the presence of a taut band in the UT muscle, the presence of sensitive and painful points at a pressure of 25 N/cm² in the taut band of the UT muscle, the presence of referral pain in response to pressure, and the presence of familiar and spontaneous pain during rest and/or movement; (3) the presence of pain at the range of 3 to 7 cm in the rest or activity, based on a 10-cm visual analogue scale (VAS); (4) patients with the symptom duration of at least three months; and (5) ability to read and write in the Persian language.

Besides, the exclusion criteria were as follows: (1) the history of neck surgery; (2) the presence of the signs and symptoms of cervical disk disease, such as radiculopathy; (3) the presence of any neurologic deficit; (4) the history of any treatment for trigger points in the upper trapezius muscle region, in the last three months; (5) pregnancy; (6) the infection or irritation of the skin in the region of the UT; (7) taking any anticoagulant therapy;

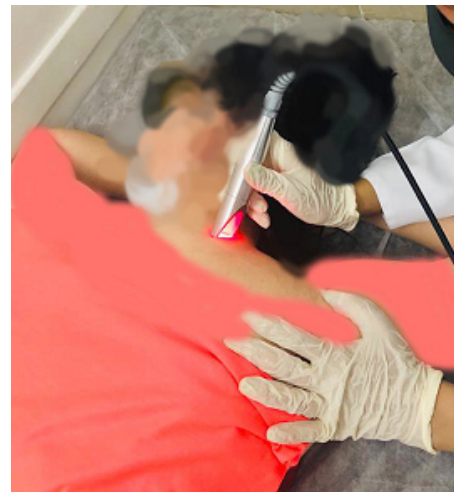


Figure 2. High-intensity laser therapy in the UT muscle

(8) the presence of malignancy in the neck and shoulder; (9) the presence of neck trauma, such as whiplash injury; (10) fibromyalgia; (11) the presence of severe kyphosis and/or scoliosis; (12) the fear of needle; (13) the presence of rheumatoid arthritis; (14) the presence of obvious cognitive and communication disorders; and (15) patient dissatisfaction with the continuation of the treatment and evaluation process.

2.3. Sample size and randomization

The sample size was calculated based on a pilot study on 10 patients. In the pilot study, G*Power software was used to compare the pain intensity of before and after treatment (primary outcome) between two groups Mean±SD in DN group and HILT group was 4.74±1.04 and 2.94±1.47, respectively. Also, the values of α and power in G*Power software were considered 0.05 and 95%, respectively. The software estimated the sample size as 30 people. The participants were randomly assigned into two treatment groups, using RandList 1.2 software and the block randomization method. Thus, 15 patients were allocated to the DN group and 15 patients were allocated to the HILT group.

2.4. Interventions

This study was conducted by two physiotherapists. The first physiotherapist performed the interventions and the second physiotherapist assessed the outcome measures. First, the participants were asked to lie in the prone position with their hands under their foreheads to find the active trigger point in the UT muscle. Then, the evaluator palpated the taut band of the UT muscle in the area

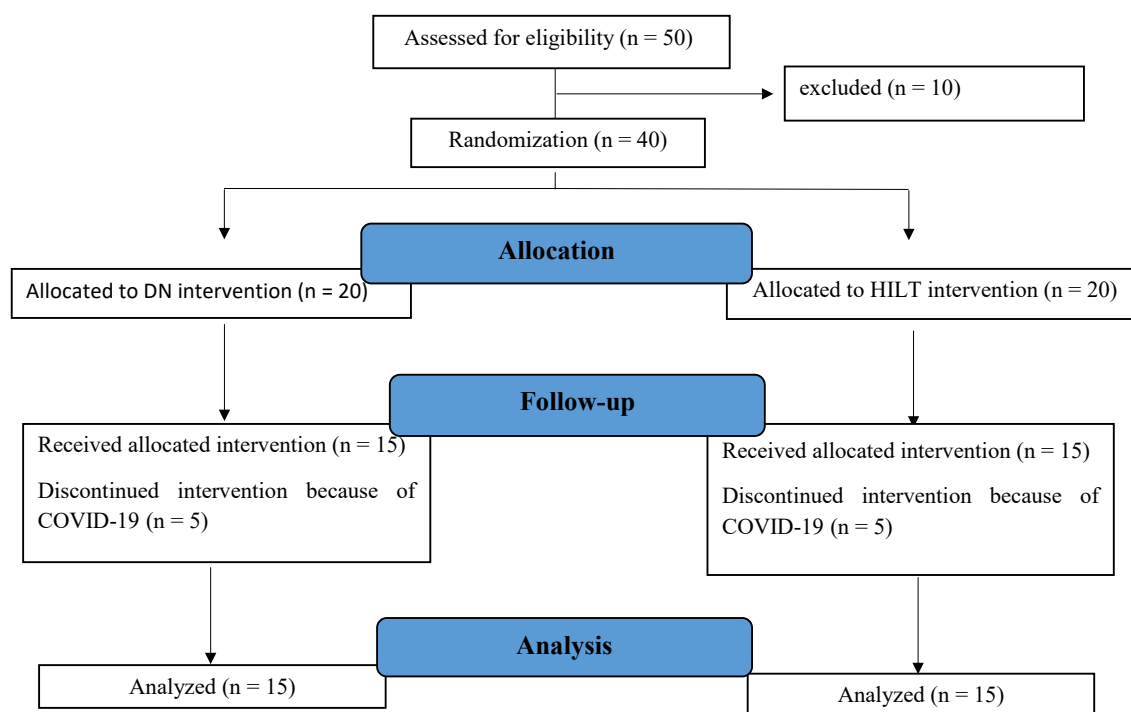


Figure 3. CONSORT flow diagram

Table 1. Comparison of demographic variables between the DN and HILT groups (independent t-test results)

Variables	Mean±SD/DN Group (n=15)	Mean±SD/HILT Group (n=15)	P
Age (y)	25.86±4.17	27.06±5.21	0.492
Weight (kg)	59.93±6.58	65.66±7.63	0.130
Height (cm)	164±5.25	164.4±5.30	0.837
Duration of pain (month)	23.66±17.17	23.26±16.89	0.949

DN: dry needling; HILT: high-intensity laser therapy.

between the acromion and the spinous process of the C7 by pincer palpation (using the thumb and index finger). The most painful MTrP in the UT muscle was detected with a digital algometer (based on VAS with the same pressure). Also, permanent markers were used to fix the location of the trigger point between sessions. In the next sessions, if the patient did not report pain in the previous point during the reexamination, the treatment would be continued on the most painful points in the UT muscle.

In the DN group, the patient lay in the prone position with her arms under her forehead and her head turned to the opposite side. After wearing the gloves on both hands, the physiotherapist cleaned the target area with alcohol. Then, the trigger point was located by pincer palpation, so that, the taut band of the UT muscle was held between the index finger and the thumb of the nondominant hand.

Next, the needle (diameter 0.25 mm, length 30 mm, Dong Bang, South Korea) was perpendicularly inserted into the muscle with the dominant hand. By wrist flexion and extension movements (fast-in and fast-out), the trigger point was needled in different directions until no Local Twitch Response (LTR) was obtained. Finally, the dry needling was removed by re-cleaning the site with cotton and alcohol (Figure 1).

In the HILT group, the patient lay in the prone position with her arms under her forehead and her head turned to the opposite side. Patients received HILT from Omega Laser device (NewAge Inc, Italy). The device provided the following options: wavelength (1064 nm), peak power (14 W), frequency (20-100 kHz), adjustable duty cycle from 20% to 100%, and adjustable spot size from 8 mm to 20 mm. The probe of the laser was placed per-

Table 2. Intra and Inter-group comparisons of the outcomes before and after the treatment (paired and independent t tests results)

Variables	Group	Mean±SD		Mean Diff.	95% CI Difference		P	P		Effect Size
		Before	After		Lower band	Upper band		Before	After	
Pain intensity (VAS, cm)	DN	5.92±0.57	2.63±1.51	3.29	2.45	4.12	0.001*	0.444	0.573	1.58
	HILT	6.16±1.04	2.94±1.47	3.22	2.57	3.86	0.001*			1.28
PPT (N/cm ²)	DN	18.01±3.83	30.94±6.17	-12.93	-16.50	-9.30	0.001*	0.624	0.441	2.58
	HILT	18.75±4.03	29.10±6.74	-10.35	-13.44	-7.26	0.001*			1.88

VAS: visual analogue scale; PPT: pain pressure threshold.

* Intra-group comparison (P<0.05).

pendicularly on the skin. Also, each treatment session was divided into three phases. The first phase was performed with the fast manual scanning and total energy of 1364 J. In this phase, the laser fluence was set to two subphases of 682 J. Moreover, scanning was performed in the transverse and longitudinal directions over the UT muscle. In the second phase, 75 J were irradiated to three active trigger points (25 J/point), for approximately one minute (14 s/point). The final phase was the same as the first phase but was performed with slow manual scanning. The treatment area was 100 cm² in the first and final phases, which was scanned with 2728 J and the energy density of 27.28 J/cm². The total energy delivered to the patient in one session was 2803 J in approximately eight minutes (Figure 2).

Furthermore, all patients in both groups received the passive stretching exercises of the UT muscle by the physiotherapist. Initially, the patient sat on the chair for stretching. Then, the head and neck were placed side-bent to the opposite side and rotated to the same side. The stretch was maintained for 45 s and released for 30 s. this cycle was repeated three times in each session. All patients were treated for five sessions with 2-day intervals between sessions (twice a week for three weeks). They were also instructed not to take any treatment during the study.

2.5. Outcome measurements

In each group, all outcomes were measured in the baseline and two days after the last session by an expert physiotherapist blinded to the groups.

2.5.1. Pain intensity

Pain intensity was the primary outcome measure determined by 0 to 10 cm VAS. The patient was asked to lie in the prone position and place her hands under the

forehead. Then, pain intensity was measured with an algometer (Force GAUGE SF-500, Amazon), while a constant vertical pressure of 25 N/cm² was applied to the active trigger point for three seconds. Then, the patient was asked to show the pain on a 10 cm graduated line, where the number 0 indicated the absence of pain and the number 10 indicated the most severe pain. This process was repeated three times with intervals of 10 s, and the average of repetitions indicated the intensity of pain. The validity and reliability of the VAS have been approved [27, 28].

2.5.2. Pain pressure threshold

The secondary outcome was the pain pressure threshold (PPT) measured by an algometer. The patient was asked to lie in the prone position and place her hands under the forehead. The algometer disk was vertically placed on the active trigger point. Also, the pressure of the algometer was gradually (1 N/cm²/s) increased and the patient was asked to report the onset of pain. This process was repeated three times with intervals of 10 s, and the average of repetitions indicated PPT. The validity and reliability of the PPT measurement have been approved [29, 30].

2.6. Data analysis

A Shapiro-Wilk test was used to determine the normal distribution of the variables before and after the treatment. Normal distribution was observed in all variables (age, weight, height, duration of pain, VAS, and PPT) in both groups. Besides, the independent and paired t tests were used to evaluate the inter and intra-group differences, before and two days after the end of treatment. The P value of less than 0.05 indicated statistically significant differences. Using the Cohen d effect size, the magnitude of treatment was calculated in the DN and HILT groups.

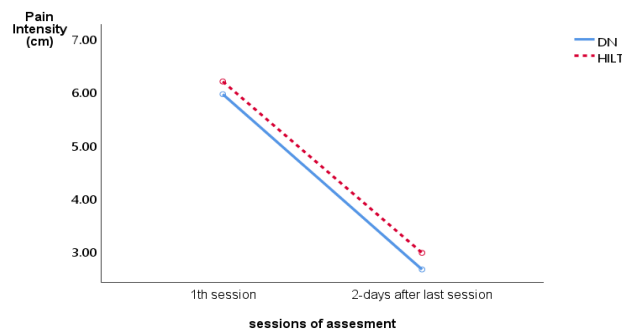


Figure 4. Comparison of Mean VAS between the groups (before and two days after the last treatment session)

Also, SPSS v. 26 was used to statistically analyze the obtained data.

3. Results

Figure 3 shows the flowchart of the present study. The Shapiro-Wilk test results showed the normal distribution of all variables (age, weight, height, duration of pain, VAS, and PPT) in both groups.

No statistically significant difference was observed between the groups in the demographic and dependent variables at baseline ($P \geq 0.05$) (Table 1).

The paired t test revealed that PPT increased and VAS reduced significantly ($P < 0.05$) in both groups, after the intervention (Table 2). Also, the independent t test results showed no statistically significant difference in VAS and PPT between the groups ($P \geq 0.05$), after the intervention (Table 2).

The effect size was calculated using the Cohen d test. It showed that the therapeutic effects of DN and HILT had large effect sizes (effect size > 0.7), also, after five treat-

ment sessions, DN showed a larger effect size than HILT on the VAS and PPT (Table 2).

4. Discussion

This study aimed to compare the effect of DN and HILT in females with the active trigger points of the UT muscle. The results showed that DN and HILT significantly improved the VAS and PPT after treatment, also, no superiority was observed between the two groups.

4.1. The effect of DN on the active trigger points of the UT muscle

In the present study, DN significantly decreased the VAS and increased the PPT, after the five treatment sessions. Consistent with the present study, many studies have investigated the effects of DN on the active trigger points of the UT muscle. Kietrys et al. showed that DN was more effective than sham DN in immediate pain reduction [1]. Also, Cerezo et al. showed that five sessions of DN significantly improved pain intensity and PPT, compared with the control group (passive stretch). They also showed that the passive stretch increased the sensitivity of trigger points alone

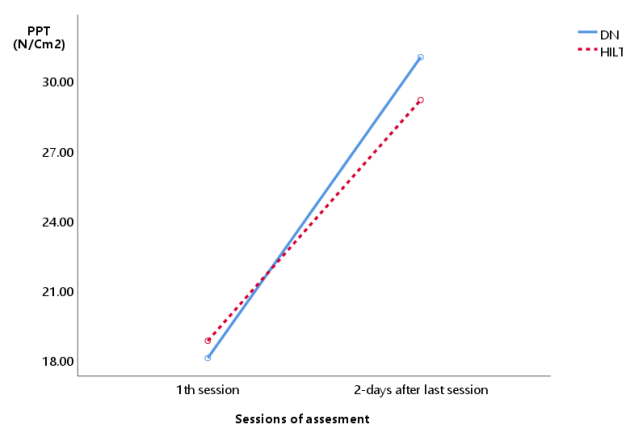


Figure 5. Comparison of Mean PPT between the groups (before and two days after the last treatment session)

[31]. Ziaieifar et al. reported that three sessions of DN (treatment group) and trigger point compression (control group) significantly reduced the pain intensity and increased the PPT in patients with the active trigger points of the UT muscle [32]. Also, Gerber et al. showed that DN (3 sessions) in patients with the active trigger points of the UT muscle significantly reduced pain and increased the threshold of pain [33]. Recently, Gallego et al. observed that DN with MT (manual therapy) was superior to sham DN with MT in pain reduction and PPT increase in patients with mechanical neck pain [34].

These studies and the present study indicate the effectiveness of DN treatment in patients with MTrP. The therapeutic effects of DN include mechanical, neurophysiological, and chemical effects [35]. Neurophysiologically, the movement of DN stimulates A-delta neurotransmitters and activates the enkephalinergic, serotonergic, and noradrenergic inhibitory systems, which block pain messages in the posterior horn of the spinal cord [36]. Mechanically, the insertion of DN in the trigger points could deactivate them by eliciting LTR. The LTR reduces irritability by relaxation of actin and myosin bands in the tightened muscles [15, 37]. Studies showed the increased levels of chemical properties, such as bradykinin, calcitonin gene-related peptide, and substance P, at the site of MTrP. The DN and subsequent LTR can directly normalize the levels of these properties [38] and increase PPT. Also, DN may increase blood flow in the skin and muscles at the site of stimulation [39].

Inconsistent with the present study, Martin et al. examined the effects of deep dry needling on people with mechanical neck pain and reported that pain intensity increased and PPT reduced 24 and 48 hours after treatment [40].

4.2. The effect of HILT on the active trigger points of the UT muscle

In the present study, HILT significantly improved the VAS and PPT after the five treatment sessions. Recently, researchers have considered HILT as one of the effective and safe therapeutic methods in the treatment of trigger points. Several systematic review studies have proven the effect of HILT on spinal disorders and musculoskeletal disorders [22, 23]. A high-intensity laser with a wavelength of 1064 nm is in the infrared range of the electromagnetic spectrum, and as a treatment method has more effective penetration depth than the low-power laser [41, 42].

Consistent with the present study, Hatem et al. compared the effects of HILT and physiotherapy (electrical

stimulation+ultrasound) on VAS, in patients with the active trigger points of the UT muscle. The authors concluded that HILT significantly reduced pain, compared with physiotherapy [43]. Also, Alayat et al. showed that HILT plus pressure release significantly improved the pain intensity and PPT in patients with MTrP in the UT muscle [44]. In line with the present study, Dundar et al. showed that HILT significantly improved the pain in patients with trigger points in the trapezius muscle [26].

The photochemical and photothermal effects of HILT increase blood flow and vascular permeability to repair damaged muscle tissue, reduce painful stimulus, and ultimately improve the energy crisis at trigger points [25]. Also, HILT helps to relax the spasm and taut band caused by the trigger point and increases the PPT by stimulating sensory receptors [45]. The HILT reduces the pain of the trigger point by direct nerve stimulation, the inhibition of A-delta and C fibers, and the secretion of enkephalin and endorphins [24, 46].

4.3. Comparing the effect of DN and HILT on the active trigger points of the UT muscle

In the present study, the groups did not significantly differ in the pain intensity and PPT, in the inter-group comparison based on independent t test results. Many studies compared DN with other interventions, such as tapping, shockwave, and manual therapies. Similar to the present study, these studies observed no significant difference between the groups.

Agung et al. evaluated the Low-level Laser Therapy (LLLT) and DN in patients with the active trigger points of the UT muscle. In this study, subjects were divided into two groups: LLLT (15 sessions) and DN (16 sessions). Akin to the present study, VAS and PPT (Figure 4 and 5, respectively) significantly improved in each group, compared with the baseline, but no statistically significant difference was observed between the groups [47].

Ebru et al. divided patients with the trigger points of the UT muscle into three treatment groups: DN, LLLT, and sham laser. The results showed a significant improvement of pain and PPT in the LLLT group, compared with the other groups [48]. This study is inconsistent with the present study.

4.4. Limitations and suggestions

The limitations of this study include the lack of a control group, the absence of long-term follow-up, a small sample size, and no considering of the number of activi-

ties in patients. We suggest future studies to use postural correction exercises plus these two therapeutic methods. Moreover, other suggestions include the comparison of DN and HILT in the latent trigger points of the UT muscle and the examination of the effects of DN and HILT in males. Also, studies should consider the side effects of DN and HILT to improve data collection.

5. Conclusion

According to the present study, DN and HILT have the same effect in reducing pain and increasing PPT in females with the active trigger points of the UT muscle.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles are considered in this article. The participants were informed about the purpose of the research and its implementation stages. They were also assured about the confidentiality of their information and were free to leave the study whenever they wished, and if desired, the research results would be available to them. This study was approved by the Ethics Committee of the Iran University of medical science (Code: IR.IUMS.REC.1398.1044).

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Authors' contributions

Conceptualization, Supervision: Marzieh Yassin; Methodology: Reza Salehi, Marzieh Yassin, Azizeh Parandnia; Investigation, Writing – review & editing: All authors. Writing – original draft: Azizeh Parandnia; Funding acquisition, Resources: Marzieh Yassin.

Conflict of interest

The authors declared no conflict of interest.

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بررسی مقایسه ای اثرات سوزن خشک و تابش لیزر پرتوان بر علائم بالینی در زنان مبتلا به نقاط ماشه‌های فعال عضله تراپزیوس فوقانی: کارآزمایی بالینی تصادفی شده یک سویه کور

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چکیده

مقدمه یکی از انواع دردهای اسکلتی-عضلانی، سندروم درد مایوفاشیال همراه با نقاط ماشه‌های میباشد. نقاط ماشه‌های نقاط حساس و تحریک پذیر در باند سفت شده عضلات اسکلتی می باشند که هنگام لمس دردناک بوده و باعث بروز درد انتشاری در یک الگوی خاص میشود. میزان شیوع نقاط ماشه‌ای در عضله تراپزیوس فوقانی به دلیل نقش مهم این عضله در حفظ پاسجر سر و گردن بیشتر می باشد. هدف از این مطالعه بررسی مقایسه‌ای اثرات سوزن خشک و تابش لیزر پرتوان بر علائم بالینی در زنان مبتلا به نقاط ماشه‌های فعال عضله تراپزیوس فوقانی بود.

مواد و روش‌ها تعداد ۳۰ داوطلب خانم که دارای نقاط ماشه‌های فعال عضله تراپزیوس فوقانی بودند بصورت تصادفی در دو گروه سوزن خشک+ کشش غیر فعال (۱۵ داوطلب) و لیزر پرتوان+کشش غیر فعال (۱۵ داوطلب) قرار گرفتند. آنها پنج جلسه درمان در طول سه هفته دریافت کردند. متغیرها شامل شدت درد، آستانه فشاری درد، دامنه حرکتی گردن و میزان ناتوانی گردن بود. ارزیابی‌ها قبل از درمان و دو روز بعد از اتمام جلسه آخر درمان انجام شد.

یافته‌ها نتایج این مطالعه نشان داد که شدت درد و شاخص ناتوانی گردن در هر دو گروه به طور معناداری بعد از درمان کاهش پیدا کرد، و همچنین دامنه‌ی حرکتی گردن و آستانه فشاری درد بعد از درمان در هر دو گروه به طور معناداری افزایش یافت ($P=0/001$). در صورتی که تفاوت معنادار آماری بین دو گروه در هیچ یک از متغیرهای مورد بررسی مشاهده نشد ($P>0/05$).

نتیجه‌گیری هر دو روش درمانی سوزن خشک و تابش لیزر پرتوان در بیماران دارای نقاط ماشه‌های فعال عضله تراپزیوس فوقانی موثر می‌باشد. با توجه به اثربخشی مناسب هر دو روش درمانی می‌توان هر یک از درمان‌ها را برای این بیماران انتخاب کرد.

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سندروم درد مایوفاشیال، نقطه ماشه ای، سوزن خشک، لیزر با شدت بالا، عضله تراپزیوس فوقانی

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