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ORIGINAL ARTICLE

Effect of high-intensity laser therapy in the management of myofascial pain syndrome of the trapezius: a double-blind, placebo-controlled study

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Abstract Myofascial pain syndrome (MPS) of the trapezius muscle is one of the main causes of neck pain. In this randomized, double-blind study, we evaluated the effects of high-intensity laser therapy (HILT) in female patients with chronic MPS of the trapezius muscle. The patients were assigned to two groups. The HILT group was treated with HILT and exercise, and the sham therapy group was treated with placebo HILT and exercise. The patients were assessed for pain, cervical active range of motion, disability, and quality of life. Evaluations were performed before treatment (week 0) and after treatment (weeks 4 and 12). Both groups showed significant improvement in all parameters at weeks 4 and 12. However, in a comparison of the percentage changes in the parameters at weeks 4 and 12 relative to pretreatment values, the HILT group showed greater improvement in pain scores, the neck disability index, and several subparts of the short-form 36 health survey (SF-36) (physical functioning, role limitations due to physical functioning, bodily pain, general health perceptions, social functioning, and role limitations due to emotional problems) than did the sham therapy group. We conclude that HILT is an effective therapeutic method in the treatment of patients with chronic MPS of the trapezius muscle.

Keywords Myofascial pain syndrome · High-intensity laser therapy · Exercise · Pain · Disability · Quality of life

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Introduction

Neck pain is a significant health care problem affecting 45 to 54 % of the general population [1]. Myofascial pain syndrome (MPS) of the trapezius is one of the main causes of neck pain. It is characterized by deep, intense pain of the skeletal muscles and their fascia and by the presence of one or more myofascial trigger points (MTPs) [2]. The treatment of MPS includes inactivation of trigger points, relaxation of taut bands, and breaking the pain–spasm–ischemia–pain cycle. The most widely used treatment methods for MPS are education, exercise, nonsteroidal anti-inflammatory drugs (NSAIDs), superficial and deep heat, electrotherapy, laser therapy, and local injections [3, 4].

Laser treatment is noninvasive and painless and can be easily administered in therapy units for a wide range of conditions [5]. Many studies have demonstrated the dose-dependent analgesic and anti-inflammatory potential of low-level laser therapy (LLLT) [6, 7]. This technique has been shown to be a low-risk and safe treatment, but its true efficacy is controversial [8, 9]. Pulsed neodymium-doped yttrium aluminum garnet (Nd:YAG) laser therapy, a form of high-intensity laser therapy (HILT), was recently introduced as a new treatment option. The advantage of HILT over LLLT is that HILT is able to reach and stimulate larger and/or deeper joints and areas that are difficult to reach with LLLT [10].

HILT using the Nd:YAG laser works with high peak power (3 kW) and a wavelength of 1,064 nm. It is considered to be a painless and noninvasive therapeutic modality [10]. Recent studies have documented the beneficial effects of Nd:YAG laser therapy in patients with pain [11, 12]. However, the effectiveness of HILT in patients with cervical MPS remains unclear.

In this randomized, double-blind study, we evaluated the effects of pulsed Nd:YAG laser therapy in female patients with chronic MPS of the trapezius muscle.

Materials and methods

This randomized, prospective, controlled, double-blind study was conducted in the physical medicine and rehabilitation department of a university hospital from March 2013 to April 2014. In total, 76 female patients with a diagnosis of MPS of the trapezius muscle (age range 20–60 years) were enrolled in the study and divided into two groups. The diagnostic method described by Simons [13], in which five major criteria and at least one of three minor criteria are needed for a clinical diagnosis of MPS, was used in the present study.

Major criteria The major criteria were (1) regional neck pain, (2) pain or altered sensation in the expected distribution of referred pain from a myofascial trigger point, (3) taut band palpable in an accessible muscle, (4) exquisite spot tenderness at one point along the length of the taut band, and (5) some degree of restricted range of motion (ROM) when measurable.

Minor criteria The minor criteria were (1) reproduction of clinical pain or altered sensation by pressure on the tender spot, (2) elicitation of a local twitch response by transverse snapping palpation at the tender spot or needle insertion into the tender spot of the taut band, and (3) pain alleviated by elongating (stretching) the muscle or by injecting the tender spot (trigger point).

The exclusion criteria were the presence of pathological findings in the blood count and sedimentation, male sex, and a history of having undergone a physical therapy program for MPS including exercise, local anesthetics, and/or steroid injections into the trigger points within 6 months. We also excluded patients with a history of cervical spinal surgery, cervical disc herniation, cervical spinal stenosis, cervical radiculopathy, fibromyalgia, and pathological findings on cervical X-rays. All enrolled patients were instructed not to take any analgesics and/or NSAIDs during the treatment and control periods. Informed consent was obtained before the examination, and approval for the study was granted by the local ethics committee of the university.

Treatment groups

Each patient was randomly assigned to one of two treatment groups: the HILT group or the sham therapy group. Randomization was allocated using numbered envelopes. The HILT group was treated with HILT and exercise, and the sham therapy group was treated with placebo HILT and exercise. All patients in both groups underwent HILT first, followed by exercise.

HILT (pulsed Nd:YAG laser therapy)

The patients underwent pulsed Nd:YAG laser treatment (HIRO 3.0; ASA laser, Arcugnano, Italy). The apparatus provided pulsed emission (1,064 nm), very high peak power (3 kW), a high level of fluency/energy density (360–1,780 mJ/cm), a brief duration (120–150 μs), a low frequency (10–40 Hz), a duty cycle of about 0.1 %, a probe diameter of 0.5 cm, and a spot size of 0.2 cm^2 [10].

The laser probe was applied perpendicularly to and in slight contact with the skin. The total energy delivered to the patient during one session was 1,060 J in three phases of treatment. The first phase involved fast manual scanning (100 cm^2 per 30 s) of the trapezius muscles. Scanning was performed in both the transverse and longitudinal directions over the bilateral trapezius muscles. A total energy dose of 500 J was administered in this phase. The laser fluency was set to three subphases of 360 mJ/cm^2 (166.7 J), 410 mJ/cm^2 (166.8 J), and 510 mJ/cm^2 (166.5 J), for a total of 500 J. The second phase involved application of the handpiece with spacers fixed vertically at 90° to the trigger points. This phase was carried out bilaterally on three trigger points (total of six points) over the trapezius muscle with 10 J, a fluency of 610 mJ/ cm^2, and a time of 6 s at each point, for a total of 60 J. The third phase involved slow manual scanning (100 cm^2 per 60 s) of the trapezius muscles. The laser fluency was set to three subphases of 360 mJ/cm^2 (166.7 J), 410 mJ/cm^2 (166.8 J), and 510 mJ/cm^2 (166.5 J), for a total energy of 500 J. The application time for one session was approximately 15 min; the total energy delivered to the patient during one session (first phase, 500 J; second phase, 60 J; and third phase, 500 J) was 1,060 J. HILT was applied once a day for 15 days during a period of 3 weeks. The same treatment protocol was given in the sham therapy group, but the laser instrument was switched off during applications. All laser applications were performed by the same physiotherapist.

Exercises

All patients in both groups performed isometric strengthening exercises, active ROM exercises, and cervical region stretching exercises under the supervision of a physiotherapist for 15 min once a day for 15 days during a period of 3 weeks. All patients performed exercises after undergoing HILT (HILT group) or placebo HILT (sham therapy group).

Outcome measurements

The patients were assessed for pain, cervical active ROM, disability, and quality of life. Before the treatment, one of the physicians evaluated the clinical assessment parameters. Posttreatment outcome measures were assessed by another physician. Both physicians were blinded to the treatments. Only the physiotherapist who did not join the study was aware of the therapy and applied it to the patients. Thus, both the patient and the evaluator were blinded, while the therapist was

not blinded. Evaluations were performed before treatment (week 0) and after treatment (weeks 4 and 12).

Outcome measures

Pain was assessed at rest, during movement, and at night using a 10-cm visual analog scale (VAS) (0, no pain; 10, worst pain).

Active ROM (cervical flexion extension, lateral flexion, and rotation) was measured using an inclinometer and goniometer.

The neck disability index (NDI) was used to measure the changes in functional disability. The NDI has become a standard instrument for measuring self-rated disability due to neck pain and is used by clinicians and researchers alike. Each of the ten items of the NDI is scored from 0 to 5. The maximum score is therefore 50. The obtained score can be multiplied by 2 to produce a percentage score; this was performed in the present study [14].

Quality of life was assessed by the short-form 36 health survey (SF-36). The SF-36 includes 36 questions that are aggregated to score eight domains: physical functioning, role limitations due to physical functioning, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems, and general mental health. The eight domains were scored from 0 to 100 (worst to best possible health, respectively) [15].

Statistical analysis

All parametric results are expressed as means and standard deviations for each group. A two-tailed p level of <0.05 was considered statistically significant. The Kolmogorov–Smirnov test showed that all variables were normally distributed. The baseline and mean values of the percentage changes calculated for both groups were compared using the independent-samples t test. The paired t test was used to compare pretreatment and posttreatment values within groups. The chi-squared test and Fischer's exact test were used to compare categorical variables. All analyses were performed using statistical software (SPSS for Windows 18.0; SPSS, Inc., Chicago, IL, USA).

Results

All patients in the HILT group completed the study. One patient in the sham therapy group failed to complete the follow-up and dropped out of the study. No side effects were observed during HILT and/or exercise therapy throughout the study. There were no statistically significant differences in the demographic features or pretreatment evaluation parameters of the patients between the two groups. The demographic properties of the patients and pretreatment evaluation parameters in each group are given in Table 1.

Both groups showed significant improvement in all parameters at weeks 4 and 12 (Tables 2 and 3). However, in a comparison of the percentage changes in the parameters at weeks 4 and 12 relative to the pretreatment values, the HILT group showed greater improvement in pain scores, the NDI, and several subparts of the SF-36 (physical functioning, role limitations due to physical functioning, bodily pain, general health perceptions, social functioning, and role limitations due to emotional problems) than did the sham therapy group (Table 4, Figs. 1, 2, and 3). Comparison of the percentage changes in the other parameters showed no significant differences between the two groups (Table 4).

Discussion

The main findings of this study were as follows: (1) both treatment groups (HILT+exercise group and sham HILT+

Table 1 Demographic features and pretreatment values (mean±standard deviation) for evaluation parameters of HILT group and sham therapy group

	HILT group (n=38)	Sham therapy group (n=37)	p value
Age (years)	40.2±12.9	38.4±12.1	0.522
Disease duration (months)	7.1±3.7	6.9±3.1	0.632
Cervical flexion (°)	54.7±9.4	55.6±9.8	0.428
Cervical extension (°)	49.3±7.5	49.7±7.6	0.823
Right cervical lateral flexion (°)	40.1±6.7	41.9±6.8	0.699
Left cervical lateral flexion (°)	42.4±6.8	41.5±7.2	0.710
Right cervical rotation (°)	75.3±7.2	74.3±6.8	0.685
Left cervical rotation (°)	77.4±6.3	75.9±7.9	0.611
Pain at rest (VAS) (cm)	5.9±1.4	5.7±1.5	0.429
Pain at movement (VAS) (cm)	6.1±1.6	6.2±1.7	0.756
Pain at night (VAS) (cm)	4.7±2.7	4.6±2.4	0.595
Neck disability index	32.6±6.6	32.9±8.3	0.832
SF-36, PF	57.7±12.2	59.1±13.9	0.651
SF-36, RL	51.7±20.8	53.1±18.3	0.547
SF-36, BP	44.9±15.6	42.8±15.9	0.486
SF-36, GH	51.8±12.3	50.9±11.4	0.587
SF-36, V	48.0±10.8	46.4±9.6	0.518
SF-36, SF	57.3±8.9	59.1±11.2	0.398
SF-36, RLEP	48.3±19.7	49.1±18.6	0.850
SF-36, GMH	49.1±9.9	50.1±11.5	0.708

HILT high-intensity laser therapy, *VAS* visual analog scale, *SF-36* short-form 36 health survey, *PF* physical function, *RL* role limitations due to physical functioning, *BP* bodily pain, *GH* general health, *V* vitality, *SF* social functioning, *RLEP* role limitations due to emotional problems, *GMH* general mental health

Table 2 The results (mean±standard deviation) and statistical comparisons of the pretreatment (week 0), and posttreatment (weeks 4 and 12) evaluation parameters in HILT group

n=38	Baseline (week 0)	Week 4	Week12	*p* (baseline-week 4)	*p* (baseline-week 12)
Cervical flexion (°)	54.7±9.4	57.2±8.4	57.4±8.6	0.002	0.001
Cervical extension (°)	49.3±7.5	52.1±7.9	52.2±8,5	0.003	0.004
Right cervical lateral flexion (°)	40.1±6.7	44.2±5.7	45.5±3,8	<0.001	<0.001
Left cervical lateral flexion (°)	42.4±6.8	45.6±6.7	46.4±6.2	<0.001	<0.001
Right cervical rotation (°)	75.3±7.2	81.4±8.2	81.5±7.8	<0.001	<0.001
Left cervical rotation (°)	77.4±6.3	83.1±7.3	82.9±7.9	<0.001	<0.001
Pain at rest (VAS) (cm)	5.9±1.4	2.7±1.2	2.6±1.2	<0.001	<0.001
Pain at movement (VAS) (cm)	6.1±1.6	3.1±1.1	3.1±1.2	<0.001	<0.001
Pain at night (VAS) (cm)	4.7±2.7	1.8±1.4	1.6±1.5	<0.001	<0.001
Neck disability index	32.6±6.6	21.1±6.3	20.3±6.22	<0.001	<0.001
SF-36, PF	57.7±12.2	73.5±11.4	72.9±13.1	<0.001	<0.001
SF-36, RL	51.7±20.8	69.8±15.4	70.5±11.7	<0.001	<0.001
SF-36, BP	44.9±15.6	61.2±13.7	60.8±14.7	<0.001	<0.001
SF-36, GH	51.8±12.3	68.3±11.9	69.4±12.9	<0.001	<0.001
SF-36, V	48.0±10.8	54.6±9.8	55.6±10.4	0.003	0.002
SF-36, SF	57.3±8.9	72.8±10.6	73.1±11.3	<0.001	<0.001
SF-36, RLEP	48.3±19.7	65.1±16.2	66.3±17.3	<0.001	<0.001
SF-36, GMH	49.1±9.9	55.7±9.6	56.3±8.9	0.005	0.003

HILT high-intensity laser therapy, *VAS* visual analog scale, *SF-36* short-form 36 health survey, *PF* physical function, *RL* role limitations due to physical functioning, *BP* bodily pain, *GH* general health, *V* vitality, *SF* social functioning, *RLEP* role limitations due to emotional problems, *GMH* general mental health

Table 3 The results (mean±standard deviation) and statistical comparisons of the pretreatment (week 0), and posttreatment (weeks 4 and 12) evaluation parameters in sham therapy group

n=37	Baseline (week 0)	Week 4	Week12	*p* (baseline-week 4)	*p* (baseline-week 12)
Cervical flexion (°)	55.6±9.8	58.1±8.8	58.3±8.4	0.004	0.003
Cervical extension (°)	49.7±7.6	52.5±7.3	52.7±7.4	0.003	0.003
Right cervical lateral flexion (°)	41.9±6.8	45.5±6.1	45.7±4.6	<0.001	<0.001
Left cervical lateral flexion (°)	41.5±7.2	45.3±6.9	45.9±6.2	<0.001	<0.001
Right cervical rotation (°)	74.3±6.8	80.5±7.1	80.9±6.9	<0.001	<0.001
Left cervical rotation (°)	75.9±7.9	82.2±7.7	81.9±7.5	<0.001	<0.001
Pain at rest (VAS) (cm)	5.7±1.5	4.2±1.6	4.1±1.4	<0.001	<0.001
Pain at movement (VAS) (cm)	6.2±1.7	4.6±1.5	4.5±1.3	<0.001	<0.001
Pain at night (VAS) (cm)	4.6±2.4	3.1±1.7	3.0±1.3	<0.001	<0.001
Neck disability index	32.9±8.3	26.6±7.1	26.1±6.7	<0.001	<0.001
SF-36, PF	59.1±13.9	66.7±15.2	65.9±14.1	0.001	0.001
SF-36, RL	53.1±18.3	61.7±12.3	61.9±11.2	<0.001	<0.001
SF-36, BP	42.8±15.9	50.3±11.5	51.2±9.6	<0.001	<0.001
SF-36, GH	50.9±11.4	57.8±13.1	56.9±12.3	0.001	0.002
SF-36, V	46.4±9.6	53.7±9.9	52.9±11.4	0.003	0.007
SF-36, SF	59.1±11.2	67.4±10.8	67.3±11.4	<0.001	<0.001
SF-36, RLEP	49.1±18.6	56.6±11.3	57.1±9.3	0.001	<0.001
SF-36, GMH	50.1±11.5	56.7±10.3	56.9±11.2	0.001	0.001

VAS visual analog scale, *SF-36* short-form 36 health survey, *PF* physical function, *RL* role limitations due to physical functioning, *BP* bodily pain, *GH* general health, *V* vitality, *SF* social functioning, *RLEP* role limitations due to emotional problems, *GMH* general mental health

Table 4 Comparison of the two groups on the basis of the posttreatment (both week 4 and week 12) percentage changes and difference scores relative to pretreatment (week 0) values

	Week 4 HILT group	Week 4 ST group	*p* value	Week 12 HILT group	Week 12 ST group	*p* value
Cervical flexion (°)	0.04±0.02	0.04±0.03	0.842	0.05±0.03	0.05±0.03	0.911
Cervical extension (°)	0.05±0.03	0.05±0.02	0.865	0.06±0.05	0.06±0.03	0.786
Right cervical lateral flexion (°)	0.10±0.05	0.08±0.04	0.462	0.13±0.07	0.09±0.05	0.378
Left cervical lateral flexion (°)	0.07±0.03	0.09±0.04	0.413	0.09±0.04	0.10±0.06	0.521
Right cervical rotation (°)	0.08±0.05	0.08±0.04	0.785	0.08±0.05	0.08±0.04	0.824
Left cervical rotation (°)	0.07±0.03	0.08±0.04	0.612	0.07±0.04	0.08±0.05	0.634
Pain at rest (VAS) (cm)	−0.54±0.17	−0.26±0.11	<0.001	−0.55±0.31	−0.28±0.15	<0.001
Pain at movement (VAS) (cm)	−0.49±0.22	−0.25±0.13	<0.001	−0.49±0.25	−0.27±0.13	<0.001
Pain at night (VAS) (cm)	−0.61±0.24	−0.32±0.13	<0.001	−0.66±0.26	−0.34±0.11	<0.001
Neck disability index	−0.35±0.15	−0.19±0.11	<0.001	−0.38±0.21	−0.20±0.12	<0.001
SF-36, PF	0.27±0.18	0.12±0.07	<0.001	0.26±0.14	0.11±0.06	<0.001
SF-36, RL	0.35±0.21	0.16±0.08	<0.001	0.36±0.17	0.16±0.09	<0.001
SF-36, BP	0.36±0.13	0.17±0.05	<0.001	0.35±0.21	0.19±0.09	<0.001
SF-36, GH	0.31±0.17	0.13±0.06	<0.001	0.34±0.15	0.11±0.05	<0.001
SF-36, V	0.13±0.05	0.15±0.08	0.467	0.15±0.08	0.14±0.06	0.527
SF-36, SF	0.27±0.11	0.14±0.06	<0.001	0.27±0.15	0.13±0.06	<0.001
SF-36, RLEP	0.34±0.16	0.15±0.08	<0.001	0.37±0.23	0.16±0.07	<0.001
SF-36, GMH	0.13±0.06	0.13±0.07	0.854	0.14±0.05	0.13±0.06	0.613

HILT high-intensity laser therapy, *ST* sham therapy, *VAS* visual analog scale, *SF-36* short-form 36 health survey, *PF* physical function, *RL* role limitations due to physical functioning, *BP* bodily pain, *GH* general health, *V* vitality, *SF* social functioning, *RLEP* role limitations due to emotional problems, *GMH* general mental health

exercise group) showed significant improvement in all evaluation parameters at weeks 4 and 12, and (2) improvement in the NDI, VAS pain scores, and several subparts of the SF-36 (physical functioning, role limitations due to physical functioning, bodily pain, general health perceptions, social functioning, and role limitations due to emotional problems) were better in the HILT group than in the sham therapy group.

LLLT is a noninvasive treatment choice for patients with acute or chronic neck pain. Trials on the effectiveness of LLLT for pain relief have shown conflicting results. One meta-analysis stated that LLLT provides moderate pain relief for up to 22 weeks in patients with chronic neck pain [16]. However, this meta-analysis has been criticized for between-study heterogeneity and publication bias [17, 18]. In a recent review, Kadhim-Saleh et al. [19] stated that their findings provide inconclusive evidence of the benefits of LLLT in patients with cervical MPS because of significant between-study heterogeneity and a potential risk of bias.

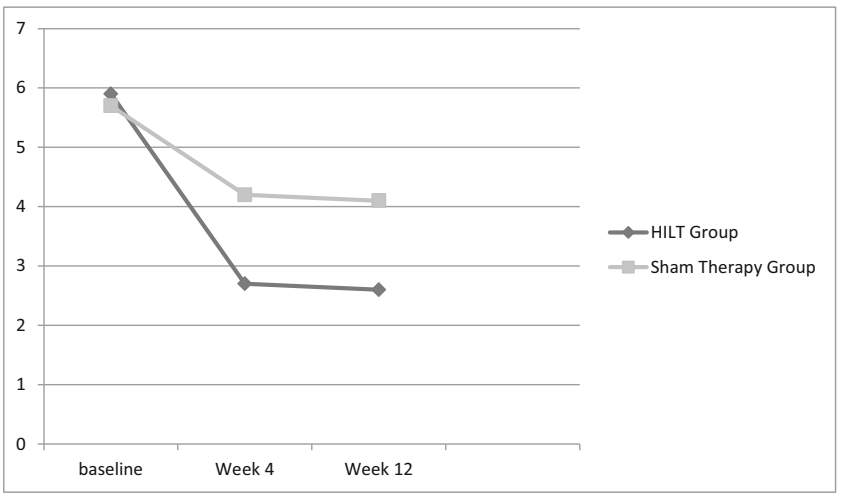

Fig. 1 Mean VAS (pain at rest) scores in the HILT and sham therapy groups at three different time points (baseline (1), week 4 (2), and week 12 (3)) [time (*x*-axis), VAS scores (*y*-axis)]. *HILT* high-intensity laser therapy, *VAS* visual analog scale

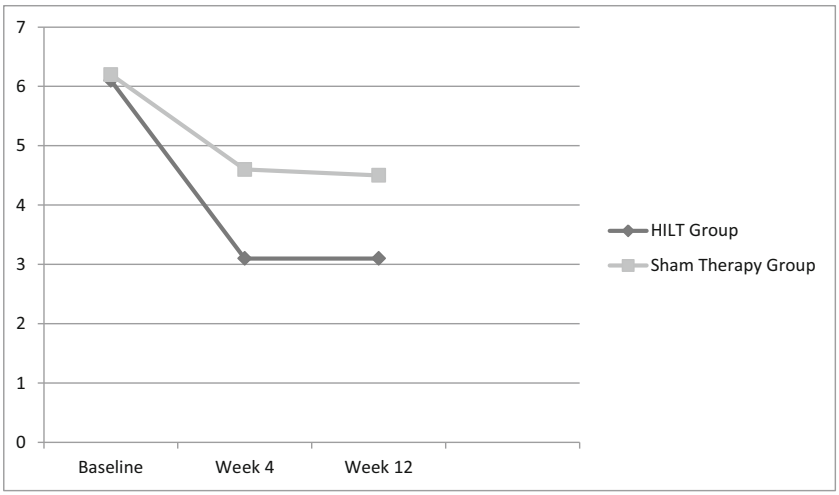

Fig. 2 Mean VAS (pain with movement) scores in the HILT and sham therapy groups at three different time points (baseline (1), week 4 (2), and week 12 (3)) [time (*x*-axis), VAS scores (*y*-axis)]. *HILT* high-intensity laser therapy, *VAS* visual analog scale

LLLT, also known as "low-energy" or "low-power" laser therapy, is performed at low radiation intensities. Therefore, it is assumed that any biologic effects are secondary to the direct effects of photonic radiation and are not the result of thermal processes [20]. HILT uses a particular waveform with regular peaks of elevated amplitudes and durations of time between them to decrease thermal accumulation phenomena, and it is able to rapidly induce photochemical and photothermic effects in the deep tissue that increase blood flow, vascular permeability, and cell metabolism [21, 22]. HILT reportedly has an analgesic effect on nerve endings, but there has been no evidence of decreased inflammation [23].

Pulsed Nd:YAG laser therapy, a form of HILT, has been used for a wide range of disorders. It has been used to relieve the symptoms of low back pain [11, 24], knee osteoarthritis [12, 25, 26], subacromial impingement syndrome (shoulder pain) [22], and ankle pain [27]. HILT has also been used in the treatment of chronic diabetic foot ulcers [28]. To the best of our knowledge, no studies have investigated the effectiveness of HILT in patients with chronic MPS of the trapezius muscle. The present results show that pulsed Nd:YAG laser therapy (HILT) was effective in the treatment of chronic MPS of the trapezius muscle in these patients with respect to decreased pain and disability and improved quality of life.

Treatment of myofascial pain involves inactivation of trigger points, restoration of normal muscle length, and correction of the factors that created or maintained the trigger points. Stretching exercises are a basic part of the treatment method for myofascial pain and allow for restoration of normal activity by gradually decreasing the muscle tightness and contraction, thereby decreasing pain [29, 30]. Our study has shown that exercise therapy is clinically able to decrease pain and disability and increase ROM and quality of life. An active exercise program is a simple, practical, and safe treatment method for chronic MPS of the trapezius muscle. The results of our study also show the superiority of HILT plus exercise over sham laser therapy plus exercise in the treatment of MPS.

A current hypothesis is that the disorder underlying MPS is related to inappropriate activity of acetylcholine at the neuromuscular junction, which produces a sustained contraction of

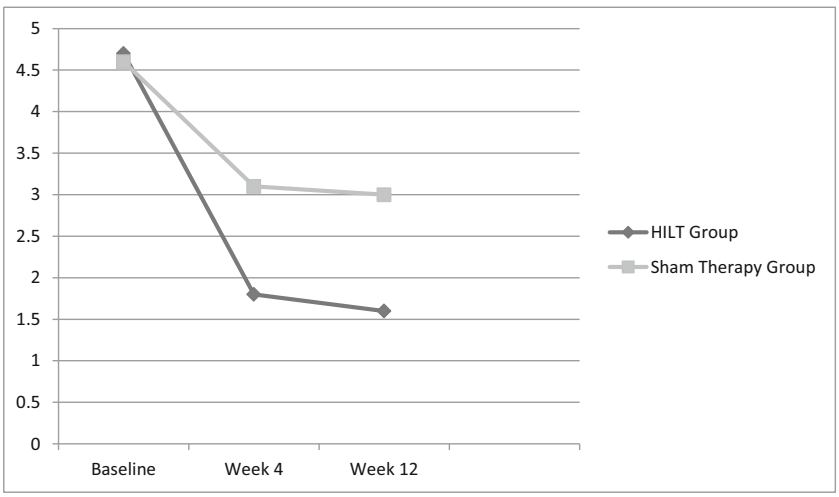

Fig. 3 Mean VAS (pain at night) scores in the HILT and sham therapy groups at three different time points (baseline (1), week 4 (2), and week 12 (3)) [time (*x*-axis), VAS scores (*y*-axis)]. *HILT* high-intensity laser therapy, *VAS* visual analog scale

the sarcomere. The acetylcholine-related effects are relevant to the development of the taut band. This activity leads to an increase in the local energy demand or an energy crisis. Local muscle pain occurs because of the release of substances from damaged muscle and from the extracellular fluid around the MTPs [31–33]. We may thus hypothesize that by applying HILT over MTPs, some photothermal energy may be transferred into deep tissue. The local energy demand or energy crisis near the MTPs may therefore be resolved. Moreover, the photochemical and photothermic effects of HILT may increase blood flow, vascular permeability, and cell metabolism and thus help to repair damaged muscle and remove the painful stimulus. An additional hypothesis for taut band relaxation is that HILT may also activate somatosensory receptors and decrease the perception of localized pain, which may help to relax the taut band.

The main limitations of our study are the absence of male patients in both groups and the low number of patients included in the study. Another limitation is that the patients performed exercise for only 3 weeks. If the patients had performed the exercise for >3 weeks (≥4 weeks), the results of the study might be different. Furthermore, we conducted a double-blind prospective randomized study to prevent bias during interpretation of the study outcomes. Thus, another limitation is that the same physician did not conduct both the preintervention and postintervention assessments; this may have contributed to the significant differences between the findings in the two groups. Our study design might have also caused low inter-rater reliability in all of our test measures. We do not know whether the findings of the two physicians were within acceptable reliability ranges, although the two investigators received the same training on the assessment of the outcome measures before the study.

In conclusion, pulsed Nd:YAG laser therapy (HILT) is an effective therapeutic method in the treatment of patients with chronic MPS of the trapezius muscle. HILT plus exercise produced greater improvement in pain scores, neck disability, and several subparts of the SF-36 (physical functioning, role limitations due to physical functioning, bodily pain, general health perceptions, social functioning, and role limitations due to emotional problems) (i.e., the patients' quality of life improved) in the HILT plus exercise group than in the sham HILT plus exercise group. Overall, we found beneficial effects of HILT in a small number of 75 available female patients with chronic MPS of the trapezius muscle. However, more reliable results may be obtained in future trials with larger sample sizes and longer follow-up periods.

Conflict of interest The authors report no conflict of interest.

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