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ORIGINAL ARTICLE

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Investigation of the effect of GaAs laser therapy on cervical myofascial pain syndrome

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Abstract Low-energy laser therapy has been applied in several rheumatoid and soft tissue disorders with varying rates of success. The objective of our study was to investigate the effect of laser therapy on cervical myofascial pain syndrome with a placebo-controlled double-blind prospective study model. It was performed with a total of 53 patients (35 females and 18 males) with cervical myofascial pain syndrome. In group 1 ($n=23$), GaAs laser treatment was applied over three trigger points bilaterally and also one point in the taut bands in trapezius muscle bilaterally with a frequency of 1000 Hz for 2 min over each point once a day for 10 days during a period of 2 weeks. In group 2 ($n=25$), the same treatment protocol was given, but the laser instrument was switched off during applications. All patients in both groups were instructed to perform daily isometric exercises and stretching just short of pain for 2 weeks at home. Evaluations were performed just before treatment (week 0), immediately after (week 2), and 12 weeks later (week 14). Evaluation parameters included pain, algometric measurements, and cervical lateral flexion. Statistical analysis was done on data collected from three evaluation stages. The results were evaluated in 48 patients (32 females, 16 males). Week 2 and week 14 results showed significant improvement in all parameters for both groups. However, comparison of the percentage changes both immediately and 12 weeks after treatment did not show a significant difference relative to pretreatment values. In conclusion, the results of our study have not shown the superiority of GaAs laser therapy over placebo in the treatment of cervical myofascial pain syndrome, but we suggest that further studies on this topic be done using different laser types and dosages in larger patient populations.

Keywords Low-level laser · Myofascial pain syndrome · Treatment

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Introduction

Myofascial pain syndrome (MPS) is characterized by pain originating from trigger points located in the taut bands in skeletal muscle. Trigger points are described as small palpable hypersensitive areas which cause radiating pain upon palpation. Neck and upper back pain is the most common complaint in MPS because of the involvement of trapezius muscle in most cases [1]. The prevalence of this syndrome has shown a dramatic increase in recent years, and it is known to rank high among the other causes of musculoskeletal pain [2]. Myofascial pain syndrome is believed to be a localized type of fibromyalgia syndrome (FMS) by several authors, and development of acute single-muscle myofascial pain in patients who otherwise have no criterion for fibrositis or fibromyalgia supports this hypothesis [1].

Since the etiology of MPS has not been clearly defined, its treatment has usually been symptomatic [3]. Electrotherapy, cold and heat application, local anesthetics, needle injections, and pharmacological agents are among the conventional methods used for treatment [4]. Acupuncture was recently reported to be effective in FMS and MPS. Birch and Jamison [5] compared the effects of relevant acupuncture points (those relevant to myofascial neck pain) and irrelevant points (those not related to neck pain) on chronic myofascial neck pain. They obtained better results with relevant than irrelevant acupuncture and NSAID treatment and also showed the relationship between acupuncture points and myofascial trigger points. On the other hand, Waylonis et al. [6] emphasized that acupuncture has some disadvantages such as pain, infection risk, and the inability to use a double-blind study model, which causes difficulty in making definitive scientific conclusions about its efficacy. They applied low-level laser therapy (LLLT) using HeNe laser over the acupuncture points in patients with chronic myofascial pain as an alternative to acupuncture but could not obtain significantly better results than with the control group.

In our study, we investigated the effect of GaAs laser treatment in patients with cervical myofascial pain. GaAs laser has previously been reported effective in relieving pain and stiffness in several locomotor system disorders [7, 8, 9]. It is also suitable for a double-blind study model, since it has an invisible light and does not cause heat or any other physical sign during its application.

Materials and methods

Patients

A total of 53 patients (35 females and 18 males) were included in the study according to the criteria below:

1. Localized pain and taut bands in the neck for a minimum of the previous 3 months
2. Bilateral and significantly more tenderness in the three cervical trigger points (midpoint of the upper border of the trapezius muscle, origin of the supraspinatus muscle, and insertion of the suboccipital muscle) compared to the control point (a non-tender point over deltoid muscle). These three trigger points are among the 18 described for FMS according to 1990 American College of Rheumatology criteria
3. Existence of no other criterion for FMS diagnosis
4. No history or finding of cervical arthrosis, discal hernia, cervical vertebral fracture, radiculopathy, or myelopathy
5. No pathological finding in blood count, urinalysis, sedimentation, or cervical X-ray

All patients were informed about the purpose of the study, and informed consent was obtained from each. They were instructed not to take nonsteroidal anti-inflammatory drugs (NSAID) or any other analgesic during the treatment and control periods.

Groups

The patients were randomly assigned to two groups. In group 1 ($n=23$, 20 females and three males), GaAs laser treatment was applied over the three trigger points bilaterally and also one point in the taut bands in trapezius muscle bilaterally with a frequency of 1000 Hz for 2 min over each point once a day for 10 weekdays during a period of 2 weeks. The head of the instrument was held perpendicularly to and in slight contact with the skin. The infrared-27 GaAs diode laser instrument (Roland Serie Elettronica Pagani) with a wavelength of 904 nm, frequency range of 5–7000 Hz, and maximum power of 27 W, 50 W, or 27×4 W was used.

A placebo laser treatment was given to the patients in group 2 ($n=25$, 12 females and 13 males) by using the same instrument in the same way over the same points as in group 1 but not turning it on. All laser applications were performed by the same physiotherapist. All patients in both groups were instructed to perform daily isometric exercises and stretching just short of pain for 2 weeks at home [10].

Evaluation parameters

Evaluations were performed just before (week 0), immediately after (week 2), and 12 weeks following the treatment (week 14) by the same researcher, who was totally unaware of the groups to which the patients belonged.

Pain

Evaluation was done according to both the visual analog and 5-point scales. In the former, patients were asked to indicate their pain severity on a scale 10 cm long in which the distance from the 0 point was measured. In the latter, they were asked to choose one of the following: 0 = no pain, 1 = mild, 2 = moderate, 3 = severe, or 4 = unbearably severe.

Algometric measurements

Tenderness A pressure of 4 kg/cm^2 was applied over trigger points using a standard pressure algometer (Force Dial FDK 60) [11] and scoring was done according to the response of the patient: 0 = no pain, 1 = slight pain with no withdrawal, 2 = moderate pain with withdrawal, and 3 = severe pain and withdrawal upon touch.

Trigger points Pressure was applied over trigger points bilaterally in the same way, and the patients were requested to report the first pain perception while the pressure was gradually increased. This was performed three times at 30-s intervals, and the pressure-pain threshold value was calculated from the average of these measurements for each point.

Taut bands The most tender point in the taut bands was found bilaterally, and the minimum pain-eliciting pressure measured by application of algometer to that point was recorded.

Cervical lateral flexion Goniometric measurements for cervical lateral range of motion on both sides were performed on the sitting patients.

Statistical analysis

The mean percentage values of the changes calculated for both groups were compared using the Mann-Whitney U test. The paired *t*-test was used for comparison of pre- and post-treatment values within groups. The chi-squared and Fischer's exact tests were used for comparison of categoric variables.

Results

Three patients in group 1 and two in group 2 were excluded because they were not available for either treatment or control stages. The results were therefore evaluated in 48 patients (32 females and 16 males). Table 1 shows data about the ages and pretreatment measurement values in both groups. Week 2 and week 14 results showed significant improvement for all parameters in both groups (Table 2, Table 3). However, comparison of the percentage changes both immediately after and 12 weeks after treatment relative to pretreatment values did not show a significant difference between the two groups (Table 4).

Table 1 Pretreatment values (mean ± standard deviation) for the evaluation parameters in groups 1 and 2. *VAS*visual analog scale, *NS* not significant

	Group 1 ($n = 23$)	Group 2 ($n = 25$)	*P*
Age (years)	43.48 ± 2.42	43.32 ± 2.10	NS
Duration of symptoms (years)	4.74 ± 1.30	4.38 ± 1.21	NS
Pain (VAS)	6.85 ± 0.35	6.24 ± 0.32	NS
Pain (5-point scale)	2.35 ± 0.16	2.20 ± 0.14	NS
Tenderness(0–18 points)	6.78 ± 0.57	6.68 ± 0.71	NS
Trigger points (kg/cm^2)	74.51 ± 1.98	72.63 ± 3.05	NS
Right lateral flexion (degrees)	40.43 ± 1.21	40.00 ± 1.04	NS
Left lateral flexion (degrees)	40.00 ± 1.04	40.20 ± 0.84	NS
Taut bands (kg/cm^2)	15.86 ± 0.78	15.43 ± 0.91	NS

Discussion

The use of GaAlAs and visible HeNe low-power lasers by physical therapy clinics has been reported in an increasing number of studies [12]. Faster wound healing with less cicatrix was obtained in animal experiments employing laser photostimulation, and the improved wound healing was attributed to increased synthesis of ATP and nucleic acids and stimulation of mitosis [13, 14, 15]. The antiedemic effect of GaAs laser treatment was shown in a clinical study for human flexor tendon rehabilitation [16]. The role of low-level laser therapy has also been investigated in several locomotor system disorders. Brosseau et al. [17] reported significant improvement in morning stiffness and finger flexibility in rheumatoid arthritis patients but no change in joint

Table 2 The results (mean ± standard deviation) and statistical comparisons of the pretreatment (week 0), and post-treatment (weeks 2 and 14) evaluation parameters in group 1. *VAS* visual analog scale, *NS* not significant

	Pretreatment	Post-treatment	14th week	*P* (pretreatment-post-treatment	*P* (pretreatment-14th week)
Pain (VAS)	6.85 ± 0.35	4.13 ± 0.58	3.17 ± 0.58	< 0.0001	< 0.0001
Pain (5 point scale)	2.35 ± 0.16	1.35 ± 0.22	1.09 ± 0.22	< 0.0001	< 0.0001
Tenderness (0–18 points)	6.78 ± 0.57	4.43 ± 0.72	3.30 ± 0.67	< 0.0001	< 0.0001
Trigger points (kg/cm^2)	74.51 ± 1.98	80.26 ± 2.54	81.97 ± 3.03	< 0.0001	< 0.001
Right lateral flexion (degrees)	40.43 ± 1.21	43.69 ± 0.56	43.26 ± 0.97	< 0.01	< 0.01
Left lateral flexion (degrees)	40.00 ± 1.04	43.04 ± 0.68	43.69 ± 0.78	< 0.01	< 0.01
Taut bands (kg/cm^2)	15.86 ± 0.78	16.34 ± 0.68	17.08 ± 0.80	NS	< 0.05

Table 3 Results (mean ± standard deviation) and statistical comparisons of the pretreatment (week 0) and post-treatment (weeks 2 and 14) evaluation parameters in group 2. *VAS* visual analog scale

	Pretreatment	Post-treatment	14th week	*P* (pretreatment-post-treatment	*P* (pretreatment-14th week)
Pain (VAS)	6.24 ± 0.32	3.92 ± 0.42	3.80 ± 0.51	< 0.0001	< 0.0001
Pain (5 point scale)	2.20 ± 0.14	1.33 ± 0.21	1.16 ± 0.20	< 0.0001	< 0.0001
Tenderness (0–18 points)	6.68 ± 0.71	4.08 ± 0.49	4.24 ± 0.71	< 0.0001	< 0.0001
Trigger points (kg/cm^2)	72.63 ± 3.05	77.69 ± 2.69	78.47 ± 2.88	< 0.01	< 0.01
Right lateral flexion (degrees)	40.00 ± 1.04	42.40 ± 0.96	42.40 ± 0.92	< 0.01	< 0.01
Left lateral flexion (degrees)	40.20 ± 0.84	43.00 ± 1.04	43.00 ± 0.87	< 0.01	< 0.001
Taut bands (kg/cm^2)	15.43 ± 0.91	16.75 ± 0.95	17.12 ± 1.14	< 0.05	< 0.05

Table 4 Comparison of the two groups on the basis of the posttreatment (both week 2 and week 14) percentage changes and difference scores relative to pretreatment (week 0) values. *VAS* visual analog scale, NS not significant

	Post-treatment			14th week		
	Group 1	Group 2	*P* value	Group 1	Group 2	*P* value
Pain (VAS)	−0,43 ± 0.06	−0.38 ± 0.05	NS	−0.55 ± 0.08	−0.40 ± 0.07	NS
Pain (5 point scale)	−0.43 ± 0.08	−0.38 ± 0.09	NS	−0.53 ± 0.11	−0.47 ± 0.08	NS
Tenderness (0–18 points)	−0.42 ± 0.07	−0.35 ± 0.08	NS	−0.58 ± 0.07	−0.41 ± 0.07	NS
Trigger points (kg/cm^2)	0.08 ± 0.02	0.08 ± 0.02	NS	0.10 ± 0.03	0.09 ± 0.03	NS
Right lateral flexion (degrees)	0.10 ± 0.03	0.07 ± 0.02	NS	0.08 ± 0.02	0.07 ± 0.02	NS
Left lateral flexion (degrees)	0.08 ± 0.02	0.07 ± 0.02	NS	0.11 ± 0.03	0.07 ± 0.02	NS
Taut bands (kg/cm^2)	0.05 ± 0.03	0.10 ± 0.04	NS	0.09 ± 0.04	0.11 ± 0.05	NS

range of motion and tenderness in osteoarthritis patients in a randomized controlled meta-analysis using low-level laser. Heussler et al. [9] failed to show the superiority of GaAlAs laser over placebo in active rheumatoid arthritis patients. GaAs laser was shown to have no superiority over placebo plus exercise in chronic back pain, plantar fasciitis, and rotator cuff tendinitis [7, 18, 19]. In another study performed on lateral epicondylitis patients, significant improvement in pain relief and hand grip strength was observed in a laser-treated group compared to a placebo group [8].

There is still debate on the analgesic effect of laser, and its mechanism of action is not clear. One explanation has focused on the systemic effect of laser, which may alter the sensorial input to the central nervous system and decrease the perception of localized pain in the treated area [17]. Other researchers have suggested a mechanism starting with secretion of endogenous opioids, as in acupuncture and transcutaneous electrical nerve stimulation, and leading to clearance of the algesic substances via stimulation of the microcirculatory system [20, 21].

The results of our study showed no superiority of GaAs laser over exercise alone in the treatment of myofascial pain, though improvement was observed in both groups. Simunovic et al. [22] obtained pain relief, restored mobility, and decreased rigidity in myofascial pain with HeNe laser treatment applied to trigger points in various locations. They applied LLLT (HeNe 632.8 nm visible red or infrared 820–830 nm continuous wave and 904 nm pulsed emission) on the trigger points of 243 myofascial pain patients. They showed that rigidity decreased, mobility was restored, and spontaneous or induced pain decreased or even disappeared. They suggested that the results are better in acute pain than in chronic pain. Olavi et al. [23] also reported similar improvement with infrared laser. Thorsen et al. [24] investigated the effect of LLLT (GaAlAs, 830 nm continuously) on chronic myofascial pain in the neck and shoulder girdle in 36 female patients. They applied laser treatment for 2 weeks but failed to show a superiority of laser over placebo. Waylonis et al. [6] treated 62 patients using HeNe laser applied to acupuncture points. After two sessions of five treatments 6 weeks apart, no statistical difference could be determined between treatment and placebo groups.

It is evident from these studies that no standard guidelines exist for the application of laser in MPS, particularly regarding duration, frequency, and optimal and minimal effective dosages. In our study, the laser-treated points were arbitrarily selected from the trigger points and taut bands described for FMS in the cervical region.

Significant improvement observed in patient complaints and objective assessment of tender points for both groups in our study seem to be attributable more to the effect of exercise than to the placebo laser effect. Stretching exercises comprise a basic treatment approach in myofascial pain and are known to allow restoration of normal activity by gradually decreasing the muscle tightness and shortening, thereby eliminating pain [1, 3]. A 5-day home program of muscle stretching exercise and self-massage was found to be superior over active range-of-motion exercises in a controlled study performed on patients with chronic cervicothoracic myofascial pain; however, a supplementary effect of massage was not mentioned [25]. In another study, immediate (94%) and lasting (63%) pain relief were obtained with the postisometric exercise technique [26]. However, exercise in the acute period of myofascial pain may lead to increased pain due to overloading of the muscle and should be employed with caution. Most of the patients in our study were in either subacute or chronic stages of MPS, with an average complaint duration of 4.5 years, and the intensity of the exercises was gradually increased under continuous supervision.

In conclusion, the results of our study have not shown the superiority of GaAs laser therapy over placebo in the treatment of cervical MPS. We suggest that further studies employing different types and dosages of laser in larger patient populations and with longer follow-up periods are necessary to investigate the effect of laser therapy in this syndrome.

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