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Low-Power Laser Treatment for Shoulder Pain

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ABSTRACT

***Objective:* The objective of this study is to investigate the effect of low-power gallium-arsenide laser treatment on the patients with shoulder pain. *Backround Data:* Low-energy laser therapy has recently been popularized in the treatment of various rheumatologic, neurologic, and musculoskeletal disorders such as osteoarthritis, rheumatoid arthritis, fibromyalgia, carpal tunnel syndrome, rotator cuff tendinitis, and chronic back pain syndromes. *Methods:* A total of 40 patients who applied to our clinic with shoulder pain and complied with the selection criteria were included in the study. The patients were randomly assigned into Group I ($n = 20$, laser treatment) and Group II ($n = 20$, control). In Group I, patients were given laser treatment and an exercise protocol for 10 sessions during a period of 2 weeks. Laser was applied over tuberculum majus and minus, bicipital groove, and anterior and posterior faces of the capsule, regardless of the existence of sensitivity, for 1 min at each location at each session with a frequency of 2000 Hz using a GaAs diode laser instrument (Roland Serie Elettronica Pagani, wavelength 904 nm, frequency range of 5–7000 Hz, and maximum peak power of 27 W, 50 W, or 27 × 4 W). In Group II, placebo laser and the same exercise protocol was given for the same period. Patients were evaluated according to the parameters of pain, palpation sensitivity, algometric sensitivity, and shoulder joint range of motion before and after treatment. *Results:* Analysis of measurement results within each group showed a significant posttreatment improvement for some active and passive movements in both groups, and also for algometric sensitivity in Group I ($p < 0.05$–0.01). Posttreatment palpation sensitivity values showed improvement in 17 patients (85%) for Group I and six patients (30%) for Group II. Comparison between two groups showed superior results ($p < 0.01$ and $p < 0.001$) in Group I for the parameters of passive extension and palpation sensitivity but no significant difference for other parameters. *Conclusions:* The results of our study have shown better results in palpation sensitivity and passive extension, but no significant improvement in pain, active range, and algometric sensitivity in laser treatment group compared to the control group in the patients with shoulder pain.**

INTRODUCTION

TEN PERCENT of the population complain of shoulder pain at least once in a lifetime.[1] The actual prevalence of shoulder pain is estimated to be 4–20%, and females are affected more frequently.[2–6] Several periarticular conditions such as rotator cuff tendinitis, impingement syndrome, and calcific tendinitis and glenohumeral diseases such as inflammatory arthritis, osteoarthritis, and adhesive capsulitis as well as other regional problems such as cervical radiculopathy, brachial neuritis, and fibrocytic neoplasms may cause shoulder pain. A variety of etiologic factors may necessitate different diagnostic and therapeutic approaches, and various diagnostic classification systems have indeed been suggested for shoulder pain.[7–10] However, regardless of the etiologic factor, the common symptoms in this entity are restriction of movement in the deltoid region and pain that is aggravated by movement and may restrict daily activities.[1,11,12] The basic goal of treatment for shoulder pain is relief of pain and stiffness, and improvement of the joint range of motion. Medical treatment with analgesics, antiinflammatory drugs, local steroid injections, and physiotherapeutic agents (such as exercise, cold application, ultrasound, and laser) have been employed to date, alone or in combinations.[13–20]

Low-energy laser therapy (LLLT) has recently been popularized in the treatment of various rheumatologic, neurologic, and musculoskeletal disorders such as osteoarthritis, rheumatoid

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arthritis, fibromyalgia, carpal tunnel syndrome, rotator cuff tendinitis, and chronic back pain syndromes.[21–25] LLLT is believed to modulate neuronal activity in the tissue and have a pain-relieving effect; however, the indication for LLLT in painful musculoskeletal system disorders is still debated.[21–23]

The purpose of this randomized double-blind controlled clinical study was to assess the role of low-energy Ga-As laser in the relief of pain and improvement of joint range of motion in patients with shoulder pain.

MATERIALS AND METHODS

Patients

Patients were selected for the study from the individuals who were admitted to our clinic for unilateral shoulder pain. Detailed disease history was recorded, examination of the neck, shoulder, arm, and the neurologic system was performed by the consultant physician, and blood chemistry, urinalysis, and cervical and bilateral shoulder roentgenograms were done for each patient. A total of 40 patients (age range of 39–80 years) who had shoulder pain during the last 3 months (visual analogue score ≥ 3) regardless of accompanying passive or active restriction of range of motion and noted pain aggravation with motion were included in the study in accordance with the selection criteria of van der Heijden et al.[16] The patients who had a diagnosis of inflammatory arthritis, polymyalgia rheumatica, cervical spondylosis, or a history of shoulder dislocation or fracture, previous deltoid surgery, neurologic problems, osteoarthritis or rotator cuff rupture, and local or systemic steroid therapy or physiotherapy applied during the last 6 months were excluded. All patients who had been taking nonsteroidal anti-inflammatory drugs (NSAIDs) or analgesics were requested to stop their medication 1 week prior to the start of the study protocol. However, the patients were allowed to take acetaminophen in doses not exceeding 2000 mg/day for pain relief.

The purpose of the study was explained, and an informed consent was obtained from each patient participating in the study.

Groups and randomization

Before the start of the study, another staff physician who was unaware of the examination results of the patients allocated the individuals into two groups of 20 each (either active laser treatment, Group I, or placebo laser [control], Group II) by drawing one card for each patient from a bag where cards numbered from 1 to 40 were placed. All evaluations before and after treatment were performed by a third staff physician who was not informed about the group of any patient. A physiotherapist instructed and supervised the exercises and performed laser applications in Group I and placebo laser in Group II, where the instrument was switched on and the patients thought they were receiving laser treatment but no laser was applied. Thus, a double-blind study model was formed.

Treatment protocol

Laser was applied over the tuberculum majus and minus, bicipital groove, and anterior and posterior faces of the capsule, regardless of the existence of sensitivity, for 1 min at each location at each session with a frequency of 2000 Hz using a GaAs diode laser instrument (Roland Serie Elettronica Pagani, wavelength 904 nm, frequency range of 5–7000 Hz, and maximum power of 27 W, 50 W, or 27×4 W). The actual treatment parameters of laser density and spot size were 2.98 J/cm^2 (at peak power = 50 W, frequency = 2000 Hz, for a duration of 60 sec) and 0.8 cm^2, respectively, for each application point. Patients in both groups then performed the supervised exercise program of 15 min consisting of Codman, shoulder wheels, and finger-stair components. Ten sessions of laser and exercise were performed during the study period of 2 weeks.

Evaluation parameters

All patients were evaluated before and at the end of the study period of 2 weeks by the same physician according to the following parameters.

Pain. Patients were asked to mark the severity of their pain on the visual analogue scale, ranging from 0 (no pain) to 10 (unbearably severe pain).

Palpation sensitivity (PS). A manual pressure of 4 kg was applied by the physician over the tuberculum majus and minus, bicipital groove, and posterior and anterior faces of the capsule (no sensitivity, 0; sensitive, 1).

Algometric sensitivity (AS). An algometric instrument (pain diagnostics thermography, force dial 17 kg $\times$ 200 g, Italy) was applied over the points where pain was elicited by the previous manual pressure. The instrument was placed perpendicular to the sensitive point, and pressure was gradually increased. The force level read by the instrument during the first pain sensation was recorded. The mean algometric sensitivity was calculated by dividing the total value by the number of the sensitive points whenever there was more than one.

Joint range of motion. Active and passive shoulder joint range of motion was measured with a hand goniometer. Measurements for flexion-abduction (0–180 degrees) and extension (0–60 degrees) were done with the patient standing and elbow extended, internal rotation (0–70 degrees) and external rotation (0–90 degrees) with the elbow in 90 degrees of flexion, and adduction (0–45 degrees) with the elbow fully flexed.

Statistical analysis

Statistical study was done by a staff statistician using SSPS (version 11.0) in the Department of Statistics. The $p < 0.05$ value was accepted as valid for significance. Non-parametric Mann-Whitney test was used to evaluate the difference between the pretreatment values of the groups. For all comparisons within and between the groups, calculated difference scores for the visual analogue score and percent change score for algometric sensitivity and active/passive range of motion were used. Wilcoxon test was used for comparisons within each group, and nonparametric Mann-Whitney test for comparisons between the groups.

RESULTS

All of the 12 females and eight males in Group I, and 19 females and one male in Group II completed the study. No significant difference between the two groups was observed according to the parameters of age, shoulder side, and pretreatment values of palpation sensitivity, algometric sensitivity, visual analogue score, and active/passive joint range of motion ($p > 0.05$; Table 1).

Significant posttreatment improvement was observed for some active and passive motions in both groups and for algometric sensitivity in Group I ($p < 0.05$–0.01; Table 2). In Group I 17 patients (85%) and in Group II six patients (30%) showed improvement in palpation sensitivity following treatment.

Comparison between the two groups showed better results in Group I only for passive extension range and palpation sensitivity ($p < 0.001$ and $p < 0.05$; Table 3).

No adverse reaction or complication was observed in any patient in either group during or after the study period.

DISCUSSION

Conclusions in several reports studying the effect of LLLT on painful musculoskeletal conditions have been observed to be contradictory in terms of negative[26–32] or positive[33–38] results. The results for laser treatment in shoulder problems are also contradictory among a limited number of studies designed specifically for shoulder pain. Vecchio et al.[39] failed to show improvement in pain and joint range of motion in a double-blind randomized study where they used low-energy laser for rotator cuff tendinitis. Gudmundssen et al.[40] found better results in laser group (80%) compared to the placebo group (41%) in a study performed in 91 patients with humeral epicondylitis and rotator cuff syndrome. England et al.[41] also observed significant improvement in all pain and range of motion parameters in the laser treatment group compared to placebo laser, and in some range of motion parameters compared to the Naproxen treatment group, in a study where laser was applied at three stages of 2 weeks each in 30 patients with supraspinatus or bicipital tendinitis. Saunders et al.,[42] on the other hand, reported improvement in shoulder pain with low-energy laser for supraspinatus tendinitis at the end of 13 weeks of therapy.

Significant improvement in joint range of motion was obtained in both groups in our study. This finding points to the positive effect of exercise, which is known to be a basic therapeutic modality in shoulder pain relief and joint range of motion improvement when used alone or combined with specific physiotherapy programs.[43]

The results of the comparison of the two groups in our study showed significantly better improvement only for passive extension range and palpation sensitivity for the laser group. While better passive extension range may be a result of the laser effect, it may also be due to our patient selection criteria, according to which patients with restriction of active and passive joint range of motion were also included in the study, regardless of the specific diagnosis for the shoulder pain. Our patient selection criteria were based on the presence of pain and range of motion measurements rather than a specific etiologic factor because of the lack of consensus on diagnosis, classification, and treatment of shoulder pain.[44–48] Contrary to our study, none of the previous related studies used the passive extension range as a primary evaluation parameter. The latter parameter has usually been cited for diagnosis and evaluation of treatment results in adhesive capsulitis.[19]

TABLE 1. COMPARISON OF THE PRETREATMENT VARIABLES BETWEEN THE TWO GROUPS

	Group 1 (laser)	*Group 2 (control)*	*Significance*
Age (years)	63.80 ± 9.77	57.25 ± 10.21	ns
Shoulder right/left	11/9	12/8	ns
VAS (cm)	6.10 ± 1.77	6.17 ± 1.64	ns
PS (*n*)	20	20	ns
AS (kg-force)	6.26 ± 3.42	5.57 ± 1.86	ns
Active abduction	137.25 ± 39.45	134.75 ± 43.33	ns
Active flexion	150.75 ± 24.07	150.50 ± 28.04	ns
Active extension	50.00 ± 9.59	53.50 ± 7.96	ns
Active internal rotation	59.25 ± 16.88	55.75 ± 12.80	ns
Active external rotation	64.50 ± 21.57	67.75 ± 22.50	ns
Active adduction	41.50 ± 7.27	41.75 ± 7.30	ns
Passive abduction	144.75 ± 34.58	146.25 ± 36.77	ns
Passive flexion	158.25 ± 22.89	157.50 ± 25.15	ns
Passive extension	54.75 ± 6.58	56.25 ± 6.25	ns
Passive internal rotation	64.50 ± 16.05	60.75 ± 11.38	ns
Passive external rotation	75.00 ± 16.70	71.25 ± 18.69	ns
Passive adduction	43.00 ± 5.47	44.00 ± 3.07	ns

Measurable numeric values are given as mean value ± standard deviation.
ns, not significant; VAS, Visual Analogue Score; PS, palpation sensitivity; AS, algometric sensitivity.

TABLE 2. COMPARISON OF THE MEAN VALUES OF MEASURABLE VARIABLES

	Group I (laser)			*Group II (control)*		
	BT	*AT*	*p*	*BT*	*AT*	*p*
AS (kg-force)	6,26 (1–15)	7,09 (3–13)	**0.022***	5,57 (3–11)	6,10 (2–11)	0.289
VAS (cm)	6,10 (3–10)	5,65 (1–9)	0.554	6,17 (3–10)	5,96 (0–9)	0.775
Active abduction	137, 25 (70–80)	147,50 (80–80)	**0.019***	134,75 (60–180)	149,50 (60–180)	**0.005****
Active flexion	150,75 (120–180)	158,50 (120–80)	**0.012***	150,50 (100–180)	160,50 (120–180)	**0.016***
Active extension	50,00 (30–60)	54,00 (30–60)	**0.016***	53,50 (40–60)	55,50 (40–60)	0.168
Active internal rotation	59,25 (20–70)	63,00 (25–70)	**0.016***	55,75 (30–70)	61,75 (30–70)	**0.048***
Active external rotation	64,50 (30–90)	69,50 (30–90)	0.169	67,75 (30–90)	75,00 (30–90)	**0.045***
Active adduction	41,50 (25–45)	44,75 (40–45)	0.059	41,75 (20–45)	43,50 (25–45)	0.109
Passive abduction	144,75 (70–80)	156,75 (100–180)	**0.005****	146,25 (60–180)	156,50 (60–180)	**0.010****
Passive flexion	158,25 (120–180)	166,25 (130–180)	**0.008****	157,50 (100–180)	165,75 (120–180)	**0.022***
Passive extension	54,75 (40–60)	58,25 (45–60)	**0.017***	56,25 (45–60)	56,50 (40–60)	0.854
Passive internal rotation	64,50 (20–90)	66,00 (25–70)	0.465	60,75 (35–70)	64,25 (30–70)	0.112
Passive external rotation	75,00 (40–90)	75,75 (40–90)	0.344	71,25 (40–90)	79,00 (40–90)	**0.007****
Passive adduction	43,00 (25–45)	7,09 (45–45)	0.109	44,00 (35–45)	43,00 (25–45)	0.357

Ranges included in parantheses within each group according to measurements before and after treatment.
BT, before treatment; AT, after treatment; $*p < 0.05$; $**p < 0.01$.

Failure to obtain significant pain relief by laser treatment corroborates the conclusions of Vecchio et al., while it contradicts the results of England et al. and Gudmundssen et al. However, it must be noted that the substantial discrepancy in the criteria of patient selection, laser type and application parameters, and treatment locations among the mentioned studies (including ours) gives rise to difficulty making sound comparisons. Brosseau et al.[31] emphasized this problem in a meta-analysis evaluating patients with rheumatoid arthritis and osteoarthritis, pointing out the variability of the selected laser wavelengths, treatment duration and doses, and application locations among the cited studies. Laser was applied over only the sensitive points by England et al., and mostly over the anatomic landmarks by Vecchio et al., while it was applied over both types of locations in our study.

The results of our study have shown better results in palpation sensitivity and passive extension but no significant improvement in pain, active range, and algometric sensitivity in the laser treatment group compared to the control group in the patients with shoulder pain. The need to standardize study de-

TABLE 3. COMPARISON OF THE IMPROVEMENT RATE,[a] DIFFERENCE SCORES,[b] AND PERCENT CHANGES OF THE EVALUATION PARAMETERS AFTER TREATMENT BETWEEN THE TWO GROUPS

	Group I (laser)	*Group II (control)*	*p*
PS (improvment ratio)[a]	17/20	6/20	**0.001*****
AS (kg-force)[b]	−0.45 ± 2.99	−0.21 ± 2.76	1.000
VAS (cm)	28.26 ± 47.95	12.83 ± 37.72	0.373
Active abduction	12.45 ± 29.17	14.56 ± 24.02	0.457
Active flexion	6.12 ± 12.00	8.15 ± 13.00	0.729
Active extension	8.79 ± 14.18	4.82 ± 15.84	0.210
Active internal rotation	9.97 ± 19.98	14.90 ± 27.28	0.306
Active external rotation	14.04 ± 46.77	17.63 ± 35.66	0.501
Active adduction	12.00 ± 25.26	7.14 ± 22.94	0.624
Passive abduction	12.48 ± 24.61	8.61 ± 18.00	0.663
Passive flexion	5.88 ± 9.07	6.37 ± 10.80	0.729
Passive extension	7.41 ± 11.61	0.73 ± 9.13	**0.029***
Passive internal rotation	6.81 ± 27.22	9.39 ± 26.35	0.246
Passive external rotation	3.29 ± 19.02	14.69 ± 24.11	0.139
Passive adduction	7.13 ± 20.57	-2.2 ± 12.07	0.060

$*p < 0.05$; $***p < 0.001$.

signs in LLLT applications, with particular emphasis on the laser type/duration and patient selection criteria, is obvious for further delineation of the role of this promising treatment modality in painful musculoskeletal conditions.

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