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Efficacy of Low Level Laser Therapy for Treatment Myofascial Trigger Points of Shoulder Pain

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Abstract: Myofascial trigger points (MTrPs) are recognized by many clinicians to be one of the most common causes of pain and dysfunction in the musculoskeletal system. Low-level laser Therapy (LLLT) is a relatively uncommon, non-invasive treatment for musculoskeletal pain, in which non-thermal laser irradiation is applied to sites of pain. Forty patients with MTrPs of shoulder pain were randomly assigned into active laser group (ALG, n = 20) and placebo laser group (PLG, n = 20). In ALG, patients were received Gallium-Arsenide I.R laser of 904 nm wave length with 3J / point for 90 sec pulse exercise therapy and in PLG, patients were received placebo laser pulse exercise therapy. Stretching and strengthening exercises program was done daily under supervision in clinic and at home for all patients. Pain intensity by visual analogue scale (VAS), active shoulder flexion and abduction by electrogonimeter and pain pressure threshold (PPT) of trigger points by electronic digital algometer were measured before and after 4-weeks of treatment. After treatment, all the outcome measurements had shown significant improvement in both groups except PPT was significantly increased in active laser group only ($p < 0.0001$). When the improved parameters were compared between the two groups, there were significant differences after treatment in favor of active laser group ($p < 0.01$). LLLT plus exercise could be effective method to decrease pain, increase shoulder range of motion and increase PPT of trigger point of shoulder pain compared with placebo laser pulse exercise.

Key words: Low-level laser therapy · Myofascial trigger points · Shoulder pain · Pressure Algometer · Electrogoniometer

INTRODUCTION

Shoulder pain is one of the most common complaints affecting the locomotor apparatus, accounting for 5% of all general medical practice consultation [1]. It is associated with significant financial costs to the individual and to the community. Many workers with chronic shoulder pain which has proved resistant to treatment are unable to resume full-time work [2]. In a minority of patients, shoulder pain originate from specific or generalized conditions, such as stroke, polyneuropathy, multiple sclerosis, rheumatoid arthritis, polymyalgia, ankylosing spondylitis, or from malignancies or referred pain from the neck or internal organs [3]. It is evidenced mainly by pain, restricted movement and strength and by loss of shoulder functionality [4]. Localized soft tissue impairment is considered to be the most common source of these symptoms [3]. The actions taken at present to relieve the symptoms of painful shoulder consists of varies approaches such as advice, analgesics, non-steroidal anti-inflammatory drugs, steroid injections and physiotherapy [4, 5]. A wide array of physiotherapy methods are used to treat shoulder disorders including thermotherapy, therapeutic ultrasound, transcutaneous electrical nerve stimulation (TENS), acupuncture, laser and therapeutic exercises [6-10]. An alternative approach to the management of persons with shoulder problems consists of a treatment aimed at inactivating myofascial trigger points (MTrPs) and eliminating factors that perpetuate them [11]. In reviews addressing the efficacy of interventions in shoulder patients, MtrPs therapy and myofascial pain are rarely mentioned. However, some published case studies suggested that treatment of MtrPs in shoulder patients may be beneficial [11-13].

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Low level Laser Therapy (LLLT) has been investigated and used clinically for over 30 years [14]. Many authors had reported the effectiveness of laser therapy in the treatment of musculoskeletal disorders through its analgesic, myorelaxant, tissue healing and biostimulation effects [15-16]. Several reviews had been conducted about the effectiveness of laser for shoulder pain [10, 17-19]. But, as yet, there seems to be insufficient evidence for the effectiveness of laser for treatment myofascial trigger points of shoulder pain [20-22]. It was supposed to add to the effect of exercise therapy in recovery from soft tissue disorders in peripheral joints. The objective of this study was to determine the effectiveness of LLLT for treatment myofascial trigger points of shoulder pain.

MATERIALS AND METHODS

Subjects: Forty male and female patients with myofascial trigger points of shoulder pain with age ranged from 25-40 years(mean age ± SD 33.7 ± 5) were selected from the outpatient clinic of orthopedic department of El Sahel teaching hospital and orthopedic department of Faculty of Physical Therapy, Cairo-University. After taking approval from ethical committee of Faculty of Physical Therapy, Cairo university. The study procedures explained and informed consent obtained from eligible participants. Patients were divided randomly into two equal number groups; each comprised 20 patients: active laser group (ALG) with a mean age ± SD (32.6±2.79), 12 males and 8 females and placebo laser group (PLG) with a mean age ± SD (34.8±7.22) years, 10 males and 10 females.

The Inclusion Criteria: Eligible participants had clinical diagnosis of unilateral shoulder pain defined as pain localized in the region of the deltoid muscle, acromioclavicular joint, superior part of the trapezoid muscle and scapula which was exacerbated by active or passive shoulder movement [4]. Patients had to experience at least three MTrPs in the deltoid and/ or upper trapezoid muscles which was identified by electronic digital algometer based on compression-produced pain that was recognized by patients. If no MTrPs were detected, the patient was excluded from the study. All measurements performed by the same physiotherapist.

The Exclusion Criteria: A history of inflammatory arthritis or polymyalgia rheumatica; gross structural or neurological abnormality affecting the shoulder; clinical indications of ruptured rotator cuff; suspicion of serious pathology or referred pain; prior fracture or surgery to the shoulder; upper limb, neck or thorax; previous physiotherapy for this episode of shoulder pain; pregnancy or breastfeeding; anticoagulation therapy; and participants for whom LLLT was contraindicated [10].

Procedure

Evaluation Procedures: The evaluation procedure had been done for all patients before starting the program and after 4 weeks of treatment.

Pain Intensity Level: Pain was evaluated by using visual analog scale (VAS; 0–10 cm; 0 means no pain, 10 means severe pain). The distance between the extreme left of the scale (“no pain”) and the subject’s mark was measured to the nearest millimeter. High levels of reliability and validity of VAS had been reported [23, 24].

Shoulder Range of Motion: Active shoulder flexion and abduction were measured by the electrogoniometer device through a stander measuring procedure [25, 26]. Three repetitive measurements were taken continually, with their mean values was used for analysis.

Trigger Point Identification and Threshold: Electronic Digital Algometer, "force one guage-model FDI" (Wagner instruments, Greeenwish, CT, USA) was used to detect and confirm the site and sensitivity of trigger points by determining the pressure pain threshold (PPT) using a pressure transducer probe, Figure 1. The most painful points on the deltoid and / or upper trapezium muscles (three points), as indicated by the patient and checked with an algometer, were chosen as the target location by obtaining PPT value. The mean value of three repetitive measurements (at 30-second intervals) was used for analysis. The target area was delineated with a waterproof marker during the first visit.

Treatment Procedures: Gymna Gallium-Arsenide (Ga-As) I.R laser" device with wave length 904 nm, maximal power 27W, frequency ranged from 1 Hz up to 1000 Hz and 0.07 cm2 spot area was used for treatment. The output of the device was calibrated at each frequency with a power meter (Omega Laser Systems)

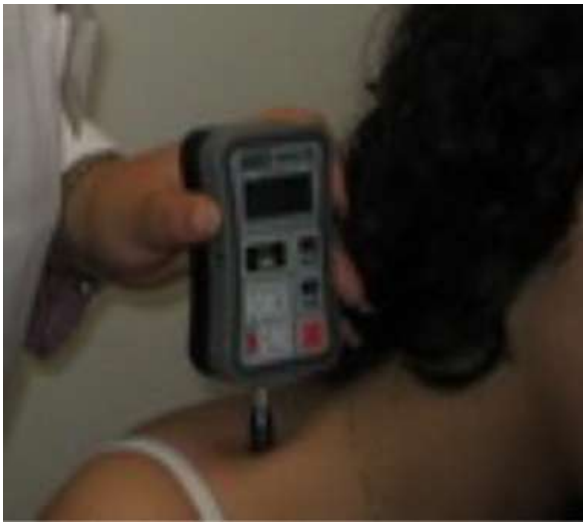

Fig. 1: Measurement of pain pressure threshold of trigger point by electronic digital algometer.

Fig. 2: Application of laser prop on trigger point

and I.R. Laser Detection Card. Patients in ALG received 904 nm Ga-As I.R laser with 3J / point for 90 sec and exercise therapy while in PLG group patients received laser with 0J / point for 90 sec and exercise therapy, Figure 2. Both therapist and patient wore protective goggles for safety during the treatment period. During 4 wks of treatment, the patients in the two groups received 12 sessions, 3 session/week. Both groups were treated under the same conditions and the patients treated individually to avoid influencing one another. The exercise treatment was administered as a home-based, daily exercise program with supervision by the physical therapist once per week, to correct and upgrade the intensity and complexity of the exercises. It was include stretching and strengthening exercises program [6]. The stretching exercises was performed for the posterior and inferior shoulder capsule and the upper trapezium muscle that hold each position 30 second and repeat it 3 times/day with 30 seconds rest period. The strengthening exercise was performed for shoulder flexors, abductors and internal rotators by carrying a proper weight that hold each position 6 seconds and relax 10 seconds with 10 repetitions for 3 sets and repeated it once daily. The patient is recommended to avoid any activity that may cause pain in the affected arm for the duration of the study.

Statistical Analysis: Statistical calculations were performed using graph pad software, Inc. San Diago, CA 92121 USA on a personal computer. All dependent variables (pain intensity, shoulder flexion and abduction and trigger points PPT were analyzed before and after treatment. Difference between before and after treatment for each dependent variable was analyzed within and between groups using paired and unpaired Independent t-test. The level of significance was set at 0.05 for all tests.

RESULTS

At initial evaluation, there was no significant difference between ALG and PLG in the mean baseline values of their demographic characteristics data (age 32.6±2.79 vs. 34.8±7.22y, gender (M:F) 12:8 vs. 10:10 and duration of symptoms 13.35 ± 2.97vs 12.95 ± 2.25 months), respectively.

Initial comparison between both groups regard to their pre treatment pain intensity level, active shoulder (flexion and abduction) ROM and PPT of trigger points revealed no significant differences in all variables ($P>0.05$), Table 1, 2. None of the participants reported any adverse reaction or side effects.

Pain Intensity Level Results: Pain level was significantly decrease in ALG and PLG ($p< 0.0001, 0.0001$) respectively, with a more significant decrease of overall pain in ALG than in PLG after 4 wks of treatment ($p<0.0004$), Table 1.

Active Shoulder ROM Results: Both ALG and PLG groups demonstrated a significant increase in shoulder flexion and abduction, where $p < 0.0001$, in both groups, Table 1. While post treatment comparison between ALG and PLG demonstrated a more significant increase of shoulder ROM in ALG than placebo group ($p < 0.03, 0.02$) respectively, Table 1.

Table 1: Pain intensity level and Active shoulder flexion and abduction ROM values of the groups pre and post treatment

Variables	Groups		Pre M±SD	Post M±SD	T	P-value
Pain intensity level	ALG N=20		9.1 ±0.99	4.6 ±1.17	14. 643	0.0001*
	PLG N=20		9.1± 0.73	6.5 ±0.70	15.922	0.0001*
	MD	Pre	0		0.00	0.999#
		Post	-1.9		4.384	0.0004*
Active Shoulder Flexion ROM	ALG N=20		48 ±16.01	108.9±14.08	23.884	0.0001*
	PLG N=20		43 ±9.48	97.3 ±7.64	25.949	0.0001*
	MD	Pre	5		1.002	o.329#
		Post	11.3		2.289	0.03*
Active Shoulder Abduction ROM	ALG N=20		44.5 ±14.62	109 ±13.40	35.040	0.0001*
	PLG N=20		44.7±16.98	97.7 ±6.13	11.389	0.0001*
	MD	Pre	0.2		0.028	0.9#
		Post	-106.5		2.531	0.02*

M±SD: Mean ± Stander deviation, MD: Mean difference, ALG: Active laser group, PLG: Placebo laser group, #: non- significant. *: Significant

Table 2: Pain pressure threshold of the three trigger points of the groups pre and post treatment

Variables	Groups		Pre M ±SD	Post M±SD	T	P-value
1st Trigger point	ALG N=20		4.68 ±0.95	5.99 ±1.04	10.324	0.0001*
	PLG N=20		4.48 ±1.23	4.79±1.00	0.773	0.4#
	MD	Pre	0.2		0.404	0.6*#
		Post	1.2		2.616	0.01*
2nd Trigger point	ALG N=20		4.93±0.815	6.20±0.91	9.336	0.0001*
	PLG N=20		5.13±0.89	5.26±0.64	0.535	0.6#
	MD	Pre	-0.2		0.521	0.6#
		Post	0.94		2.660	0.01*
3rd Trigger point	ALG N=20		5.12±0.75	6.38±0.91	11.107	0.0001*
	PLG N=20		5.14±1.40	5.33±1.09	0.836	0.4#
	MD	Pre	-0.2		0.039	0.9#
		Post	1.05		2.329	0.03*

M±SD: Mean ± Stander deviation, MD: Mean difference, ALG: Active laser group, PLG: Placebo laser group, #: non- significant. *: Significant

PPT of the Trigger Points Results: There was a highly significant increase in PPT of the three trigger points in the ALG group ($P < 0.0001$) with no significant change in PLG, Table 2. While post treatment comparison provide a significant difference of PPT between ALG and PLA for the three trigger points in favor of ALG group, Table 2.

DISCUSSION

The aim of the present study was to investigate the efficacy of low-level laser for treatment patients with painful shoulder of myofascial trigger points origin after 4 wks of treatment. This study revealed that within active and placebo laser group, there was a significant decreased in pain intensity, increased in active shoulder flexion and abduction and increased in PPT of the trigger points in the ALG only.

The outcome measures were the difference between groups in pain intensity by VAS, active shoulder ROM by electrogonimeter and PPT of trigger points by electronic digital algometer.

There are several types of pain scales that can be used, the most common and reliable type is the visual analogue scale. This allows clinician to measure decreases or increases in the levels of pain felt by patients and to measure effectiveness of treatment [27]. Goodwin *et al.* [25] suggested that electrogoniometer produced best result when compared with universal and fluid goniometer in measuring joint range of motion. Electronic digital algometer is reliable and valid tool for measuring MTrP sensitivity [28, 29]. Pressure pain threshold scores were the outcome measures used in the analyzed trials. Reliability of PPT using pressure algometer had been studied in previous research [30]. Algometric measurements have good or excellent inter-rater reliability (intraclass correlation coefficient values range from 0.74 to 0.90) [31] and intra-rater reliability (intraclass correlation coefficient values range from 0.75 to 0.99) [32].

According to published summaries of research focusing on treatment of shoulder pain, it seems that exercise therapy (eg, home exercises with regular therapist follow-up) is not enough to treat chronic shoulder pain and it is necessary to combine with other modalities to obtain the best results. Adjunct therapies include thermotherapy, magnet therapy, acupuncture, TENS and LLLT [6-10, 21]. The rationale for the use of laser therapy as an adjuvant treatment for shoulder pain stems from its beneficial effects on reducing pain and inflammatory process without any significant complication. Many authors had reported significant pain reduction with LLLT in acute and chronic painful conditions [33, 34]. Subjects of this study that received LLLT were improved with respect to pain, range of motion and PPT of trigger point, supporting the view that laser treatment has analgesic effects. The analgesia provided by laser treatment allows other therapeutic procedures, such as exercise, to be performed more comfortably. Decreasing shoulder pain increases the confidence of patient and facilitates shoulder relaxation, which are essential for range of motion recovery. Mechanism whereby LLLT relieves pain is unknown. The analgesic effects of LLLT may be due to release of local neurotransmitters such as serotonin [35], increase mitochondrial ATP production [36], increase release of endorphins [37] or anti-inflammatory effects [33, 38] and/or by reducing interstitial swelling by stimulating the motoricity of lymphatics [39]. Athermic laser irradiation was found to induce a significant increase in skin microcirculation [40]. There is also in vivo and in vitro evidenced that 830 nm laser inhibits Ad and C nerve fiber transmission [41, 42]. It is possible that laser-induced neural blockade that may lead to long-term altered nociception, analogous to the prolonged analgesia seen in some patients with local anaesthetics [43]. The repeated application of laser may reduce tonic peripheral nociceptive afferent input to dorsal horn and facilitate reorganization of synaptic connections in the central nervous system producing pain modulation [44, 45].

Laser irradiation to trigger points was suggested to provide analgesia that increase PPT by improving local microcirculation that can increase oxygen supply to hypoxic cells in the trigger points areas, decreasing the spasm in muscle arterioles which is essential for tissue oxygenation and by increasing ATP formation with a consequent normalization in metabolic rate of tissues with diminished energy levels and at the same time it can remove the collected waste products [21, 40]. The other mechanisms may be related to its effects on endorphin levels and gate control theory of pain. By all these mechanisms, Laser can interrupt the vicious cycle of pain of the trigger point(Melzak: muscular tension > pain > increased tension > increased pain, etc.) [46].

These results agree with the study of Olavi [46] who suggested that infrared laser with 1.5J/point dose had a significant effect in increasing pain threshold of trigger points than placebo laser. Hakgüder et al., [22] concluded that LLLT seemed to be beneficial for pain in MPS in the neck or upper back region by using algometry and thermography evaluation. Gur *et al.* [47] revealed that short period application of LLLT was effective in relief pain and in improving functional ability of patients with chronic myofascial syndrome in the neck. The study of Bingol *et al.* [10] showed better results in palpation sensitivity and passive extension, but no significant improvement in pain and active range in laser treatment group compared to the sham control group in treatment of patients with shoulder pain. The results of Stergioulas, [17] suggested that laser treatment was more effective in reducing pain and disability scores than placebo at the end of treatment of patients with frozen shoulder, as well as at follow-up. Laser therapy provide significant better results in reducing pain, swelling, disability and improving independency of patients after stroke with painful shoulder and shoulder-hand syndrome [18]. Chow *et al.* [48, 49] study showed that LLLT reduced pain immediately after treatment in acute neck pain and up to 22 weeks after completion of treatment in patients with chronic neck pain. Also Shirani *et al.* [50] found that LLLT with 660 nm and 890 nm was the effective treatment for reducing pain in patients with myofascial pain dysfunction syndrome. While Thorsen *et al.* [20, 51] found no significant effect of LLLT (GaAlAs, 830 nm) for chronic myofascial pain in the neck and shoulder girdle. The study of Altan *et al.* [52] and Dundar *et al.* [53] revealed that laser therapy had no superiority over placebo groups in treatment of patients with chronic MPS in the neck.

In conclusion, low level laser therapy plus exercise could be effective method to decrease pain, increase shoulder range of motion and increase trigger point PPT in myofascial trigger points of shoulder pain compared with placebo laser with exercise.

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