

# LOW LEVEL LASER VERSUS SHOCK WAVE THERAPY IN TREATMENT OF MYOFASCIAL TRIGGER POINTS OF ROTATOR CUFF MUSCLE DYSFUNCTION: RANDOMIZED CONTROLLED TRIAL

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## ABSTRACT

**Background:** Myofascial trigger points (MTrPs) are perceived by numerous clinicians to be one of the most prevalent cause of pain and dysfunction in musculoskeletal system.

**Purpose:** of this study was to examine the effect of shock wave therapy versus low level laser (LLLT) in treatment of myofascial trigger points (MTrPs) of rotator cuff muscle dysfunction.

**Materials and Methods:** Thirty patients from both genders were randomly distributed into two groups (fifteen patients for each group). They were all diagnosed as unilateral shoulder pain and suffering from myofascial trigger points in rotator cuff muscle. The first group(A) with a mean age of 34.67( $\pm$  5.95) years subjected to LLLT( Gallium-Arsenide I.R laser of 904 nm wave length with 3J / point for 90 sec pulse) in addition to ischaemic pressure for 12 sessions, 3 session a week. While the second group(B) with a mean age of 34.07 ( $\pm$  4.51) got shock wave treatment (6000shocks, 2000 shock/ session, 4 session separated by one week, energy flux density 0.38 mJ/mm<sup>2</sup>, 1.6 bar and 10HZ) in addition to ischemic pressure for 12 sessions, 3 sessions a week. Pre and post treatment evaluations were recorded with respect to measuring pain intensity level, pressure pain threshold of myofascial trigger points and range of motion (ROM) of shoulder flexion and abduction.

**Results:** Patients of both groups showed statistical significant improvement in all the measured variables. Between groups difference the shock wave group (B) showed a statistical significant improvement in decreasing pain intensity level, increasing pressure pain threshold and improving shoulder range of motion than LLLT group (A) (p value<0.05).

**Conclusion:** Both shock wave and LLLT had a significant effect on decreasing shoulder pain intensity level, increasing pressure pain threshold and increasing in shoulder flexion and abduction (ROM). However, the shockwave therapy was more effective than LLLT in treatment of myofascial trigger points of rotator cuff muscle dysfunction.

**KEY WORDS:** Low level laser, Myofascial trigger points, Rotator cuff muscle dysfunction, and Shock wave therapy.

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## INTRODUCTION

Many people suffer from musculoskeletal pain. The myofascial trigger point perceived a main element of the pathophysiology of the musculoskeletal pain [1]. Injury of the rotator cuff and shoulder pain cause problems spreading in the

general, sporting, and working community [2].

It was obvious that there is a relationship between the widespread presence of active MTrPs and shoulder pain and the impact of MTrPs on shoulder muscle function and this accentuates the significance of assessing myofascial pain

for each situation of shoulder pain. Thus; myofascial pain assessment ought to be regularly performed while assessing shoulder pain [3]. A wide range of structures may cause shoulder pain, incorporating the structures in the subacromial space such as the subacromial bursa, the rotator cuff, the long head of biceps and muscle specifically myofascial trigger points [4,5]. Some investigation announced that the alluded pain inspired by active TrPs in the supraspinatus, infraspinatus, pectoralis major and subscapularis muscles duplicated pain level pattern in subjects with shoulder impingement [6].

Shock wave is a compression wave with a high peak pressure and a short life cycle that in medicine is usually generated by electrohydraulic, electromagnetic, or piezoelectric emitter machines(7). It has been proved that extracorporeal shock wave therapy (ESWT) is efficient for pain relief, further it is invigorating healing of chronic tendinoses. Despite the fact that it has been reported that ESWT is an efficient treatment for patients experiencing a few sorts of orthopedic disorders [8].

Research on shock wave therapy (SWT) in the treatment of MTrPs is limited; nevertheless one preparatory examination elucidated that active MTrPs could be recognized by causing the frequent alluded pain from muscles that are normally hard to access by palpation [9]. The biological effects of ESWT are manifested in improved vascularization, the local release of growth factors and local anti-inflammatory effects. Shock wave is considered a sound decision as an immediate treatment for MTrPs; in any case, clinicians ought to have the capacity to palpate for MTrPs to ensure correct location [10].

A few investigations detailed a beneficial outcome of low- level laser for MTrPs when contrasted with placebo laser treatment [11,12]. Arsenide, helium-neon, and infrared diode. Generally, laser therapy has proved its efficacy for the short-term management of MTrPs [13], with its advantages of being safe, very much endured, available, and noninvasive [12]. Investigations carried out to compare between the impact of shock wave therapy and low level laser (LLLT) in treatment of myofascial trigger points(MTrPs)

of rotator cuff muscle dysfunction have not reported any results emphasizing which of them both are more efficient in treatment of (MTrPs) of rotator cuff muscle dysfunction, and that is the purpose of the current study.

## METHODOLOGY

### Design of the study:

Pretest-Posttest randomized controlled experimental design was used In this study, To compare the effect of SWT versus LLLT in treatment of myofascial trigger points of rotator cuff muscle dysfunction.

### Subjects' selection:

Subjects were recruited using publically distributed posters, online social media, and by verbal invitation. This study was approved by the Ethical Committee of the Faculty of Physical Therapy; Cairo University. Treatment was carried out on thirty male and female patients suffering from unilateral shoulder pain and myofascial trigger points in rotator cuff muscles.

The patients, whose age ranged from 25 to 40 [14], were selected from the outpatient clinic of the faculty of physical therapy, Cairo University. The study procedure explained and informed consent obtained from eligible participants. Patients were randomly distributed in two equal groups. The first group(A) comprised of 15 s patients, with a mean age of 34.67( $\pm$  5.95) year, was treated with (LLLT) in addition to ischemic pressure (traditional treatment). The second group(B), 15 patients with a mean age of 34.07 ( $\pm$  4.51) years (6 male and 9 female) had undergone shock wave therapy and ischemic pressure (traditional treatment).

The inclusion Criteria for participants were diagnosed with unilateral shoulder pain and presenting with myofascial trigger points in the rotator cuff muscles. Patients had experienced at least four point and body mass index (BMI) from 18-22 kg/m<sup>2</sup>. Exclusion Criteria for participants were shoulder pain due to other causes as cervical radiculopathy ,shoulder tumors, Glenohumeral acromioclavicular arthritis, frozen shoulder, rotator cuff tears, implanted pace maker ,having undergone myofascial pain therapy within the past month before the study and Pregnancy.

### **Instrumentation:**

**Pressure Algometer(PA):** JTECH medical algometer made in the United states of America with number443142. Pressure algometer is a device that is used to evaluate and quantify pain pressure threshold (PPT) measurement; further, it quantitatively assesses PPT measurement. It has been proven to be a reliable instrument [15]. The algometer registers the force applied to a tissue in terms of kilograms per square centimeters. The recorded value is the measure of force that reproduces pain [16].

**Visual analogue scale (VAS):** Pain intensity level was evaluated by using visual analogue scale (VAS), which is a generally utilized technique. Visual analogue scale is a measurement instrument amongst other various pain scales, yet considered the most well-known and dependable one. It enables clinician indicate reductions or increments in the levels of pain that patients experience and to quantify adequacy of treatment. It consists of a 10 cm line drawn on a paper, with marks at each end, the zero end of the line means having no pain, while ten at the other end means having the worst pain imaginable and the subject's mark was measured to the nearest millimeter. VAS can be utilized to estimate pain intensity improvement with patients by comparing the pain score after some time [17].

### **OB Goniometer:**

The OB goniometer is a simple and adequate technique for the range of motion assessment [18]. The instrument consists of a small fluid-filled box fixed to a plate upon which it can be rotated. In the box, there's a compass needle which is affected by earth magnetic field, and inclination needle which is affected by gravity. The compass needle measures motion on the horizontal plane, and the inclination needle measures motion on the vertical plane. A strap with Velcro fastener, and when required, an angled plastic support makes it easy to place the Goniometer at the correct location in relation to the joint function to be measured [18].

### **Procedures:**

The current study consists of three stages: Pretest measurements, Intervention period, Posttest measurements.

All procedures had been carried out for all patients pre the assigned program and following a month of treatment.

### **Pretest measurements:**

**Pain Intensity Level:** by using VAS the patient was asked to mark at his/her level of pain at the sheet of VAS.

### **Trigger Points Identification Pressure Pain Threshold:**

**Palpation of trigger points:** Flat palpation was used to detect site of trigger points of the affected side for all patients: in rotator cuff muscles at least four active points one for each muscle (A trigger point is palpated as a tender spot on taut band of muscles which produces comparable sign and jump sign) then mark them.

**Pressure Pain Threshold:** by using JTECH medical algometer, the patient was side lying or in the sitting position in which pressure algometer applied perpendicular on the skin and sufficient pressure applied on trigger point then take mean of four points. The subject is instructed to express pain by raising their hands when only slight pain was felt, until the pressure is increased at a constant rate. The procedure was repeated for three times to record the mean difference..

**Shoulder Range Motions:** Active shoulder flexion and abduction measured by using OB Myrine Goniometer through stander measuring procedure.

### **Intervention period:**

**The first group(A):** Received LLLT( Gallium-Arsenide I.R laser of 904 nm wave length with 3J / point for 90 sec pulse ) plus ischaemic pressure(as a traditional treatment) for 12 sessions, 3 sessions /week.( 14 ) Both therapist and patient wore protective goggles for safety during the treatment period. Ischemic pressure is a mechanical treatment of myofascial trigger points that consists of application of sustained pressure for a long enough time to inactivate the trigger points. Specific pressure is applied directly to the center of the trigger point to the patient's tolerance. Care must be taken not to exceed tolerance of the patient (19). Ischaemic pressure consisted of continuous perpendicular deep thumb pressure to the identified rotator cuff trigger point for 30-60 s.

**The second group (B):** All subjects were received traditional therapy (ischemic pressure) as first group plus the Shock master 500. Patients in this group were received (6000shocks, 2000 shock/session, 4 session one week apart , energy flux density 0.38 mJ/mm<sup>2</sup>, 1.6 barand10HZ). The shock wave applicator was directed in most tender point near the insertion of rotator cuff at greater tuberosity under the acromion and other myofascial trigger points in rotator cuff muscle. The treatment area was prepared with a coupling gel to minimize the loss of shockwave at the interface between applicator tip and skin (20).

Both groups were treated under the same conditions and the patients were treated individually to avoid influencing one another.

**Posttest measurements:** Pain intensity level, Pain threshold measurement and shoulder range of motion were repeated as discussed before in pretest measurements after the intervention period to determine its effect.

**Data analysis and statistical design:** Results are expressed as mean, standard deviation (SD). Comparison between values of different variables in the two studied groups was performed using unpaired t test. Pairwise comparison (pre vs post) within the same group was performed using paired t test. SPSS computer program (version 16 windows) was used for data analysis. P value d" 0.05 was considered significant.

**Sample size:** The sample size estimation was based on power analysis in a pilot study with 10 subjects (mean difference 26.87 and SD 5.64). G\*power 3.1 software (University of Dusseldorf, Dusseldorf, Germany) was used in the present study. With power 80% and probability 0.05.

## RESULTS

There was no significant difference between first group and second group in the mean baseline values of their demographic characteristics data Initial comparison between both groups regard to their pre treatment pain intensity level, active shoulder ROM and PPT of trigger points revealed no significant differences in all variables(P>0.05), Table 1. None of the participants reported any adverse reaction or side effects.

**Table 1:** Demographic features of the two studied groups.

	Group (A) (n= 15)	Group(B) (n= 15)	t value	P value
Age (yrs)	34.67 ± 5.95	34.07 ± 4.51	-0.369	0.758 (NS)
Sex				
Female	12 (80.0%)	9 (60.0%)	χ <sup>2</sup> = 1.429	0.232 (NS)
Male	3 (20.0%)	6 (40.0%)		
Weight (kg.)	80.07 ± 18.33	72.60 ± 9.14	1.412	0.169 (NS)
Height (m.)	162.73 ± 8.50	161.93 ± 7.59	0.272	0.788 (NS)
BMI (kig/m <sup>2</sup> )	30.83 ± 6.36	27.67 ± 2.95	1.746	0.092 (NS)

Data are expressed as mean ± SD or number (%).

x<sup>2</sup>= Chi square test. NS= p> 0.05= not significant.

**Pain Level Results:** Pain level was significantly decrease in first and second group (p< 0.001, 0.001) respectively,with a more significant decrease of overall pain in study than in second group after 4 wks of treatment (p<0.001),Tab. 2.

**Table 2:** Intra and inter-group comparison between mean values of pain in the two studied groups measured pre- and post-treatment.

	Group (A) (n= 15)	Group (B) (n= 15)	t value	p value
Pre treatment	8.00 ± 0.85	8.07 ± 0.70	-0.235	0.816 (NS)
Post treatment	4.20 ± 0.68	1.20 ± 0.41	14.655	0.001 (S)
Difference	3.8	6.87		
% change	47.5 ↓↓	85.13 ↓↓		
t value	26.252	35.783		
p value	0.001 (S)	0.001 (S)		

Data are expressed as mean ± SD.

NS=p> 0.05= not significant; \*p< 0.05= significant.

**Total pressure pain threshold Results:** Total pressure pain threshold was significantly increase in first and second group (p< 0.001, 0.001) respectively,with a more significant increase of Total pressure pain threshold in second group than in first group after 4 weeks of treatment (p<0.001), Table3.

**Table 3:** Intra and inter-group comparison between mean values of total pressure pain threshold in the two studied groups measured pre- and post-treatment.

	Group (A) (n= 15)	Group (B) (n= 15)	t value	p value
Pre treatment	0.71 ± 0.08	0.65 ± 0.09	1.673	0.106 (NS)
Post treatment	0.95 ± 0.08	1.18 ± 0.11	-6.437	0.001 (S)
Difference	-0.24	-0.53		
% change	33.8 ↑↑	81.54 ↑↑		
t value	-12.686	-32.515		
p value	0.001 (S)	0.001 (S)		

Data are expressed as mean ± SD.

NS=p> 0.05= not significant; \*\*p< 0.01= highly significant.

**Shoulder flexion and abduction Results:** Shoulder flexion and abduction were significantly increase in first and second group ( $p < 0.001$ ,  $0.001$ ) respectively, with a more significant increase of Shoulder flexion and abduction in second than in first group after 4 wks of treatment ( $p < 0.001$ ), Table 4,5.

**Table 4:** Intra and inter-group comparison between mean values of shoulder flexion in the two studied groups measured pre- and post-treatment.

	Group (A) (n= 15)	Group (B) (n= 15)	t value	p value
Pre treatment	86.67 ± 9.94	86.33 ± 7.67	0.103	0.919 (NS)
Post treatment	122.33 ± 10.33	156.00 ± 8.28	-9.85	0.001 (S)
Difference	-35.66	-69.67		
% change	41.15 ↑↑	80.70 ↑↑		
t value	-27.894	-33.224		
p value	0.001 (S)	0.001 (S)		

Data are expressed as mean ± SD.

NS= $p > 0.05$ = not significant; \*\* $p < 0.01$ = highly significant.

**Table 5:** Intra and inter-group comparison between mean values of shoulder abduction in the two studied groups measured pre- and post-treatment.

	Group (A) (n= 15)	Group (B) (n= 15)	t value	p value
Pre treatment	81.33 ± 16.31	86.33 ± 8.55	-1.052	0.305 (NS)
Post treatment	114.00 ± 15.02	153.67 ± 7.19	-9.224	0.001 (S)
Difference	-32.67	-67.33		
% change	40.17 ↑↑	78.0 ↑↑		
t value	-16.301	-37.057		
p value	0.001 (S)	0.001 (S)		

Data are expressed as mean ± SD.

NS= $p > 0.05$ = not significant; \*\* $p < 0.01$ = highly significant.

## DISCUSSION

This study tackles low-level laser versus shockwave therapy in the treatment of patients experiencing shoulder pain of myofascial trigger points origin after 4 wks of applying the assigned program. Thus; it is an investigation to determine the efficacy of both techniques on patients. Records regarding pain intensity level, pressure pain threshold and shoulder joint range of motion (flexion and abduction) was assessed before and after treatment of both groups using VAS, basic algometer and OB Goniometer.

The outcomes of this investigation revealed that within Shock wave therapy and low-level laser,

pain intensity level seems to decrease notably, while there was a noteworthy increase in active shoulder flexion and abduction, with an increment in PPT of the trigger points, whereas the utilization of shockwave therapy revealed better improvement and has proven to be more efficient than low-level laser.

There are many research focusing on treatment of shoulder pain, it seems that treatment of myofascial trigger points are varied, maybe invasive as Injection Therapy (e.g., Botox) and Acupuncture, and may be non invasive as TENS, Laser, Ultrasound, Spray and Stretch Techniques, Ischemic Compression, Massage and recently used Shock wave Therapy. Limited to one modality is insufficient in treating chronic shoulder pain and the importance of incorporating other modalities was clear to get the best outcomes [20].

Investigations carried out by Yamany and salim (2011) revealed that the application of Low level laser therapy plus exercise was more efficient than placebo laser with exercise [14], since the outcomes showed a decrease in pain intensity level, an increase in shoulder range of motion and increase trigger point PPT in myofascial trigger points of shoulder pain by applying the LLLT and exercise protocol.

Our results of Laser therapy can be supported by the work of Thorsen H et al. (1992) whom studied Laser irradiation on trigger points and 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].

The results of shock wave in our study can be attributed to the concept that explained by the work of Chen C et al. (2014) whom determine that pain arising from tendinopathy is due to hypovascular change with a degenerative process with or without trauma. Shockwave relieves the pain of tendinopathy at the tendon-bone junction by inducing neo-vascularization and improving tissue regeneration [22].

Also our results confirmed by the results of Perez M et al.(2003) about the effect Extracorporeal shockwave therapy for plantar fasciitis. Shockwaves are sound waves that are generated by a source that creates vibrations which are then transported through tissues via fluid and solid particle interaction. Proponents of shockwave therapy suggest that ESWT creates controlled local tissue injury that causes neovascularization, and is associated with increased amounts of tissue growth factors within the locally injured structures. It is therefore hypothesized that ESWT stimulates healing by creating a wound environment at the site of shockwave delivery [23].

The present study also showed statistically significant decrease in the pain intensity level and improvement in PPT of the trigger points in both groups but more improvement in shock wave therapy group, This result may be because the explanation of Ji- Hyun Lee et al.(2017) that shock waves are a sort of sound waves that can be transmitted through soft tissues without loss of energy, and their fine and repetitive stimulations are effective for reducing pain. In addition, stimulations caused by shock waves form new muscular fibers by facilitating the secretion of substances that generate blood vessels around an affected region. These new muscular fibers increase blood flow around a lesion and induce the reformation of blood vessels, which eventually stimulates and reactivates the healing process of the tendons and the tissues around them, thereby stabilizing the tissues. The secretion of substances induces lymphangiogenesis through upregulation of expression of vascular endothelial growth factor and basic fibroblast growth factor [24].

Plaisier PW et al.(1994) provided other hypothesized mechanisms of action include the physical alteration of small axons, thereby inhibiting pain impulse conduction; chemical alteration of pain receptor neurotransmitter, thereby preventing pain perception; and hyperstimulation activation of the gate control mechanism, thereby affecting analgesia [25].

Our finding confirmed by Wang et al.(2002) who attributed the analgesic effect of SWT to the following mechanisms; after application of shock waves was finding reduced CGRP expres-

sion in DRG neurons provides, in part, a possible explanation for pain relief following shockwave therapy [26].

Subject of this study that received shock waves were improved with respect to pain intensity level, range of motion and pressure pain threshold of trigger point, supporting the view that shock waves treatment has analgesic effect so this increases the confidence of patient and facilities shoulder relaxation, which are essential for range of motion recovery [27].

Our findings consistent with the results of Harniman et al.(2004) those reported that moderate evidence that high energy ESWT (0.2-0.4 mJ/mm<sup>2</sup>) provides effective long-term improvement in pain, disability, motion, and power in patients with chronic rotator cuff tendonitis [28].

Our finding also supported by El Shiwi et al(2010) who said that shockwave therapy is effective interventions to reduce shoulder pain severity, functional disability and to increase shoulder flexion, abduction, internal rotation in case of shoulder impingement syndrome [29].

In contrast with Kim&Kong (2014) who reported that the most important finding of his study is that US-guided needling was more effective than ESWT in function restoration and pain relief in patients with chronic calcific rotator cuff tendonitis [30].

## CONCLUSION

From the findings of the current study we can conclude that both shockwave and LLLT are effective interventions to reduce shoulder pain severity, increase pain pressure threshold of myofascial trigger point's rotator cuff muscle and to increase shoulder range of motions. However, shock wave therapy is more effective than LLLT.

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**Conflicts of interest: None**

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