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Efficacy of Shockwave Therapy in Treatment of Myofascial Trigger Points of Rotator Cuff Muscle Dysfunction

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Abstract : The purpose of this study was to examine the effect of shock wave therapy in treatment of myofascial trigger points of rotator cuff muscle dysfunction in which Myofascial trigger points are recognized by many clinicians to be one the most common cause of pain and dysfunction in musculoskeletal system. **Subjects:** Thirty patients diagnosed as shoulder pain including cases of rotator cuff tendinitis. **Methods:** Patients were randomly distributed into two equal groups. The first group (control) consisted of 15 patients with a mean age of 34.67(± 5.95) years received traditional therapy (ultrasound (1 MHZ, Continuous Pulse for 5 minute) for12sessions, 3 session /week. The second group (study) consisted of 15 patients with a mean age of 34.07 (± 4.51) years received shock wave therapy (6000shocks, 2000 shock/ session, 3 session one week apart , energy flux density 0.38 mJ/mm^2, 1.6 bar and10HZ) In addition to traditional therapy . Patients were evaluated pretreatment and post treatment for shoulder pain intensity, pressure pain threshold of myofascial trigger points, shoulder flexion, abduction, extension, external and internal rotation motions. **Results:** Patients of both groups showed significant improvement in all the measured variables. Between groups difference the shock wave group showed a significant improvement in decreasing pain intensity, increasing pressure pain threshold and improving shoulder range of motion than control group. **Conclusion:** Both shock wave and the traditional treatment had a significant effect on decreasing shoulder pain intensity, increasing pressure pain threshold and increasing in shoulder flexion, extension, abduction, external and internal rotation motions. However, the shockwave therapy was more effective than traditional therapy in treatment of myofascial trigger points of rotator cuff muscle dysfunction.
Keywords: Myofascial trigger points, shock wave therapy, and rotator cuff muscle dysfunction.

Introduction

Myofascial pain is the most common form of musculoskeletal pain, which affects more than 40 million Americans. It has a major impact on health services, accounting for approximately 15% of consultations in primary care and up to 90% of patients treated in pain clinics[1]**.** Shoulder problems are common with a 1-year prevalence ranging from 4.7% to 46.7% and a lifetime prevalence of 6.7% to 66.7%. Many different structures give rise to shoulder pain, including the structures in the subacromial space such as the subacromial bursa, the rotator cuff tendon, the long head of biceps and Muscle specifically myofascial trigger points[2], [3]**.**People have evolved to undertake many overhead activities in everyday life, in the workplace and in the sporting area. The relatively short lever arm of the shoulder muscles acting on the significantly long lever arm of the upper limb, often with extra load in the hand, leads to very high loads through the tendons and large reaction forces across the joint surfaces[4]**.**

Myofascial trigger points have been recognized to refer pain to the shoulder region and may be a source of peripheral nociceptive input that gives rise to sensitization and pain in which Myofascial trigger points are common with rotator cuff tendinopathy and shoulder impingement[2,3]**.** A recent study reported that the referred pain elicited by active trigger points in the supraspinatus, infraspinatus, pectoralis major and subscapularis muscles reproduced the pain pattern in subjects with shoulder impingement and rotator cuff tendinitis and this related to a greater intensity of pain in this patients[5]**.**

Trigger points may be active (causing spontaneous pain or pain with movement) or latent (causing pain only in response to compression), and classified as central (within taut band) or attachment (musculotendinous junction). When accompanied by other symptoms, myofascial trigger points may also constitute myofascial pain syndrome, one of the most frequent causes of musculoskeletal pain.

American study(1990) found that 14.4% of the population experienced myofascial pain, whereas suggested that 21% to 93% of pain complaints were myofascial[6,7].The spontaneous electrical activity found in active MTrP loci was abnormal endplate potentials from excessive acetylcholine (Ach) leakage. This depolarized the post junctional membrane resulting in prolonged Ca release, continuous sarcomere shortening, and increased metabolism. Additionally, local circulation was compromised, thus reducing oxygen and nutrient supply [2,6]**.**

MTrPs are not just contracted muscle fibers but neuromuscular lesions that form part of a neurological loop that affects and is affected by the CNS. This is evidenced by the fact that removing LTrPs normalizes the muscle activation pattern. The presence of LTrPs in the scapular rotator muscles is associated with changes in motor control prior to the presence of pain. The changes described above may predispose individuals to increased risk of subacromial impingement, overuse of the muscle and decsreased efficiency of movement during scapular plane elevation[8].

Treatment of myofascial trigger points are varied, may be non invasive as TENS, Laser, Ultrasound ,Spray and Stretch Techniques, Ischemic Compression ,Massage and recently used Shock wave Therapy, and may be invasive as Injection Therapy (e.g., Botox) and Acupuncture[3]. Low-energy extracorporeal shock wave treatment (ESWT) is a relatively new therapeutic tool that is widely used for the treatment of epicondylitis and plantar fasciitis and to foster bone and wound healing. Shock waves are sonic pulses with high energy impact, are thought to induce biochemical changes within the targeted tissues through mechanotransduction. The biological effects of ESWT are manifested in improved vascularization, the local release of growth factors and local anti-inflammatory effects[9]**.** Extracorporeal shock wave application (ESWA) is increasingly investigated for the management of acute and chronic inflammatory pathologies of muscle, nerve, and skin[10].More recently interest has been shown in the use of shock waves for muscle. Research on SWT in the treatment of MTrPs is limited; however one preliminary study demonstrated that active MTrPs could be identified by causing the familiar referred pain from muscles that are usually difficult to access by palpation[11].

Materials and Methods

Subjects' selection: this study was approved by the Ethical Committee of the Faculty of Physical Therapy; Cairo University. thirty male and female patients with shoulder pain and myofascial trigger points in rotator cuff muscle with age ranged from25-45 years old were selected from outpatient clinic of faculty of physical therapy, CairoUniversity and outpatient clinic of faculty of medicine, Zagazeg University, Al Sharqia .the study procedure explained and informed consent obtained from eligible participants. Patients were randomly distributed into two equal groups. The first group (control) consisted of 15 patients with a mean age of 34.67(± 5.95) years 3 male and 12 female received traditional therapy (ultrasound). The second group(study) consisted of 15 patients with a mean age of 34.07 (± 4.51) years (6 male and 9female received shock wave therapy In addition to traditional therapy.

The inclusion Criteria for participants were diagnosed with unilateral shoulder pain and Presenting with myofascial trigger points in the rotator cuff muscle. Patients had experience at least four point one of them active and other latent. Exclusion Criteria for participants were shoulder pain due to other causes as cervical radiculopathy ,Shoulder tumors ,Frozen shoulder ,Rotator cuff tears, Glenohumeral acromioclavicular arthritis, Implanted pace maker, Having under gone myofascial pain therapy within the past month before the study and Pregnancy.

Design of the study:

Pretest-Posttest control group design was used. In this study, the patients were randomly assigned in to two groups, 15 patients for each group to examine the effect of shock wave therapy in treatment of myofascial trigger points of rotator cuff muscle dysfunction.

Procedures:

Evaluation procedures: The evaluation procedures 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 analogue scale (VAS), which is a widely used method. This consist of a 10 cm lie drawn on a paper ,with marks at each end ,the zero end of the line is marked as representing no pain at all and the other end as representing the worse and the subject ' s mark was measured to the nearest millimeter. The VAS can be used to measure progress by comparing the pain score over time [12] .

Sometimes descriptive terms such as mild, moderate , sever, very sever and worst pain or number are provided along the scale for guidance as shown in, and the scale is then referred as a graphic rating scale [13]**.**

Trigger Points Identification and Pressure Pain Threshold Measurement: Flat palpation was used to detect site of trigger points in rotator cuff muscle at least four point (one active and other latent) and mark them then used basic algometer in which the patient was side lying or sitting position in which pressure algometer applied perpendicular on the skin and sufficient pressure applied on trigger point once pain appear take the reading then take mean of four point. A basic algometer (pressure threshold meter) is a hand held, spring-load, rubber-tipped, pressure-measuring device that offers a mean of achieving standardized pressure application fig (1).

Shoulder Range Motions: Active shoulder flexion, extension, abduction, external and internal rotation was measured by using OB Myrine Goniometer through stander measuring procedure. The O.B Myrine Goniometer 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 and strap with Velcro fastener when required[14].

Treatment Procedure: The Shock master 500 was used. Patients in study group were received (6000shocks, 2000 shock/ session, 3 session one week apart , energy flux density 0.38 mJ/mm^2, 1.6 barand10HZ) fig (2) (McevoDommerholt.,2012),In addition to traditional treatment. While control group were received traditional therapy (ultrasound (1 MHZ, Continuous Pulse for 5 minute) for 12 sessions, 3 session /week, in addition to ischaemic pressure to MTrPs.

Both group treated under the same condition and the patients treated individually to avoid influencing on another. 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 the patient[15].

Fig.(1)measurement of Pain Pressure Threashould of infraspinatus using pressure algometer

Fig.(2)Application of shock wave therapy for trigger points of rotator cuff muscle

Data analysis and statistical design

Statistical Package for Social Sciences (SPSS) computer program (version 19 windows) was used for data analysis. P value ≤ 0.05 was considered significant and < 0.01 was considered highly significant. Results are expressed as mean ± standard deviation (SD) or number (%). Comparison between categorical data in the two studied groups was performed using Chi square test. Comparison between values of different variables in the two studied groups was performed using unpaired t test or Mann Whitney test whenever it is appropriate while comparison between pre- and post-treatment within the same group was performed using paired t test or Wilcoxon Signed Ranks test whenever it is appropriate.

Results

At initial evaluation, there was no significant difference between control and study 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.

Table1: Demographic features of the two studied groups.

	Control group (n= 15)	Study group (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^2= 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^2)	30.83 ± 6.36	27.67 ± 2.95	1.746	0.092 (NS)

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

χ^2= Chi square test.

NS= p> 0.05= not significant.

Pain Intensity Level Results: Pain level was significantlydecrease in study and control group (p< 0.001, 0.001) respectively,with a more significant decrease of overall pain in study than in control group after 4 wks of treatment (p<0.001), Table 2, Fig.3.

Table 2: Inter- and intra-group comparison between pain intensity values measured pre- and post-treatment in the two studied groups.

	Control group (n= 15)	Study group (n= 15)	Z value	p value
Pre	8.00 ± 0.85	8.07 ± 0.70	-0.222	0.824 (NS)
Post	3.53 ± 0.74	1.20 ± 0.41	-4.816	0.001**
Difference	4.47	6.87		
% improvement	55.88	85.13		
Z value	-3.462	-3.464		
p value	0.001**	0.001**		

Data are expressed as mean ± SD.

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

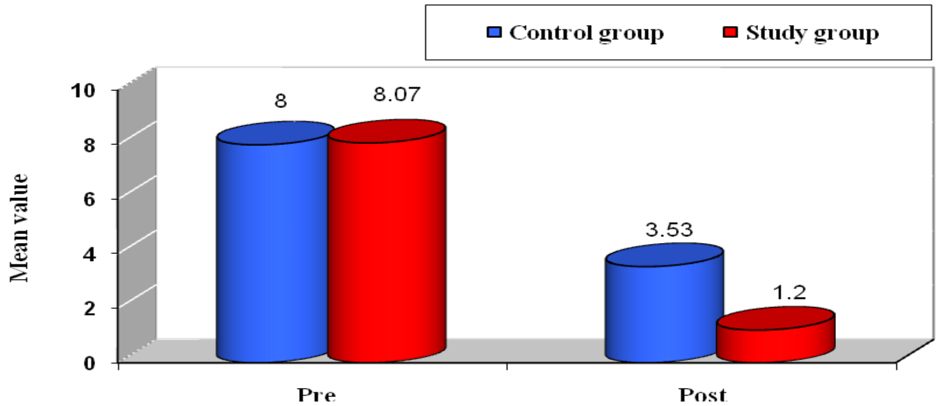

Fig.3: Mean values of pain intensity measured pre- and post- treatment in the two studied groups.

Total Pressure Pain Threshold of the Trigger Points Results: There was a significant increase in PPT of the trigger points in both group however study group was higher in study group (81.54%) than in control group (45.71%)(Table3; Fig.4) .

Table3:Inter- and intra-group comparison between mean values of total pain pressure threshold measured pre- and post- treatment in the two studied groups.

	Control group (n= 15)	Study group (n= 15)	t value	p value
Pre	0.70 ± 0.08	0.65 ± 0.09	1.673	0.106 (NS)
Post	1.02 ± 0.10	1.18 ± 0.11	-4.171	0.001**
Difference	0.32	0.53		
% improvement	45.71	81.54		
t value	-12.270	-32.515		
p value	0.001**	0.001**		

Data are expressed as mean ± SD.

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

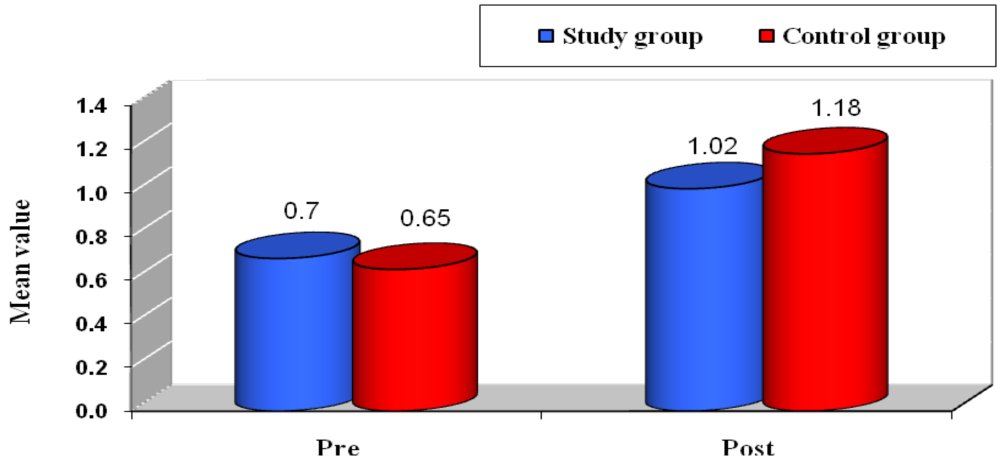

Fig.4: Inter and intra-group comparison between mean values of total pressure pain threshold measured pre- and post- treatment in the two studied groups.

Active Shoulder ROM Results: Both study and control groups demonstrated a significant increase in shoulder flexion, extention, abduction, external rotation and internal rotation, where p < 0.001, in both groups . While post treatment comparison between study and control demonstrated a more significant increase of shoulder ROM in study than control group (p <0.001)respectively, Table4,5,6,7,8),figure(5,6,7,8,9) .

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

	Control group (n= 15)	**Study group (n= 15)**	**t value**	**p value**
Pre **Post**	86.67 ± 9.94 125.33 ± 8.96	86.33 ± 7.67 156.00 ± 8.28	0.103 -9.736	0.919 (NS) 0.001**
Difference **% improvement** **t value** **p value**	38.66 44.61 -18.961 0.001**	69.67 80.7 -33.224 0.001**		

Data are expressed as mean ± SD.

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

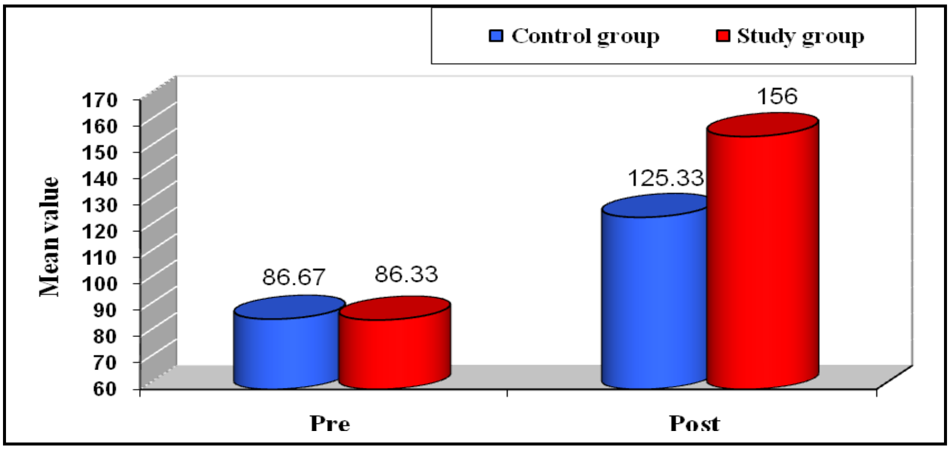

Fig.5:Mean values of shoulder flexion measured pre- and post- treatment in the two studied groups

Table5:Inter- and intra-group comparison between mean values of shoulder extension measured pre- and post- treatment in the two studied groups.

	Control group (n= 15)	Study group (n= 15)	t value	p value
Pre **Post**	34.00 ± 6.33 43.67 ± 5.16	34.67 ± 5.16 47.33 ± 3.20	-0.316 -2.338	0.754 (NS) 0.028*
Difference **% improvement** **t value** **p value**	9.67 28.44 -10.640 0.001**	12.66 36.52 -11.767 0.001**		

Data are expressed as mean ± SD.

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

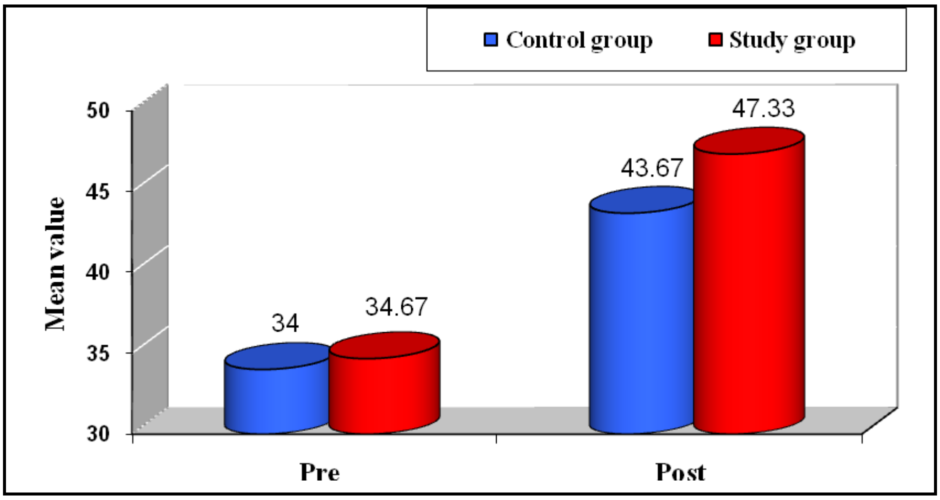

Fig.6:Mean values of shoulder extension measured pre- and post- treatment in the two studied groups.

Table 6: Inter- and intra-group comparison between mean value of shoulder abduction measured pre- and post- treatment in the two studied groups.

	Control group (n= 15)	Study group (n= 15)	t value	p value
Pre **Post**	81.33 ± 16.31 119.33 ± 17.10	86.33 ± 8.55 153.67 ± 7.19	-1.052 -7.169	0.302 (NS) 0.001**
Difference **% improvement** **t value** **P value**	38.0 46.72 -13.016 0.001**	-67.34 78 -37.057 0.001**		

Data are expressed as mean ± SD.

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

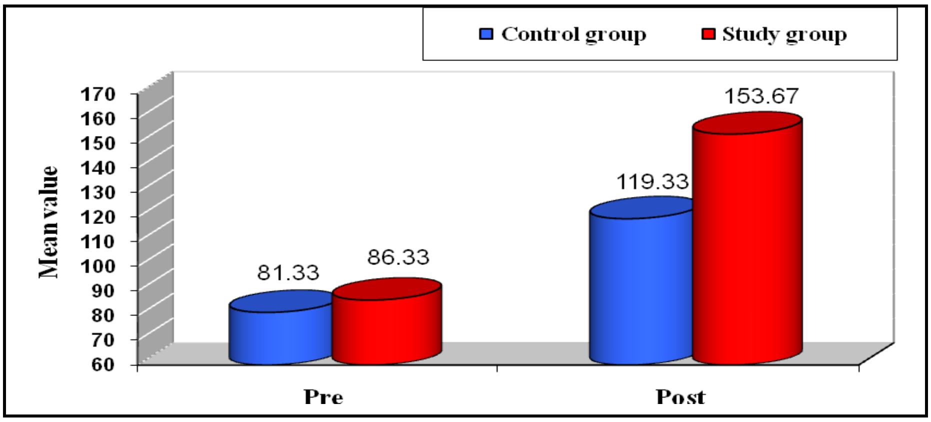

Fig.7:Mean values of shoulder abduction measured pre- and post- treatment in the two studied groups.

Table 7: Inter- and intra-group comparison between mean value of shoulder external rotation measured pre- and post- treatment in the two studied groups.

	Control group (n= 15)	**Study group (n= 15)**	**t value**	**p value**
Pre **Post**	57.33 ± 8.21 75.00 ± 8.24	55.33 ± 5.82 86.00 ± 5.07	0.770 -4.404	0.448 (NS) 0.001**
Difference **% improvement** **t value** **p value**	17.67 30.82 -9.089 0.001**	30.67 55.43% -15.778 0.001**		

Data are expressed as mean ± SD.

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

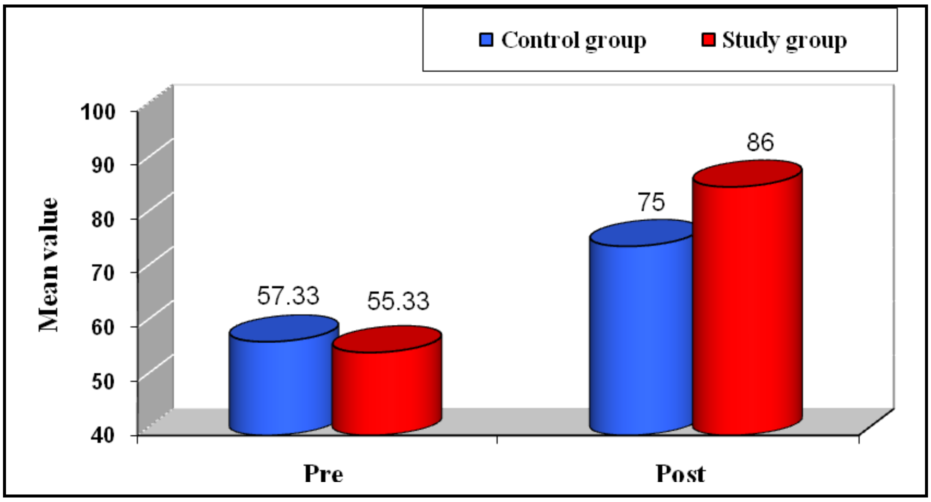

Fig. 8: Mean values of shoulder external rotation measured pre- and post- treatment in the two studied groups

Table 8:Inter- and intra-group comparison between mean value of shoulder internal rotation measured pre- and post- treatment in the two studied groups.

	Control group (n= 15)	Study group (n= 15)	t value	p value
Pre **Post**	59.67 ± 8.12 75.67 ± 5.63	57.33 ± 6.78 84.67 ± 6.40	0.854 -4.090	0.400 (NS) 0.001**
Difference **% improvement** **t value** **p value**	16.00 26.81 -10.267 0.001**	27.34 47.69 -25.392 0.001**		

Data are expressed as mean ± SD.

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

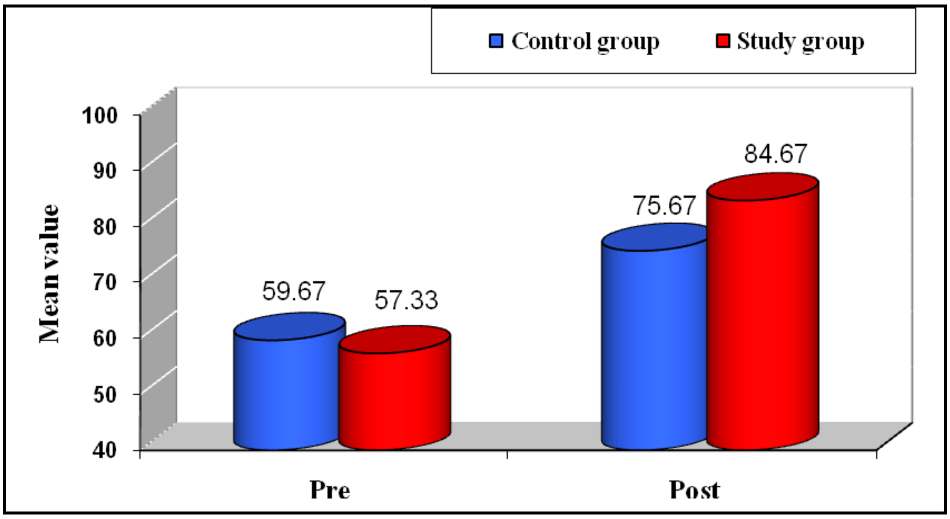

Fig. 9: Mean values of shoulder internal rotation measured pre- and post-assessment in the two studied groups.

Discussion

The purpose of this study was to examine the effect of shock wave therapy in treatment of myofascial trigger points of rotator cuff muscle dysfunction and its effect on improvement of pain intensity, pressure pain threshold and range of motion in the shoulder joint.

We found that myofascial pain was common cause of shoulder pain so we must included myofascial examination as a routine during assessment and management of shoulder pain.

This study found that Shock wave therapy in addition to traditional therapy has been reported to be effective in the treatment of patients with shoulder pain, there was a significant decreased in pain intensity, increased in pressure pain threshold and active shoulder flexion and abduction, extension, external rotation and internal rotation in shockwave group rather than control group. ESWT had faster and better functional outcome improvements and decrease pain in shoulder capsulitis [16].

Pain intensity, pressure pain threshold and shoulder joint range of motion (flexion, extension, abduction and external rotation and internal rotation) was assessed before and after treatment of both groups using VAS, basic algometer and OB Goniometer.

Using a VAS for the evaluation of pain perception is a valid method for the

Objectification of subjective discomfort . The VAS is an easy to administer scale and provides accurate information on the patients' status[13],OB Goniometer is an easy and valid method for assessment of range of motion[14].

According to published summaries of research focusing on treatment of shoulder pain, it seems that treatment of myofascial trigger points are varied, may be non invasive as TENS ,Laser ,Ultrasound ,Spray and Stretch Techniques, Ischemic Compression ,Massage and recently used Shock wave Therapy, and may be invasive as Injection Therapy (e.g., Botox) and Acupuncture. Using one modality is not enough to treat chronic shoulder pain and is necessary to combine with other modalities to obtain the best results [3].

Our opinion 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[17].

The analgesic effect of SWT could be attributed to the following mechanisms; after application of shock waves was finding reduced CGRP expression in DRG neurons provides, in part, a possible explanation for pain relief following shockwave therapy[18] .

The physiological explanation concerned with pain reduction of shoulder after shock waves was described that shock waves causes hyper stimulation of nociceptor and interruption the flow of nerve impulses leads to pain alleviation[19].

The analgesic effect of shock waves could be attributed to the following mechanisms, shock waves induced analgesic effect by over stimulating the axons (gate-control theory) thereby increasing a person pain threshold[20] **.**

Other hypothesized mechanisms of action include the physical alteration of small axons, therapy inhibiting pain impulse conduction, and chemical alteration of pain receptors neurotransmitter, thereby preventing pain perception[21].

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

Our finding also supported by El Shiwi 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.[23]

Our findings consistent with those reported that moderate evidence that high energy ESWT (0.2-0.4 mJ/mm^2) provides effective long-term improvement in pain, disability, motion, and power in patients with chronic rotator cuff tendonitis[24].

In contrast with kim 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[25]. Also the findings are consistent with those reported by that concluded that ultrasound treatment of the supraspinatus and infraspinatus trigger points evoked a significantly greater short-term decrease in pain sensitivity and increase PPT in patients with myofascial trigger points[26].

Conclusions

From the findings of the current study we can conclude that both shockwave and traditional therapy (ultrasound plus ischemic pressure) 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 in addition to traditional therapy is more effective than traditional therapy if used alone.

Abbreviations:

VAS (Visual analog scales), LTrPs (Latent trigger points)
ESWT (Extracorporeal shock wave therapy), Ach(Acetyl choline)
CGRP (Calcitonin gene related peptide), CNS(Central nerves system)
DRG (Dorsal Root Ganglion), MTrPs(Myofascial trigger points)

ROM(Range of Motion)

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