Journal of Positive School Psychology http://journalppw.com
2022, Vol. 6, No. 8, 6183-6193

The Influence of Manual Exercise Therapy Versus Shock Wave Therapy on Ultrasonography Measurements in Patients with subacromial Impingement Syndrome. A Randomized Trial

Ghada Mohamed Rashad Koura [1, 2,*], Raghad Mudawi Yahya Asiri [3], Sara Awad Gharama Alasmry [3], Mohamed Ibrahim Mabrouk [4], Ahmed Mohamed Fathi Elshiwi [5]

[1] Assistant professor in department of physical Therapy for musculoskeletal disorders and its surgery, faculty of physical therapy, Cairo University, Egypt,

[2] Assistant professor in department of medical rehabilitation, collage of applied medical sciences, KKU, Saudi Arabia.

[3] Physiotherapy specialist, college of applied medical sciences, King Khalid university, physiotherapist in Saudi German hospital, Aseer, Saudi Arabia.

[4] lecturer of physical therapy for internal medicine at Al-Nahda University, Beni-suef, Egypt colleague at National Heart Institute, Giza, Egypt

[5] PhD of physical therapy, Faculty of physical therapy, Cairo University, Egypt, Consultant of physical therapy, head of department of physical therapy in Saudi German hospital, Aseer, Saudi Arabia.

***Corresponding Author: -** Ghada Mohamed Rashad Koura

Assistant professor in department of physical Therapy for musculoskeletal disorders and its surgery, faculty of physical therapy, Cairo University, Egypt, Assistant professor in department of medical rehabilitation, collage of applied medical sciences, KKU, Saudi Arabia.

Abstract

The purpose: of this study was to compare the effects of manual exercise therapy versus shock wave therapy on ultrasonography measurements in patients with subacromial impingement syndrome. **Methods:** Thirty patients diagnosed as shoulder subacromial impingement syndrome stage II Neer classification due to mechanical causes. Patients were randomly distributed into two equal groups. The first group included 15 patients with a mean age of 36.26 (+ 6.54) who had manual exercise therapy three times per week, every other day, for four weeks. This included strengthening exercises, stretching exercises and mobilization exercises for shoulder joint. The second group, which included 15 patients with an average age of 36.46 (+ 6.68) years, underwent shockwave treatment (3000 shocks, 1000 each session, 3 sessions, two-week intervals, 0.32mJ/mm^2). Ultrasonography was used to assess patients pre- and post-treatment. Patients evaluated pretreatment and post treatment for shoulder functional impairment as well as shoulder acromiohumeral distance in adduction and abduction. **Results:** Manual exercise therapy group had a substantial decrease in shoulder functional impairment and a greater increase in acromiohumeral distance in both adduction and abduction in comparison to the shock wave therapy group. **Conclusion:** Manual exercise therapy is more effective than shock wave therapy in reducing shoulder functional impairment and increasing the acromiohumeral distance in both adduction and abduction in patients with subacromial impingement syndrome.

Keywords: subacromial impingement syndrome, manual exercises therapy, shockwave therapy, acromiohumeral distance (AHD).

Introduction

Shoulder impingement is a clinical syndrome in which soft tissues become painfully entrapped in the area of the shoulder joint,[1,2] Sub acromial impingement syndrome (SIS) is a group of problems in the sub acromial space. It includes partial thickness rotator cuff tears, rotator cuff tendinitis, calcific tendinitis, and sub acromial bursitis. Shoulder impingement syndrome (SIS) has been suggested as the most common cause of shoulder pain.[3,4]

Subacromial impingement syndrome happens when the rotator cuff is pressed against the underside of the acromion and the coracoacromial ligament. This usually happens when the arm is raised. People have said that it is more of a group of symptoms than a clear diagnosis.

Subacromial impingement syndrome (SAIS) of the shoulder is the most common shoulder disorder. Between 44 and 65% of all shoulder pain complaints made to a doctor's office are due to SAIS .[5]
The humeral head, the anterior edge and under surface of the first third of the acromion, the coracoacromial ligament, and the acromioclavicular joint make up the subacromial space. The supraspinatus tendon, the sub acromial bursa, the long head of the biceps brachii tendon, and the shoulder joint capsule are all parts of the sub acromial space. SAIS could damage any or all of these structures.[3]

The subacromial space or supraspinatus outlet is made up of the top of the humerus, the bottom of the acromion, the acromioclavicular joint, and the coracoacromial ligament, which is the roof of the glenohumeral joint. The rotator cuff tendons (supraspinatus, infraspinatus, teresminor, and sub scapularis), the long head of the biceps, and the sub deltoid/acromial bursa are all in the sub acromial space. In healthy shoulders, the height of this space is between 9 and 10 mm. A radiographic measurement of less than 6 mm means that the rotator cuff is being compressed, which is bad. The actual thickness of the rotator cuff tendon in this area is 5 to 6 mm, which doesn't leave much room for the bursa or tendon.[5]

Rotator cuff syndrome, also called SIS, is a common problem with the shoulder. In general practice, the number of shoulder complaints is thought to be 11.2/1000 patients per year, with impingement being the most common disorder.

It is the most common shoulder problem. The disorder causes the tendons in the rotator cuff to become inflamed or to break down, which leads to loss of function and disability.[6,7]

Long-term or repetitive use of one's arms above the head might injure the rotator cuff tendon. Biomechanical trauma occurs when the subacromial structures press on the anterior acromion and the coracoacromial ligament, particularly in abduction and flexion with the arm internally rotated, causing a lack of blood supply to the subacromial tendons and the rotator cuff tendons.[8] Most of the time, physical therapy is the first step in treating conservative treatment usually involves therapeutic exercise programs, that aim to restore normal scapula motion and muscle control.[9]

The effectiveness of therapeutic exercise for treating SIS, showing a general decrease in pain and improvement in shoulder function.[10]
A recent network meta-analysis found that specific exercises, manual therapy, kinesio taping, and acupuncture, along with general exercises, are effective treatments for people in the early stages of SIS.[11]
Shock waves are sound waves with a sharp rise in pressure at the front of the wave. About 8 and 10 mm are the width and depth of the focus areas.[12]

Extracorporeal shock waves are high-pressure acoustic waves that are focused and have a very short duration. They are made outside of the body, travel through soft tissue without losing much energy, and are reflected at the points where different organs meet.[13] Extracorporeal shock wave therapy (ESWT) has been used to treat things like fractures that don't heal, lateral epicondylitis, plantar fasciitis, and calcific tendinitis of the shoulder. It has shown promise in helping broken bones heal and tendinopathies treatment.[14]

ESWT is used to treat these conditions because it speeds up the healing of soft tissues through local hyperemia, neovascularization, reduction of calcification, inhibition of pain receptors, and/or denervation. This reduces pain and helps chronic inflammatory processes heal over time.[15]

Ultrasound is a cheap test that can be done right away. It lets the rotator cuff be looked at and compared to the other shoulder during a dynamic examination of the shoulder joint. Patients do well with it as well . Ultrasonography can tell if the damage to the rotator cuff tendon is partial or complete, and it can also show where the damage is. It is used to figure out what's wrong with the shoulder joint and to see how well therapy is working.[16] Research shows that ultrasound is just as accurate and sensitive as MRI when it comes to finding full-thickness tears, but it is less sensitive than MRI when it comes to finding partial tears.[17]

Reduced sub-acromial space has been linked to sub acromial impingement syndrome, which can damage structures like the sub acromial bursa or the rotator cuff tendons.[19,20]

When a person has symptoms of impingement the acromiohumeral distance (AHD), which is the linear distance between the acromion and the head of the humerus, can be used to measure the subacromial space. Ultrasonography (US) has many benefits, such as low costs, a high level of usability, and no radiation.[21,22]
The goal of the study was to see how patients with subacromial impingement syndrome responded to manual exercises therapy versus Shock wave therapy, as measured by ultrasonography.

Subjects and Methods

Study Design

Type of study: The study is an experimental randomized clinical trial. **Site of the study:** the study was conducted in the out clinic of the Faculty of Physical Therapy, Cairo University, Egypt.

Participants

Thirty men and women between the ages of 25 and 45 with shoulder subacromial impingement syndrome due to mechanical causes (stage II Neer classification) took part in this study. Thy were recruited from outpatient physical therapy clinic National Institute of Neoromotor System and Elsahel Teaching Hospital, Cairo, Egypt to compare the effects of manual exercise therapy and Shock wave therapy on ultrasonography measurements in subacromial impingement syndrome patients.

Randomization

Each participant received information on the nature and importance of this study, and her freedom to withdraw from the research anytime as well as the confidentiality of any collected data. Using a computer-based randomization method, participants were randomly divided into two equal groups for the experiment. The patients in group A received manual exercises, while the patients in group B received shock wave therapy. They were checked to see if they were eligible for the study. Following randomization, no volunteers dropped out of the trail (figure 1).

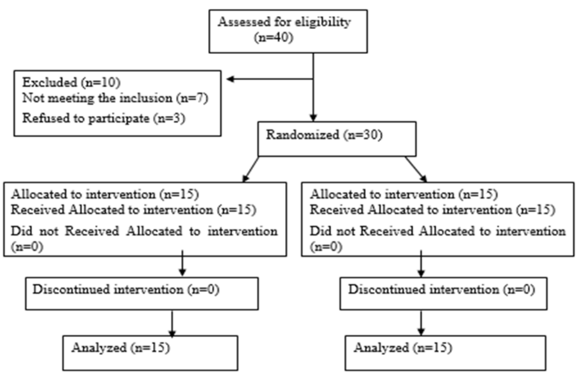

Figure (1): Participant flow diagram

Inclusion criteria:

- The patient's "Neer sign" and "Hawkins sign" were both positive.
- The patient said he felt pain when he moved his shoulder up in the scapular plane (eg: welders, plate workers, slaughterhouse workers and overhead playing athletes).
- When the patient's rotator cuff tendons were touched, they hurt.
- The patient said it hurt to do isometric abduction with resistance.

Exclusion criteria:

- Frozen shoulder.
- Rotator cuff tears.
- Glenohumeral or acromioclavicular arthritis.
- Implanted pace maker.

2- Instrumentation:

(a)- Assessment instrumentations:

1. Shoulder pain and disability index (SPADI) based on the work of
2. Diagnostic Ultrasound.

- Assessment procedures

1- The shoulder pain and disability index (SPADI), a robust and accurate index for quantifying shoulder pain and disability, was used to measure pain and functional impairment. It's divided into two sections: one for evaluating pain and another for evaluating functional impairment. This was done as follows: pain ratings from all questions were summed together, and the mean value was selected. For the purposes of data analysis, the functional scores for all questions in section two were combined. The final score for each section was evaluated statistically.[22]

2- Ultrasonography measurements of the sub acromial space were made by placing the transducer on the lateral surface of the shoulder along the longitudinal axis of the hummers.[23]

This measurement was defined as the distance between the humeral head and the outside margin of the acromion, which appeared on the longitudinal ultrasonography as highly echoic bony markers that were frozen. The AHD at the sub acromial space's intake is consequently represented by this measurement. To prevent internal rotation of the shoulder, the participants were told to keep their hands in pronation while taking the AHD measurements while sitting with their arms at zero and 45 degrees of active abduction. (figure 2).

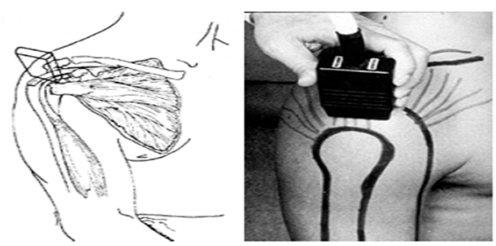

Figure (2): Measurement of shoulder (AHD) by placing the transducer on the lateral surface of the shoulder while the forearm in pronation.

(b) Treatment Instrumentation:
- Shock wave therapy:
The Orthospec ESWT (Medispec LTD, Germantown, MD) device is an extracorporeal shockwave delivery system that it's approved for distribution and use in the United States by the Food and Drug Administration (FDA).

The orthospec ESWT device used in this study uses an electrohydraulic, or "spark-gap", method of creating therapeutic shockwaves. In this system, and electrode ignites and electrical charge within a water-filled, stanless-steel, semiellipsoid chamber, evaporating a small portion of the water contained in the chamber and creating a shockwave that is reflected outward. The portable shockwave generator used in this study targets the shockwaves to a 35-mm diameter therapy zone that enables shockwaves of sufficient energy to be delivered to the tissues in a single therapeutic session [6]It is connected to electrical main supply 115/230V, single phase 60/50Hz and 10/5A.

Treatment procedures:
Group (A):

They were received 12 sessions, 3 session/week, consisted of:

1- Stretching exercise of posterior shoulder capsule:

It was a passive exercise for stretching the back of the shoulder and the muscles around it. This single exercise was done only three times, with a hold time of 30 seconds and a 10-second break between each time, there was a 10-second break between each set.

2- Strengthening exercises:

The strengthening exercises are a set of six exercises that are all important parts of any shoulder rehabilitation program. Shoulder flexion, rowing, and horizontal extension were all parts of these exercises. For each exercise, the maximum number of times it could be done was set at 10. The examiner made this decision based on how the subject moved and how he or she responded when asked about fatigue and pain. During all strengthening exercises, the level of resistance or range of motion (ROM) was changed until the subject was able to move on. This kept the quality of movement from getting worse or the pain from getting worse than mild discomfort. Each exercise was done three times with 10 reps each, and there was a 60-second break between each set.

The last two exercises are the seated press-up and the elbow push-up. Both were done until the muscles got tired or up to a maximum of 25 times. The quality of all repetitions of each exercise was always monitored by the investigator of the study.

3- Mobilization exercises:

Patients got grade III and grade IV Maitland technique gliding mobilization for the shoulder. The caudal mobilization (figure 3), technique was done 2 to 4 times, with a 30 second hold and a 10 second break between each time. Based on the work, the dorsal mobilization (figure 4), technique was done with the glenohumeral joint rotated 90 degrees in the scapular plane, and the force was applied in the direction of the back and sides.

Figure (3): Caudal gliding mobilization.

Figure (4): Dorsal gliding mobilization.

Group (B):

All of the patients got ESWT while sitting down, with the affected shoulder exposed, the shoulder adducted, and the elbow extended. The shock wave applicator was aimed at the most painful spot near where the rotator cuff attaches to the greater tuberosity under the acromion.

A coupling gel was used to prepare the treatment area so that less shockwave would be lost between the applicator tip and the skin.
Each patient got 3000 shocks (1000 shocks per session, 3 sessions separated by 2 weeks, energy flux density of 0.32 mJ/mm2, energy level of 5–7, pulse rate of 160 beats per minute, and a frequency of 2–3Hz).

Statistical analysis

The statistical package SSPS was used to code and enter the data from the study. The mean and standard deviation were used to describe demographic data and all measures of outcomes.

The paired t-test was used to compare the two groups. Statistics said that P values between 0.05 and 0.01 were statistically significant.

Results

Demographic data of patients

Thirty patients, both men and women, took part in this study. They were divided randomly into two groups, experimental group (I) and experimental group (II).

The 15 people in the experimental group (I) (6 men and 9 women) had an average age of 36.26 (+6.54) years and had been sick for an average of 1.96 (+0.69) months. This group was treated with manual exercises therapy. The experimental group (II) had (2 men and 13 women), with a mean age of 36.46 (+6.68) years and a mean length of illness of 1.83 (+0.54) months. Shock wave therapy was used to treat this group. With these demographic data (Table 1), the unpaired t-test showed that there was no significant difference between the groups before treatment.

Table 1: Demographic data of patients

Variable	Manual Therapeutic exercise group(I)	Shockwave group (II)	t-value	p-value
Age (year)	36.26 (± 6.54)	36.46 (± 6.68)	0.06	0.82 (N.S)
Duration of illness (Mo.)	1.96 (± 0.69)	1.83 (±0. 54)	0.50	0.62 (N.S)

Comparison between groups before treatment

Before treatment, the unpaired t test was used to see if there were any differences between the groups. As shown in (Table 2), there wasn't a significant difference between the groups in terms of functional disability (t=-0.40, P=0.69), acromiohumeral distance in adduction (t=0.30, P=0.76), or acromiohumeral distance in abduction (t=-0.33, P=0.73).

Table 2: Comparison between groups before treatment

Variable	Manual therapeutic Exercises Group (I)	Shockwave group (II)	t-value	P-value
Functional disability	76.17(± 10.47)	74.73 (± 8.95)	-0.40	0.69 (N.S)
Acromiohumeral distance in adduction	6.74(± 1.06)	6. 86 (± 1.21)	0.30	0.76 (N.S)
Acromiohumeral distance in abduction	5.22(± 1.13)	5.09 (± 0.88)	-0.33	0.73 (N.S)

Comparison between groups after treatment

1- Between groups difference for shoulder functional disability.

Using unpaired t-test, a significant difference was found between groups in favor of the manual exercises therapy group which had a mean difference of 67.25 (± 10.59) while shockwave group had a mean difference of 58.4 (± 9.20) with (t= 4.11, P< 0.001) as shown in (figure 5).

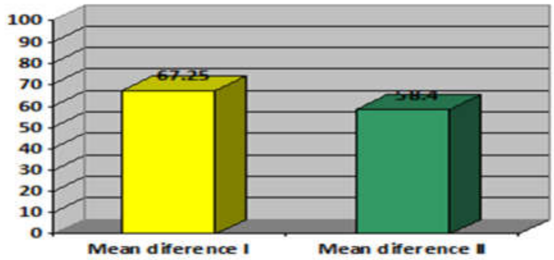

Figure (5): Between groups difference for shoulder functional disability

This means that the manual exercises therapy is more effective than shockwave therapy in decreasing shoulder functional disability in shoulder subacromial impingement syndrome patients.

2- Between groups difference for shoulder acromiohumeral distance in adduction.

Using unpaired t-test, a significant difference was found between groups in favor of manual exercises therapy which had a mean difference of 1.90 (± 1.10) mm while the shockwave group had a mean difference of 0.46 (± 1.04) mm with (t= -2.86, P< 0.008) as shown in (figure 6).

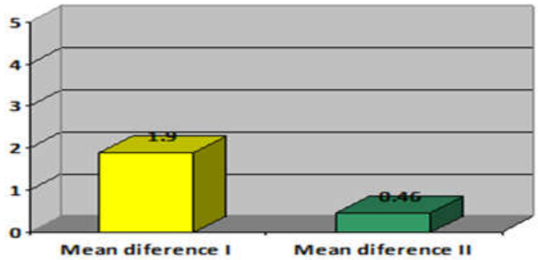

Figure (6): Between groups difference for shoulder acromiohumeral distance in adduction

This means that the manual exercises therapy is more effective than shockwave therapy in increasing shoulder acromiohumeral distance in adduction in shoulder subacromial impingement syndrome patients.

Between groups difference for shoulder acromiohumeral distance in abduction

Using unpaired t-test, a significant difference was found between groups in favor of the manual exercises therapy group which had a mean difference of 2.27 (± 0.99) mm while the shockwave group had a mean difference of 0.89 (± 1.56) mm with (t= -3.27, P< 0.003), (figure 7).

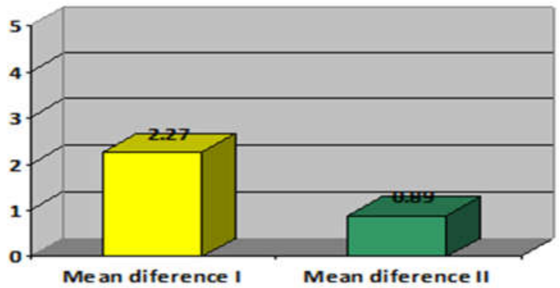

Figure (7): Between groups difference for Shoulder acromiohumeral distance in abduction

This means that the manual exercises therapy is more effective than shockwave in increasing shoulder acromiohumeral distance in abduction in shoulder subacromial impingement syndrome patients.

Discussion

Sub acromial impingement syndrome is one of the most common shoulder problems. It happens when the rotator cuff and sub acromial tissue under the coracoacromial arch are mechanically pressed together. Frequent or long-term use of the arm overhead in certain jobs or sports.

All of the patients in both groups had symptoms of sub acromial impingement syndrome. Pain is localized to the anterolateral acromion and often spreads to the lateral mid humerus. Patients usually complain of pain at night, which is made worse by lying on the affected shoulder or doing overhead activities.

To enhance shoulder functional impairment and subacromial space, manual exercise therapy is more effective than shock wave therapy.

Ultrasonography:

In the early 1980s, ultrasound was introduced as a noninvasive diagnostic tool for the soft tissues of the shoulder. This technique has now been shown to be very sensitive and specific for showing rotator-cuff tear, as well as rupture and dislocation of the biceps muscle's long head.[24]

Ultrasound and MRI were equally accurate in diagnosing biceps diseases and rotator cuff injuries.[25] Based on the patient's clinical information (such as the location of the glenoid labrum, the joint capsule, the muscle, and the bone), the cost, and the radiology department's imaging expertise, the appropriate imaging test should be selected.

Bursitis, fluid distention, and fluid pooling in the burasalateral to the subdeltoid burasa were identified as early indicators of subacromial impingement using dynamic sonography. Sub-acromial impingement was reported to lead to more abnormalities being seen on dynamic sonography.[26]

The acromion, humeral head, and interfering soft tissue interactions may be seen with dynamic sonography during active shoulder motion, and this can offer important information about possible intrinsic and extrinsic causes of shoulder impingement syndrome.[27]

Shoulder ultrasonography has grown in popularity in recent years as better technology, a better understanding of ultrasound anatomy, and a more defined examination approach have all been developed. Patients prefer ultrasonography over MRI because it is less expensive, faster, and more accurate in detecting rotator cuff injuries.[23]

Patients with impingement are often examined with ultrasound to determine whether or not a rotator cuff tear exists. Secondary evidence of impingement tendinosis or tear, fluid in or thickening of the subacromial deltoid bursa, hypertrophy of the coroacromial ligament, or hyperostosis at the greater tuberosity and acromion may be seen using ultrasound. In addition to compression of the subdeltoid bursa, dynamic examination also shows impingement in the supraspinatus tendon.[19]

You may be confident in using an ultrasound to determine the acromiohumeral distance (AHD). Since (AHD) variation in patients with shoulder impingement syndrome cannot be substantiated, it was discovered that an increase in (AHD) distance and functional improvement after rehabilitation were strongly linked.

The transducer was placed on the lateral surface of the shoulder along the longitudinal axis of the humerus for ultrasonography measurements of the AHD. To ensure the accuracy of this approach, a tiny AHD was regularly discovered in the front region of the acromion in preliminary research. As a result, the AHD was assessed at the acromial arch's most anterior portion and 1 centimeter behind that measurement.[28]

A) Manual exercises therapy group:

Manual physical therapy applied by an experienced physical therapist combined with supervised exercises may be better and earlier than exercises alone for increasing strength, decreasing pain, and improving function in patients with impingement syndrome. Specifically, the manual physical therapy group showed a significant decrease in functional disability.[29]

Exercise and joint mobilization were shown to be effective in reducing discomfort and increasing function in individuals with impingement syndrome. Using therapeutic exercises and mobilization in the treatment of individuals with impingement syndrome was shown to be beneficial.[30]

It has been shown that physical therapy procedures such as joint mobilization and laser treatment may reduce pain and impairment in people with impingement syndrome.[31]

The functional ability of SIS patients also improves because their muscles get stronger. This is supported by studies that found that isokinetic evaluation of rotational strength in normal shoulders and shoulders with impingement syndrome showed that rotator cuff strengthening plays a big role in reducing humeral head depressor weakness.[32]

Gutierrez-Espinoza et al.,(2020) .[33] reported changes in how the shoulder moves and how the muscles around it work in people with shoulder impingement symptoms. The "rotation about a medial to lateral axis" of the scapula and the function of the serratus anterior muscle are important things to think about when rehabilitating patients with symptoms of shoulder impingement syndrome caused by overhead work.

Manual physical therapy along with supervised shoulder exercises is better than supervised shoulder exercises alone in improving strength, function, and reducing pain in people with shoulder impingement syndrome.[29]

The shoulder function got better because the range of motion got better after therapy. Passive joint mobilization is thought to be a good way to help people with shoulder impingement increase their range of motion.[30]

To see how manual exercises therapy affected the sub acromial space of the shoulder; we used ultrasonography during shoulder adduction and shoulder abduction for SIS patients before and after treatment. At the end of treatment, there was a significant increase in sub acromial space.

Using ultrasonography to look at the shoulder before and after treatment, there was a big difference in the amount of space under the acromion between before and after.

In people with shoulder impingement syndrome, the rotator cuff muscles may not be able to depress the humeral head enough to counteract the action of the deltoid. This causes the humeral head to move too far up and the shoulder blade to move down too much (AHD),[28] This shows that strengthening exercises for the rotator cuff are a good way to help people with shoulder impingement syndrome. So, it helps to raise the (AHD) and makes the patient's symptoms better.

When a person has impingement symptoms, the rotator cuff is usually strengthened, and the posterior capsule is stretched to restore normal humeral head transition.[32]

The acromiohumeral distance gets shorter because the humeral head moves better during the first part of abduction. This may be due to the action of the deltoid muscle.[28]

The significant clinical improvement in shoulder functional disability may be due to the use of stretching excises of the posterior shoulder capsule, which increase the sub acromial space. This is because a tight posterior shoulder capsule keeps the humeral head higher than it should be.[32]

Joint mobilization effectively stretched the posterior and inferior parts of the capsule to such a degree that, as the maneuver shortened the distance between the acromion and humerus, the more flexible capsules of the experimental group allowed more glide in the opposite direction, which made the pain and pressure under the acromion less. This means that joint mobilization increases the distance between the acromion and humerus, which makes the pain go away and the disability get better.[29]

Mobilization and therapeutic exercises help to improve the shoulder impingement syndrome patient's symptoms by making the rotator cuffs stronger and the posterior capsule less tight. [32]

The subacromial space may have gotten better because strengthening the rotator cuff muscles helped stop the humeral head from moving up and to the right and because a therapeutic exercises program made the posterior capsule more flexible.

B) Shock wave therapy group:

To see how well ESWT works at reducing functional disability, the shoulder functional disability index was used to measure functional disability before and after treatment. At the end of the treatment, functional disability had gone down by a lot.

ESWT improves function by increasing blood flow to ischemic tissues, stimulating growth factors, reducing inflammation, and speeding up the healing process.[34]

After treatment, extracorporeal shock wave therapy makes the shoulder work better. ESWT made a big difference in how well people with shoulder pain could do their jobs.[35,36]

SWT has the potential to help people with shoulder tendinitis get back to work without any serious side effects.[37]

Using (ESWT) to treat shoulder tendinitis is safe and effective, and it led to a significant improvement in shoulder function[36,32] Self-questionnaire scores also went up after (ESWT) was used to treat rotator cuff tendinitis, proving that the treatment worked.

In this study, patients with shoulder impingement syndrome were able to function better because the treatment helped reduce inflammation, kill bacteria, relieve pain, and improve blood flow and tissue growth. SW increases neovascularization, which is linked to early release of markers for angiogenesis.[36] It can increase new blood flow and decrease muscle tone and spasticity.[38]

Extracorporeal shock wave therapy improves the infiltration of polymorph nuclear neutrophils and macrophages and kills bacteria. ESWT caused the growth of new blood vessels, which helps improve blood flow and tissue repair at the bone-tendon junction.[34]

Using ultrasonography to look at the shoulder before and after treatment, there was a big difference in the amount of space under the acromion between before and after.

This may be because ESWT has a mechanical effect on living tissue, which changes mechanical signals into biochemical or molecular-biological signals, which then cause changes in the cell.[34] SWT causes a sudden rise in pressure and cavitation in the target tissue. This causes extracellular damage, which leads to the formation of a hematoma and then promotes the growth of new tissue.[35,36]

SWT can cause an increase in angiogenesis in tendon and regeneration of muscle and tendon tissue. (ESWT) produce an adequate amount of energy that can cause controlled inflammation, which stimulates many mediators like transforming growth factor b1 (TGF-B1) and insulin-like growth factor 1 (IGF-1) and starts the healing process.[39,40]

ESWT improves blood flow to ischemic tissue, stimulates growth factors, reduces inflammation, and speeds up healing.[32]

Extracorporeal shock wave therapy increases vascular endothelial growth factors (VGEF), eNOS, and proliferating cell nuclear antigen (PCNA), which stimulates angiogenesis.[39]

Nitric oxide stimulation after (ESWT) is responsible for vasodilation, angiogenesis, and a decrease in NF-KB and NF-KB-dependent genes, which reduces the whole inflammatory process.[40]
In this study, the subacromial space of the shoulder got better after ESWT treatment. This could be because NO levels went up, angiogenesis went up, edema and inflammation went down, and tendon healing went up.

From all of this, it was decided that ESWT is a good way to treat patients with SIS because it relieves pain, reduces inflammation, and helps tissues heal. This means that it helps reduce pain and functional disability and improve range of motion (ROM) and subacromial space.

Comparison between groups after treatment:

After treatment, the other variables (function disability and acromiohumeral distance) got better in the manual exercises therapy group more than in the shock wave group. This is was because muscle strength helped reduce superior numeral head translation, and posterior capsule stretch and shoulder joint mobilization helped improve joint mobility.

Conservative treatment for patients with impingement symptoms often includes exercise program that aim to restore normal kinematics, or patterns of muscle activity. In particular, the muscle control of the scapula has become a recent focus of therapeutic intervention in the treatment of shoulder impingement syndrome.[32,37]

Physical therapists have also said that passive joint mobilization and stretching the muscles are good ways to treat shoulder dysfunction.[43]

Subject with signs and symptoms of primary impingement has clear deficits in shoulder ROM and shoulder muscle fore production in multiple directions, which cause pain and real changes in neuromuscular and periarticular connective tissues. These deficits support the need for exercises rehabilitation.[44]

Conclusions

Based on the results of this study, we can say that manual exercise therapy is more effective than shock wave therapy at reducing shoulder functional disability and increasing the distance between the acromion and humerus in both directions.

Acknowledgment

The authors would like to thank all individuals who participated in this study.

Ethics Statement:

The study was designed as an experimental randomized controlled clinical trial. The study was examined and approved by the Ethics Committee of Faculty of physical therapy, Cairo University, Cairo,Egypt (approval number :P.T.REC/012/004028), The Helsinki Declaration Criteria for human research were followed in this study. A written informed consent was obtained from each patient.

Authors Contributions:

GMRK took part in the concept and design of the study. MIM and GMRK contributed to applying each treatment according to the treatment schedule. AMFI participated in acquisition of data and contributed to Data analysis and interpretation. SAGA and RMYI participated in writing and editing, All authors collaborated on the study's statistical analysis, interpretation of the data, writing, and editing

Disclosure statement

No authors have any financial interest or received any financial benefit from this research.

Conflict of interest

Authors state no conflict of interest.

References

[1]. Wellmann M. Diagnostics and treatment of anterosuperior rotator cuff tears. Der Orthopade. 2016;45(2):130–5.

[2]. Abdulla SY, Southerst D, Cot E P, Shearer HM, Sutton D, Randhawa K. Is exercise effective for the management of subacromial impingement syndrome and other soft tissue injuries of the shoulder? A systematic review by the ontario protocol for traffic injury management (OPTIMa) collaboration. Manual Therapy. 2015;20:646–56.

[3]. Impingement lesions. Clin Orthop Relat Res. 1983;173(173):70–7.

[4]. Morrison DS, Greenbaum BS. Greenbaum BS: Shoulder impingement. Orthop Clin North Am. 2000;31:285–93.

[5]. Bigliani LU, Levine WN. Subacromial impingement syndrome. J Bone Joint Surg Am. 1997;79:1854–68.

[6]. Van Der Windt DA, Koes BW, De Jong BA, Bouter LM. Shoulder disorders in general practice: incidence, patient characteristics, and management. Ann Rheum Dis. 1995;54:959–64.

[7]. Tempelhof S, Rupp S, Seil R. Age-related prevalence of rotator cuff tears in asymptomatic shoulders. J Shoulder Elbow Surg. 1999;8(4):296–9.

[8]. Lehman C, Cuomo F, Kummer FJ, Zuckerman JD. The incidence of full thickness rotator cuff tears in a large cadaveric population. Bull Hosp Jt Dis. 1995;54(1):30–1.

[9]. Ginn K, Cohen M. Exercise therapy shoulder pain aimed at restoring neuromuscular control: a randomized comparative clinical trial. Journal of Rehabilitation Medicine. 2005;37(2):115–22.

[10]. Hanratty CE. The effectiveness of physiotherapy exercises in subacromial impingement syndrome: a systematic review and meta-analysis. In: Seminars in arthritis and rheumatism WB Saunders. 2012. p. 297–316.

[11]. Dong W, Goost H, Lin XB, Burger C, Paul C, Wang ZL, et al. Treatments for shoulder impingement syndrome: a PRISMA systematic review and network meta-analysis. Medicine. 2015;(10).

[12]. Cheng J, Wang C. Biological mechanism of shockwave in bone. Int J Surg. 2015;24:143–6.

[13]. Cacchio A, Paoloni M, Barile A, Don R, De Paulis F, Calvisi V, et al. Effectiveness of radial shock-wave therapy for calcific tendinitis of the shoulder: single-blind, randomized clinical study. Physical therapy. 2006;86(5):672–82.

[14]. Shaheen H, Alarab A, Ahmad MS. Effectiveness of Therapeutic Ultrasound and Kinesio Tape in Treatment of Tennis Elbow. J Nov Physiother Rehabil. 2019;3:25–33.

[15]. Braman JP, Zhao KD, Lawrence RL, Harrison AK, Ludewig P. Shoulder impingement syndrome revisited: Evolution of diagnostic understanding in orthopedic surgery and physical therapy. Medical, & Biological Engineering & Computing. 2014;52:211–9.

[16]. Elmorsy A, Keightley A, Flannery M. Accuracy of ultrasonography (US) and magnetic resonance imaging (MRI) in detection of rotator cuff tears in district general hospital. Pol J Radiol. 2017;82:634–637.

[17]. Churchill SR, Fehringer EV, Dubinsky TJ, Matsen I. Rotator cuff ultrasonography: diagnostic capabilities. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2004;12(1):6–11.

[18]. Rutten MJ, Spaargaren GJ, Van Loon T, De Waal Malefijt MC, Kiemeney LA, Jager GJ. Detection of rotator cuff tears: the value of MRI following ultrasound. European radiology. 2010;20(2):450–7.

[19]. Pesquer L, Borghol S, Meyer P, Ropars M, Dallaudière B, Abadie P. Multimodality imaging of subacromial impingement syndrome. Skeletal Radiology. 2018;47(7):923–37.

[20]. Seitz AL, Michener LA. Ultrasonographic measures of subacromial space in patients with rotator cuff disease: a systematic review. Journal of clinical ultrasound. 2011;39(3):146–54.

[21]. Garving C, Jakob S, Bauer I, Nadjar R, Brunner UH. Impingement syndrome of the shoulder. Deutsches Ärzteblatt International. 2017;114(45).

[22]. Breckenridge JD, Mcauley JH. Shoulder pain and disability index (SPADI). Journal of physiotherapy. 2011;57(3):197–197.

[23]. Singh AP. Rao a, Devaru S, Amithavikrama. Role of ultrasound in evaluation of shoulder injuries: a comparative study of ultrasound and MRI. Int J Anat Radiol Surg. 2017;6: R012–R018.

[24]. Mohtasib RS, Alzahrani AM, Asiri YN, Rayes Z, Alshaalan M. Accuracy of shoulder ultrasound examination for diagnosis of rotator cuff pathologies: a single-center retrospective study. Ann Saudi Me. 2019;39(3):162–71.

[25]. Moosmayer S, Jorgensmith H. Diagnostic ultrasound of the shoulder - a method for experts only. Acta orthopaedica. 2005;76(4):503–8.

[26]. Razavi Ratki SK. Comparison of sonography and MRI in diagnosis of rotator cuff injuries. Int J Clin Exp Med Sci. 2015;1(3):35–7.

[27]. Rentz C, Legerlotz K. Methodological aspects of the acromiohumeral distance measurement with ultrasonography-Reliability and effects of extrinsic and intrinsic factors in overhead and non-overhead athletes. Sonography. 2021;8(3):116–24.

[28]. Deutch A, Altechek DW, Schwarts E. Radiological measurement of superior displacement of humeral head in the impingement syndrome. J Shoulder Elbow Surg. 1996;5:186–93.

[29]. Senbursa G, Baltacı G, Atay A. Comparison of conservative treatment with and without manual physical therapy for patients with shoulder impingement syndrome: a prospective, randomized clinical trial. Knee Surg Sports Traumatol Arthroscopy. 2007;15(7):915–21.

[30]. Kamkar A, Irrgang JW. Non-operative management to secondary shoulder impingement syndrome. J Orthop Sports Phys Ther. 1993;17:212–24.

[31]. Karel YHJM, Scholten-Peeters GGM, Thomes-De Graaf M, Duijn E, Van Broekhoven JB, Koes BW. Physiotherapy for patients with shoulder pain in primary care: A descriptive study of diagnostic- and therapeutic management. Physiotherapy. 2017;103:369–78.

[32]. Mcclure PW, Bilker J, Neff N, Williams G, Karduna A. Shoulder function and 3-dimensional kinematics in people with shoulder impingement syndrome before and after a 6-week exercise program. Phys Ther. 2004;84:832–48.

[33]. Gutierrez-Espinoza H, Araya-Quintanilla F, Cereceda-Muriel C, Alvarez-Bueno C, Martínez-Vizcaíno V, Cavero-Redondo I. Effect of supervised physiotherapy versus home exercise program in patients with subacromial impingement syndrome: A systematic review and meta-analysis. Physical Therapy in Sport. 2020;41:34–42.

[34]. Malay DS, Pressman MM, Assili A, Kline JT. Extracorporeal shock wave therapy versus placebo for the treatment of chronic proximal fasciitis. The journal of foot and ankle surgery. 2006;45:196–209.

[35]. Chuckpaiwong B, Berkson EM, Theodore GH. Extracorporeal shock wave for chronic proximal plantar fasciitis: 225 patients with results and outcome predictors. J Foot Ankle Surg [Internet]. 2009;48(2):148–55.

[36]. Testa G, Vescio A, Perez S, Consoli A, Costarella L, Sessa G, et al. Extracorporeal shockwave therapy treatment in upper limb diseases: a systematic review. Journal of Clinical Medicine. 2020;9(2).

[37]. Barrett E, O'Keeffe M, O'Sullivan K, Lewis J, McCreesh K. Is thoracic spine posture associated with shoulder pain, range of motion and function? A systematic review. Man Ther. 2016;26:38–46.

[38]. Simplicio CL, Purita J, Murrell W, Santos GS, Santos RG, Lana JFSD. Extracorporeal shock wave therapy mechanisms in musculoskeletal regenerative medicine. Journal of Clinical Orthopaedics and Trauma. 2020;11:S309–18.

[39]. Persichini T, Colasanti M, Musci G, Marlinghaus E. Nitric oxide mediates anti-inflammatory action of extracorporeal. FEBS Letters. 2005;579:6839–45.

[40]. Wang CJ, Wang FS, Yang KD, Weng LH, Hsu CC, Huang CS, et al. Shock wave therapy induces neovascularization at the tendon-bone junction. A study in rabbits. Journal of Orthopaedic Research. 2003;21(6):984–9.

[41]. Michener LA, Walsworth MK, Burnet EN. Effectiveness of rehabilitation for patients with subacromial impingement syndrome: a systematic review. J Hand Ther [Internet]. 2004;17(2):152–64.

[42]. Maitland G. passive movement techniques for intra-articular and prearticular disorders. Aust J physiother. 1985;31:3–8.

[43]. Sauers EL. Effectiveness of rehabilitation for patients with subacromial impingement syndrome. J Athl Train. 2005;40(3):221–3.

[44]. Escamilla RF, Hooks TR, Wilk KE. Optimal management of shoulder impingement syndrome. Open Access J Sports Med [Internet]. 2014;5:13–24.