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Effect of Extracorporeal Shock Wave Therapy on Functional Disability and Sub Acromial Space in Patients with Sub Acromial Impingement Syndrome

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Abstract

Background: Rotator cuff tendinopathy, calcific tendinitis, and sub acromial bursitis are all included in the spectrum of sub acromial space disorders known as the Sub Acromial Impingement Syndrome (SIS). The rotator cuff tendon is particularly vulnerable to damage in activities that need frequent or prolonged movement of the arms above. **Purpose:** To examine how extracorporeal shock wave treatment (ESWT) affects the functional disability and sub acromial region in individuals with sub acromial impingement syndrome. **Materials and Methods**: 20 patients (slaughterhouse workers and overhead playing athletes) with a mean age of 36.46 (+6.68) received shockwave therapy (3000 shock, 1000/session, 3 sessions, 2 weeks a part, 0.32mJ/mm2). Patients were evaluated pretreatment and post treatment for shoulder functional disability and shoulder subacromial space in adduction and abduction using ultrasonography. **Results:** All of the patients' shoulder function and subacromial space in adduction and abduction improved significantly. Conclusion: Extracorporeal shock wave therapy is a good way to help people with subacromial impingement syndrome improve their shoulder function and subacromial space in adduction and abduction.

Keywords: Sub acromial Impingement Syndrome, Extracorporeal shock wave therapy, sub acromial space.

Introduction

Impingement syndrome is a disease in which the supraspinatus tendon becomes inflamed because it rubs against the underside of the front one-third of the acromion .[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 tendinosis, calcific tendonitis, and sub acromial bursitis.[3,4]

When the rotator cuff is compressed against the bottom of the acromion and the coracoacromial ligament, a condition known as impingement syndrome may develop. Whenever the arm is lifted, this is the typical occurrence. Rather than a single diagnosis, many believe it to be a collection of signs and symptoms. This is the most common source of discomfort in the shoulders.

The most frequent condition affecting the shoulder is known as subacromial impingement syndrome (SAIS). SAIS is

responsible for between 44 and 65 percent of all complaints of shoulder discomfort that are brought to the attention of medical professionals.[5]

The subacromial space is composed of the humeral head, the anterior border and under surface of the first third of the acromion, the coracoacromial ligament, and the acromioclavicular joint. In addition, the area also contains the acromioclavicular joint. Subacromial space includes the long head of the biceps brachii tendon, the subacromial bursa, the supraspinatus tendon, as well as the shoulder capsule. The SAIS has the potential to cause harm to any one or more of these buildings. As the sub acromial gap decreases in size, the sub acromial tissues will begin to develop into the empty area left behind. This is what the SAIS institution is.[3]

Impingement syndrome is one of the most common rotator cuff conditions. Rotator cuff disease may also be caused by tears or lesions in the muscles or tendons in the region. Studies on dead people have shown that cuff tears can happen anywhere from 5% to 30% of the time, and that between 2% and 18% of adults have bursitis, impingement syndrome, or rotator cuff tendonitis.[6]

10–25% of the general population has shoulder pain, which is a pretty high number. Subacromial impingement (SI), which is beneath the coracoacromial arch, the mechanical compression of the rotator cuff, is one of the main causes of long-term disability and pain in the shoulder. SI is more likely to happen in jobs and sports where the arm is used overhead often or for long periods of time. In fact, epidemiological studies have shown that 5–20 percent of people have impingement. In some jobs, like welding, working with plates, or working in a slaughterhouse. Ten to thirty percent of competitive overhead athletes say they have shoulder pain.[7]

The top of the humerus, the bottom of the acromion, the acromioclavicular joint, as well as the coracoacromial ligament, which is the cover of the glenohumeral joint, make up the subacromial space or supraspinatus outlet. The rotator cuff tendons (supraspinatus, teres minor, infraspinatus, and subscapularis), the long head of the biceps, and the sub-deltoid/acromial bursa are all located in the subacromial region. Shoulders that are in good shape have a height of between 9 and 10 milli meters in this area. 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, or SIS, is a common problem with the shoulder. It is estimated that 11.2% of all patients in general practice have shoulder problems each year, with impingement being the most common disorder recorded.

It is the most common shoulder problem. The disorder causes the rotator cuff tendons to become inflamed or to break down. This leads to a loss of function and disability.[8] The cost of care for this disorder varies because there are different ways to treat it. Choosing an effective treatment plan is hard because impingement syndrome is caused by many different things.[6,7]

Activities that call for holding the arms above the head repeatedly or for extended periods of time often tear the rotator cuff tendon. This biomechanical injury occurs for two reasons: (1) mechanical impingement of the subacromial structures against the anterior acromion and coracoacromial ligament when the arm is raised above the head, particularly in abduction and flexion with the arm internally rotated; and (2) insufficient blood flow to the rotator cuff tendons in this region.[8]

Most of the time, physical therapy is the first thing that is done to treat shoulder pain. When a person has symptoms of impingement, conservative treatment usually involves therapeutic exercise program, that aim to restore normal scapula motion and muscle control.[9]

Sound waves that exhibit a sudden increase in pressure at the front of the wave are known as shock waves. The width of the focus regions is around 8 mm 13, and the depth is approximately 10 mm.[10]

Extracorporeal shock waves are short, focused, high-pressure acoustic waves that are made outside of the body. They travel through soft tissue without losing much energy and are reflected at the edges of different organs.[11]

Nonunion of fractures, lateral epicondylitis, plantar fasciitis, and shoulder calcific tendinitis have all been treated using extracorporeal shock wave treatment (ESWT). It has showed promising results in the treatment of fractures and tendinopathies.[12]

Due to its ability to generate local hyperemia, neovascularization, a reduction in calcification, the inhibition of pain receptors, and/or denervation, ESWT is used to treat several illnesses.[13]

Most of the time, there aren't many side effects, but there may be some local bruising, swelling, or pain that goes away quickly.

Subjects and Methods

Study Design

The study was designed as a clinical trial. The study was approved by the ethical committee of Faculty Physical Therapy, Cairo University, Egypt (approval number:P.T.REC/012/004027) The Helsinki Declaration Criteria for human research were followed in this study. A written informed consent was obtained from each patient.

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, Cairo, Egypt, to examine how extracorporeal shock wave treatment (ESWT) affects the functional disability and sub acromial region in individuals with sub acromial impingement syndrome. Patients were found to have sub acromial impingement syndrome based on the location of trigger points in their rotator cuff muscles and the fact that their pain got worse when they lifted their arms above their heads (Figure 1)

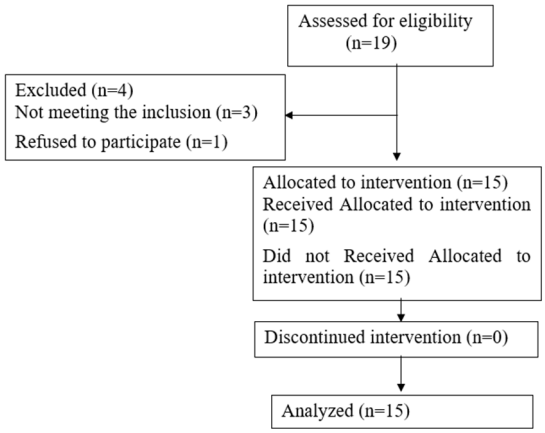

Figure 1: Participant flow diagram

Inclusion criteria:

- "Neer sign" and "Hawkins sign" were reported as positive by the patient.
- In a scapular plane, the patient complained of discomfort with active shoulder elevation (eg: welders, plate workers, slaughterhouse workers and overhead playing athletes).
- The patient complained of discomfort when the rotator cuff tendons were palpated.
- Resisted isometric abduction caused the patient discomfort.

Exclusion criteria:

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

The experiment continued with 15 patients (13 female and 2 male), their age ranges from 30 to 50 years signed an informed consent. They were treated with shockwave treatment (0.32mJ/mm2, 3 sessions, 3000 shocks, 1000 each session).

2- Instrumentation:

(a)- Assessment instrumentations:

1. Shoulder pain and disability index (SPADI).
2. Diagnostic Ultrasound.

- Assessment procedures

1- A reliable and effective index for assessing shoulder pain and disability, the SPADI, was utilized to assess the severity of pain and functional impairment in patients. Sections of the exam include a pain evaluation and a functional disability evaluation. Each participant's pain score was totaled and then averaged to arrive at their final score. To figure out the mean score in Part 2, the functional scores of all questions were totaled. There were two statistical analyses done on the final score: one for each of the parts.[14]

2- Ultrasonography measurements of the sub acromial space were made by placing the transducer on the lateral surface of the shoulder along the hummer's longitudinal axis.
The subacromial space, which is the distance between the head of the humerus and the acromion, was quantified using the hyperechoic bone markers on a longitudinal ultrasound with the image frozen. As a result, the AHD at the subacromial space's entry is the source of the discovered number. In order to maintain the shoulder in a neutral posture, At 60 degrees of flexion, the patient's elbow was at zero to 45 degrees of active abduction for the AHD test. To prevent internal rotation, the participants were instructed to hold their hands in a pronated posture, as illustrated in (figure 2).

Figure (2): measurement of the shoulder (AHD) with the forearm in pronation and the transducer on the lateral surface of the shoulder

(b) Treatment Instrumentation:

- Shock wave therapy:

The Orthospec ESWT (Medispec LTD, Germantown, MD) is an extracorporeal shockwave delivery device that has been given the green light by the FDA. Selling and using it is legal in the US (FDA).
Electrohydraulic or "spark-gap" ESWT is employed in this work via the orthospec ESWT device. A stainless steel, semi ellipsoid container filled with water is filled with an electrode that generates an electrical charge. A shockwave is sent outward as a result of a little quantity of water being vaporized in the chamber. The shockwaves produced by the portable shockwave generator employed in this research have a diameter of 35 mm. This implies that enough energy can be delivered to the tissues in a single session of treatment. It is connected to a 115/230V, single-phase, 60/50Hz, 10/5A mains supply.

Treatment procedures:

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 to 7, pulse rate of 160 beats per minute, and a frequency of 2 to 3 Hz) (figure 3).

Figure (3): Application of shockwave therapy

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

A total of 15 patients (13 females and 2 males) with mean age of 36.46 (+ 6.68) years and mean duration of illness of 1.83 (± 0.54) months, participated in this study.

Within group difference of shockwave therapy:

To identify group differences between the shockwave group before and after treatment, a paired t test was performed. As indicated in Table, there were differences that were statistically significant for functional disability (t=24.57, P=0.001), sub acromial space in adduction (t=-2.38, P=0.03), and sub acromial space in abduction (t=-2.20, P=0.04) (Table 1).

Table 1: Within group difference of shockwave therapy after treatment

Variable	Pretreatment	Post treatment	t-value	P-value
Functional disability	74.73 (± 8.95)	16.33 (± 6.67)	24.57	0.001(S)
Sub acromial space in adduction	7.05 (± 0.96)	7.63 (± 0.95)	-2.38	0.03(S)
Sub acromial space in abduction	5.09 (± 0.88)	5.95 (± 1.37)	-2.20	0.04 (S)

Shoulder functional disability within the shockwave group.

Using paired t-test, a significant decrease in shoulder functional disability was found between the pretreatment mean of 74.33(± 8.18) and the post treatment mean of 16.33 (± 6.67) with (t=24.57 , P< 0.001). as shown in (figure 4).

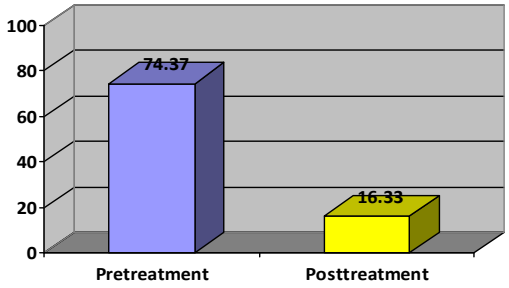

Figure (4): Shoulder functional disability within the shockwave group

Shoulder acromiohumeral distance in adduction within the shockwave group.

Using paired t-test, a significant increase in shoulder acromiohumeral distance in adduction was found between the pretreatment mean of 7.05 (± 0.96) mm and the post treatment mean of 7.63 (± 0. 95) mm with (t= -2.38 , P< 0.03) as shown in (figure 5).

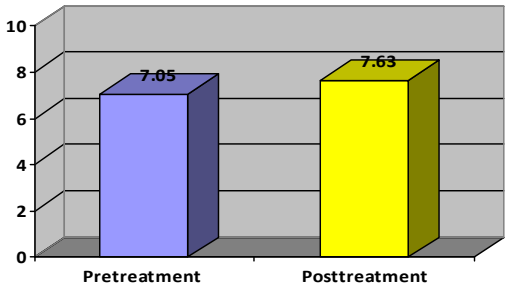

Figure (5): Shoulder acromiohumeral distance in adduction within the shockwave group

Shoulder acromiohumeral distance in abduction within the shockwave group.

Using paired t-test, a significant increase in shoulder acromiohumeral distance in abduction was found between the pretreatment mean of 5.09 (± 0.88) mm and the post treatment mean of 5.98 (± 1.37) mm with (t= -2.20, P< 0.045) as shown in (figure 6).

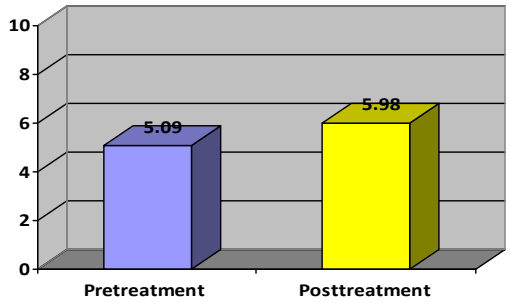

Figure (6): Shoulder acromiohumeral distance in abduction within the shockwave group

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.[5] Frequent or long-term use of the arm above the head in certain jobs or sports
All of the people in both groups had signs of subacromial impingement syndrome. People with subacromial impingement syndrome have pain in the front and side of the acromion, which often spreads to the side of the mid-humerus. People with this condition often have nighttime shoulder discomfort that is exacerbated by lying on the afflicted shoulder or doing overhead tasks.[8]
Extracorporeal shock wave treatment improves shoulder functional impairment and shoulder subacromial space in adduction and abduction, according to the findings of this research.[12]

1- Functional disability:

To see how effective ESWT is at reducing functional disability, prior to and during therapy, the shoulder functional disability index was used to gauge improvement in function. There was a considerable decrease in impairment at the conclusion of the therapy.[15]
These results agree with Michener et al., (2003) who said that ESWT improves function by increasing blood flow to ischemic tissues, stimulating growth factors, reducing inflammation, and speeding up the healing process.[16]

After treatment, extracorporeal shock wave therapy makes the shoulder work better. Using ESWT on people with shoulder pain made a big difference in how well they could do their jobs.[17-18]

SWT has the potential to help people with shoulder tendinitis get back to work without any serious side effects.[19]

(ESWT) is a safe and effective way to treat shoulder tendinitis, and it leads to a significant improvement in shoulder function. Self-questionnaire scores improved after (ESWT) treatment of rotator cuff tendinitis.[18,20]

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 causes early release of angiogenesis-related markers to lead to more new blood vessels.
It can increase the growth of new blood vessels and reduce muscle tone and spasticity.[21]

Extracorporeal shock wave therapy increases the infiltration of polymorph nuclear neutrophils and macrophages and kills bacteria.[15]

Researchers came to the conclusion that ESWT led to the growth of new blood vessels, which help improve blood flow and tissue repair at the bone-tendon joint.[22]

2- Subacromial space:

To look at the effect of SWT on the subacromial 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, the subacromial space had increased significantly.

Ultrasonography is a way to look at the soft parts of the shoulder that doesn't hurt. It was first used in the early 1980s. Since then, several studies done by experienced radiologists have shown that MRI has a high sensitivity and specificity for showing tears in the rotator cuff and the tearing and

dislocation of the long head of the biceps muscle.[23]

Clinical evidence supports the diagnosis of sub acromial impingement. Patients with impingement are often tested for rotator cuff tears using an ultrasound.[24] It is possible to detect secondary symptoms of impingement tendinosis or tendon rupture, fluid or thickening of the deltoid burst, hypertrophy of the coroacromial ligament or acromion hyperostosis at the greater tuberosity or acromion with ultrasound. Impingement may be noticed during a dynamic examination if the sub-deltoid bursa or supraspinatus tendon is compressed.[25]

The acromiohumeral distance (AHD) measured by ultrasound is accurate and sensitive. Even though there wasn't a clear pattern of (AHD) change in SIS patients, a strong link was found between an increase in (AHD) distance and functional improvement in patients with shoulder impingement syndrome after rehabilitation.[26]

Using dynamic sonography, the signs of early-stage sub acromial impingement were found to be bursitis, fluid distention, and fluid pooling on the side of the sub deltoid bursa. When there is sub acromial impingement, they were able to see a wider range of abnormalities on dynamic sonography.[25]

Dynamic sonography makes it possible to see with dynamic shoulder movement, the acromion, the humeral head, and the soft tissues that connect them Useful in determining whether internal and environmental factors may be contributing to shoulder impingement syndrome.[27]

Ultrasonography of the shoulder has become more popular in recent years, thanks to better equipment, a better understanding of ultrasound anatomy, and clearer instructions on how to do an exam. Ultrasonography is cheaper and faster than MRI, and it can find rotator cuff tears just as well as MRI. Patients prefer it.[28]

The transducer was placed on the humerus longitudinal axis, at the side of the shoulder, to perform ultrasonography to estimate the AHD. The smallest AHD was regularly found in the first two centimeters of the Acromion's front. It was found that the AHD was measured at the acromial arch and 1 cm back from this starting point (figure 7).

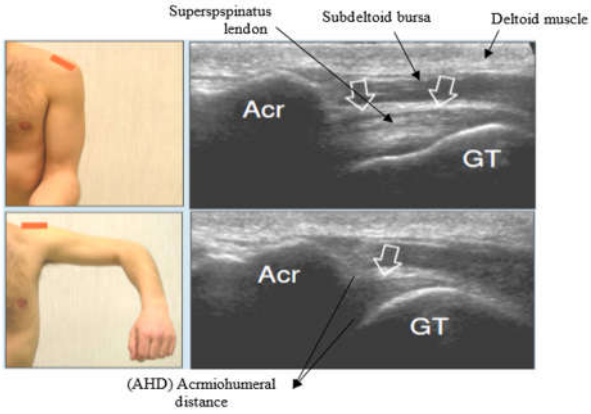

Figure (7): Measuring the (AHD) with Ultrasonography.

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.

SWT causes a sudden rise in pressure and cavitations in the target tissue. This causes extracellular damage, which leads to a hematoma and then stimulates the growth of new tissue.

SWT can speed up the growth of new blood vessels in tendons and help muscle and tendon tissue grow back.[15]

(ESWT) make enough energy to 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.[29,30]

(ESWT) increases blood flow to the tissue that isn't getting enough oxygen, stimulates growth factors, reduces inflammation, and speeds up the healing process.[20]

Extracorporeal shock wave therapy increases vascular endothelial growth factors (VGEF), eNOS, and proliferating cell nuclear antigen (PCNA), which stimulates angiogenesis.[29]

Nitric oxide stimulation after (ESWT) is responsible for vasodilation, angiogenesis, and a decrease in NF-KB and genes that depend on NF-KB, which reduces the whole inflammatory process.[30]

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.

(ESWT) is a new method of treatment that does not involve surgery and is possible, safe, and cost-effective.[29]

Conclusions

Patients with subacromial impingement syndrome benefit from extracorporeal shock wave therapy, according to this study's results, which reveal that it improves shoulder function and subacromial space during adduction and abduction.

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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.

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