



Shock Wave Therapy and Ultrasound Therapy plus Exercises for Frozen Shoulder Joint Clients

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Abstract

Purpose: The aim of this study is to assess influence of shockwave therapy plus exercise and ultrasound therapy plus exercises on pain severity and range of motion with frozen shoulder joint patients.

Patients: twenty patients with frozen shoulder joint patients, illness time ranging between 2-9 months participated in this study at Palestine Ahliya University. They were randomly chosen from orthopedic surgeon assigned into 2 equal groups. Each group consists of ten patients.

Methods: Patients were analyzed pre and post treatment for shoulder pain severity by pain scale (VAS) and range of motion (ROM) of the shoulder joint by using goniometer. Group (A) received shock wave therapy, 2000 impulses per session, an energy flux density of 0.22mJ/mm², pulse rate 10/sec and frequency 1-15 Hz plus an exercise program. Group (B) received ultrasound with a frequency of 3MHz, and intensity 1w/cm was applied on the affected shoulder at the site of pain using ultrasound gel for 5 minute plus the same exercise program. The two groups received treatment 3 times per week for 4 weeks.

Results: (SWT) plus exercises and (UST) plus exercise were effective in decreasing shoulder joint pain and increase ROM. Moreover, (SWT) group was the most influential in decreasing pain and exaggerating range of motion of the shoulder joint.

Conclusion: (SWT) group and (US) group are beneficial in decreasing pain and increasing range of motion with frozen shoulder joint and should emphasis added to the physical therapy program.

Keywords: Shockwave therapy (SWT); Ultrasound therapy (UST); Exercises; Frozen shoulder

Abbreviations: SWT: Shockwave Therapy; UST: Ultrasound Therapy; ROM: Range of Motion; ESWT: Extracorporeal Shock Wave Therapy; VAS: Visual Analogue Scale; BMI: Body Mass Index

Frozen shoulder is signified by pain and stiffness in the shoulder joint; limited range of motion and pain are the most common symptoms. It is also known as adhesive capsulitis [1]. Frozen shoulder is thought to have an incidence of 3%-5% in the general population and up to 20% in those with diabetes [2]. Its peak incidence in

Introduction

between the ages of 40 and 60 and is rare outside these age groups and in manual workers [3] and is slightly more common in women. In terms of consultations to general practice it is thought that the cumulative incidence of consultations is 2.4/1000/year (95%CI: 1.9-2.9) [4]. Bilateral contemporaneous frozen shoulder occurs in 14% of patients whilst up to 20% of patients will develop some form of similar symptoms in the other shoulder [5]. Diabetes is the most common associated disease with frozen shoulder and a patient with diabetes has a lifetime risk of 10%-20% of developing this condition [6].

Frozen shoulder clinical course is divided into stages of freezing, lasting from onset to between 10 and 36 weeks, characterized by severe pain and a gradual diminution of articular volume, frozen stage lasting between 4 and 12 months when pain decreases gradually but without appreciable improvement in motion and thawing stage which is marked by gradual return of motion and may last between 12 months to few years [7]. The biomechanics of frozen shoulder indicate that the primary pathology can be correlated to contractures of individual structures in the capsule. Gerber demonstrated with capsulorrhaphy in cadaveric experiments that restriction of the antero-superior capsule (including the rotator interval, superior glenohumeral ligament and coracohumeral ligament) produces restriction of external rotation in the adducted shoulder whilst anteroinferior capsular restriction produces restriction of external rotation in the abducted shoulder. Posterior capsular restriction reduces internal rotation of the shoulder and may be present in more severe forms of frozen shoulder [8].

One of the important diseases that could be treated by physiotherapy and by using the shockwave therapy and ultrasound is Frozen Shoulder, it has always been considered important because of the impact on the quality of life and long period of illness. Therefore, the use of noninvasive and safe techniques that can speed up the healing process of the disease is important. However, ultrasound therapy differs from shockwave therapy, they both are used for injuries and pain treatments, but each one has its own characteristics that distinguish each type [9]. Physical therapy modalities and exercises can be listed as the most common treatment for shoulder pain [10]. Exercises and muscle stretching are effective means of treating shoulder dysfunction and enhancing range of motion in patients with shoulder impingement [11].

One non-surgical treatment method that has been receiving attention recently is extracorporeal shock wave therapy (ESWT). ESWT is a treatment method that applies extracorporeal shock waves to lesions to aid revascularization and stimulate or reactivate the healing

of bones and connective tissues such as tendons, thereby relieving pain and improving functions [12]. Ultrasound therapy (UST), one of the modalities used to treat frozen shoulder elevates tissue temperature to depths of more than 5 cm causing increased collagen tissue extensibility, pain threshold, and enzymatic activity. It also changes nerve conduction velocity, contractile activity of the skeletal muscle [13].

This study would be hypothesized that, the application of ultrasound therapy as a treatment approach have a positive effect on pain severity, function and range of motion in frozen shoulder cases. Also it would be hypothesized that, Shock wave as a line of treatment have a significant result on pain severity, function and ROM in frozen shoulder cases. Last hypothesis, there will be no significant difference between ultrasound therapy and shock wave on pain severity, function and ROM in frozen shoulder. First purpose of the study is to assess the therapeutic effect of ultrasound therapy and shock wave in decreasing severity of pain, and improving range of motion with frozen shoulder patients. Second purpose is to determine which one of these two physiotherapy modalities is more effective to reduce pain intensity and improving range of motion.

Materials and Methods

This study was determined by the following 20 patients of both sexes with age ranged from 40 to 60 years old will participate in the study and patient with frozen shoulder. The current study was designed to assess the therapeutic effect of ultrasound therapy and shock wave in decreasing severity of pain and improving range of motion with frozen shoulder patients. This part of the present study will be presented under the following heading:

Subjects

20 male and female patients with age from 40-60 years suffering from frozen shoulder would be participated in this study. All patients were randomly selected from orthopedic surgeon. They was divide into two groups; Group(A): ten patients were shock wave therapy plus exercise therapy for 12 sessions over a four week period, three sessions each week. Group (B): ten patients were received ultrasound therapy combined with the same exercises for 12 sessions over a four week period, three sessions each week. The criteria for patient's selection will be classified in to two types:

- Inclusion Criteria:
- Frozen shoulder.
 - Age 40-60.

c. Illness time ranging between 2-9 months.

Exclusion criteria:

- a. Rotator cuff tears.
- b. Glenohumeral or acromioclavicular arthritis.
- c. Any previous shoulder surgeries.

Instruments

Instruments that use in this study were divided into:

Instruments for assessment:

- a. A Visual Analogue Scale (VAS) is a measurement instrument that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured. It is often used in epidemiologic and clinical research to measure the intensity or frequency of various symptoms. For example, the amount of pain that a patient feels ranges across a continuum from none to an extreme amount of pain. From the patient's perspective, this spectrum appears continuous \pm their pain does not take discrete jumps, as a categorization of none, mild, moderate and severe would suggest. It was to capture this idea of an underlying continuum that the VAS was devised [14,15]. VAS is a 10 cm line, at one end was written (no pain = zero) and at the other end was written (worst pain the patient ever felt = 10). Each subject was asked to mark and score on the line at the point that representing her intensity of pain [16].
- b. Goniometer: Goniometer was used to assess the range of motion of the shoulder joint.

Instruments for treatment:

- a. Shock wave: Extracorporeal shock wave therapy (ESWT) is a noninvasive option for pain relief. Originally developed to dissolve kidney stones, this procedure involves shock-waves being directed from outside the body onto the affected areas. Extracorporeal shock wave therapy is thought to provide analgesia and stimulate the healing process by removal of inflammatory debris and promotion of neovascularisation. It has been recommended as a treatment for chronic plantar fasciitis in patients unresponsive to conservative treatment [17].
- b. Ultrasound therapy: Ultrasound waves are generated by a piezoelectric effect caused by vibration of crystals within the head of the wand/probe. The sound waves that pass through the skin cause vibration of the local tissue. This vibration or cavitations can cause a deep heating locally though usually no sensation of heat is felt by the patient, frequency of therapeutic ultrasound range from 0.5-3.0 MHz [18].

Procedures

Evaluation procedures: Each patient was evaluated just pre and post treatment period. Pain intensity was assessed using the visual analogue scale and range of motion of the shoulder joint was assessed using goniometer.

Treatment procedures

- a. Shock wave therapy: From sitting with shoulder abducted at 45 degree and elbow flexed and the forearm rested on flat surface, the shock wave applicator was applied on most tender point near the insertion of rotator cuff at greater tuberosity under the acromion. The shock wave therapy was administered using 15mm head applicator. Each patient in the experimental group A received 4 sessions, one session per week for four consecutive weeks with 2000 impulses per session, an energy flux density of 0.22mJ/mm², pulse rate 10/sec and frequency 1-15 Hz. The treatment area was prepared with a coupling gel to minimize the loss of shock wave energy at the interface between applicator tip and skin.
- b. Ultrasound therapy: In addition to the exercise program given to group (A), subjects representing the sample of this study received ultrasound for 12 sessions, 3 sessions per week as follows: From sitting position with the affected arm facing the therapist, continuous ultrasound with a frequency of 3MHz, and intensity 1w/cm was applied on the affected shoulder at the site of pain using ultrasound gel for 5 minutes.
- c. The exercises program (For all groups): The exercise program consisted of
 - i. Passive stretching exercise for the posterior shoulder capsule and surrounding musculature was done for only 3 times with a holding time 30 seconds and 10 seconds rest period between repetitions in each session.
 - ii. Strengthening exercises for shoulder flexion, and horizontal abduction. For each of the exercises, a 10-repetition maximum was determined. This determination was based on the examiner's observation of movement quality and the subject's responses with regard to fatigue and pain. Deterioration in movement quality or pain exceeding a mild discomfort was avoided during all strengthening exercises by either reducing the level of resistance or modifying the ROM until the subject was able to progress. Each exercise was performed as 3 sets of 10 repetitions with a 60- seconds rest period between each set. A seated press-up and the elbow push-up exercises were also included. Both were performed to fatigue or for a maximum of 25 repetitions. The quality of all repetitions of each exercise was continuously monitored by the investigator of the study.

- iii. Mobilizing exercises in the following form: Patients received sustained mobilization technique with grades (I, II, III, and IV) and oscillatory mobilization technique in the form of inferior, anterior, and posterior glide. The mobilization was done for 2-4 times with a holding time of 30 seconds and a rest period of 10 seconds. The oscillatory technique is done at the rate of 5-6 oscillation/second for 20 minutes.

Results

The results of the study after the suggested period of treatment revealed significant improvement in the measured variables including pain, function, and range of motion in Group A and Group B when comparing the pre and post treatment mean values. Significant difference was observed in favour of GA in pain severity and shoulder range of motion, when comparing the post treatment mean values of the two groups.

Subjects

Group (A): Ten patients (females and males) with frozen shoulder syndrome were included in this group that received shock wave therapy and exercises. The mean (\pm SD) of age 45.33 ± 8.64 years, weight 78 ± 5.26 kg, height 168.53 ± 0.04 cm, and BMI 27.54 ± 2.65 kg/m².

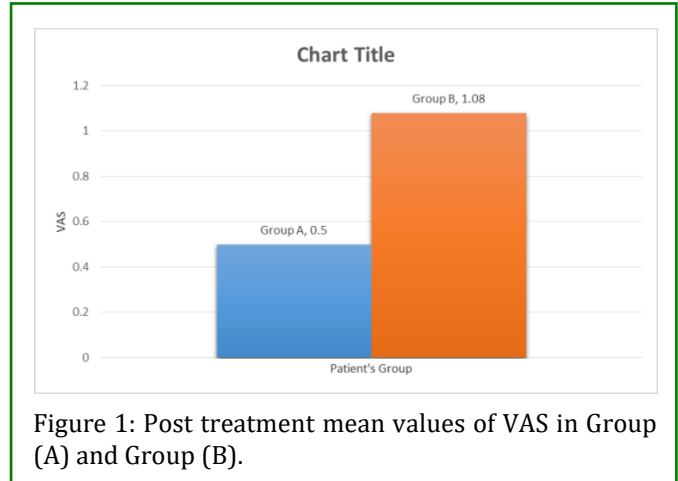
Group (B): Ten patients (females and males) with frozen shoulder were included in this group that received ultrasound therapy and exercises.

Pain intensity for Group (A) and Group (B) pre and post treatment

The mean (\pm SD) of age 46.26 ± 8.05 years, weight 79.06 ± 8.41 kg, height 169.4 ± 0.06 cm, and BMI 27.60 ± 3.09 kg/m². Comparing the general characteristics of the subjects of both groups revealed that there was no significance difference between both groups in the mean age, weight, height, or BMI ($p > 0.05$). The mean and standard deviation values (SD) of VAS for GA before application of shock wave was 6.7 ± 1.05 , while after application of shock wave was 0.5 ± 0.6 . The mean difference was 6.2. There was a significant difference between pre and post treatment in VAS ($p = 0.0001$). The mean and SD of VAS for GB before application of ultrasound therapy was 6.63 ± 1.35 , while after application was 1.08 ± 0.6 . The mean difference was 5.55. There was a significant difference between pre and post treatment in VAS ($p = 0.0001$).

Pain between subjects of for Group (A) and Group (B) post treatment

The mean value \pm SD of VAS after treatment for group A was 0.5 ± 0.6 and that for group B was 1.08 ± 0.6 . The mean difference between both groups was -0.58. There was a significant difference between GA and GB in VAS post treatment with ($p = 0.005$) (Figure 1).



ROM for Group (A) pre and post treatment

The mean and SD values of shoulder flexion, abduction, and internal rotation for GA before the application of shock wave were 109.88 ± 23.36 , 100.30 ± 7.04 , and 29 ± 5.64 degrees respectively, while after application of shock wave were 172.33 ± 5.41 , 173.55 ± 5.06 , and 43.4 ± 0.63 degrees respectively. The mean difference between pre and post treatment in mean values of shoulder flexion, abduction, and internal rotation were - 62.45, - 73.25, and -14.4 respectively. There was a significant difference between pre and post treatment mean values of shoulder ROM ($p < 0.05$).

ROM for Group (B) pre and post treatment

The mean and SD values of shoulder flexion, abduction, and internal rotation for GB before the application of ultrasound therapy were 110 ± 21.38 , 100.56 ± 13.54 , and 28.46 ± 3.92 degrees respectively, while after application of ultrasound therapy were 156.30 ± 12.46 , 159.3 ± 11.46 , and 41.72 ± 2.09 degrees respectively. The mean difference between pre and post treatment in mean values of shoulder flexion, abduction, and internal rotation were - 46.3, - 58.74, and -13.26 respectively. There was a significant difference between pre and post treatment mean values of shoulder ROM ($p < 0.05$).

Post treatment mean values of ROM for Group (A) and Group (B)

The mean value \pm SD of shoulder flexion, abduction, and internal rotation post treatment for group A were 172.33 ± 5.41 , 173.55 ± 5.06 , and 43.4 ± 0.63 degrees respectively, and that for group B were 156.30 ± 12.46 , 159.3 ± 11.46 , and 41.72 ± 2.09 degrees respectively. The mean difference between both groups in mean values of shoulder flexion, abduction, and internal rotation were 16.03, 14.25, and 1.68 respectively. There was a significant difference between group A and group B in shoulder ROM post treatment with ($p < 0.05$) (Figure 2).

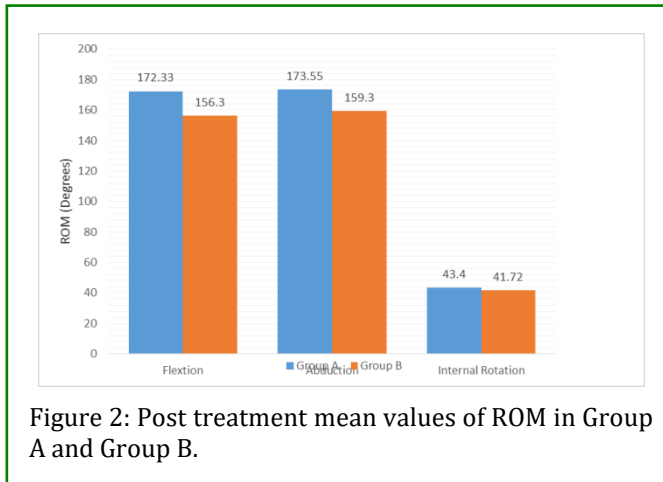


Figure 2: Post treatment mean values of ROM in Group A and Group B.

Discussion

Frozen shoulder is a common disease which causes significant morbidity. Despite over a hundred years of treating this condition the definition, diagnosis, pathology and most efficacious treatments are still largely unclear, frozen shoulder syndrome is a condition of uncertain etiology characterized by progressive loss of both active and passive shoulder motion, and muscle weakness from disuse [19]. It has been estimated that a minimum of 2% of the population are at risk of being affected by frozen shoulder per year. Patients with frozen shoulder usually present between the fifth and sixth decades of life, and onset before the age of forty is very uncommon. The peak age is 56 years, and 70% of patients are females [6].

To assess the therapeutic effects of SWT, comparison was done between pre and post treatment mean values of pain for the frozen shoulder joint patients in the first experimental group. The results showed positive significant decrease in shoulder joint pain at the end of the treatment program. Cacchio et al. [20] showed significant reduction in shoulder pain after 4 weeks of treatment by RSWT. These results may be clarified by the work of Lebrun [21], who clarified that, Shock wave therapy works on one level to treat pain through

overstimulation of the "pain transmission nerves", or "hyper stimulation analgesia, and local production of pain inhibiting substance.

This is confirmed by the work of Rompe et al. [22] who stated that, shock waves induced analgesic effect by over stimulating the axons thereby increasing pain threshold. And the work of Malay et al. [23] who mentioned that, shock waves include the physical alteration of small axons, so that inhibiting pain impulse conduction, and chemical alteration of pain receptors neurotransmitter, and preventing pain perception. Pan et al. [12] stated that visual analogue scale (VAS) improved after ESWT treatment to tendinitis of the shoulder. ESW increases microcirculation in lower-leg chronic ischemia, improves myocardial perfusion in patients with severe coronary artery, decreases pain and enhances re-epithelialization in chronic leg ulcers and, it may improve bone vascular disorders such as osteonecrosis and may have a bactericidal effect against staphylococcus aureus [24]. This may be attributed to the effect of ESWT that, cause reduction of substance P in the target tissue in conjunction with reduced synthesis of this molecule in dorsal root ganglia cells as well as by selective destruction of unmyelinated nerve fibers within the focal zone of ESW [25].

To examine the effect of shock wave therapy, comparison between pre and post treatment results of ROM using goniometer for the frozen shoulder patients was done. There was significant improve in ROM at the end of the treatment. These results come in agreement with Arno et al. [24] who reported that (SWT) increases perfusion in ischemic tissues, stimulate growth factors, decreases inflammation and accelerate healing so improve function. These results come in agreement with HO & Hsu [26] and Cacchio et al. [20]. They revealed significant functional improvement due to application of (SWT) for patient with shoulder pain.

To know the therapeutic effects of ultrasound therapy, comparison was done between pre and post treatment mean values of pain and range of motion for the frozen shoulder joint patients in the first experimental group. The results showed positive significant decrease in shoulder joint pain and improving of ROM at the end of the treatment program. Therapeutic ultrasound (US) is frequently used in physiotherapy clinics to treat various musculoskeletal disorders. Although the exact mechanism of action is unclear, heating is the most important effect. It encourages regional effect of shock wave therapy which was stronger than that effect of phonophoresis blood flow and increases connective tissue extensibility. Non-thermal effects are less understood and include molecular

vibration, which increase cell membrane permeability and thereby enhances metabolic product transport [27].

Topically applied drugs can include local and systemic effects that can be distinguished by examining local tissue drug concentrations (under the site of application) and blood or urine level. For years it was thought that all topically applied drugs entered the capillary network, became systemic, and then returned to the local area through the bloodstream. Research has shown that local delivery is separate from systemic delivery [10]. After treatment there was a significant reduction of pain intensity of shock wave group than ultrasound group this may be due to the potent analgesic effect.

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