



Radial Shockwave Versus Ultrasound Phonophoresis in Management of Chronic Supraspinatus Tendinitis

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ABSTRACT

Background: Chronic supraspinatus tendinitis is a prevalent cause of shoulder pain and dysfunction, often resulting from repetitive strain or overuse. Effective non-invasive treatments are essential for improving patient outcomes without surgical intervention.

Objective: This study aims to compare the efficacy of Radial Shockwave Therapy (RSWT) versus Ultrasound Phonophoresis with Diclofenac Sodium in managing chronic supraspinatus tendinitis. The primary outcomes assessed were supraspinatus tendon thickness, pain intensity, shoulder range of motion (ROM), and upper limb function.

Methods: Sixty-nine patients aged 18-60 with clinically diagnosed chronic supraspinatus tendinitis were randomly assigned to three groups (23 each). Group A received RSWT combined with conventional physiotherapy, Group B underwent ultrasound phonophoresis with Diclofenac Sodium alongside conventional physiotherapy, and Group C received only conventional physiotherapy. Treatment lasted four weeks with three sessions per week. Outcome measures included tendon thickness (via ultrasonography), Visual Analog Scale (VAS) for pain, Quick Disabilities of the Arm, Shoulder, and Hand (Quick DASH) questionnaire for function, and ROM assessments (abduction, flexion, external rotation). Statistical analysis utilized Mixed MANOVA with post-hoc Bonferroni tests ($p < 0.05$).

Results: All groups demonstrated significant improvements in all measured variables post-intervention ($p < 0.001$). Group A showed a greater reduction in VAS scores compared to Groups B ($p = 0.005$) and C ($p = 0.001$). Additionally, Group A exhibited more pronounced improvements in Quick DASH scores and ROM measures than Groups B and C ($p < 0.05$). Group B also outperformed Group C in reducing pain and enhancing function ($p = 0.02$).

Conclusion: While all treatment modalities were effective, RSWT combined with conventional physiotherapy provided superior benefits in reducing pain, improving function, and enhancing shoulder mobility compared to ultrasound phonophoresis and conventional therapy alone. Phonophoresis remains a valuable option for pain and inflammation management in chronic supraspinatus tendinitis.

Keywords: Supraspinatus tendinitis, Radial shockwave therapy, Ultrasound phonophoresis, Diclofenac Sodium, Shoulder impingement

1. Introduction

Chronic supraspinatus tendinitis is a common condition affecting the rotator cuff, often characterized by persistent shoulder pain and dysfunction due to repeated strain or overuse. It is frequently associated with shoulder impingement and rotator cuff tears, particularly involving the supraspinatus tendon. This condition can lead to fibrosis, calcifications, and tendon thickening, which are often visible through ultrasonography or MRI. (Elattar et al., 2021)

Shock wave is an effective and noninvasive method of reducing pain and increasing ROM and functional status without the need for surgery. Shock wave therapy is a treatment method in which high-amplitude sound waves are focused on the desired part of the body. The use of this method has become widespread in various musculoskeletal disorders including tendinopathy and calcifications (Reilly et al., 2018)

Phonophoresis is a type of therapeutic US that uses mechanical waves of a very high frequency to cause vibration. Tissues are heated intensely due to the vibrations. Using this energy source to generate deep heat has been shown to boost local blood flow, alleviate pain, as well as aid in the resolution of fibrosis (Gonnade et al., 2018).

The medication gel or cream could be used. It is clear that ultrasound common modalities for the management of skeletal muscle injury and often used in attempt to augment repair and regeneration of muscle tissue (Markert et al., 2005).

2. Methods

Study design

Pre – test and Post – test A randomized controlled clinical trial three groups were compared. Group A received radial shockwave and conventional physiotherapy, group B received ultrasound phonophoresis and the conventional physical therapy, and group C received the conventional physical therapy.

Participants

Participants of the study comprised Sixty-nine patients with chronic supraspinatus tendonitis participated in this study aged between 18-60years old . the participant Body Mass Index range from 18.5- 24.5'. both Sex (male, female) . was clinically diagnosed using the "Jobe's test referred from orthopedic physician participated in this study. Additionally, Tenderness is found over the supraspinatus as it passes sub acromial and anterolateral Patients were excluded if they had undergone treatments after surgery, Partial or massive tears, Implanted pace maker and pregnancy. Subjects were randomly subdivided into three groups, Twenty-three in each group. Group A received radial shockwave and conventional physiotherapy, group B received ultrasound phonophoresis and the conventional physical therapy, and group C received the conventional physical therapy.

Ethics Statement

Our research adhered to all relevant law and institutional guideline was approved by The ethical committee of faculty of physical therapy Cairo university, approved the conduction of the trial (No:P.T.REC/012/005075) and clinical trial registration (NCT06386926).We obtained consent from all participants involved in the study.

Procedures

Pain was evaluated using a visual analogue scale. Scores are determined based on self-reported symptoms, with a single handwritten mark placed on a 10-cm line that signifies a continuum from "no pain" on the left end (0 cm) to "worst pain" on the right end (10 cm).The "Disability of Arm, Shoulder, and Hand"(DASH-Arabic)is the Arabic version of the assessment. It comprises 30 items that gauge the difficulty a patient experiences when performing various activities using the "arm, shoulder, and hand". This includes "assessing the severity of pain symptoms and evaluating issues that impact social activities, work, sleep, and psychological well-being".

Intervention

Group A (Experimental 1): 23 patients diagnosed and referred from orthopedist will receive Shock wave and conventional physical therapy

1- all patients were sitting with shoulder abduction at 45 and elbow flexed and the forearm rested on flat surface and shock wave applicator directed in the most tender point near the insertion at the greater tuberosity unde acromion.

Will receive 3 sessions one session per week for four consecutive weeks with 6000 impulses, and energy flex density of 0.22mj/mm, pulse rate 10/sec and frequency 1-15 Hz.

2- Exercise in form of stretching exercise of shoulder supraspinatus muscle, passive stretching exercise, done only 3 times with holding time 30 sec and 10 sec rest period between repetitions.

3- Strengthening exercise consists of 3 exercises all have been recommended as essential for any shoulder rehabilitation program. These exercise include shoulder side lying scaption , external rotation and Prone back strength of the shoulder V shape for each exercise a 10 repetitions maximum for 3 sets wit 60 sec rest between every set. (Mashaly, 2014)

4- TENS will be applied for each patient by placing four electrodes on either side of the deltoid muscle on the front and back surfaces of the shoulder joint for 20 min .A constant current of high frequency (100 Hz) was used with an intensity initiated at 10 mA that was gradually increased to 15 mA (Vrouva et al., 2019)

5- Moist heat will be applied for 20 minutes of superficial heat using hot pack Then will be instructed to do the stretching, strengthening exercise same as the previous groups .(Kazempour Mofrad et al., 2021)

Group B (Experimental 2) 23 patient diagnosed and referred from orthopedist will receive ultrasound with Diclofenac sodium (Voltaren gel)in form of phonophoresis:

1- the treatment starts by application of ultrasound with Diclofenac sodium in form of phonophoresis

-the patient sitting where the affected arm facing the therapist

-Continuous ultrasound with frequency 3MH and intensity 1w/cm applied on the affected shoulder site of pain using diclofenac sodium for 5 minutes

Each patient receive 12 session, 3 sessions per week. (Adel et al., 2013)

Group C (Control Group): 23 patient diagnosed and referred from orthopedist will receive Conventional physical therapy in form of Tens, moist heat, stretching and strengthening exercise Each patient receive 12 session, 3 sessions per week as the same in the previous two groups.

Statistical analysis

data was checked using the Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Mixed MANOVA was performed to compare within and between groups effects on VAS, ODI, PPT, PASS and trunk ROM. Post-hoc tests using the Bonferroni correction were carried out for subsequent multiple comparison. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

3. Results- Subject characteristics:

Table (1) shows the subject characteristics of group A, B and C. There was no significant difference between groups in age, BMI, MOCA and sex distribution ($p > 0.05$).

Table 1. Basic characteristics of participants.

	Group A	Group B	Group C	
	mean \pm SD	mean \pm SD	mean \pm SD	p-value
Age (years)	36.05 \pm 3.64	35.89 \pm 3.33	35.26 \pm 4.23	0.79
BMI (kg/m ²)	21.32 \pm 1.34	21.15 \pm 1.57	21.37 \pm 1.77	0.78
Duration of illness (months)	12.26 \pm 4.37	11.42 \pm 3.55	11.68 \pm 3.13	0.90
Sex, n (%)				
Females	11 (58%)	11 (58%)	12 (63%)	0.93
Males	8 (42%)	8 (42%)	7 (37%)	

SD, standard deviation; p-value, level of significance

Effect of treatment on VAS, quick DASH, supraspinatus tendon thickness and shoulder ROM:

Mixed MANOVA revealed that there was a significant interaction of treatment and time ($F = 15.13$, $p = 0.001$, $\eta^2 = 0.65$). There was a significant main effect of time ($F = 498.66$, $p = 0.001$, $\eta^2 = 0.98$). There was a significant main effect of treatment ($F = 4.59$, $p = 0.001$, $\eta^2 = 0.36$).

Within group comparison

There was a significant decrease in VAS, quick DASH and supraspinatus tendon thickness in the three groups post treatment compared with that pre treatment ($p < 0.001$). (Table 2). There was a significant increase in shoulder external rotation, flexion and abduction ROM in the three groups post treatment compared with that pre treatment ($p < 0.001$). (Table 3).

Between group comparison

There was a significant decrease in VAS, quick DASH and supraspinatus tendon thickness and a significant increase in shoulder external rotation, flexion and abduction ROM of group A compared with that of group B ($p < 0.05$) and group C post treatment ($p < 0.001$). There was a significant decrease in VAS, quick DASH and supraspinatus tendon thickness and a significant increase in shoulder external rotation, flexion and abduction ROM of group B compared with that of group C post treatment ($p < 0.05$) (Table 3).

Table 2. Mean VAS, quick DASH and supraspinatus tendon thickness pre and post treatment of group A, B and C:

	Group A	Group B	Group C
	mean \pm SD	mean \pm SD	mean \pm SD
VAS			
Pre treatment	6.63 \pm 0.68	6.53 \pm 0.61	6.58 \pm 0.69
Post treatment	2.63 \pm 1.07	3.68 \pm 0.95	4.53 \pm 0.96

MD (% of change)	4.04	2.86	2.09
	(61.12%)	(44.48%)	(32.25%)
95% CI	3.59: 4.50	2.41: 3.33	1.63: 2.54
	<i>p = 0.001</i>	<i>p = 0.001</i>	<i>p = 0.001</i>
Quick DASH			
Pre treatment	72.34 ± 8.58	69.57 ± 7.36	71.01 ± 9.63
Post treatment	24.46 ± 12.20	44.39 ± 15.94	59.61 ± 12.31
MD (% of change)	49.17	25.84	12.11
	(66.54%)	(37.06%)	(16.91%)
95% CI	44.75: 53.59	21.42: 30.27	7.69: 16.53
	<i>p = 0.001</i>	<i>p = 0.001</i>	<i>p = 0.001</i>
Supraspinatus tendon thickness (mm)			
Pre treatment	7.63 ± 0.61	7.66 ± 0.48	7.59 ± 0.59
Post treatment	6.21 ± 0.40	6.63 ± 0.52	7.05 ± 0.53
MD (% of change)	1.50	1.07	0.54
	(19.56%)	(13.93%)	(7.13%)
95% CI	1.31: 1.68	0.88: 1.25	0.35: 0.72
	<i>p = 0.001</i>	<i>p = 0.001</i>	<i>p = 0.001</i>

SD, Standard deviation; MD, Mean difference; CI, Confidence interval; p value, Probability value

Table 3. Mean shoulder external rotation, flexion and abduction ROM pre and post treatment of group A, B and C:

	Group A	Group B	Group C
	mean ± SD	mean ± SD	mean ± SD
ROM (degrees)			
External rotation			
Pre treatment	57.89 ± 9.41	55.74 ± 9.66	56.58 ± 9.54
Post treatment	82.42 ± 5.36	77.05 ± 5.84	71.79 ± 7.21
MD (% of change)	-21.26	-19.61	-13.57
	(34.65%)	(33.53%)	(22.98%)
95% CI	-25.13: -17.39	-23.48: -15.74	-17.43: -9.70
	<i>p = 0.001</i>	<i>p = 0.001</i>	<i>p = 0.001</i>
Flexion ROM			

Pre treatment	108.63 ± 11.25	106.74 ± 12.36	107.11 ± 11.97
Post treatment	170.42 ± 13.26	159.95 ± 11.98	147.79 ± 11.57
MD (% of change)	-60.61 (54.80%)	-49.35 (45.15%)	-38.39 (34.97%)
95% CI	-66.79: - 54.43 <i>p = 0.001</i>	-55.53: - 43.17 <i>p = 0.001</i>	-44.57: - 32.21 <i>p = 0.01</i>
Abduction ROM			
Pre treatment	105.11 ± 5.46	106.53 ± 4.66	105.58 ± 3.85
Post treatment	120.26 ± 3.80	115.42 ± 5.52	111.37 ± 4.70
MD (% of change)	-15.13 (14.46%)	-9.91 (9.33%)	-5.65 (5.31%)
95% CI	-16.75: - 13.52 <i>p = 0.001</i>	-11.53: -8.30 <i>p = 0.001</i>	-7.27: -4.04 <i>p = 0.001</i>

SD, Standard deviation; MD, Mean difference; CI, Confidence interval; p value, Probability value

Table 4. Comparison between group A, B and C post treatment.

Outcome	Group A vs B		Group A vs C		Group B vs C		η^2
	MD (95% CI)	p value	MD (95% CI)	p value	MD (95% CI)	p value	
VAS	-1 (-1.74: - 0.26)	0.005	-1.82 (-2.57: - 1.08)	0.001	-0.82 (-1.57: - 0.08)	0.02	0.35
Quick DASH	-19.16 (-28.20: -10.12)	0.001	-34.77 (- 43.81: -25.73)	0.001	-15.61 (- 24.66: -6.58)	0.003	0.56
Supraspinatus tendon thickness (mm)	-0.44 (-0.79: - 0.09)	0.01	-0.86 (-1.21: - 0.51)	0.001	-0.42 (-0.77: - 0.07)	0.01	0.34
ROM (degrees)							
External rotation	4.52 (0.20: 8.84)	0.03	10 (5.68: 14.32)	0.001	5.48 (1.16: 9.80)	0.009	0.32
Flexion ROM	12.57 (4.19: 20.94)	0.002	23.05 (14.67: 31.42)	0.001	10.48 (2.10: 18.86)	0.01	0.40
Abduction	3.61 (0.47: 6.75)	0.02	7.78 (4.65: 10.92)	0.001	4.17 (1.04: 7.31)	0.006	0.35

MD, Mean difference; CI, Confidence interval; p value, Probability value; η^2 , Partial Eta Squared.

4. Discussion

This study evaluated to compare the effectiveness of radial shockwave therapy (RSWT) and phonophoresis with diclofenac sodium gel in management of chronic supraspinatus tendinitis. Both modalities significantly improved pain, function, range of motion (ROM), and tendon thickness, with RSWT demonstrating superior overall outcomes in most measures.

Group (B) (phonophoresis) showed significance improvements in VAS scores and QuickDASH functional outcomes. Diclofenac sodium gel, as an anti-inflammatory agent, has been shown to reduce pain and inflammation effectively when delivered via ultrasound. Tolu et al. (2021) demonstrated that phonophoresis enhances the depth and bioavailability of diclofenac sodium, leading to significant pain relief and functional improvement, similar to the results observed in this study.

However, improvements in tendon thickness were more pronounced in the RSWT group. This could be attributed to RSWT's ability to stimulate cellular regeneration and tissue remodeling, as reported by Notarnicola et al. (2017). These findings suggest that while phonophoresis effectively addresses inflammation and pain, it may not provide the mechanical stimulation necessary for significant tendon remodeling.

Also, Our results align with studies by Özmen et al. (2019), who demonstrated that Group (A) (RSWT)significantly reduced VAS pain scores and improved shoulder ROM in chronic tendinopathies

Ultrasonographic assessment in this study highlighted RSWT's advantage in reducing tendon thickness and enhancing tissue integrity. This aligns with findings by Speed (2014), emphasizing the utility of ultrasonography in tracking structural changes in tendinopathy management.

The functional improvements observed in both groups, particularly in ROM and QuickDASH scores, are consistent with Chang et al. (2014), who reported significant gains in upper limb functionality following RSWT treatment for rotator cuff tendinopathies. Diclofenac sodium phonophoresis, although slightly less effective than RSWT in some parameters, remains a viable option, particularly for patients seeking a less intensive intervention.

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