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Effect of Shockwave Therapy and Home Exercises for Treatment of Chronic Supraspinatus Tendinitis

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ABSTRACT
Background: About sixty percent of all shoulder discomfort cases are caused by supraspinatus tendonitis. Extracorporeal shock wave therapy (ESWT), which has been shown to be effective in treating a number of musculoskeletal conditions, including enthesopathies, seems to be a potential alternative. Supraspinatus tendinopathy is treated with a variety of progressive exercises.
Objective: In order to effectively treat chronic supraspinatus tendonitis, this study evaluated the therapeutic effects of SWT, at-home exercises, and their combination.
Patients and Methods: This study was a clinical trial study and was carried out on patients with chronic supraspinatus tendinitis and were randomly divided into three groups according to the line of treatment. Shockwave therapy group included 26 patients. Home exercises program group included 26 patients. Combined shockwave therapy and home exercises program group included 26 patients. Diagnosis of supraspinatus tendinitis was confirmed by diagnostic musculoskeletal ultrasonography.
Results: There were improvement in all groups but combined therapy group was superior to other groups. Shockwave therapy group showed improvement in shoulder pain, tenderness, active abduction and disability but home exercises group had better effects while combined therapy group showed more improvements in all shoulder parameters relative to the baseline and between groups.
Conclusion: Shockwave therapy and home exercises have been proved to be effective for the treatment of chronic supraspinatus tendinitis, improving shoulder pain, tenderness, active abduction and disability. They also reduced the treatment cost. Adding home exercises to shock wave therapy interventions increases the gained improvements in all shoulder parameters relative to the baseline and between groups.
Keywords: Extracorporeal shock wave therapy, Supraspinatus tendinopathy, Home exercises.

INTRODUCTION
Only the back and the knees are more common locations for musculoskeletal pain than the shoulder joint. According to estimates, 11.2 per one thousand patients in primary care experience shoulder pain annually [1]. Around sixty percent of all shoulder pain presentations are clinically caused by supraspinatus tendonitis. The muscle most frequently used in the overall shoulder complex is the supraspinatus [2]. Although supraspinatus tendonitis frequently resolves on its own, symptoms may linger. Non-steroidal anti-inflammatory medicines, physical therapy such as shortwave and therapeutic ultrasonography, steroid injections, needling, and lavage are some of the available therapeutic alternatives. However, there is not much proof that these treatments are effective. The efficiency of surgical procedures such as arthroscopic or open acromioplasty with the option of curettage of calcific deposits is still debatable [3].

Extracorporeal shock wave therapy (ESWT) has been shown to be effective in treating a number of musculoskeletal conditions, particularly enthesopathies, such as plantar fasciitis, elbow epicondylitis, patellar tendinitis, and Achilles tendinitis [4–7]. It has been hypothesized that early release of angiogenic and proliferating growth factors was induced by ESWT, with a positive effect on neovascularization of the tendon, which may lead to regeneration potential reactivation, even though the precise mechanism of action of ESWT for chronic tendinosis has not been identified [8].

Prior to surgery, ESWT has been suggested as a second-line therapy [9]. Supraspinatus tendinopathy treatment involves a variety of progressive exercises. Exercise programmes are broken down into three stages: self-stretching, strengthening, and joint mobility [10]. Its usefulness is still unknown, though.

AIM OF WORK
In order to effectively treat chronic supraspinatus tendonitis, this study evaluated the therapeutic effects of SWT, at-home exercises, and their combination.

PATIENTS AND METHODS
Patients with persistent supraspinatus tendonitis for at least six months were the subjects of this clinical trial investigation. From June 2021 to February 2023, candidates were chosen from the Physical Medicine, Rheumatology and Rehabilitation Department's outpatient clinics at Mansoura University Hospital.

In this study, patients with a single shoulder's chronic supraspinatus tendinitis were included. These patients' symptoms included anterior shoulder joint pain, painful shoulder abduction in the scapular plane, and positive results for the empty/full can test, Hawkins-Kennedy test, and Neer Impingement test. MSK US supported the diagnosis of supraspinatus tendonitis. We also included patients who did not

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respond to a standard course of NSAIDS for a minimum of three weeks or local steroid injection, or any therapeutic ultrasound, or cryotherapy, or immobilization or activity modification for minimum 3 weeks. Patients under the age of 18 who had shoulder pain from glenohumeral or acromioclavicular arthritis, a supraspinatus tendon tear, local tumors or infections, acute bursitis, previous shoulder surgery, any neurological disorder determined by a focused neurological exam and neurophysiological tests (such as thoracic outlet syndrome, reflex sympathetic dystrophy, etc.), polyarthritis or rheumatoid arthritis, or shoulder instability (dislocation/subluxation), with frozen shoulder, with bleeding disorder, with malignant tumors, with cardiac pacemaker, with uncontrolled HTN, and with ventricular arrhythmias were excluded from this study.

The participants in this study were randomly divided into three groups according to the line of treatment. ESWT group, which consisted of 26 patients, received three sessions spaced one week apart, and the home exercise programme group, which consisted of 26 patients, received self-stretching, strengthening, and joint mobility exercises by performing exercises of each group 3 times per week for two months. 26 individuals who had received the same treatment in groups one and two were included in the combined shockwave therapy and home exercise programme group. Prior to starting therapy, six weeks, two months, and three months following the final session, all patients had evaluations.

Methods

All patients were subjected to personal history (name, age, sex, occupation), the patient's complaint, present history, an analysis of the patient's complaint (pain) encompassing origin, course, duration, place, character, radiation, aggravating and relieving factors, prior history, therapeutic history, and family history, marital status, habitation, and unique habits of medical value.

In order to rule out any other disorders, patients underwent a general and systemic examination. A local shoulder examination also included palpation to gauge discomfort and warmth as well as visual inspection to look for any redness, swelling, muscular atrophy, or deformities. (VAS) was used to gauge how much shoulder pain there was when exercising, whilst "Tenderness Grading Scale" was used to gauge how tender the shoulder was. Due to its mobility, affordability, convenience of use, and noninvasive nature, goniometric examination of shoulder abduction was performed to measure range of motion. With the help of specific tests like the empty can test, full can test, Hawkins-Kennedy test, and Neer impingement test, we evaluated the supraspinatus tendon. In order to assess the functional status limitations in patients with shoulder diseases, we used the SDQ. There are three possible responses: yes, no, and not applicable (NA). A final score was determined by dividing the number of items with positive scores by the total number of applicable items, multiplying the result by one hundred, and ranging from 0 (no disability) to one hundred (all applicable items with positive scores).

Radiological Assessment

We used plain X-ray to exclude trauma, osteoarthritis or coracoid abnormality, and musculoskeletal ultrasonography to assess the supraspinatus tendon. In our study, the thickness of supraspinatus tendon was measured by millimeter (mm) in transverse view. The normal SSP tendon thickness ranged from 3.5–6.9 millimeters, with a mean of 5.31 ± 0.69 millimeters.

Methods of Treatment

➢ ***Extracorporeal Shockwave Therapy (ESWT)***

ESWT was administered to patients in groups 1 and 3 over the course of three sessions spaced one week apart using a shock wave generator (SHOCK MASTER 500, gymna, Belgium). At 120 impulses per minute, 2000 radial shocks with an energy flux density of 0.011 mJ/mm^2 were delivered across one centimeter area at the supraspinatus tendon insertion during each session. ESWT was carried out in a silent space with a constant temperature. During the procedure, patients were comfortably seated or lying down.

Home Exercises Program

By executing four simple exercises, each of which involved self-stretching and joint mobility, the participants were able to complete the programme independently at home. Over a two-month period, the participants were instructed to exercise three times each week. Only during the first week did patients who complained of moderate shoulder pain during exercise and fading at rest begin using paracetamol.

Ethical approval:

All cases under study gave their informed consent to take part in the study. After receiving clearance from the institutional review board and the Faculty of Medicine at Mansoura University, the Department of Internal Medicine approved conducting research. The entire process of conducting the study adhered to the Helsinki Declaration.

Statistical analysis

SPSS software, version 18, was used to analyze the data. SPSS Inc., Chicago, USA. Number and percentage were used to describe qualitative data. After confirming that the quantitative data were normally distributed using the Kolmogorov-Smirnov test, the mean and SD were used to summarize the data. When necessary, Monte Carlo and Chi-Square tests were employed for comparing qualitative data between groups. More than two independent groups were compared using the one-way ANOVA test, and pair-wise comparisons were found using the post-hoc Tukey test. For comparing pre and post treatment values, a paired t test was utilised. The acquired results' significance was assessed at the (0.05) level.

RESULTS

Patients with chronic SSP tendonitis and shoulder pain lasting longer than six months participated in this clinical trial investigation. Regarding age, sex, disease duration, BMI, affected shoulder side and occupation and other factors, there were no statistical significance variations between the three groups (Table 1).

Table (1): Comparison of demographic data, disease duration, BMI, affected shoulder side and occupation between different treatment groups

	ESWT +Exercise n=26 (%)	ESWT only n=26 (%)	Exercise only n=26 (%)	Test of significance
Age/ years	48.73±5.43	50.46±7.08	52.12±6.08	F=1.92 P=0.154
Gender				
Male	15(57.7)	14(53.8)	13(50)	χ^2=0.310
Female	11(42.3)	12(46.2)	13(50)	P=0.857
Disease duration / months	8.58±1.03	8.52±1.18	8.71±1.64	F=1.85 P=0.220
BMI (kg/m^2)	32.12±1.77	31.38±2.74	31.04±2.39	F=1.44 P=0.244
Affected side				
Right	19(73.1)	20(76.9)	22(84.6)	χ^2=1.05
Left	7(26.9)	6(23.1)	4(15.4)	P=0.591
Occupation				
Student	2(7.7)	3(11.5)	3(11.5)	χ^{2MC}=1.39
Employee	5(19.2)	5(19.2)	6(23.1)	P=0.967
Manual worker	13(50)	11(42.3)	9(34.6)	
Housewife	6(23.1)	7(26.9)	8(30.8)	

There were no discernible differences in the baseline VAS for pain between the three groups; though, the combined therapy group showed more improvement after six weeks, and after two and three months more improvement was seen in the combined therapy group. Compared to before treatment, after six weeks, two months, and three months of treatment, each group's VAS for pain in the afflicted shoulders showed a substantial improvement, although the combined therapy and exercise groups showed more improvement (Table 2).

Table (2): Comparison of VAS for pain between studied groups

VAS	ESWT +Exercise (n=26)	ESWT Only (n=26)	Exercise Only (n=26)	Significance
Before treatment mean±SD	8.58±0.64	8.80±0.40	8.69±0.47	p$=0.111 p#=0.422 p@=0.422
After 6 weeks mean±SD	6.38±0.49	7.54±0.65	7.14±0.99	p$<0.001* p#=0.002* p@=0.068
After 2 months mean±SD	3.85±0.61	5.97±1.14	5.50±1.39	p$<0.001* p#=0.02* p@=0.380
After 3 months mean±SD	3.96±5.77	5.86±1.14	5.62±1.44	p$<0.001* p#=0.012* p@=0.628
Within group significance	p1=0.006* p2=0.001* p3=0.002*	p1=0.009* p2=0.006* p3=0.005*	p1=0.006* p2=0.004* p3=0.003*	

*Statistically significant
p1: difference between before and after 6 weeks, p2: difference between before and after 2 months,
p3: difference between before and after 3 months, p$: difference between ESWT+ Exercise and ESWT only,
p#: difference between ESWT+ Exercise and Exercise only,
p@: difference between ESWT only and Exercise only.

There were no significant differences in the baseline tenderness scores of the three groups, but after six weeks, the combined therapy group showed more improvement, and after two and three months, the combined therapy group showed even more improvement. Compared to before treatment, after six weeks, two months, and three months of treatment, each group's tenderness score for the afflicted shoulders significantly improved, while the combination therapy and exercise groups showed the greatest improvement (Table 3).

Table (3): Comparison of tenderness score between studied groups

Tenderness Score	ESWT +Exercise (n=26)	ESWT Only (n=26)	Exercise Only (n=26)	Significance
Before treatment mean±SD	3.62±0.496	3.62±0.49	3.69±0.47	p$=1.0 p#=0.571 p@=0.589
After 6 weeks mean±SD	2.50±0.51	3.19±0.62	3.12±0.52	p$=0.001* p#=0.002* p@=0.211
After 2 months mean±SD	2.40±0.68	3.13±0.60	3.10±0.58	p$=0.009* p#=0.008* p@=0.09
After 3 months mean±SD	2.531±0.66	3.14±0.76	3.09±0.40	p$=0.001* p#<0.003* p@=0.767
within group significance	P1=0.005* P2=0.004* p3=0.006*	P1=0.008* P2=0.006* p3=0.007*	P1=0.007* P2=0.006* p3=0.005*	

*Statistically significant
p1: difference between before and after 6 weeks, p2: difference between before and after 2 months,
p3: difference between before and after 3 months, p$: difference between ESWT+ Exercise and ESWT only,
p#: difference between ESWT+ Exercise and Exercise only,
p@: difference between ESWT only and Exercise only.

No significant differences were found in the baseline shoulder abduction of the affected shoulders between the three groups when it came to active shoulder abduction; however, after six weeks of treatment, the combined therapy group showed more improvement, and after two and three months, the combined therapy group showed even more improvement. Shoulder abduction of the afflicted shoulders considerably improved in each group following treatment at six weeks, two months, and three months. However, the combined therapy and exercise groups showed the greatest improvement (Table 4).

Table (4): Comparison of active shoulder abduction between studied groups

Active shoulder abduction	ESWT +Exercise (n=26)	ESWT Only (n=26)	Exercise Only (n=26)	Significance
Before treatment mean±SD	148.85±8.16	150.0±8.0	150.08±8.46	p$=0.614 p#=0.590 p@=0.973
After 6 weeks mean±SD	161.15±8.04	152.92±7.17	154.62±8.30	p$<0.001* p#=0.004* p@=0.440
After 2 months mean±SD	160.77±7.71	152.92±7.17	153.88±8.76	p$=0.001* p#=0.02* p@=0.662
After 3 months mean±SD	161.92±6.34	151.85±8.66	152±8.77	p$=0.003* p#=0.01* p@=0.159
Within group significance	P1=0.001* P2=0.003* p3=0.002*	P1=0.008* P2=0.008* p3<0.03*	P1=0.004* P2=0.005* p3=0.02*	

*Statistically significant
p1: difference between before and after 6 weeks, p2: difference between before and after 2 months,
p3: difference between before and after 3 months, p$: difference between ESWT+ Exercise and ESWT only,
p#: difference between ESWT+ Exercise and Exercise only,
p@: difference between ESWT only and Exercise only.

In terms of the baseline empty can test of the affected shoulders between the three groups, there were no significant differences found. However, more improvement was seen in the combined therapy group after six weeks of treatment, and after two and three months more improvement was seen in the combined therapy group.

Compared to before treatment, after 6 weeks, 2 months, and 3 months of treatment, empty can tests of the afflicted shoulders showed a significant improvement in each group, but the combination therapy group showed the greatest improvement. Full can tests of the afflicted shoulders were considerably improved in each group following treatment at six weeks, two months, and three months, however, combination therapy and exercise groups showed the greatest improvement. When comparing the baseline **Hawkin tests** of the affected shoulders between the three groups that were studied, no significant differences were found. However, more improvement was seen in the combined therapy group after 6 weeks, and after 2 and 3 months more improvement was seen in the combined therapy group. **Hawkin tests** of the afflicted shoulders were significantly improved in each group following treatment at six weeks, two months, and three months, but combination therapy and exercise groups showed the greatest improvement.

There were no statistical significance variations in the baseline **Neer test** results of the affected shoulders between the three groups under study. After six weeks, the combined therapy group showed continued improvement, and at two and three months, they showed continued improvement.

Neer tests of the afflicted shoulders were significantly improved in each group following treatment at six weeks, two months, and three months. But combined therapy and exercise groups showed the most improvement (Table 5).

Table (5): Comparison of empty can test, full can test, Hawkin test and Neer test between studied groups

	ESWT+ Exercise n=26 (%)	ESWT only n=26 (%)	Exercise only n=26 (%)	Significance
Empty Can Test				
Before treatment **-ve** **+ve**	 14(53.8) 12(46.2)	 15(57.7) 11(42.3)	 15(57.7) 11(42.3)	p$=0.780 p#=0.780 p@=1.0
After 6 weeks **-ve** **+ve**	 25(96.2) 1(3.8)	 20(76.9) 6(23.1)	 18(69.2) 8(30.8)	p$=0.04* p#=0.01* p@=0.532
After 2 months **-ve** **+ve**	 26(100) 0(0.0)	 22(84.6) 4(15.4)	 21(80.8) 5(19.2)	p$=0.037* p#=0.019* p@=0.714
After 3 months **-ve** **+ve**	 26(100) 0(0.0)	 21(80.8) 5(19.2)	 20(76.9) 6(23.1)	p$=0.019* #=0.004* p@=0.510
Within group significance	P1=0.002* p2<0.001* P2<0.001*	P1=0.02* P2=0.001* p=0.03*	P1=0.02* P2<0.001* p3=0.02*	
Full Can test				
Before treatment **-ve** **+ve**	 3(11.5) 23(76.9)	 5(19.2) 21(80.8)	 4(15.4) 22(84.6)	p$=0.442 p#=0.684 p@=0.714
After 6 weeks **-ve** **+ve**	 14(53.8) 12(46.2)	 7(26.9) 19(73.1)	 8(30.8) 18(69.2)	p$=0.047* p#=0.092 p@=0.759
After 2 months **-ve** **+ve**	 19(73.1) 7(26.9)	 10(38.5) 16(61.5)	 11(42.3) 15(57.7)	p$=0.011* p#=0.024* p@=0.777
After 3 months **-ve** **+ve**	 22(84.6) 4(15.4)	 13(50) 13(50)	 14(53.8) 12(46.2)	p$=0.007* p#=0.016* p@=0.781
Within group significance	p1=0.001* p2<0.001* p3<0.001*	p1=0.510 p2=0.125 p3=0.019*	p1=0.188 p2=0.032* p3=0.003*	

	ESWT+ Exercise n=26 (%)	ESWT only n=26 (%)	Exercise only n=26 (%)	Significance
Hawkin test				
Before treatment				p$=0.684
-ve	4(15.4)	3(11.5)	5(19.2)	p#=0.714
+ve	22(84.6)	23(76.9)	21(80.8)	p@=0.442
After 6 weeks				p$=0.022*
-ve	14(53.8)	6(23.1)	9(34.6)	p#=0.162
+ve	12(46.2)	20(76.9)	17(65.4)	p@=0.358
After 2 months				p$=0.001*
-ve	20(76.9)	8(30.8)	13(50)	p#=0.043*
+ve	6(23.1)	18(69.2)	13(50)	p@=0.157
After 3 months				p$=<0.001*
-ve	22(84.6)	10(38.5)	15(57.7)	p#=0.034*
+ve	4(15.4)	16(61.5)	11(42.3)	p@=0.032*
Within group significance	p1=0.003 p2=<0.001* p3=<0.001*	p1=0.273 p2=0.089 p3=0.024*	p1=0.211 p2=0.019* p3=0.004*	
Neer test				
Before treatment				p$=0.222
-ve	5(19.2)	2(7.69)	3(11.5)	p#=0.442
+ve	21(80.8)	24(92.3)	23(88.4)	p@=0.638
After 6 weeks				p$=0.0438*
-ve	13(50)	6(76.9)	7(26.9)	p#=0.087
+ve	13(50)	20(23.1)	19(73.1)	p@=0.748
After 2 months				p$=0.002*
-ve	19(73.1)	8(30.8)	11(42.3)	p#=0.024*
+ve	7(26.9)	18(69.2)	15(57.7)	p@=0.387
After 3 months				p$=<0.001*
-ve	22(84.6)	10(38.5)	16(61.5)	p#=0.0249*
+ve	4(15.4)	16(61.5)	10(38.5)	p@=0.0961
Within group significance	p1=0.019* p2=0.002* p3=<0.001*	p1=0.124 p2=0.034* p3=0.017*	p1=0.159 p2=0.012* p3=<0.001*	

*Statistically significant
p1: difference between before and after 6 weeks, p2: difference between before and after 2 months,
p3: difference between before and after 3 months, p$: difference between ESWT+ Exercise and ESWT only,
p#: difference between ESWT+ Exercise and Exercise only,
p@: difference between ESWT only and Exercise only.

The baseline SDQ of the affected shoulders amongst the studied groups did not show any significant variations in the (SDQ) total score between the three groups. After six weeks, the combined therapy group showed continued improvement, and at two and three months, they showed continued improvement. The SDQ total score of the afflicted shoulders considerably improved in each group following treatment at 6 weeks, 2 months, and 3 months, but combination therapy and exercise groups showed the greatest improvement (Table 6).

Table (6): SDQ total score between studied groups

SDQ score total	ESWT+ Exercise n=26(%)	ESWT only n=26(%)	Exercise only n=26(%)	Significance
Before treatment mean±SD	68.9± 9.47%	70.2±7.09%	72.65±8.12%	p$=0.577 p#=0.132 p@=0.252
After 6 weeks mean±SD	54.3±18.5%	64.45±9.08%	63.68±9.35%	p$=0.015* p#=0.025* p@=0.764
After 2 months mean±SD	45.35±19.8%	58.65±12.5%	55.82±8.3%	p$=0.005* p#=0.016* p@=0.341
After 3 months mean±SD	39.25±16.4%	55.32±19.9%	50.84±9.9%	p$=0.002* p#=0.003* p@=0.309
Within group significance	P1=0.008* P2<0.001* p3<0.001*	P1=0.014* P2=0.002* p3=0.007*	P1=0.005* P2=0.001* p3<0.001*	

*Statistically significant
p1: difference between before and after 6 weeks, p2: difference between before and after 2 months,
p3: difference between before and after 3 months, p$: difference between ESWT+ Exercise and ESWT only,
p#: difference between ESWT+ Exercise and Exercise only, p@: difference between ESWT only and Exercise only.

There were no discernible variations in the baseline tendon hypoechogenicity of the affected shoulders between the three groups according to musculoskeletal ultrasound for the supraspinatus tendon. More improvement was seen in the combined therapy group after six weeks.

More improvement was seen in the combined therapy group after two and three months. There were no discernible variations in tendon hypoechogenicity between the groups before and six weeks, two months, and three months after therapy. No discernible changes were identified in the baseline abnormal tendon fibrillar pattern of the affected shoulders between the three groups when comparing SSP tendon abnormal fibrillar pattern by musculoskeletal ultrasound. More improvement was seen in the combined therapy group after six weeks. More improvement was seen in the combined therapy group after two and three months.

There were no discernible variations in the tendon fibrillary pattern between the groups before and six weeks, two months, and three months after therapy. Using musculoskeletal ultrasonography, to compare the thickness of the SSP tendon in the three groups, the baseline tendon thickness of the affected shoulders did not differ significantly across the study groups.

More improvement was seen in the combined therapy group after six weeks. More improvement was seen in the combined therapy group after two and three months (Table 7).

Table (7): Comparison of supraspinatus tendon hypoechogenicity, abnormal fibrillar pattern, and tendon thickness by MSKUS between studied groups

	ESWT+ Exercise n=26 (%)	**ESWT only n=26 (%)**	**Exercise only n=26 (%)**	Significance
MSK US hypoechogenicity				
Before treatment **Focal** **Diffuse**	 11(42.3) 15(57.7)	 17(65.4) 9(34.6)	 16(61.5) 10(38.5)	p$=0.095 p#=0.165 p@=0.773
After 6 weeks **Focal** **Diffuse**	n=19 6(23.1) 13(50)	n=23 15(57.7) 8(30.8)	n=19 13(50) 6(23.1)	p$=0.030* p#=0.023* p@=0.826
After 2 months **Focal** **Diffuse**	n=14 4(15.4) 10(38.5)	n=17 12(46.2) 5(19.2)	n=14 10(38.5) 4(15.4)	p$=0.019* p#=0.023* p@=0.956
After 3 months **Focal** **Diffuse**	n=13 3(11.5) 10(38.5)	n=18 12(46.2) 6(23.1)	n=12 9(34.6) 3(11.5)	p$=0.016* p#=0.009* p@=0.625
Within group significance	p1=0.463 p2=0.391 p3=0.237	p1=0.773 p2=0.721 p3=0.928	p1=0.633 p2=0.531 p3=0.416	
Abnormal Fibrillar Pattern				
Before treatment **Focal** **Diffuse**	 6(23.1) 20(76.9)	 10(38.5) 16(61.5)	 9(34.6) 17(65.4)	p$=0.229 p#=0.358 p@=0.773
After 6 weeks **Focal** **Diffuse**	n=21 3(11.5) 18(69.2)	n=22 10(38.5) 12(46.2)	n=22 9(34.6) 13(50)	p$=0.014* p#=0.0261* p@=0.554
After 2 months **Focal** **Diffuse**	n=13 1(3.8) 12(46.2)	n=14 8(30.1) 6(23.1)	n=16 7(26.9) 9(34.6)	p$=0.006* p#=0.031* p@=0.464
After 3 months **Focal** **Diffuse**	n=10 1(3.8) 9(34.6)	n=12 7(26.9) 5(19.2)	n=12 6(23.1) 6(23.1)	p$=0.018* p#=0.044* p@=0.681
Within group significance	p1=0.446 p2=0.237 p3=0.374	p1=0.434 p2=0.257 p3=0.252	p1=0.653 p2=0.554 p3=0.367	
Tendon Thickness				
Before treatment	8.87±0.712	9.03±0.39	9.10±0.41	p$=0.272 p#=0.06 p@=0.200
After 6 weeks	8.32±0.58	8.64±0.34	8.75±0.40	p$=0.015* p#=0.002* p@=0.430
After 2 months **mean±SD**	5.65±0.78	7.37±0.30	7.45±0.56	p$=0.002* p#=0.001* p@=0.07
After 3 months	5.58±0.68	7.38±0.29	7.45±0.56	p$=0.002* p#=0.001* p@=0.08
Within group significance	P1=0.01* p2=0.001* P3<0.001*	P1=0.03* p2=0.003* P3=0.002*	P1=0.02* P2<0.001* p3<0.001*	

*statistically significant
p1: difference between before and after 6 weeks, p2: difference between before and after 2 months,
p3: difference between before and after 3 months, p$: difference between ESWT+ Exercise and ESWT only,
p#: difference between ESWT+ Exercise and Exercise only,
p@: difference between ESWT only and Exercise only.

DISCUSSION

A chronic degenerative musculoskeletal condition known as tendinopathy is widespread in both the general public and athletes. One of the most popular forms of treatment for mediating tendon healing and regeneration is extracorporeal shockwave therapy (ESWT) [11]. As far as we are aware, the majority of prior studies largely focused on the effects of SWT and home exercises separately, but the current study assessed both approaches as well as their mixtures. The current study's objective was to assess the effectiveness of shock wave therapy, at-home exercise programmes, and their combinations in the treatment of chronic SSP tendonitis.

Patients with chronic supraspinatus tendonitis and shoulder pain lasting longer than six months participated in this clinical trial investigation. They were then randomly assigned to one of three groups, with twenty-six individuals in each group, each group being treated in a different way.

The current investigation showed statistically significant clinical and radiological improvement in chronic supraspinatus tendonitis.

This was in line with **Galasso *et al.*** findings [12], who advocated the use of ESWT in the treatment of supraspinatus tendinitis in terms of pain, ROM, and the Constant-Murley score (CMS). They randomly assigned 20 patients with supraspinatus tendinopathy to receive active treatment or a sham procedure. When compared to the baseline values, the ESWT group's total CMS score and the majority of the CMS subscales showed a substantial improvement at the final follow-up. Comparing the ESWT group to the placebo, there were noticeably higher scores for CMS pain and ROM.

The clinical outcomes of (ESWT) and US-guided shoulder steroid injection therapy in SSP tendonitis patients were compared by **Lee *et al.*** [13] and were similar. 26 patients were divided into 2 groups using block randomization: 13 were given US-guided shoulder injections, while 13 were given ESWT. The results showed that US-guided shoulder injection therapy did not perform better than ESWT therapy. Given the disadvantages and propensity for recurrence of steroid injections, ESWT therapies may be a helpful substitute for treating patients with SPP tendonitis.

ESWT was also recommended by **Malliaropoulos *et al.*** [14] for the treatment of shoulder calcific tendinopathy. They looked at 76 people who had calcific tendinopathy. They came to the conclusion that in this retrospective investigation, an individualized ESWT regimen led to a high rate of success and a low number of recurrences in the treatment of calcific tendinopathy.

Radial shockwave therapy does not provide any additional benefits over US-guided steroid injection in the short term for patients with chronic SSP tendinopathy, according to **Zamzam *et al.*** [15]. For more over three months, they examined 30 individuals with supraspinatus tendinopathy. Radial shockwave therapy was administered to fifteen patients in four sessions, and an ultrasound-guided subacromial steroid injection was administered to the remaining fifteen patients in one session. In terms of pain reduction (visual analogue scale) and clinical assessment (tenderness, range of motion in the shoulder, and muscle strength), both groups demonstrated statistically significant improvements. Between the two groups, there was no statistically significant difference.

The following processes may be responsible for SWT analgesic effects: By overstimulating the axons (gate-control theory), shock waves cause analgesia and raise a person's pain threshold [16]. Endorphins are likely released locally after a specific amount of shock waves, which reduces discomfort [17].

The most significant aspect to explain the therapy impact of shockwaves is probably the mechanical disturbances they produce. This is consistent with the theory of mechano-transduction [18], according to which mechanical stress on the cytoskeleton causes reactions from the mechanosensitive tendon cells, which then start a process of tendon remodelling and healing. Shockwaves improve angiogenesis, boost production of important tendon substances including collagen, glycosaminoglycans, and extracellular matrix proteins, in addition, growth factors like transforming growth factor (TGF)-1, while lowering inflammatory cytokines [19].

ESWT diminish substance P levels in the target tissue along with decreased dorsal root ganglion cell synthesis of this molecule also by selectively destroying unmyelinated nerve fibres in the focal zone of ESW [20].

According to **Arnó *et al.*** [21], (SW) boosts polymorph nuclear neutrophils and macrophage infiltration, decreases inflammation, speeds healing, and has an antimicrobial impact. It also promotes perfusion in ischemic tissues and stimulates growth factors.

Using microdialysis samples from the surrounding peri-tendon, **Waugh *et al.*** [22] investigated the metabolic response of normal and tendinopathic tendons after shockwave treatment. Several cytokines, growth factors, and proteases were examined before and right away following a single shockwave session. (IL)-1 and IL-2 were discovered, however their levels did not significantly change after (SWT), although IL-6 and IL-8 concentrations increased. Matrix (MMP)-2 and -9, which remodel the ECM, were also increased after shockwave therapy. These results imply that SWT therapy may facilitate tendon remodelling in tendinopathy by accelerating the inflammatory and catabolic processes linked to the removal of damaged ECM components.

According to the current study, home exercise programmes for chronic supraspinatus tendonitis showed statistically significant clinical and radiological improvement. A systematic review and meta-analysis of randomized clinical trials conducted by **Gutiérrez-Espinoza *et al.*** [23] stated that, in adults older than eighteen years of age with a diagnosis of chronic SSP tendinitis and treated conservatively, at-home shoulder strengthening and stretching exercises for the rotator cuff and scapular muscles are equally effective at improving shoulder function, pain, and range of motion.

Abdulla *et al.* [24] supported the introduction of a home exercise regimen. The effects were compared to those of surgery and corticosteroid injections, and they all agreed that it was comparable. They contrasted physical activity with various therapies for subacromial impingement syndrome, SSP tendinitis, and shoulder discomfort. They came to the conclusion that home-based strengthening and stretching under supervision produces better short-term pain and disability improvement as compared to no treatment.

In patients with rotator cuff tendinopathy, **Santello *et al.*** [10] supported home-based exercise programmes because they improved shoulder function and decreased pain intensity and medication intake over a two-month period. They looked at sixty patients who had rotator cuff tendinopathy and were awaiting physiotherapy. The control group (n = 30) was given very little information on their shoulder status and was told to carry on with their regular activities. Change in the Shoulder Pain and Disability Index (SPADI) was the main result. The change in the numerical pain rating scale and the use of painkillers were the secondary objectives. Pain severity and medication use were both decreased in the intervention group (P 0.001).

The current study showed that adding ESWT to home exercise boosts the gains in improvements in clinical and radiological data while treating chronic SSP tendonitis with combined therapy (ESWT + Exercise).

In the context of subacromial impingement syndrome, **Santamato *et al.*** [25] found that at 2 months posttreatment, participants in the focused ESWT-plus-isokinetic exercise (IE) group displayed significantly less pain and greater improvement in functionality and muscle endurance than the subjects in the focused-ESWT group. Thus, they deduced that, in participants with subacromial impingement syndrome, targeted ESWT combined with isokinetic rotator cuff training produced improved pain alleviation, functional recovery, and muscle endurance in the short to medium term, compared to ESWT alone.

However, **Carlisi *et al.*** [26] disproved the idea that incorporating an exercise programme would enhance the effectiveness of ESWT in the treatment of calcific SSP tendinopathy in terms of pain and function. Because they found no statistically significant changes favouring the combo group following therapy.

Combined ESWT and exercise therapies are beneficial for Achilles, lateral elbow, and rotator cuff tendinopathy, particularly when calcification is present, according to results of a recent study by **Burton** [11]**.** Despite generally excellent results in patellar tendinopathy, it hasn't been discovered that the combined therapy offers any advantages over eccentric exercise alone. There aren't enough high-quality RCTs looking into combined interventions for tendinopathies, like ESWT, exercise, and other cutting-edge therapies. There is a definite need for more research comparing integrated therapies, such as comprehensive exercise regimens that incorporate several types of exercise rather than just one.

For rotator cuff, lateral elbow, and Achilles tendinopathies, combined targeted exercise and ESWT therapies should be advised, according to encouraging findings. To offer definite recommendations on the best treatment procedures for tendinopathies, particularly patellar tendinopathy, additional well-designed RCTs are needed [11]**.** The exact cause of this improvement after exercise can be traced to stretching and strengthening activities for the muscles around the shoulder joint [27]**.**

CONCLUSION

Chronic SSP tendonitis has been successfully treated with SWT and at-home exercises, reducing shoulder pain, tenderness, active abduction, and disability. They also lower the price of treatment. The gains in all shoulder parameters relative to the baseline and between groups are increased when home exercises are added to SWT regimens.

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