

Influence of Nonoperative Treatments for Subacromial Shoulder Pain: A Review Article

Tengku Fadilah Tengku Kamalden^{1,*}, Qais Gasibat¹, Agiela Emhemed Rafieda²,
Walied Ashoor Sulayman³, Roxana Dev Omar Dev¹, Alif Syamim Syazwan¹, Mohd Rozilee Wazir¹

¹Department of Sport Studies, University Putra Malaysia (UPM), 43000 Serdang, Selangor, Malaysia

²Department of Physiotherapy, Faculty of Medical Technology, Misurata, Libya

³University of Mediterranean Karpasia, Şht. M.Ruso Cad. No:79 Küçükaymaklı, Nicosia, Cyprus

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Abstract Sub-acromial pain syndrome (SAPS) in overhead athletes is the most common reason for shoulder pain. As a rational decision, the medical treatments of today will likely be the best cure for this particular population. Conservative techniques are generally utilised to treat inflammation and pain through electrophysical approaches or to control the subacromial space to avoid impingement by rotator cuff and scapular muscle exercises, as the SAPS (subacromial pressure) mechanism remains unclear. The aim of this analysis is to assess the efficiency of these measures for pain reduction and function improvement. The literature, the best research source to be used, was searched using such search engines as PubMed, Medline, and Google Scholar. The articles were chosen in a manner that relates to the study objective and also their scientific relevance. This research may inform that in subjects with a reduced subacromial space, exercise can have a greater impact on overhead athletes. The effectiveness of centred therapy with Extracorporeal Shockwave (ESWT) on severe plantar fasciitis is uncertain. A greater cohort with its training efficiency in comparison with the conventional physiotherapy programme is required to demonstrate the efficacy of SAPS bodyblade exercise on overhead athletes.

Keywords Conservative Intervention, Exercises, Electrophysical, Bodyblade Exercise, Subacromial Pain

Syndrome, Extracorporeal Shockwave

1. Introduction

A common shoulder disorder found in sports medicine is Subacromial Pain Syndrome (SAPS) [28]. Among the treatments provided for non-operational areas, including physical exercise, modalities of electrotherapy that help alleviate pain and improve function, the methods are varied, and include a wide range of options. In order to normalise scapular and glenohumeral activity, certain fitness programmes consist of calming, regional and global reinforcement exercises [11], while the focus of extracorporeal shockwave (ESWT) therapy is on the supraspinatus tendon in order to produce positive physiological effects. Although it has already been shown that exercise has a beneficial effect on pain and function after intervention, the intermediate effects of treatment and ESWT, as well as their mechanisms, are still unclear. Physiotherapists have been using electrophysical therapy for relief of pain in the shoulder such as pulsed electric field, laser and ultrasound [1,2].

Extracorporeal Shockwave Treatment (ESWT) is a fairly recent approach that is used to treat this disorder. ESWT has been successfully applied to a wide variety of

musculoskeletal disorders, such as pain in the shoulder, elbow, knee and ankle. Traditionally, there are two types of threnody blows, namely the centred and the radial. A high peak pulse wave with a pulse width of 1 μ s (equal to 1 MHz) and a peak pressure above 50 bar is the fundamental ESWT [18].

SAPS is related to tightness of the soft tissue [36] and muscle fatigue [35]. This dysfunction can affect the subacromial space and cause the underlying structures, such as the supraspinatus tendon, to be overly compressed [37]. The standard exercise programme consists of relaxing the soft tissue and positive reinforcement exercises have been reported to reduce the pain [32,40] and function [16,32,37,48,52] at week 4 through week 24. However, in these above-mentioned studies, the participants were middle-aged individuals (mean age ranged from 44 to 58), and the level of activity was not recorded. In younger overhead athletes, disease-induced pathological changes can differ from those of 100 middle-aged individuals. Ludewing et al. [32] found that the feature shift was however, below the minimum clinically observable difference in a group of middle-aged (mean age 49) construction workers. More recent studies have indicated exercise style and intensity have an effect on their functional outcomes [50].

An article written in *Nature* [24] stated that exercise that focuses on the shoulder muscle area, and combined with manual therapy, is more effective than exercise that does not focus on the muscles in the shoulder area. Studies have shown that high-intensity exercises that require from upper to super-classification levels of exercise have shown greater benefits than a moderate intensity category [40]. It is believed that when throwing an object (such as a baseball) a piece of the energy from the lower part of our bodies is changed into the upper part of our bodies. The energy then goes to the chest and goes through the heart. This gets changed into the shoulder, and as it makes it way to the arm, the arm then completes the last link to the peak. Any mild weakness in the lower extremity or trunk regions areas of the body may affect the movement of the shoulder [45].

Popularised in the 70's, Bodyblade fitness is a modern form of exercise that involves trunk and shoulder muscle mobilisation by swinging a flexible blade at 270 vibrations per minute [30]. One of the ways of helping an aching patient heal is to use a type of treatment called kinesio taping, in which taping is applied to someone's body. After this is done, the injured area feels better [29]. When these studies were done using the Bodyblade exercise, the results showed that it could be an alternative solution to traditional exercise. The details concerning the intermediate implications of this research have not yet been examined in overhead athletes. After an athlete sustained a glenohumeral dislocation injury, significant changes in their pain and joint function were recorded. The bodyblade allows for a highly intense physical activity involving trunk and shoulder muscle mobilisation,

thus shaking a lightweight blade at 270 vibrations per minute. The mechanism of treatment is suggested as being a decline in neuromuscular development, decline in the joint proprioception, and decline in accuracy in the movement [30]. As a result of all this, the bodyblade exercise can be used in a different way or for different patients other than traditional exercises.

Comparable to incisions and punch through for the shoulder pain of SAPS, ESWT has been utilised to treat shoulder pain [17, 43].

Recent research by Galasso et al. [17] has shown that regulation therapy using electrical stimulation of the foot is more effective and leads to improvement in movement and recovery in three months. It is known that one of the mechanisms of the action of ESWT includes regulating the blood flow in the tendon, and facilitating tendon repair [39]. Keenly noted, the reduced vascularity of the tendon supraspinatus was, in fact, immediate after application of ESWT in case-series studies, followed by reduced pain terms in the first two weeks post procedure [38]. Should similar findings be found in three months post prophylactic, this would be worth looking into. After conducting a three-month controlled trial test on ESWT and Bodyblade, it was found that both of these therapies are very helpful in decreasing the deficits in understanding the effects of traditional exercise in the area of motivation for pain control and function.

By analysing the changes in the subacromial space and the response of the tendon to specific medication, it is possible to deduce what the relationship is between that and the response of the actual healing symptoms of the patient.

There are a lot of people, who are addicted to exercise, that have SAPS. The idea behind the concept is based on the theory of impingement-instability that excessive superior migration of the humeral head causes the subacromial space to narrow. This can result in impingement of the subacromial tissues, resulting in pain and dysfunction. The rotator cuff muscle is responsible for driving the humeral head. With the hand and the elbow in alignment, the elbow stabilises the humeral head so the lower arm may be pushed forward. The supraspinatus muscles also serve to keep the upper arm under the bone (vena cava) sagging. Research shows that this prevents excessive arm motion [14]. In contrast, the shoulder rotators on the thoracic side provide the scapular with a synchronous rotation during the humeral movement and a stable base from which to activate the rotator cuff [28]. In addition, this study suggests that reduced internal rotation of the shoulder as a measurement of the tightness of the capsule can contribute to anterior and higher migration of the humeral head [23].

In response, shoulder strengthening exercises are performed to maximise glenohumeral motion, improved scapular and rotator cuff strength and improved muscular activation. This can be achieved with internal rotation exercises to optimise scapular depression. The purpose of

this research is to evaluate the effects of the relief of pain and improvement of the functions of conventional exercise, ESWT, Bodyblade exercise in SAPS.

2. Method

The following keywords and variations of these terms were searched for relevant keywords in work-related electronic databases, including PubMed, ScienceDirect, Protection Article Archive, and Google Scholar: Conservative Interference, exercises, Electrophysical, Bodyblade Exercise, Subacromial Pain Syndrome, Extracorporeal Shockwave.

3. Results

A total of twenty-two trials were performed in conjunction with monitoring or other treatments in patients with SAPS with exercise therapy, and four clinical studies compared control group exercise, three of which demonstrated positive outcomes for pain relief or control group exercise task improvement [7,31,32]. When taking a measure of pain magnitude, the pain was reduced in 2 to 3 out of 10 of the Visual Analogue Scale or 10.8 % of the Impairment for Shoulder Hand Score (DASH) [31]. There was a modest but consistent rise in the improvement rate over the 2 to 3 years of the study, from 60 % to 68 %. At first, the average speed of the growth was around 2 weeks a month; then, it changed to 4 weeks in a month; then, it went slower than that. The most recent analyses of the impact, forms, and strength of supervision on pain management and work revealed three significant themes. High-dose workouts and precise exercises have been found to relieve discomfort and improve function better than low-dose or non-specific exercises [40]. Though it is not proven scientifically, the increased quality of life caused by exercising almost every day is recorded and proven. Twelve researchers went through the rigors of measuring the difference of exercise, diet, and medication. Physical exercises are much more common than electric procedures such as ESWT, which is far more popular than ESWT [15,16]. Exercise therapy has been found to have similar effects such as surgery [7,21,41], injections [9,19], and functional braces [46]. One aim of the study was to compare the effects of combined physical activities (exercise) with the effects of physical activity alone. There has been a wide range of such contradictory studies concerning the relationship between manual therapy and exercise. For example, an extensive follow-up study outlined by Bang et al. [2] and Kachingwe et al. [25] demonstrated that those with more muscle strength experienced a much larger increase in strength than the rest. The results of studies [3,44,48] suggest the treatment decisions are not very different between the two options. Ginn et al. [19] observed this same effect in their study

where the mixed and exercise groups spent equal amounts of time exercising physically. Particularly with the use of exercise, the results are very promising with 61 to 69 % of people in pain showing improvements in their functionality, and patients being able to tolerate the therapy better. Furthermore, it has the same psychological or psychological disruption effect of a surgical operation or an injection. Two clinical trials compared the effect of ESWT with placebo ESWT on non-calcific shoulder tendinosis. Schmitt et al. found that there was no significant difference in pain relief between ESWT and control groups with an amplitude of 0.11 mJ/mm² for 2,000 shocks in three sessions. Of fifty per cent of the participants, only about half would recover in the recovery group [43].

It was found by Galasso et al. [17] that positive results have been found for ESWT-based deep tissue therapy three month post-intervention over power. It found that the effectiveness of the program was 63.7 % of the patients for three months post intervention. The investigators were pleased with some of the children cared for by making follow-ups calls nine years after the intervention. During the study, the authors used a comparatively limited dosage of 0.068 mJ/mm² and gave more of it, in larger doses, to test animals while testing. Based on the studies, the effectiveness of the specific focal electro-acupuncture was not yet known. As a result of the difference in dose between the equipment and the drug used, there was an increase in the variance in the sample. Notarnicola et al. [38] reviewed the literature and discovered that ESWT (ESWT focused on pain and oxygen tissue relief) could be a useful treatment for individuals with supraspinatus tendinosis. The investigators administered 2,000 impulses of 0.04 to 0.07 mJ/mm² over the course of the study, and found considerable pain reduction in 65.6 % of the testing participants, as well as a drop in oxygen tissue saturation that occurred after the usage of focused ESWT exams on patients. Lack of pain reduction with the use of this method was linked to a problem with the oxygen levels of some individuals [51].

Due to this lack of research, no one knows for sure if the routine exercise using the Bodyblade is physically sound. The article on glenohumeral dislocations in a journal [8] describes a case study where the researchers documented pain relief for a patient with a glenohumeral dislocation. The therapy method involving elastic bands and a body blade workout showed a demonstrable stabilising impact on nine ice hockey athletes suffering from shoulder weakness [29]. In order to have proper training for the Bodyblade exercise with the SAPS type of athletes, a greater training group is required made up of athletes that have a greater variety of and in greater in difficulties compared to the other types of programme. Table 1 to Table 8 illustrates the effectiveness of the various therapies used in pain treatment illustrated in improvements in terms of pain and function.

Table 1. Comparison of Exercise vs Control for SAPS

Author	Participants	Age	Intervention	Frequency	Follow up	Outcome measures	Results
Brox et al. [7]	N=125 (Male: 54; Female: 71)	18 to 66	<ol style="list-style-type: none"> 1. Arthroscopic surgery (n=31) 2. Placebo laser (n=13) 3. Supervised exercise (n=33) Sling suspension exercises, wall push-ups, pulley exercises and light elastic band internal rotation, external rotation in standing for 1 hour daily 	<p>12 sessions for 6 weeks in placebo group</p> <p>2/weeks plus home exercise programme for 3 to 6 months in an exercise group</p>	3, 6 months, 2.5 years	<p>Pain: Numeric pain rating scale</p> <p>Function: Neer shoulder score Scores for pain and disability were dichotomised and considered successful if scores before randomisation were reduced >50 % at follow-up</p>	6 months: The success rate of both exercise (61.4 %) and surgery (68.4 %) groups were significantly better than the placebo group (25 %)
Lombardi et al. [31]	N=60 (Male: 14; Female: 46)	<p>Group 1: 54.8±9.4</p> <p>Group 2: 56.3±11.1</p>	<ol style="list-style-type: none"> 1. Exercise group (n=30) Resisted flexion/extension/ internal rotation, external rotation, 1 set of 8 reps at 50 % of the 6 repetition maximum followed by 2 minutes rest and 1 set of 70 % of the 6 repetition maximum. Speed of the movement 2 seconds for the concentric and eccentric phase. Multi-pulley equipment used for exercises. 2. Control (n=30) 	Visual analogue scale	<p>Pain: 10 cm visual analogue scale</p> <p>Function: DASH quality of life:</p> <p>Short Form 36 range of motion</p> <p>Strength: Isokinetic assessment, measured in 3 planes of movement at 600 /s and 1800 /s.</p>	As compared with the control group, the exercise group showed a statistically significant decrease in pain relief and impairment. Discomfort decreased from 4.2 cm to 2.4 cm at rest and from 7.4 to 5.2 cm during activity. DASH decreased from 44.0 to 33.2 in the exercise category.	
Kachingwe et al. [25]	N=33 (Male :17; Female : 16)	18 to 74	<ol style="list-style-type: none"> 1. Supervised exercise only: posterior capsular stretching, posture correction exercises, rotation of the cuff (external rotation of the elastic resistance), scapular stability exercise (elastic resistance exercises), ice pack 2. Supervised exercise as per group 1 with glenohumeral joint mobilisations 3. Supervised exercises as per group 1 with Mulligan mobilisations technique. 4. Control group with advice only. 	Group 1 to 3 received Physiotherapy x1/week x 6 weeks with home exercise programme daily	6 weeks	<p>Pain: 10 point visual analogue scale range of motion: Goniometric measurement of flex and scaption</p> <p>Function: shoulder pain and disability index</p>	<p>Repeated analyses of treatments demonstrated substantial decreases in pain, enhanced performance and increased active range of movement for each dependent variable, univariate analyses of pre-post treatment progress showed no statistically significant differences between the four groups.</p> <p>Exercise category vs Control: visual analogue scale: 14.4 (119.8) % vs 20.8 (112.3) % Neer: 46.4 (49.5) % vs 44.0 (57.2) %: 11.2 (130.7) % vs 39.5 (54.9) % shoulder pain and disability index : 34.2 (58.9) % vs 61.6 (35.9) %</p>

Table 1 Continued

<p>Ludewig et al. [32]</p>	<p>N=92 (overhead male construction workers)</p>	<p>Mean age 49</p>	<p>1. Exercise group Stretches: pectoral minor and posterior shoulder stretches (2x30s, 5x/day); upper trapezius muscle relaxation (5x/day); and strengthening of anterior and humeral serratus external rotation (progress from 3x10 to 3x20 reps, 3 days/week) 2. Control (n=33) 3. Asymptomatic control (n=25)</p>	<p>3x/week for 8 weeks</p>	<p>8 to 12 weeks post treatment</p>	<p>Pain and function: i) Shoulder rating questionnaire. ii) Modified shoulder pain and disability index</p>	<p>Shoulder rating questionnaire and shoulder satisfaction score 6.2 (0.35) vs 5.0 (3.72) percent (group 2) & 0.36 (1.65) (group 3) showed statistically significantly greater changes than control groups. Shift in per cent of shoulder rating questionnaire Group 1 vs Group 2 vs Group 3: 19.23 (4.75) % vs -0.27(3.72)% vs 0.36 161 (1.65)% Pre-post test score of satisfaction score Group 1 vs Group 2 vs Group 3: 4.5 (0.31) to 6.2(0.35) vs 5.0 (0.31) to 5.0 (0.34) vs 9.1 (0.37) to 8.8 (0.40)</p>
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Table 2. Comparison of High Dosage with Low Dosage Exercise or Supervision of Exercise

Author	Participants	Age	Intervention	Frequency	Follow up	Outcome measures	Results
Granviken et al. [20]	N=46	18 to 65	1. Home exercise group (n=23): One Supervised treatment +home exercises 2. Supervised exercise group (n=23): 10 supervised treatments +home exercises	6 weeks intervention including scapular stabilising exercises, rotator cuff exercises and pain-free range of motion exercises; 30x3 sets performed at home, 4 to 6 exercises 2/day everyday	6th and 26th week	Shoulder pain and disability index visual analogue scale: numeric pain rating scale	Both groups changed substantially, with no major variations in the shoulder pain and disability index at 6 weeks (0 points, 95 percent CI-14 to 14) or 26 weeks follow-up (-2 points, 95 percent CI-21 to 17) There were no differences in pain between groups at either time >= 2 positive tests Home exercises vs supervised exercises: 85.71 percent vs 47.83 percent.
Holmgren et al. [24]	N=97	30 to 65	1. Specific exercise group (n=51): Two eccentric exercises for rotator cuff, three concentric/eccentric exercises for the scapular stabilisers and posterior stretch 2. Control exercise group (n=46): six unspecific movement exercises for neck and shoulder without external load	Group 1: 15x3 sets twice daily for 8 weeks; 30 to 60 seconds of posterior stretch, repeated three times twice daily for 8 weeks; once a day from week 8 to 12. Group 2: Repeated 10 times for each movement exercise and three times twice daily at home for each stretching exercise	3 months	Constant-Murley Score DASH Successful outcome (defined as large improvement or recovered)	Group 1 vs Group 2: Constant-Murley score score: 24 vs 9 points (significant) Successful outcome: 69 % vs 24 %
Osteras et al. [40]	N=61 (Male:10; Female : 51)	18 to 60	1. High-dosage exercise: 11 exercises, total of 36 treatments (3x30 repsx3/weeksx3 month) including 35 to 40 minutes static cycling at moderate to high intensity, 70 to 80 % maximum heart rate Resisted shoulder flexion (deloaded pulley exercise), resisted extension (dumbbells), elbow flexion/extension (dumbbells), external rotation, internal rotation, abduction (deloaded shoulder pulley). 2. Low-dosage exercise: 6 exercises (2x10 reps each exercise) plus 5 to 10 minutes of static cycling at moderate to high, 70 to 80 % maximum heart rate.	X3 physiotherapy sessions/ week x 12 weeks	3 months	Pain: 100 visual analogue scale. Function: shoulder rating questionnaire Strength: isometric strength flexion, external rotation, internal rotation, abduction using dynamometer	Significant difference between groups

Table 3. Comparison of Exercise with other Modalities, Including Manual Therapy, Physiotherapy, Surgery and Injection

Author	Participants	Age	Intervention	Frequency	Follow up	Outcome measures	Results
Cloke et al. [9]	N=112 (Male: 48; Female : 64)	22 to 88	1. Manual therapy not specified. 2. Corticosteroid injection 3. Combination of 1 and 2	6 sessions over maximum 18 weeks	18 weeks and 1 year	Patient's perceived improvement: rated better, same, or worse and need for surgery at 1 year.	No major difference between groups at the conclusion of the intervention or within 1 year of the follow-up
Conroy et al. [10]	N=14 (Male :8; Female :6)	Mean age 52.9	1. Manual therapy (n=7): Joint mobilisations plus comprehensive physiotherapy 2. Exercise therapy (n=7) Active range of motion-pendulum exercises, cane-assisted stretching into flexion and external rotation, towel-assisted internal rotation, assisted horizontal adduction Strengthening: chair press, isometric internal rotation, external rotation, scapular strengthening exercises Stretching	3 sessions (45 to 60 minutes)/ week for 3 weeks	3 weeks post treatment	Pain: 100 mm visual analogue scale Range of motion: flexion, abduction, Scaption, internal rotation, external rotation using goniometer. Overhead function: graded by examiner on 3-point rating scale	Both groups have become better. The manual therapy group dramatically improved with the subacromial compression test on 24-hour pain and discomfort, but no improvements in range of motion and function relative to the exercise group. On all factors, the Manual Therapy group improved, while the exercise group only improved agility and function. 24-hour pain: Group 1 vs Group 2: 49.71(29.01) to 12.5(14.93) vs 48.07(21.33) to 45.86(33.26) Pain with subacromial compression test Group 1 vs Group 2: 50.50 (25.18) to 22.43 (14.13) vs 56.71(31.42) to 53.57 (32.86)
Dickens et al. [13]	N=85 (Male: 48; Female : 37)	27 to 68	1. Individualised rehabilitation programme (n=45): based on findings from initial assessment. Modalities inclusive mobilisation, postural advice, strapping, electrotherapy, progressive exercise therapy (for scapulothoracic and rotator cuff muscles) with Theraband 2. No intervention (n=40)	1: 1 or 2/week and home exercise programme	6 months	Patients opting for surgery after intervention Constant Score	Significantly lower opting surgery rates in the exercise group (74 %) than in the control group (100 %) Mean change in the exercise group is 20 (4 to 45) vs. 0.65 (-16 to -14) in the control group in the Constant Score group

Table 3 Continued

Engebretsen et al. [15,16]	N=104 (Male:52; Female :52)	18 to 70	1. Exercise group (same as Brox et al. 1993, 1994) 2. Radial ESWT group	1. Two 45 minute sessions weekly plus home exercise programme for up to 12 weeks 2. 1/week x 4 to 6 weeks	6,12,18 week, 1 year	Pain: 9-point rating scale Function: 7 point rating scale Work status: self-reported questionnaire	A beneficial effect was observed in favour of supervised exercises at 6, 12 and 18 weeks. The changed impact of treatment was - 84 (-16.5 to -0.6). Improved the slightly greater percentage of patients in the population treated with supervised exercises, odd ratio 32 (13 to 7.8). In the ESWT group, more patients received additional therapy between 12 and 18 weeks-odd ratio of 555 (1.3 to 26.4) At 1 year, there were no major variations between the 2 primary outcome assessment classes (-7.6 points, 95 % confidence interval=-16.6 to 0.5) and the use of pain, function and treatment. In contrast with the ESWT category, the higher percentage in the exercise group (60 %) was classified as clinically improved (52 %)
Ginn et al. [19]	N=138 (Male: 82; Female: 56)	>=18	1. Single subacromial injection with methylprednisone acetate (n=48) 2. Regular home-based exercises for 5 weeks, customised for each patient, restoration exercises Dynamic flexibility (n=48) and shoulder muscle coordination, including muscle stretching, poor muscle strengthening, motor re-training to enhance scapula-humeral rhythm, and muscle coordination. 3. Electrophysical modalities, passive joint mobilisation, daily range of motion exercises (abduction, flexion, extension, horizontal flexion) against elastic resistance (n=42)	Group 2: 5/weeks for 5 weeks; supervised once a week for progression Group 3: daily for 5 weeks	5 weeks	Pain: 100 mm visual analogue scale function: non-validated questionnaire Strength: abduction strength measured using dynamometer range of motion: pain free flexion, abduction Self-assessed improvement: perceived change in symptoms	Both approaches were similarly successful in reducing short-term pain. No major variations were found between the classes.

Table 3 Continued

Kachingwe et al. [25]	N=33 (Male: 17; Female: 16)	18 to 74	<p>1. Supervised exercise: posterior capsular stretching, postural correction exercises, rotator cuff strengthening (elastic resistance external rotation), scapular stability exercise (scapular exercises with elastic resistance), ice pack</p> <p>2. Supervised exercise as per group 1 with glenohumeral joint mobilisations</p> <p>3. Supervised exercises as per group 1 with technique (Mulligan mobilisations).</p> <p>4. Control group with advice only</p>	Group 1 to 3 received physiotherapy x1/week x 6 weeks with home exercise programme daily	6 weeks	<p>Pain: 10 point visual analogue scale.</p> <p>Range of motion: Goniometric measurement of flex and scaption</p> <p>Function: shoulder pain and disability index</p>	<p>Both classes got stronger. Manual therapy group improved substantially on 24-hour pain and discomfort with subacromial compression test but no changes in range of motion and function compared with exercise group. The manual therapy group improved on all variables while the exercise group improved on mobility and work only.</p> <p>Group 2 and 3 had higher % change from pre-to post on all 3 pain treatment measures than group 1 though not statistically significant Group 1 vs Group 2: visual analogue scale: 20.8 (112.3) % vs 44.2 (38.6) % Neer: 44.0 (57.2) % vs 57.6 (38.7) %: 39.5 (54.9) % vs 52.1 (62.9) %</p>
Walther et al. [46]	N=60 (Male: 34; Female :26)	25 to 66	<p>1: Exercise: Standardised self-training; centring and stretching using elastic resistance, scapular stability with and without elastic resistance. Weighted pendulum exercises for range of motion</p> <p>2: Conventional physiotherapy: centring training for the rotator cuff and stretching with advice</p> <p>3: Functional brace</p>	<p>Group 1: x4 sessions, plus x5/weeks x10 to 15 minutes home exercise programme</p> <p>Group 2: x10 sessions-given 2 to 3 sessions/week</p>	6 and 12 weeks	<p>Pain: 100 mm visual analogue scale</p> <p>Function: Constant-Murley scale</p>	All groups showed substantial pain and work improvement No major differences between groups were found
Haahr et al. [21]	N=90 (Male:32; Female: 58)	18 to 55	<p>1: Active training of scapular stability, hot/ cold packs and soft tissue treatments</p> <p>2: Arthroscopic surgery</p>	Group 1: 19 sessions (x3/week in first 2 weeks, x2/week for next 3 weeks, x1/week in last 7 weeks)	3, 6, 12 months	Pain and function: Constant-Murley subscores 4-point rating scale rating pain and dysfunction.	No significant differences between groups

Table 3 Continued

Rahme et al. [41]	N=42 (Male:19; Female : 23)	28 to 63	<p>1. Anterior acromioplasty + post-op physiotherapy (n=21):</p> <p>2.Physiotherapy (n=21)</p> <p>3. (n=12): from Group 2 who opted for surgery 6 months after physiotherapy</p> <p>Exercises include unloaded movement of shoulder, measures to normalise the scapulohumeral rhythm and to increase postural awareness, strengthening of the shoulder muscles and endurance training. Submaximal training of rotator cuff was started about 3 months after the operation in Group 1 and 3</p>	X2 to 3/weeks	6 and 12 months	Visual analogue scale : reduction of more than 50 % from initial score	6 months: Group 1 had higher successful cases than Group 2 (57 % vs 33 %) but no statistical analysis was done
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Table 4. Comparison of Exercise with Exercise Combined with other Modalities Including Manual Therapy or Physiotherapy

Author	Participants	Age	Intervention	Frequency	Follow up	Outcome measures	Results
Bang et al. [2]	N=52 (Male: 30; Female : 22)	18 to 65	<p>1. Exercise (n=28)</p> <p>2. Exercise+manual therapy (n=23)</p> <p>Supervised exercise: Flexibility: Anterior and posterior shoulder stretches</p> <p>Strengthening: seated press up, elbow push-up, scapular exercises with elastic resistance</p>	2x30 minutes/week 3 weeks	Post treatment, 2 months after treatment	<p>Pain: 100 mm visual analogue scale</p> <p>Function: modified Oswestry low back disability questionnaire</p>	Subjects in both groups experienced significant decreases in pain and increases in function, but there was significantly more improvement in the manual therapy group compared to the exercise group. Pain in the manual therapy group reduced from a pre-treatment mean of 575.8 (272.3) to a post treatment mean of 174.4(183.1). In contrast, pain in the exercise group was reduced from a pre-treatment mean of 557.1 (237.2) to post treatment mean of 360.6 (272.3). Strength in the manual therapy group improved significantly while strength in the exercise group did not.
Bennell et al. [3]	N=120 (Male: 74; Female: 46)	>=18	<p>1. Control group: placebo-inactive ultrasound therapy+ 10 sessions of individual standardised treatment over 10 weeks</p> <p>2. Active treatment group: 10 sessions of individual standardised treatment over 10 weeks manual therapy and home exercises</p> <p>Exercises: A progressive programme of scapular stability retraining, rotator cuff and scapular muscle resisted exercises against elastic resistance or hand weights, and shoulder girdle and thoracic spine flexibility exercises. All resistance exercises progressed by increasing repetitions, resistance, and working rotator cuff muscles through range to 90° abduction</p>	10 sessions for 10 weeks Group 2 performed home exercises for 12 weeks	11 and 22 weeks	Pain: numeric pain rating scale and visual analogue scale	<p>11 weeks: Both groups significantly improved with decreased pain and increased function but no difference was found between groups</p> <p>22 weeks: Active treatment group showed a significantly greater improvement in shoulder pain and disability index than the control group (between group difference 7.1, 0.3 to 13.9) but no significant difference existed between groups for change in pain (0.9, -0.03 to 1.7) or for percentage of participants reporting a successful treatment outcome (42 % vs 30 %)</p>

Table 4 Continued

Senbursa et al. [44]	N=30	30 to 55	<p>1. Home exercise (n=15) home exercise programme (10 to 15 minutes): Stretching and strength exercises of rotator cuff, rhomboids, levator scapulae, and serratus anterior using elastic band</p> <p>2. Combined physiotherapy group manual therapy (joint and soft tissue mobilisations, and proprioceptive neuromuscular facilitation)+home exercise (n=15)</p>	<p>Group 1: home exercise programme for 4 weeks</p> <p>Group 2: x3/weeks for 4 weeks</p>	Post treatment and 3 months after initiation of treatment	Pain: 10 cm visual analogue scale active range of motion: goniometry flexion, abduction, internal rotation, external rotation Function: Neer Questionnaire	<p>Subjects in both groups had significant decrease in pain and increase in shoulder function. But there was significantly more improvement in the manual therapy group compared to the exercise group. Change in pain in manual therapy vs exercise group: 6.7 (0.3) to 2.0 (2.0) vs 6.6 (1.4) to 3.0 (1.8) range of motion at flexion, abduction and external rotation in the manual therapy group improved significantly while Range of motion in the exercise group did not. Combined physiotherapy group showed significantly greater improvement in the Neer Questionnaire score and shoulder satisfaction score than home exercise group.</p>
Yiasemides et l. [48]	N=98	27 to 85	<p>1. Control exercise group (n=51): Advice and exercises including stretching, strengthening of weakened muscles and restoring scapulohumeral rhythm, motor retraining</p> <p>2. Experimental group (n=47): Low velocity passive joint mobilisation to glenohumeral joint, sternoclavicular joint, acromioclavicular joint</p>	Daily home based programme for 12 weeks and reviewed by physiotherapist 1 to 2/weeks	1, 3, 6 months	Shoulder pain and disability index Self-rate change active range of motion	No statistically significant differences were detected in any outcome measures in the follow up

Table 5. Comparison of ESWT with Sham ESWT

Author	Participants	Age	Intervention	Frequency	Follow up	Outcome measures	Results
Galasso et al. [17]	N=20 Noncalcifying supraspinatus tendinopathy	Mean age 50	Group 1 (n=11): ESWT 2x3000 Group 2 (n=9): Sham ESWT	1-week interval/ energy flux density: 0.068 mJ/mm ²	6, 12 week, 9 years	Constant and Murley score range of motion The definition of success rate same as Schmitt (2001)	Significantly higher Constant and Murley score and range of motion in Group 1 when compared with Group 2 Constant score Control vs treatment group: Pre-treatment: 42.45(9.83) vs 41.67(12.53) At 6 weeks: 43.11(19.16) vs 64. (16.6) At 12 weeks: 48 (22.3) vs 74.09 (20.56) Success rate 3 months post treatment Success rate: 63.7 % vs 22.3 % A telephone recall of ESWT patients has been carried out nine years after treatment and were able to reach 10 out of 11 individuals, all patients were satisfied with the treatment received and would have repeated the same therapy again.
Schmitt et al. [43]	N=40 Noncalcific supraspinatus tendinosis	Mean age 52 years (29 to 66)	Group 1 (n=20): ESWT 3x2000 Group 2 (n=20): Sham ESWT	Group 1: 1 week interval/ 0.11 mJ/mm ²	6.12 week	Pain: 11-point constant score patient were considered a treatment success if they showed an improvement of at least 30 points, or their Constant Murley score at the endpoint of the study was at least 80 % of the standard age and gender-related value.	No significant difference between groups was found. Constant score Control vs treatment group: Pre-treatment: 42.20(13.04) vs 40.70(13.29) At 6 weeks: 64.17(25.17) vs 60.95(29.62) At 12 weeks: 64.39(32.68) vs 66.50(37.92) Success rate: 44 % vs 50 %

Table 6. Effects of ESWT on pain and Oxygen saturation

Author	Participants	Age	Intervention	Frequency	Follow up	Outcome measures	Results
Notarincola et al. [38]	N=30	45 to 78		3x2000, 3 to 4 days interval/ 0.04 to 0.07 mJ/mm ²	1st, 2nd, 3rd session of ESWT, 2 months, 6 months	Pain: visual analogue scale constant Score	A clinical improvement was obtained in 65.6 % of patients at 2 and 6 months. This was associated with statistically significant reduction in the oxygen tissue saturation, during treatment as well as at subsequent follow-up visits

Table 7. Comparison of ESWT plus Kinesitherapy vs Kinesitherapy vs Postural Hygiene

Author	Participants	Age	Intervention	Frequency	Follow up	Outcome measures	Results
Melegati et al. [34]	N=90 Noncalcific subacromia impingement syndrome	Not reported	Group 1 (n=30): Kinesitherapy sessions (Exercise: Codman, capsular stretching, isometric for rotators and deltoid, elastic resistance for rotator cuff, deltoid and trapezius) Group 2 (n=30): medium ESWT 3x2000 pulses followed by kinesitherapy session Group 3 (n=30): Control, one session postural hygiene and joint economy suggestion	Group 1: 6x at 3 week interval Group 2: 1 week interval/ 0.22 mJ/mm ²	80 days	Improvement in constant score	Significant improvement within Group 1 (p<0.0001) and Group 2 p<0.0001). Significant better Constant score in Group 1 and Group 2 when compared with Group 3: Group 2 vs Group 1: 27.95 % (in favour of Group 2) Group 2 vs Group 3: 80.41 % (in favour of Group 2) Group 1 vs Group 3: 72.81 % (in favour of Group 1)

Table 8. Using Bodyblade Exercise

Author	Participants	Age	Intervention	Frequency	Follow up	Outcome measures	Results
Buteau et al. [8]	N=1, male suffered from glenohumeral dislocation	18	Bodyblade exercise session: 5 minutes of warm up on arm ergometer, each session consists of 4 to 7 movements with 5 to 10 reps x 1 to 2 sets; the exercises progressed from scapula control, unilateral upper extremity in pure anatomical movement, diagonal pattern; feet off ground with fit ball plus torso flexion, extension	12 sessions over 4 to 6 weeks sessions 4 to 6	6th, post treatment, 6 months post treatment	Pain: 11-point numeric pain active range of motion shoulder strength with handheld dynamometer Pain and function: shoulder pain and disability index and Western Ontario shoulder index	Pain decreased from 4 to 0 at discharge Range of motion and strength improved shoulder pain and disability index Decrease of 11 points which indicates a meaningful clinical change Western Ontario shoulder index decreased from 129 to 46 6 months: no recurrent dislocation was reported
Lee & Yoo [29]	N=18, ice hockey players	Group1 : mean 25.56 ± 1.33 Group 2: mean 26.56 ± 2.83	Group 1: Players without shoulder instability (control) (n=9) Group 2: Players with shoulder instability (n=9) training programme using elastic bands (five exercises: horizontal abduction, adduction, internal rotation, external rotation scapular retraction and protraction at 12 repetition maximum 10 to 20 for 40 to 50 minutes) and Bodyblade (4 exercises: horizontal abduction, front horizontal, scapular retraction and stability trainer push-up; 5 sets x 1 minute)	4x/week 8 weeks	Week 0, 4, 8	Pain: 100 mm visual analogue scale isokinetic strength on flexion, extension, internal rotation, external rotation	There were interactions in flexion, extension, internal rotation and subjective pain score

4. Discussion

For non-operational care, there are a variety of therapies available, ranging from physical exercises to electrotherapy modalities that help to relieve pain and improve function. Many of the workout programmes are calming, reinforcing exercises aimed at normalising the operation of the scapular and glenohumeral [11,53]. The beneficial impact of exercise on pain and post-treatment function has previously been shown [1,22].

In order to improve pain reduction [32,40] and work [16,40,32,48] from week 4 through week 24, a daily workout routine comprising of soft tissue calming and positive affirmation exercises has been published [49]. Centred on Holmgrens et al. [24], high-dose exercises involving federal, semi-national, national and aerobic shoulder exercises have demonstrated greater functional progress than the low-dose exercise category [40]. In physical events such as tossing at baseball and tennis, the energy is thought to be passed from the lower limbs from the trunk to the elbow. The operation of the shoulder will be affected by some weakening of the lower extremities or trunk muscles [45]. Exercise treatment involving stretching, glenohuermal and relaxation of the scapular muscles has been found to be effective for pain management and functional recovery 1 year after intervention [40,52]. The result is equivalent to that of 1 year post-intervention corticosteroid injection [9] and arthroscopic surgery [6,21]. The exercise category, which was tested after two years, demonstrated greater functional progress compared to placebo [6], which was close to the results for arthroscopic surgery [26,27].

The functional improvements observed ranged from 50.8 to 81 percent [15,21], despite these promising results. A stretching method for posterior capsules has reported an improvement in subacromial space in a group of overhead athletes with 27 glenohumeral inner rotation deficits [33]. However, Savoie et al. [42] and Desmeules et al. [12] found only the subacromic space to be increased in those patients with decreased subacromic space prior to recovery. As a result, a therapeutic or ergonomic exercise involving people with limited physical space may be more likely to be successful for this purpose. In patients who tend to be sedentary, the effectiveness of traditional therapy has shown its effects. The Bodyblade is a fairly new approach to rehabilitating shoulder-dysfunction athletes by strengthening and stretching their soft tissues. With repetitive forceful arm and shoulder contractions, the bar tips are able to move around. The muscles of the human body have to contract rapidly and therefore have to undergo up to 270 contractions per minute. It is known that externally induced vibration and oscillatory devices on the skeletal muscles have been documented to be used to enhance neuromuscular efficiency and induce short and long-term neurogenic adaptations [4,5]. Increased activation of primary movers, improved inter- and

intramuscular synchronisation, enhanced synergistic synchronisation, and improved proprioception responses have been the potential benefits of vibration therapy. A study by Lister et al. [30] found that when a body weight equated as 35 pounds was placed on the upper chest and shoulder blades, the activation of the upper trapezius plus lower trapezius and anterior serratus was greater than the square of the body weight when the shoulder was flexed and abducted.

The effectiveness of middle-age localised ESWT on SAPS is not altogether proven. The effectiveness of its influence has not been tested on overhead athletes, who are younger in age and have a greater demand for tendons. Furthermore, all the studies used symptoms and subjective satisfaction as their main results, apart from the study by Notarnicola et al. [38]. Wang et al. [47] have also seen the neoangiogenic impact on the Achilles tendon caused by ESWT. For patients with subacromial tendinopathy, the therapeutic mechanism may be based on ESWT-mediated vascularisation, with the most recent results from Notarnicola et al. [38].

5. Conclusions

On the basis of these few experiments, exercise was found to be better than electrophysical modalities such as radial ESWT. It was also noted that the outcome of exercise therapy was similar to surgery. Exercise combined with manual therapy found that functional change, as well as an operation technique that had the same effects, was better than exercise alone. The efficacy of ESWT for shoulder SAPS has been unclear. To substantiate the effectiveness of Bodyblade exercise with SAPS, a wider range of cohorts with their performance quality compared to the conventional physiotherapy method will be essential. This knowledge enables better tracking of SAPS overhead athletes at the start of the conservation intervention.

Competing Interests

The authors declare that they have no competing interests.

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