Effect of Adding Scapular Focused Exercises Program to the Conventional Physical Therapy Program on Shoulder Impingement Syndrome

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Abstract

Background: Shoulder Impingement Syndrome is one of the most common shoulder complaints that account for 44-65% of all visits for shoulder pain which are characterized by pain and functional impairments. Treatment results for shoulder impingement could be achieved with conservative treatment, exercise therapy such as scapular stabilization exercises, stretching and strengthening, especially for rotator cuff muscle was recommended to improve pain, mobility, and function. **Aim of Study:** To compare between the effect of adding scapular focused exercises program to conventional physical therapy program and conventional physical therapy program alone on secondary shoulder impingement syndrome. **Methods:** Thirty patients diagnosed with subacute and chronic SAIS; age ranged from (18-35) years old. The patients had a painful arc in abduction and flexion above 60 degrees and the point of greatest tenderness was over the coracoacromial arch. Our measurements variables were x ray for measuring subacromial space, VAS for measuring shoulder pain, SPADI for measuring shoulder pain and function and Lateral scapular slide test for scapular dyskinesia. They were randomized into two groups, A and B, each group received a rehabilitation program 3 sessions per week for 6 weeks. Group A received a

conventional physical therapy program by shoulder stretching and strengthening exercises, while group B received a conventional physical therapy program plus scapular focused exercises program (stabilizing and strengthening exercises for scapular muscles). **Results:** according to group (B) there was shown that there was significantly (P<0.05) increase in sub acromial space by X-ray at 0 ABD (P=0.0001), significant (P<0.05) decreases in VAS (P=0.0001), improved LSST difference percentages at 0 ABD, 45 ABD, and 90 ABD, According to SPADI, showed more improved pain, function, and total score of SPADI **Conclusion:** it could be concluded that scapular focused exercises program was more effective than Conventional Physical Therapy Program alone in terms of subacromial space width, shoulder pain and function and scapular dyskinesia in patients with secondary SAIS.

Key words: Shoulder impingement syndrome, radiographic x ray, scapular dyskinesia, scapular stabilizing exercises.

Introduction

Subacromial Impingement Syndrome (SAIS) is one of the most common musculoskeletal complaints that drive patients into medical care [1], which accounts for 44-65% of all clinical visits[2]. SAIS has a negative effect on quality of life with shoulder elevation, sleeping and throwing[3]. SAIS report pain with overhead activities between 60° and 120° of arm elevation[4].

SAIS has both primary and secondary forms, primary impingement is due to structural changes[5]. Secondary impingement results from muscular imbalance results in increasing the narrowing of subacromial space[6].

According to the changes of alignments and mechanics of the Glenohumeral joint with chronic loss of range of motion (ROM) result in increased medications consumption to deal with the pain[7]. According to SAIS treatment, it stated that 70% to 90% reliable treatment results could be achieved with conservative treatment[8]. Scapular stabilization exercises, stretching and strengthening, especially for rotator cuff muscle was recommended to improve pain, mobility, and function in patients with SAIS[9].

Scapular stabilization exercises reducing abnormal movement patterns and promotes posterior tilting, upward rotation, and external rotation of the scapula[10]. These normal biomechanics of the scapula improve scapular muscular control and enhance shoulder joint stability that can contribute to impingement[11].

Rotator cuff strengthening exercises are obvious treatment for SAIS as they have a great effect on improving the strength and function of muscles that control the position of scapula[12]. Current research lacks evidence for the outcome of these exercise therapies but, specifically, there is a limitation as to which exercise therapies are most effective in cases of SAIS[13].

Purpose of the Study to compare the effects of adding scapular focused exercises program[14] to conventional physical therapy program versus conventional physical therapy program alone (stretching and strengthening exercises) on improving subacromial space narrowing using radiographical x ray, pain and function using Shoulder Pain and Disability Index (SPADI), shoulder pain using visual analogue scale (VAS) and measuring scapular kinematics using lateral scapular slide test (LSST) in patients with secondary shoulder impingement syndrome.

Patients and methods

A group of thirty patients diagnosed with secondary sub acromial impingement syndrome and referred to physical therapy by orthopedic physicians aged from 40-60 years were enrolled in the study after they signed a consent form. The research protocol was accepted by the local institutional Committee of Medical Ethics with number (P.T.REC/012/005240) in the faculty of physical therapy, Cairo university. The patients have signed and informed consent to start the practical part of the study. The study was conducted at the outpatient clinics of Faculty of Physical Therapy and Radiology Departments of outpatient clinics on Philips Radiography 3000 F-DuraDiagnost F30 machine at Horus University, Damietta Governorate, Egypt 2024

Study Design

Double blinded Randomized clinical trial (Patients blinded during assessment pre and post treatment and blinded to the treatment) and research assistant was blinded to the treatment group.

Participants

Thirty patients participated in the study according to G Power and Sample Size Calculations software, (16 females and 14 males). Females have higher prevalence of shoulder pain than male 21 Patients who met the following inclusion criteria of both genders with their age range from 18-35 years old[22] diagnosed with secondary subacute and chronic SAIS (more than 2 weeks)[23], had a painful arc in abduction and flexion above 60 degrees and the point of greatest tenderness was over the coracoacromial ligament[24] were given detailed information of the study objectives.

Patients permitted to participate were asked to sign an informed consent form, after which their assignment to either group was disclosed.

Patients with the following exclusion criteria: history of shoulder instability, history of rheumatoid, inflammatory, degenerative, or neurological disease, acromial abnormalities, history of shoulder pain during cervical motion, history of shoulder capsulitis were excluded from the study.

Objective assessment pre and post treatment was performed by radiologist who took AP view of shoulder joint with x ray then measured subacromial space width and physiotherapist with other observer who performed a Lateral Scapular Slide Test pre and post treatment with tape measurement.

Assessment procedures:

1.Subacromial space measurement

Subacromial space measurement by radiological x-ray was performed for each patient before and after 6 weeks of physical therapy treatment program, as shown in Figure (1) measures the space between the humeral head and the acromion. The measurement of sub-acromial space will be attained by radiographic x-ray at 0˚of shoulder abduction. Subacromial space at rest is a good indicator of the magnitude of its reduction in elevation position[15].

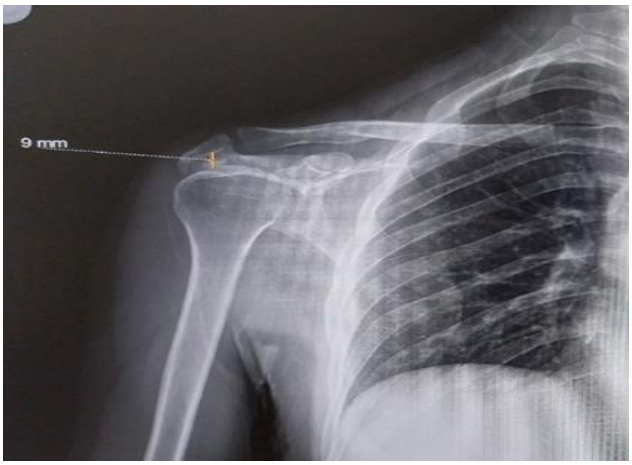

Figure (1): Subacromial space measurement by X ray

2.The Shoulder Pain and Disability Index (SPADI)

It is a self-reported questionnaire with two dimensions: one assessing pain and the other evaluating functional activities. The pain dimension comprises five inquiries concerning the intensity of an individual's pain. Functional activities are evaluated by eight questions aimed at

determining the level of difficulties an individual experiences with various tasks of daily living that necessitate upper-extremity utilization. The SPADI requires 5 to 10 minutes for a patient to complete and is the sole reliable and accurate region-specific assessment for the shoulder[16].

3.Lateral scapular slide test:

Firstly, two prominent bony landmarks marked with a permanent ink pen (The inferior angle of the scapula and the T7 spinous process), the distance between these two points will be measured in three upper extremity positions bilaterally with tape measurement in 0° of shoulder abduction, 45° of shoulder abduction with about 10° of shoulder extension and 90° of shoulder abduction with full internal rotation of the shoulder joint[17] as shown in **Figure (2).** A bilateral difference of greater than 1.0 cm in scapular distance measurements was the original criterion used by Kibler to determine a positive LSST[18].

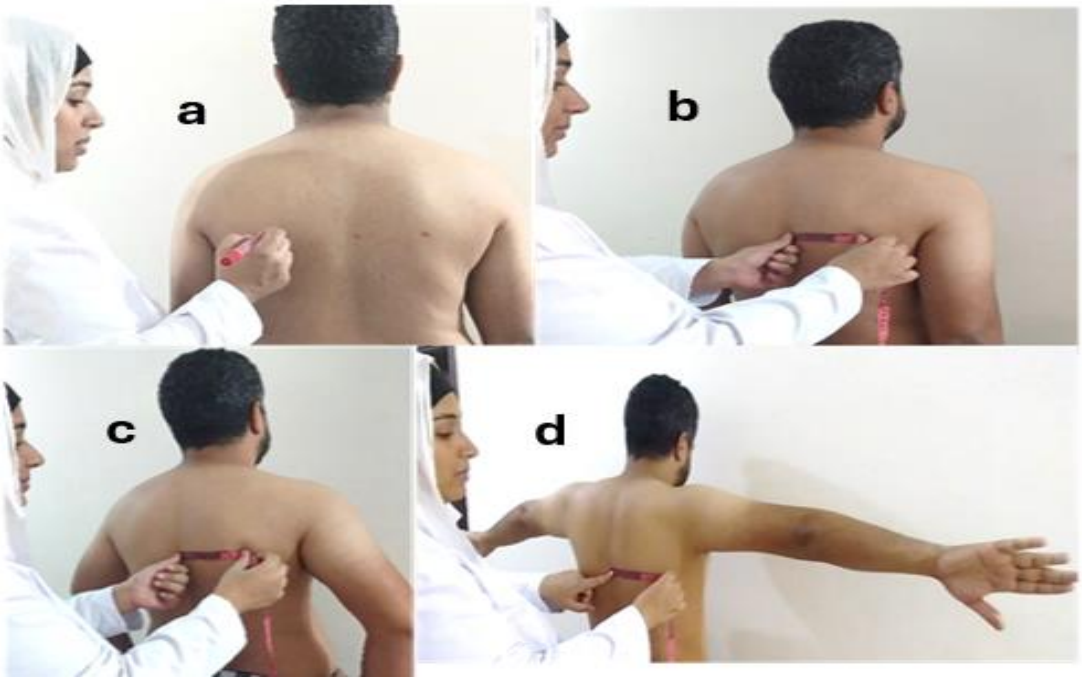

Fig. (2): Lateral scapular slide test in different position

a) Bony landmarks b) 0° shoulder Abd c) 45° of shoulder Abd d) 90° of shoulder Abd with full internal rotation

4.Visual Analogue Scale (VAS):

The patient will be instructed to create a handwritten mark on a 100 mm line (10 cm). Measurements from the scale's origin to the individuals' indicators will be documented and analyzed as their pain severity. The outcomes will be classified as: no pain (0–4 mm), mild pain (5–44 mm), moderate pain (45–74 mm), and severe pain (75–100 mm)[19].

Treatment Procedures:

Group (A): Patients in the control group participated in a supervised 6-week standard physical therapy regimen that included stretching exercises (e.g., posterior shoulder, pectoralis minor, Levator scapula self-stretching) and strengthening activities (e.g., rotator cuff strengthening). Rotator cuff strengthening exercises comprised resisted shoulder internal rotation at 0º abduction, shoulder external rotation at 0º abduction, and the whole can exercise[9].

Group (B): Participants in the experimental group engaged in a supervised 6-week exercise regimen that included a blend of closed and open kinetic chain scapular stabilization exercises targeting the serratus anterior, trapezius, and rhomboids, followed by a conventional physical therapy program comprising shoulder girdle strengthening exercises for the rotator cuff and stretching exercises for the posterior shoulder, pectoralis minor, levator scapula, and self-stretching techniques[9].

Scapular stability exercises depicted in **Figure (3)** comprised wall slides with a squat, wall push-ups accompanied by ipsilateral leg extension, lawnmower with diagonal squat, robbery with squat, horizontal abduction with external rotation, prone extension, and side-lying external rotation[20].

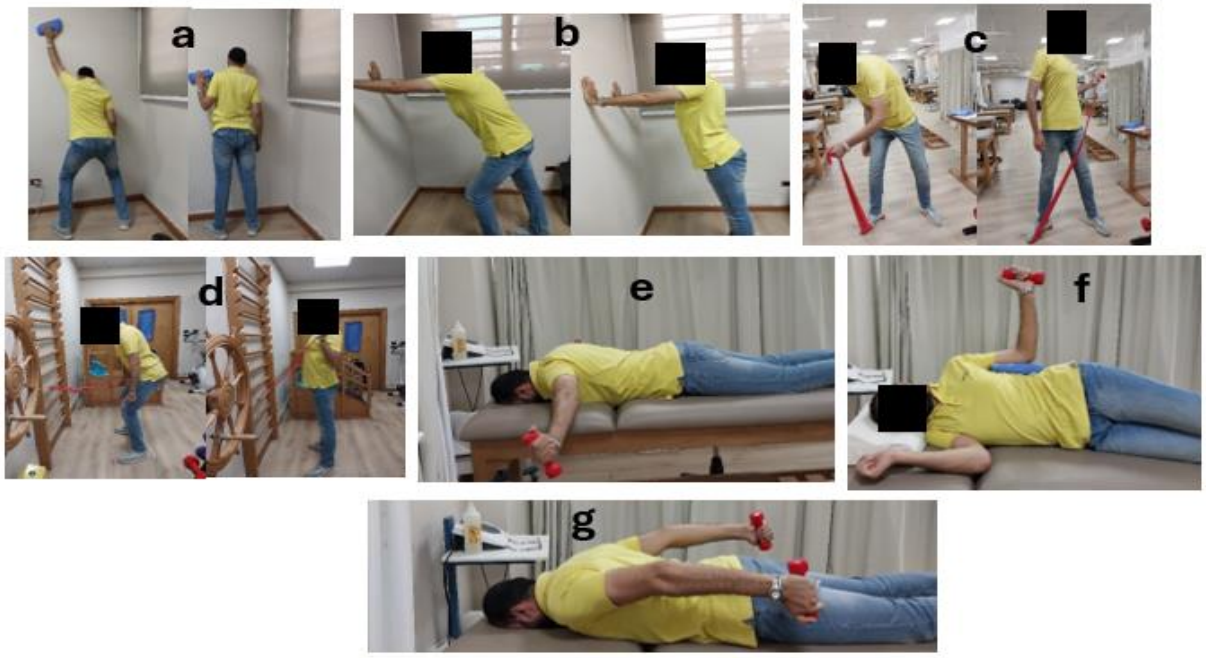

Fig (3): Scapular stabilization exercises

a) Wall slides with squat, b) Wall push-ups with ipsilateral leg extension, c) Lawnmower with diagonal squat, d) Robbery with squat, e) Horizontal abduction with external rotation, f) Side-lying external rotation, g) Prone extension

Statistical analysis

The statistical analysis was conducted by using statistical SPSS Package program version 25 for Windows (SPSS, Inc., Chicago, IL). Quantitative data are expressed as mean and standard deviation for SAIS patient's general demographic data (age, weight, height, and BMI), acromial space by X-ray at 0 ABD, LSST difference, VAS, and SPADI variables. All statistical analyses were significant at the level of probability ($P \leq 0.05$).

Ethical Approval

Before conducting the study, the institutional review board of the Faculty of Physical Therapy, Cairo University, Egypt accepted our procedures. All participants signed a consent form after thorough explanation of the procedure. They are aware that they can withdraw quit taking part in the study at any time. The study followed the regulations specified by the Helsinki Declaration for human beings.

RESULTS

In the current study, a total of 30 with secondary SAIA from both gender (14 males and 16 females) was participated in this study and assigned randomly into 2 equal groups (15 patients / group). No significant differences ($P<0.05$) between group A and group B in clinical general characteristics **(Table 1)** for SAIA patients age (P=0.916), weight (P=0.972), height (P=0.956), BMI (P=0.991), gender (P=0.464), and affected shoulder (P=0.705)

Table 1. General Clinical characteristics of patients

Items	Groups		P-value
	Group A (n=15)	Group B (n=15)	
Quantitative variables	**Mean ±SD**	**Mean ±SD**	
Age (year)	28.67 ±3.24	28.80 ±3.59	0.916
Weight (kg)	74.73 ±11.48	74.87 ±9.02	0.972
Height (cm)	170.73 ±6.57	170.87 ±6.41	0.956
BMI (kg/m^2)	25.59 ±3.42	25.58 ±2.06	0.991
Qualitative variables	Number (%)	Number (%)	
Gender (males: females)	8 (53.30%) : 7 (46.70%)	6 (40.00%): 9 (60.00%)	0.464
Affected shoulder (Right: left)	5 (33.50%): 10 (66.70%)	6 (40.00%): 9 (60.00%)	0.705

Group A (control group) received traditional treatment; Group B (experimental group) received traditional treatment plus scapular focused treatment.
Quantitative variables data (age, weight, height, and BMI) are reported as mean ±standard deviation and compared by independent t test.
Qualitative variable data (gender and affected shoulder) are reported as frequency (percentage) and compared by Chi-square test P-value: probability value

Statistical multiple pairwise comparison tests for sub acromial space by X-ray at 0 ABD and pain (VAS) within each group **(Table 2)** showed that there was significantly (P<0.05) increased in sub acromial space by X-ray at 0 ABD at post-treatment compared to pre-treatment within group B (P=0.0001), but insignificantly (P>0.05) increased at post-treatment within group A (P=0.150). Moreover, there were significant (P<0.05) decreases in VAS at post-treatment compared to pre-treatment within group A (P=0.001) and group B (P=0.0001. The SAIS patients received conventional physical therapy program plus scapular focused exercise program in group B more improved sub acromial space by X-ray at 0 ABD and pain percentages (25.30 and 35.31%, respectively) than patients with SAIS who received conventional physical therapy program alone in group A (9.00 and 25.33%, respectively).

Statistical multiple pairwise comparison tests for sub acromial space by X-ray at 0 ABD and pain between both groups **(Table 2)** indicated that no significant differences (P>0.05) between group A and group B at pre-treatment in sub acromial space by X-ray at 0 ABD (P=0.872) and pain (P=0.903). However, there were significant differences (P<0.05) between group A and group B at post-treatment in acromial space by X-ray at 0 ABD (P=0.018) and pain (P=0.0001). These significant differences in mean values of sub acromial space by X-ray at 0 ABD and pain at post-treatment are favorable for patients with SAIS in experimental group (group B) as shown in figure (4) than SAIS patients in control group (group A).

Table 2: Within and between group comparisons for sub acromial space by X-ray at 0º ABD and pain

Variables	Items	Groups (Mean ±SD)		Change	Effect size (η^2)	*P*-value[2]
		Group A (n=15)	Group B (n=15)			
Sub acromial space at 0º ABD (mm)	Pre-treatment	6.67 ±0.97	6.60 ±1.29	0.07	0.00	0.872
	Post-treatment	7.27 ±1.03	8.27 ±1.16	1.00	0.10	0.018*
	MD (Change)	0.60	1.67			
	95% CI	-0.22 – 1.42	0.84 – 2.48			
	Improvement %	9.00%	25.30%			
	Effect size (η^2)	0.04	0.23			
	P-value[1]	0.150	0.0001*			
Pain (mm)	Pre-treatment	77.67 ±12.22	78.33 ±17.99	0.66	0.00	0.903
	Post-treatment	58.00 ±12.79	50.67 ±16.13	7.33	0.23	0.0001
	MD (Change)	19.67	27.66			
	95% CI	8.71 – 30.62	16.71 – 38.62			
	Improvement %	25.33%	35.31%			
	Effect size (η^2)	0.19	0.31			
	P-value[1]	0.001*	0.0001*			

Group A (control group) received a conventional physical therapy program; Group B (experimental group) received conventional physical therapy program plus scapular focused treatment.
Data are expressed as mean ±standard deviation and compared statistically by MANOVA test
MD: Mean difference CI: confidence interval η^2: Eta square P-value: probability value * Significant (P<0.05)
P-value1: Probability value within each group; P-value2: Probability value within among groups

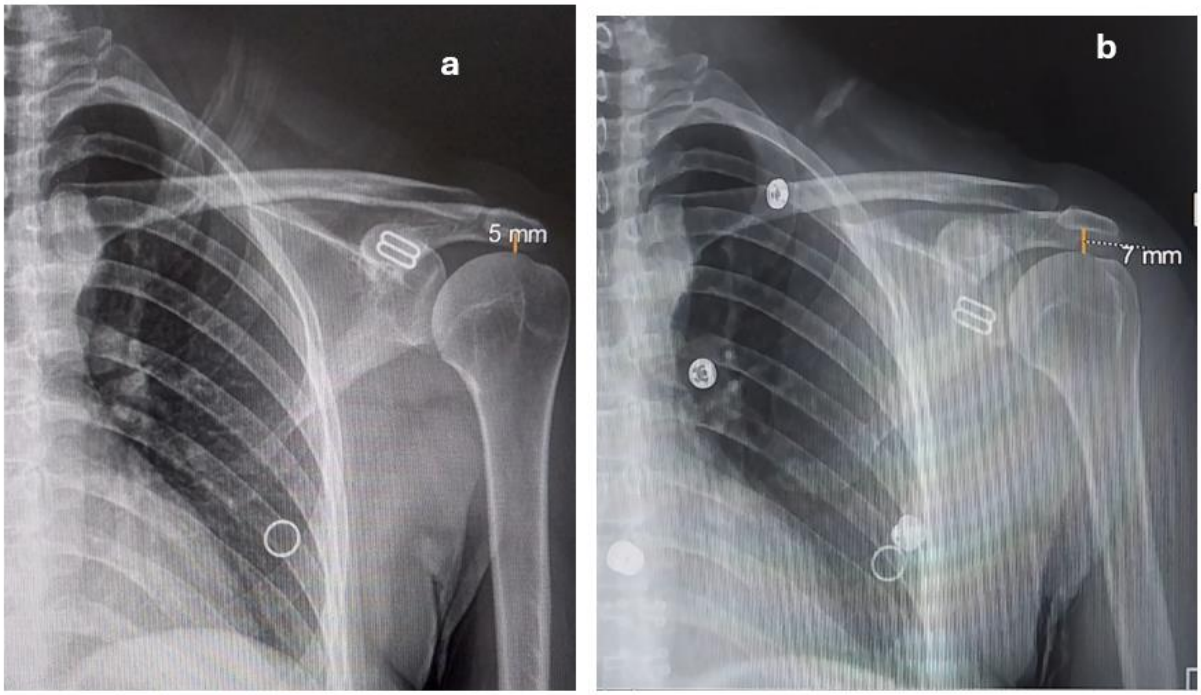

Fig (4): increased subacromial space width before and after treatment: a) before treatment b) after treatment

Statistical multiple pairwise comparison tests for LSST difference within each group (Table 3) showed that there was significantly (P<0.05) decreased in 0 ABD, 45 ABD, and 90 ABD at post-treatment compared to pre-treatment within group A (P=0.036, P=0.032, and P=0.047, respectively) and group B (P=0.0001, P=0.0001, and P=0.001, respectively).The SAIA patients received conventional physical therapy program plus scapular focused exercise program in group B more improved LSST difference percentages at 0 ABD, 45 ABD, and 90 ABD (26.88, 30.59, and 22.92%, respectively) than patients with SAIA who conventional physical therapy program alone in group A (11.83, 11.68, and 12.18%, respectively).

Statistical multiple pairwise comparison tests for LSST difference between both groups (Table 3) indicated that no significant differences (P>0.05) between group A and group B at pre-treatment in LSST difference at 0 ABD (P=0.948), 45 ABD (P=0.636), and 90 ABD (P=0.930). However, there were significant differences (P<0.05) between group A and group B at post-treatment in LSST difference at 0 ABD (P=0.008), 45 ABD (P=0.002), and 90 ABD (P=0.011). These significant differences in mean values of LSST differences (0ABD, 45 ABD, and 90 ABD) at post-treatment are favorable for patients with SAIA in experimental group (group B) than SAIA patients in control group (group A).

Table 3: Within and between group comparisons for LSST difference

Variables	Items	Groups (Mean ±SD)		Change	Effect size (η^2)	*P*-value[2]
		Group A (n=15)	Group B (n=15)			
0º ABD (cm)	Pre-treatment	1.86 ±0.23	1.86 ±0.36	0.00	0.00	0.948
	Post-treatment	1.64 ±0.25	1.36 ±0.26	0.28	0.12	0.008*
	MD (Change)	0.22	0.50			
	95% CI	0.01 – 0.42	0.28 – 0.69			
	Improvement %	11.83%	26.88%			
	Effect size (η^2)	0.08	0.29			
	P-value[1]	0.036*	0.0001*			
45º ABD (cm)	Pre-treatment	2.14 ±0.28	2.19 ±0.32	0.05	0.01	0.636
	Post-treatment	1.89 ±0.27	1.52 ±0.34	0.37	0.16	0.002*
	MD (Change)	0.25	0.67			
	95% CI	0.02 – 0.47	0.44 – 0.89			
	Improvement %	11.68%	30.59%			
	Effect size (η^2)	0.08	0.39			
	P-value[1]	0.032*	0.0001*			
90º ABD (cm)	Pre-treatment	2.38 ±0.30	2.40 ±0.46	0.02	0.00	0.930
	Post-treatment	2.09 ±0.27	1.85 ±0.55	0.24	0.14	0.011*
	MD (Change)	0.29	0.55			
	95% CI	0.01 – 0.57	0.24 – 0.85			
	Improvement %	12.18%	22.92%			
	Effect size (η^2)	0.06	0.19			
	P-value[1]	0.047*	0.001*			

Group A (control group) received a conventional physical therapy program; Group B (experimental group) received conventional physical therapy program plus scapular focused exercise.
Data are expressed as a mean standard deviation and compared statistically by MANOVA test.
MD: Mean difference CI: confidence interval η^2: Eta square P-value: probability value * Significant (P<0.05)
P-value[1]: Probability value within each group; P-value[2]: Probability value within among groups

Statistical multiple pairwise comparison tests for shoulder pain and disability index (pain, function, and total) within each group (Table 4) showed that there was significantly (P<0.05) decreased in pain, function, and total of SPADI at post-treatment compared to pre-treatment within group A (P=0.0001, P=0.0001, and P=0.011, respectively) and group B (P=0.0001, P=0.0001, and P=0.0001, respectively).The SAIS patients received conventional physical therapy program plus scapular focused treatment exercise in group B more improved pain, function, and total of SPADI (35.91, 40.28, and 37.85%, respectively) than patients with SAIS who received conventional physical therapy program in group A (26.70, 33.95, and 25.12%, respectively).

Statistical multiple pairwise comparison tests for shoulder pain and disability index (pain, function, and total) between both groups (Table 4) indicated that no significant differences (P>0.05) between group A and group B at pre-treatment in pain (P=0.871), function (P=0.959),

and total of SPADI (P=0.499). However, there were significant differences (P<0.05) between group A and group B at post-treatment in pain (P=0.006), function (P=0.0001), and total of SPADI (P=0.036). These significant differences in mean values of pain, function, and total of SPADI at post-treatment are favorable for patients with SAIS in experimental group (group B) than SAIS patients in control group (group A).

Table 4: Within and between group comparisons for shoulder pain and disability index (SPADI)

Variables	Items	Groups (Mean ±SD)		Change	Effect size (η^2)	*P*-value[2]
		Group A (n=15)	Group B (n=15)			
Pain	Pre-treatment	79.13 ±14.07	78.33 ±15.82	0.80	0.00	0.871
	Post-treatment	58.00 ±12.68	50.20 ±10.39	7.80	0.14	0.006*
	MD (Change)	21.13	28.13			
	95% CI	11.33 – 30.93	18.33 – 37.93			
	Improvement %	26.70%	35.91%			
	Effect size (η^2)	0.25	0.37			
	P-value[1]	0.0001*	0.0001*			
Function	Pre-treatment	66.72 ±21.60	67.10 ±22.98	0.38	0.00	0.959
	Post-treatment	44.07 ±18.06	40.07 ±15.46	4.00	0.13	0.0001
	MD (Change)	22.65	27.03			
	95% CI	8.20 – 37.09	12.57 – 41.47			
	Improvement %	33.95%	40.28%			
	Effect size (η^2)	0.15	0.20			
	P-value[1]	0.0001*	0.0001*			
Total of SPADI	Pre-treatment	65.18 ±16.43	69.43 ±20.17	4.24	0.01	0.499
	Post-treatment	48.81 ±17.46	43.15 ±13.45	5.66	0.09	0.036*
	MD (Change)	16.37	26.28			
	95% CI	3.90 – 28.84	13.80 – 38.75			
	Improvement %	25.12%	37.85%			
	Effect size (η^2)	0.11	0.24			
	P-value[1]	0.011*	0.0001*			

Group A (control group) received a conventional physical therapy program; Group B (experimental group) received conventional physical therapy program plus scapular focused exercise program.
Data are expressed as a mean standard deviation and compared statistically by MANOVA test.
MD: Mean difference CI: confidence interval η^2: Eta square P-value: probability value * Significant (P<0.05)
P-value[1]: Probability value within each group; P-value[2]: Probability value within among groups

Discussion

The finding of the current study concluded that scapular focused exercises program had more significant effect than conventional physical therapy program alone in terms of subacromial space width, shoulder pain and function and scapular dyskinesia in patients with secondary SAIS.

Sub acromial space:

Reduction in subacromial space has been associated with shoulder injury and is thought to be a primary cause of sub acromial impingement syndrome[15].

This study focused on the accuracy of X-ray as it is an objective diagnostic tool, an unbiased, clinically applicable, and non-invasive method of diagnosing SAIS and measuring subacromial space[25], which fills an essential gap in the current literature. Overall, the results of this study will improve clinical diagnosis of SAIS through evidence-based practice.

In our study about subacromial space measurements by radiographic x-ray was determined to be perfect and reliable, as both the control and experimental groups had got a significant change in sub acromial space measurements and determined the degree of patient improvement which came in agreement with the findings of Martino et al., 202026, showing that narrowing of the subacromial space can be directly measured as the minimum distance between the acromial undersurface and the humeral head on radiographs in patients with shoulder impingement[26].

A reduced subacromial space can be caused by space-occupying structures of the coracoacromial arch or an abnormal tilt of the scapula may also lead to a decreased sub acromial space 24, X-ray is still recommended and can clearly visualize and detect a proximal migration of the head of the humerus and narrowing of the subacromial space[22].

This result contradicts with Andrea et al., 2024 [27] who estimated subacromial distance using genuine anterior-posterior shoulder X-ray images. Statistical analysis indicated no significant relationships between radiological parameters and the degree of subacromial impingement ($p > 0.05$). A notable connection ($p = 0.0049$) existed between patient age and subacromial impingement. The findings indicate that radiological assessments of the subacromial distance lack sufficient clinical value as predictive indicators for subacromial impingement syndrome.

Scapula dyskinesia (SDK):

Lateral scapular slide test assesses scapular dyskinesia, it is based on subjective observation of shoulder mechanics[18]. The result of this study about SDK was that both the control and experimental groups had a significant improvement in SDK due to the decrease in LSST in three positions (0˚, 45˚ and 90˚ abduction). While the experimental group was superior to the control in decrease lateral scapular slide test (LSST) in all positions.

The superiority of the experimental group to the control in improvement in LSST could be explained as the effect of scapular stabilizing exercises on improving scapular control, enhance the strength, coordination of the muscles that control the scapula, increased muscle strength and endurance which reduced strain on shoulder joint and enhanced postural alignment [28].

This result came in agreement with Luo et al., 2024 [29], showed that the improvement in SDK due to decrease in LSST within groups could be explained as the effect of scapular stabilizers exercises on correct the scapular position, improve the force couples muscle balance such as activated the serratus anterior and lower trapezius muscles and Cools et al., 2007 [30] showed that increase the strength of the lower and middle trapezius with a minimal activation of the upper trapezius [30].

This result come into agreement with the finding of Shankar et al., 2021[31], showed that scapular stabilization exercises improved the force couple muscles balance such as upper, lower trapezius and serratus anterior in type II Scapular dyskinesia patients, Özdemir et al., 2021[32] explained the improvement in trapezius and serratus anterior muscles activation after scapular exercises in SAIS patients with scapula dyskinesia and Moslehi et al., 2021[33], showed that scapular exercises improved the muscle patterns and scapular position in SAIS patients.

This result contradicts with Khodaverdizadeh et al., 2023[34] who reported that scapula positioning in 0°, 45° and 90° as an outcome measure. Upon pooling the results from the random effects model, it was found that exercise therapy had no significant effect on scapula positioning at any angle (0° : MD=-0.44; 95% CI, -1.43%, 0.55%; P=0.38; 45° : MD=- 0.17; 95% CI, -0.72%, 0.37%; P=0.53; 90° : MD=-0.25; 95% CI, -1.06%, 0.57%; P=0.56

Pain intensity:

The result of this study about shoulder pain intensity was that both groups had got improvement in pain intensity due to decrease in VAS. While the experimental group was superior to the control.

The superiority of the experimental group to the control could be explained as scapular exercises and stretching exercises as scapular exercises activated the serratus anterior and lower trapezius and returned the force couple balance, decreased load on levator scapular muscles and upper trapezius that led to reduce shoulder pain and improved the strength of the lower and middle trapezius with a minimal activation of the upper trapezius [14]. Shoulder stretching exercises reduced muscle tension, improved blood flow that led to decrease pain [35].

Our result, according to decreasing in pain intensity in VAS came in agreement with Khodaverdizadeh et al., 2023[34], who showed adding scapular-focused exercise training to conventional therapy produced a significant decrease in shoulder pain (SMD=-0.83; 95% CI, -1.44%, -0.22%; P=0.008) [34].

This result came in agreement with the finding of Moslehi et al., 2021[33], explained decrease in VAS due to scapular focused exercises training in shoulder pain patients, Zhong et al., 202436, conducted a systematic review and found decrease on VAS due to the effect of scapular stabilization exercises in shoulder pain, Mahna et al., 2022[14], found that scapular stabilization exercise decrease shoulder pain in females with SAIS and Schydlowsky et al., 2022[37], found that scapular exercises and stretching exercise for levator scapular and pectoralis minor muscles had a significant effect in decreasing VAS in shoulder pain patients with scapula dyskinesia related SAIS.

This result contradicts with Akgüller et al., 2023[38] who showed that the scapular stabilization exercises had no extra effect on pain measured by VAS comparing to Conventional physical therapy program in SAIS patients with scapula dyskinesia in the short-term treatment.

Shoulder Pain and Disability Index:

The result of this study about shoulder pain and function was that both groups had an improvement in pain intensity and function due to decrease in SPADI. While the experimental group was superior to the control.

The improvement in this study due to combination of scapular stabilization exercises, stretching, and rotator cuff strengthening exercises interventions have a significant effect on scapular kinematic and effective in obtaining increased scapular external rotation, upward rotation, and posterior tilt and increasing blood supply which improve shoulder pain and function[39].

This result came in agreement with Kim et al., 2019[40] who found appropriate scapular posterior tilt is one factor that can elevate the anterior acromion during humeral elevation and, in turn, increase the subacromial space and decreased impingement symptoms.

This result came in agreement with Hotta al., 2020[41] who reported improved SPADI scores and increased posterior tilt after 4-week progressive Scapular stabilizers and strengthening training. Similarly, Yeşilyaprak al., 2023[42] who reported an improved SPADI score of

approximately ten points and increased posterior tilt of approximately 3.7 after 10 weeks of scapular training exercises.

Conclusion

In the present study, it could be seen that adding scapular focused exercises program to the conventional physical therapy program was statistically significant in increased sub acromial space width, relieving pain and improving physical function in SAIS patients than conventional physical therapy program alone as seen with radiographic X ray, Visual Analogue Scale, Shoulder Pain and Disability Index and Lateral Scapular Stability Test.

According to clinical implications of our treatment program, it could be highly effective in treatment of SAIS patients as improving posterior flexibility of shoulder joint which decreased poor posture as rounded shoulders and forward heads positions, increasing range of motion, reducing muscle tension, improve force couple around shoulder ,enhancing posture, decreased humeral retroversion and translation of the humeral head, decreased scapula being tipped forward and pulled toward the side of the body increased the subacromial space width providing pain relief and improving in all our measurements and patient symptoms'.

Limitation of study

This was a short-term study of 4 (four) weeks and no further follow-up of subjects was conducted.

Recommendations

The finding of the current study offered the need for considering the following

Recommendations:

- Future studies should be conducted to evaluate the long-term effect of scapular focused exercises program on SAIS patients.
- Future studies should be conducted to evaluate the effect of increasing the treatment period of scapular focused exercises program for 3 months on SAIS patients.
- Future studies should be conducted to evaluate the effect of scapular stabilizers and rotator cuff muscles strengthening in exercise programs in dealing with patients with SAIS.

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Conflicts of interest

There is no conflict of interest.

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