Research Article

Effect OF Blackburn Stabilization Exercises In Patients With Subacromial Impingement Syndrome

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ABSTRACT

BACKGROUND: Subacromial impingement syndrome (SIS) is one of the most common causes of shoulder pain and functional limitation. Scapular stabilization exercises, particularly the Blackburn stabilization exercise program, have been proposed to improve shoulder function by enhancing scapular stability and movement coordination.
AIM: To investigate the effects of Blackburn stabilization exercises on shoulder pain, function, and shoulder elevation range of motion (ROM) in patients with subacromial impingement syndrome.
METHODS: A single arm clinical trial study was conducted on 15 patients with unilateral SIS . Participants underwent a 6-week Blackburn stabilization exercise program. Pain and Function were assessed using the Shoulder Pain and Disability Index (SPADI), and shoulder elevation ROM was measured at baseline, after 3 weeks, and after 6 weeks. Data were analyzed using repeated-measures ANOVA.
RESULTS: Significant improvements were observed in SPADI scores and shoulder elevation ROM after both 3 and 6 weeks of intervention, with greater improvements evident at 6 weeks. These findings indicate progressive clinical benefits associated with the Blackburn stabilization exercise program.
CONCLUSION: Blackburn stabilization exercises were effective in improving shoulder pain, function, and shoulder elevation ROM in patients with SIS. These findings support the use of Blackburn stabilization exercises as rehabilitation programs for patients with SIS.

Keywords: Subacromial Impingement syndrome; Blackburn stabilization exercises; Scapular stabilization; Shoulder elevation; Rehabilitation.

INTRODUCTION

Subacromial impingement syndrome (SIS) is one of the most common cause of shoulder pain. It occurs due to compression of the rotator cuff tendons and the subacromial bursa beneath the coracoacromial arch during arm elevation, resulting in pain, inflammation, and, in some cases, subacromial bursitis. SIS accounts for approximately 44–65% of all shoulder disorders, making it one of the most prevalent musculoskeletal conditions affecting the shoulder. [1, 2].

The development of SIS is multifactorial and is influenced by both structural and functional factors. Among the functional contributors, abnormal scapular kinematics, commonly referred to as scapular dyskinesis, play a crucial role in altering the biomechanics of the shoulder. Normal scapular motion during arm elevation involves coordinated upward rotation, posterior tilting, and external rotation, which help maintain the subacromial space and optimize glenohumeral stability [3]. Alterations in these movements may reduce the available subacromial space, increase mechanical stress on the rotator cuff tendons, and contribute to the development and persistence of impingement symptoms [4].

Scapular dyskinesis is frequently associated with weakness or delayed activation of the scapular stabilizing muscles, particularly the lower trapezius and serratus anterior, accompanied by increased activity of the upper trapezius. This muscular imbalance disrupts the normal scapulohumeral rhythm, compromises dynamic shoulder stability, and leads to inefficient force transmission during upper-limb movements. Consequently, patients often experience pain during overhead activities, restricted ROM , muscle weakness, reduced functional performance, and limitations in activities of daily living, all of which negatively affect quality of life [5].

Conservative management remains the first-line treatment for individuals with SIS, with therapeutic exercise representing one of the most effective interventions. Current rehabilitation strategies emphasize restoring normal scapular mechanics through exercises designed to improve neuromuscular control, strengthen the scapular stabilizers,

and enhance dynamic shoulder stability. Optimizing scapular positioning and movement has been shown to decrease mechanical loading within the subacromial space, reduce pain, and improve upper-extremity function [6,7]
Among scapular rehabilitation approaches, Blackburn stabilization exercises have gained increasing attention because they selectively target the upper trapezius, middle trapezius, lower trapezius , and posterior shoulder musculature while minimizing excessive activation of the upper trapezius [8]. By enhancing scapular muscle strength, endurance, and motor control, these exercises may promote more efficient scapular kinematics, improve scapulohumeral coordination, and restore shoulder function. Despite the growing use of Blackburn exercises in clinical rehabilitation, evidence regarding their specific effectiveness in individuals with SIS remains limited. Therefore, the present study aimed to investigate the effect of scapular Blackburn stabilization exercises on patients with SIS [9].

Materials And Methods

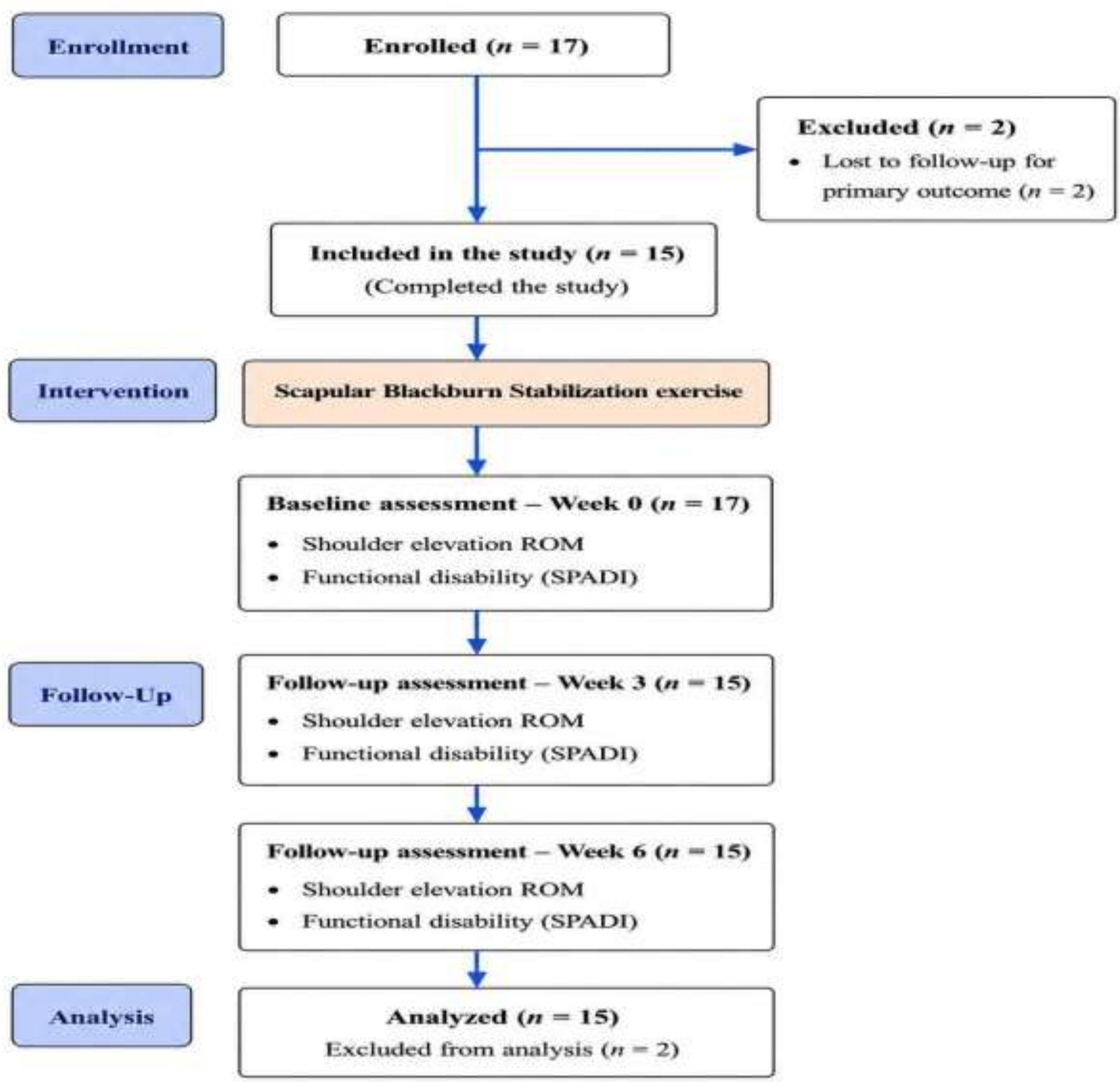

Figure 1: flow diagram of the study

Study design

This study was designed as a single-arm clinical trial study with repeated measures to investigate the effect of a scapular stabilization blackburn stabilization exercise program in patients with SIS. Outcome measures were assessed at baseline, after 3 weeks of treatment, and at the end of the 6-week intervention period to evaluate changes over time. The study flow diagram is presented in Figure 1 in accordance with the Consolidated Standards of Reporting Trials (CONSORT) statement to illustrate participant enrollment, follow-up, and analysis [10].

Study setting

The study was conducted at the outpatient orthopedic clinic at MTI University from July 2024 to February 2025.

Patients

Patients included in this study were adults aged 30-50 years, with a body mass index (BMI) ranging from 18.5 to 29.9 kg/m² [27,28]. They were diagnosed with unilateral SIS associated with scapular dyskinesia, confirmed through clinical evaluation [11,12].

Patients diagnosed with unilateral SIS were recruited following referral from an orthopedic surgeon. All Patients received Blackburn stabilization exercise program only. The intervention was administered three sessions per week for six consecutive weeks. Outcome measures were assessed at three time points: baseline (before the intervention), after 3 weeks of treatment, and at the end of the 6-week intervention period.Patients were excluded if they had any of the following conditions: neurological deficit affecting shoulder function during daily activities [13], cervical disc pathology [14], brain injuries [15], fractures in the upper limb, or previous shoulder surgery [16].

Sample size calculation

The sample size was estimated based on the effect size (Cohen's f = 0.373) derived from a previous study using SPADI scores (Nakra et al., 2013). The calculation was performed assuming a statistical power of 80%, a significance level of $\alpha = 0.05$, and three repeated measurements (baseline, 3 weeks, and 6 weeks). A repeated-measures ANOVA (within-subjects design) using the F-test was applied to estimate the required sample size. The minimum required sample size was 14 patients. To account for potential dropouts (estimated at 15%), three additional patients were recruited, yielding a final sample size of 17 patients. The computation was performed using G*Power software (version 3.0.10).

Outcome measures

The primary outcome measures were shoulder pain and shoulder function, assessed using the SPADI, respectively. The secondary outcome measure was active shoulder elevation, assessed using a digital inclinometer. All outcome measures were recorded at baseline, after 3 weeks of treatment, and after completion of the 6-week intervention.

Primary outcome measures

Shoulder pain and function

Shoulder pain and function were assessed using the Arabic version of the SPADI, a valid and reliable patient-reported outcome measure for individuals with shoulder disorders [17]. The SPADI consists of 13 items divided into two subscales: a pain subscale (5 items) and a disability subscale (8 items) [18]. Each item is rated on an 11-point numerical scale ranging from 0 (no pain or difficulty) to 10 (worst imaginable pain or maximum difficulty). The scores for each subscale were converted to percentages, and the overall SPADI score was calculated as the mean of the pain and disability subscale scores, yielding a total score ranging from 0 to 100. Higher scores indicate greater pain and functional disability [19].

Secondary outcome measure

Active shoulder elevation

Active shoulder elevation was assessed using a digital inclinometer (model 12-1057), which has demonstrated moderate to excellent reliability for measuring shoulder elevation in individuals with SIS [20,21]. Before each assessment, the inclinometer was calibrated to zero and positioned along the midline of the humerus, just above the elbow. Patients were instructed to actively elevate the arm in the sagittal plane to the maximum pain-free range while avoiding compensatory trunk or shoulder movements. The angle reached at the end of the movement was recorded. Three consecutive measurements were obtained for each patient , and the mean value was used for statistical analysis [22].

Treatment procedures

All patients received Blackburn scapular stabilization exercises three sessions per week for six consecutive weeks. Each treatment session lasted approximately 30–60 minutes and was supervised by the researcher. The exercise program was designed to improve scapular muscle performance, dynamic stability, and neuromuscular control. Exercise intensity was progressively increased according to each patient's tolerance while maintaining proper movement quality and minimizing compensatory trunk or cervical movements.

Blackburn scapular stabilization exercises

The Blackburn exercise program consisted of six prone-based exercises targeting the scapular stabilizing muscles: (1) horizontal shoulder abduction with neutral rotation (T), (2) horizontal shoulder abduction with external rotation (T with thumbs up), (3) scaption with neutral rotation (Y), (4) scaption with external rotation (Y with thumbs up), (5) prone external rotation at 90° of shoulder abduction, and (6) prone shoulder extension [9,23]. During all exercises, patients were positioned prone with the neck maintained in a neutral position to minimize upper trapezius compensation.

Each exercise was performed for 3 sets of 10 repetitions, with a 2-second hold at the end of each repetition and 1–2 minutes of rest between sets. Exercise intensity was progressively increased throughout the 6-week intervention by adding light weights (0.5–1.2 kg) as tolerated while emphasizing proper scapular control and avoiding compensatory trunk or cervical movements [23].

Statistical analysis

Statistical analysis of the measured variables was conducted using SPSS for Windows version 23 (SPSS, Inc., Chicago, IL), with an alpha level set at 0.05. The data were checked for normality and extreme values. Normality was assessed using the Shapiro–Wilk test, which showed normality ($p > 0.05$) and no outliers. A one-way repeated-measures ANOVA was used to examine the effect of time on all outcome measures across the three assessment time points (baseline, 3 weeks, and 6 weeks). If the ANOVA was significant, pairwise comparisons with Bonferroni correction were performed for each outcome measure to control the type I error rate.

RESULTS

Demographic characteristics

The baseline demographic characteristics of the patients are presented in Table 1, including age, weight, height, BMI, working hours, sex distribution, dominant side, and affected side.

Table 1: Baseline Demographic Characteristics of Patients (N=15) *

Characteristics	Value (n=15)
Age (years)	42.82±5.4
Weight (kg)	81.53±7.59
Height (cm)	174.71±6.74
BMI (kg/m²)	25.92±1.37
Working hours (hours/day)	8.35±1.22
Female	3 (17.65%)
Male	14 (82.35%)
Dominant Right, n (%)	
Right	13 (76.47%)
Left	4 (23.53%)
Affected side, n (%)	
Right	14 (82.35%)
Left	3 (17.65%)

BMI, body mass index; SD, standard deviation; * Data are ± SD for all continuous variables and n (%) for categorical variables.

Clinical outcomes at baseline, after 3 weeks, and after 6 weeks

The clinical outcomes of the patients at baseline, after 3 weeks, and after 6 weeks of intervention are presented in Table 2. A progressive improvement was observed in the measured outcomes over the intervention period, with SPADI scores decreasing and shoulder elevation ROM increasing from baseline to 3 weeks and showing further improvement after 6 weeks.

Table 2. Clinical outcomes of patients at baseline, after 3 weeks, and after 6 weeks of intervention (N=15) *

Outcomes	time	Value (n=15)
SPADI (%)	**Baseline**	63.5±10.71
	After 3 weeks	51.25±8.02
	After 6 weeks	36.1±4.15
Shoulder elevation (degree)	**Baseline**	84.18±9.37
	After 3 weeks	97.06±4.41
	After 6 weeks	140.35±14.55

* Data are mean ± SD; SPADI: shoulder pain and disability index.

Within-group comparisons after 3 and 6 weeks of intervention

Within-group analysis showed no statistically significant improvements in either SPADI scores or shoulder elevation ROM after 3 weeks of intervention compared with baseline ($p = 0.24$ and $p = 0.45$, respectively). However, after 6 weeks of intervention, significant improvements were observed in both SPADI scores and shoulder elevation ROM compared with baseline ($p = 0.001$ for both outcomes).

Table 3. Within-group comparisons after 3 and 6 weeks of intervention

Outcome	After 3 weeks MD (95% CI)	P value	After 6 weeks MD (95% CI)	P value
SPADI (%)	**3.76 (-1.46, 8.97)**	**0.24**	**10.79 (5.17, 16.41)**	**0.001**
Shoulder elevation ROM (degree)	**-6.88 (-18.51, 4.75)**	**0.45**	**-29.29 (-42.29, -16.3)**	**0.001**

MD: mean difference; CI: confidence interval; SPADI: Shoulder Pain and Disability Index; ROM: range of motion.

Discussion

The present study investigated the effects of Blackburn stabilization exercises on shoulder pain, function, and shoulder elevation ROM in patients with SIS. Clinical outcomes were assessed at baseline, after 3 weeks, and after 6 weeks to evaluate the progression of treatment effects over time. The findings demonstrated significant improvements in shoulder pain, function, and shoulder elevation ROM following the intervention. These results suggest that Blackburn stabilization exercises may be an effective treatment strategy for patients with SIS [9,23].

The study measured outcomes at baseline, after 3 weeks, and after 6 weeks. The 3-week assessment was included to evaluate the early response to the intervention, as previous studies have reported early improvements following scapular stabilization exercises [9,23]. The 6-week assessment was performed to determine whether these improvements were maintained and further enhanced over time. Therefore, evaluating outcomes at both time points provided insight into the progression of treatment effects throughout the intervention period.

Significant improvements in shoulder pain and function were observed after both 3 and 6 weeks of Blackburn stabilization exercises. These improvements may be attributed to the ability of Blackburn stabilization exercises to enhance scapular stability and improve the coordination of shoulder movement, thereby reducing mechanical stress on the subacromial structures and improving functional performance in patients with SIS . The progressive nature of the Blackburn exercise program may also have contributed to the continuous improvements observed throughout the intervention period [9,23,24]

These findings are consistent with those of Raut et al. [23], who reported that a 6-week Blackburn stabilization exercise program significantly improved shoulder pain and function in individuals with SIS. Similarly, Jeon et al. [25] demonstrated that scapular stabilization exercises effectively reduced pain and improved shoulder function in patients with SIS. These findings support the effectiveness of scapular stabilization exercises, particularly the Blackburn protocol, in improving clinical outcomes in patients with SIS.

However, Hotta et al. [26] reported that scapular stabilization exercises did not provide additional improvements in pain or function when added to a general strengthening program. This discrepancy may be related to differences in the intervention protocol, treatment duration, exercise progression, and patient characteristics. The structured and progressive design of the Blackburn stabilization exercise program used in the present study may have provided a more specific therapeutic stimulus, thereby contributing to the improvements observed in shoulder pain and function.

Regarding shoulder elevation ROM in the present study, it improved significantly following Blackburn stabilization exercises, with further improvement observed between the third and sixth weeks of the intervention. These improvements may be attributed to enhanced scapular stability and improved scapulohumeral coordination, which facilitate more efficient shoulder movement and reduce mechanical stress on the subacromial structures [24]. In addition, the progressive nature of the Blackburn stabilization exercise program may have contributed to the gradual improvement in shoulder elevation ROM throughout the intervention period.

The present findings of shoulder elevation ROM improvement are consistent with those of Raut et al. [23], who reported significant improvements in shoulder ROM following a Blackburn stabilization exercise program in patients with SIS . Similarly, Moezy et al. [27] demonstrated that scapular stabilization exercises significantly improved shoulder mobility in patients with SIS , supporting the role of scapular-focused rehabilitation in restoring normal shoulder movement. Collectively, these findings reinforce the effectiveness of Blackburn stabilization exercises in improving shoulder elevation ROM in patients with SIS.

The present study had several limitations. First, the follow-up period was limited to six weeks, which does not allow evaluation of the long-term sustainability of the observed improvements. Second, the study was conducted in a single clinical setting with a relatively homogeneous sample, which may limit the generalizability of the findings to broader populations. Future studies should include longer follow-up periods to determine whether the improvements in pain, function, and shoulder elevation ROM are maintained over time. Further research involving larger and more diverse populations is also recommended to confirm the effectiveness of Blackburn stabilization exercises and to establish optimal exercise dosage, frequency, and progression.

CONCLUSIONS

Blackburn stabilization exercises resulted in significant improvements in shoulder pain, function, and shoulder elevation ROM in patients with SIS. These findings support the use of Blackburn stabilization exercises as an effective rehabilitation strategy for improving clinical outcomes in patients with SIS. Further studies are warranted to confirm the long-term effectiveness of this intervention using larger sample sizes and longer follow-up periods.

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DECLARATIONS

Author contributions: Fouad ME and Aziz MZ contributed to study conception and design. Fouad ME performed the trial procedures and drafted the manuscript. Aziz MZ revised the manuscript. Youssef EF reviewed the study design, supervised the research process, and approved the final version for publication. Zakaria ZM supervised the research process, contributed to writing the discussion, and performed the final revision. All authors critically reviewed and approved the final manuscript and agree to be accountable for the integrity and accuracy of the work.

Ethics approval and consent to participate: This study was approved by the Research Ethics Committee of the Faculty of Physical Therapy, Cairo University, Egypt (approval no. P.T.REC/012/004706). Written informed consent was obtained from all participants before enrollment.

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Data availability: The datasets analyzed during the current study are available from the corresponding author upon reasonable request, subject to institutional and ethical regulations.
CONSORT statement: The authors have read the CONSORT 2010 statement, and the manuscript was prepared and revised in accordance with CONSORT reporting guidelines for randomized trials.
Country/Territory of origin: Egypt.

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