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EFFECT OF SCAPULAR STRENGTHENING EXERCISE VS CERVICAL STRENGTHENING EXERCISE ON PAIN AND DISABILITY IN IMPINGEMENT SYNDROME: AN EXPERIMENTAL STUDY

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ABSTRACT

Background & Purpose: Shoulder Impingement Syndrome (SIS) is a common musculoskeletal disorder characterized by pain and functional limitation due to altered scapular mechanics, rotator cuff dysfunction, and possible cervical involvement. Exercise-based rehabilitation remains the cornerstone of management; however, the comparative effectiveness of scapular strengthening and cervical strengthening exercises requires further clarification. To compare the effects of scapular strengthening exercises and cervical strengthening exercises on pain and disability in individuals with Shoulder Impingement Syndrome.

Methodology: An experimental comparative study was conducted on 30 participants diagnosed with unilateral Shoulder Impingement Syndrome. Subjects were randomly allocated into two groups: Group A (Scapular Strengthening Group, n=15) and Group B (Cervical Strengthening Group, n=15). Both groups received their respective intervention protocols for six weeks. Pain intensity was measured using the Numeric Pain Rating Scale (NPRS), and functional disability was assessed using the Shoulder Pain and Disability Index (SPADI). Assessments were conducted at baseline, 3rd week, and 6th week. Statistical analysis included repeated measures ANOVA for within-group comparison and independent t-test for between group comparison, with significance set at $p < 0.05$.

Results: Both groups showed statistically significant improvements in NPRS and SPADI scores over time ($p < 0.05$). However, between-group comparison revealed significantly greater reduction in pain and disability in the scapular strengthening group at the 3rd and 6th weeks ($p < 0.001$).

Conclusion: Both scapular and cervical strengthening exercises are effective in reducing pain and disability in individuals with Shoulder Impingement Syndrome. However, scapular strengthening exercises demonstrated superior clinical outcomes compared to cervical strengthening exercises over a six-week intervention period.

Keywords: Shoulder Impingement Syndrome, Scapular Strengthening, Cervical Strengthening, NPRS, SPADI, Rehabilitation

INTRODUCTION

The glenohumeral joint is an enarthrodial synovial joint formed by the humeral head articulating with the shallow glenoid cavity of the scapula. This structure provides exceptional multiplanar mobility for activities like reaching, lifting, throwing, and overhead motions essential in daily life, work, and sports. However, this mobility compromises inherent bony stability (unlike the hip), relying instead on dynamic and static soft-tissue stabilizers: rotator cuff muscles, glenoid labrum, capsular ligaments, and scapular stabilizers [1].

Disruptions in dynamic stabilization—due to muscular weakness, impaired neuromuscular control, or altered scapulothoracic mechanics—predispose the shoulder to pathology. Altered scapulothoracic rhythm and glenohumeral kinematics redistribute forces, increasing tendon and periarticular tissue loads, contributing to overuse injuries in individuals with repetitive overhead activities, faulty postures, muscular imbalances, or poor movement patterns [2]. Shoulder Impingement Syndrome (SIS) arises from recurrent mechanical irritation

of subacromial structures—primarily rotator cuff tendons and bursa—during humeral elevation, causing inflammation, degeneration, pain, and restricted overhead motion [6, 7]. External impingement involves compression of tendons and bursa under the coracoacromial arch, exacerbated by repetitive overhead use, acromial variations (e.g., hooked shape), or inflammation; it may be primary or secondary [7, 10, 11]. Internal impingement occurs when the articular rotator cuff surface is pinched between the humeral greater tuberosity and posterosuperior glenoid rim during abduction-external rotation. Repetitive shear leads to microtrauma, tendinosis, articular-sided partial tears and instability, often linked to glenohumeral internal rotation deficit (GIRD), posterior capsular tightness, and scapular dyskinesis [8, 9, 12-16]. It predominates in overhead athletes due to adaptive changes like increased external rotation and posterior tightness, but also affects non-athletes with repetitive overhead work, forward head/protracted shoulders, or dyskinesis [14, 15, 19].

Internal Shoulder Impingement Syndrome (ISIS) imposes significant burden, with impingement comprising 44–65% of outpatient shoulder cases [17, 18]. In elite overhead athletes, high proportions exhibit signs [19]. Etiology is multifactorial, involving biomechanical, postural, and neuromuscular glenohumeral/scapulothoracic impairments [20]. Repetitive overhead stress causes rotator cuff microtrauma; scapular dyskinesis disrupts force couples, impairing humeral centering and exacerbating impingement [21, 23, 26, 27]. Forward head posture and thoracic kyphosis misalign scapular position [23]. Additional factors include GIRD, posterior tightness, cervical dysfunction, upper trapezius dominance, and scapular stabilizer weakness, promoting posterosuperior humeral migration and tendon overload [24, 27, 30].

The scapula acts as a dynamic base for glenohumeral motion and kinetic transfer, preserving humeral congruence [26]. Dyskinesis narrows subacromial/posterosuperior spaces, raising impingement risk [27]. Targeted scapular strengthening restores rhythm, reduces winging/tilting, improves upward/posterior tilt, decreases pain, enhances function, and prevents SIS recurrence [28, 29].

MATERIALS AND METHODS

Study Design

This comparative experimental study is a randomized controlled trial with simple random sampling to allocate participants to either Group A: Scapular Strengthening Exercise Group (SSG) or Group B: Cervical Strengthening Exercise Group (CSG). The intervention was conducted over 6 weeks, with sessions held three times per week at Sainath Hospital, Ahmedabad.

Participants

30 participants with Internal Shoulder impingement syndrome were recruited in the study, 15 per group. Inclusion Criteria include Patients with unilateral pain in the shoulder (morse critical value 6) beyond six weeks were included into study, Healthy male and female subjects aged 25 to 40 years. Positive impingement tests or nociceptive arc of motion between 60°–120° [43, 48, 49]. Exclusion Criteria include patients with history of shoulder surgery, fracture, or dislocation; traumatic onset of shoulder pain, Intermediate to advanced shoulder pathology, Presence of systemic, rheumatologic or neurologic diseases, Presence of neuromusculoskeletal diagnosis including cervical radiculopathy and History of shoulder surgery, musculoskeletal or cardiovascular diagnoses that limit ability to complete rehabilitation, Pregnant patients, Subjects who had received corticosteroid injections or physical treatment in the six months prior to the study, Inability to reach 140° of shoulder

elevation to perform the scapular musculature assessment, Development of paresthesia or tingling in the upper limb, Symptom onset in the setting of an acute traumatic injury such as glenohumeral dislocation, acromioclavicular sprain, or shoulder fracture, A history of shoulder surgery, fibromyalgia or other type of therapy in the last 3 months [43, 48, 49].

Intervention

Scapular Strengthening Exercise Group (Group A):

Exercises are: Lawnmower Exercise with Diagonal Squat movement, Scapular Retraction and Contralateral Single-Leg Squat, Scapular Clock Exercise, T-to-Y-to-W Sequence on Swiss Ball, Prone Shoulder Arm Lift, Protraction Punches, Theraband D2 PNF Pattern, Stretching: The stretch of the levator scapulae and rhomboids was applied for 30 seconds to hold with three repetitions and a rest period of 30 seconds.

Cervical Strengthening Exercise Group (Group B):

Exercises are: Deep Cervical Flexor Training, Semispinalis Cervicis Isometric, Static Sternocleidomastoid Stretch, Static Levator Scapulae Stretch

Outcome Measures

Shoulder Pain and Disability Index (SPADI): Nociception and functional impairment assessment scale

Numeric pain rating scale (NPRS): Pain Assessment scale

Procedure

Participants were randomized into Group A (n=15) and Group B (n=15) groups following baseline assessments SPADI and NPRS. Intervention was provided to both the groups for 6 weeks. Reassessment was done after 3rd week and 6th week of intervention.

STATISTICAL ANALYSIS

Data were analyzed using IBM SPSS Statistics version 25. Descriptive statistics (mean $\pm$ standard deviation) were calculated for all outcome measures. Time-based within-group comparisons were analyzed with ANOVA, comparing outcome measures at baseline (0th week), 3-week and 6-week timepoints. Pairwise comparisons were performed using post-hoc analysis with Bonferroni correction. For intergroup comparison, the mean values of group A and B at the 0th week, 3rd week, 6th week Metrics were compared by applying statistical test – independent samples t-test as the data was normally distributed. Threshold for statistical significance established at $p < 0.05$.

RESULTS

Table 1: Demographic Data

CHARACTERISTIC	Group A (mean $\pm$ SD)	Group B (mean $\pm$ SD)	P - value
Population	15	15	
Age (year)	31.43 $\pm$ 4.33	32.26 $\pm$ 4.52	0.856
Height (cm)	165.66 $\pm$ 7.07	166.66 $\pm$ 8.10	0.625
Weight (Kg)	64.73 $\pm$ 9.19	64.86 $\pm$ 10.29	0.234
BMI (kg/m ²)	23.46 $\pm$ 1.66	23.19 $\pm$ 1.82	0.784

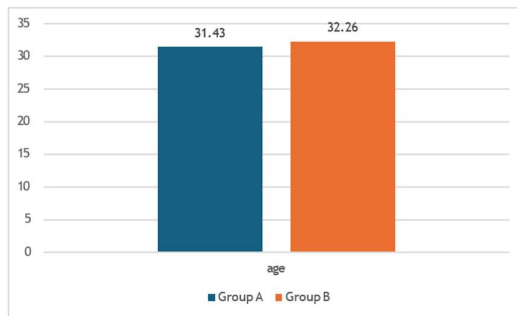


Chart 1: Age Distribution

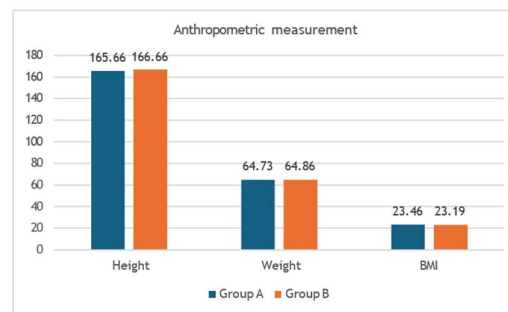


Chart 2: Anthropometric measurement

Table 2: Comparative within-Group Analysis of SPADI Outcomes in Group A Participants

SPADI	Mean $\pm$ SD	F value	p value	x1-x2	x2-x3	x3-x1
0 th week	89.13 $\pm$ 7.68	249.37	0.001	0.001	0.001	0.001
3 rd week	63.93 $\pm$ 6.32					
6 th week	36.93 $\pm$ 4.87					

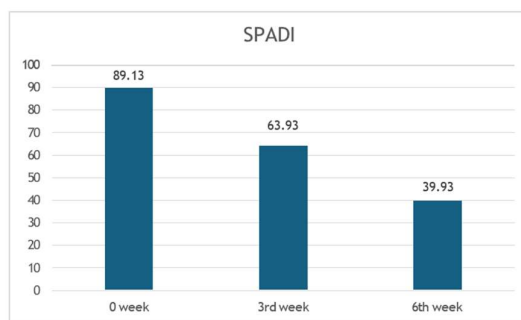


Chart 3: Graph of SPADI in group A

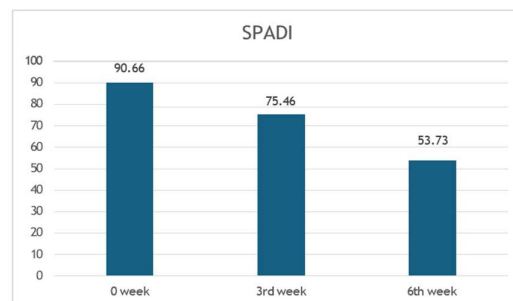


Chart 4: Graph of SPADI in group B

Table 3: Comparative within-Group Analysis of SPADI Outcomes in Group B Participants

SPADI	Mean $\pm$ SD	F value	p value	x1-x2	x2-x3	x3-x1
0 th week	90.66 $\pm$ 9.83	117.34	0.001	0.001	0.001	0.001
3 rd week	75.46 $\pm$ 3.39					
6 th week	53.73 $\pm$ 4.87					

Table 4: Comparative within-Group Analysis of NPRS Outcomes in Group A Participants

NPRS	Mean $\pm$ SD	F value	p value	x1-x2	x2-x3	x3-x1
0 th week	7.46 $\pm$ 1.06	129.73	0.001	0.001	0.001	0.001
3 rd week	5.06 $\pm$ 0.79					
6 th week	2.4 $\pm$ 0.63					

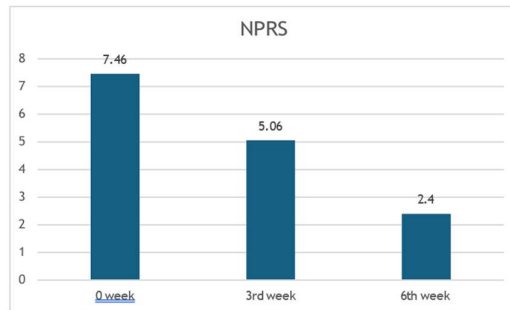


Chart 5: Graph of NPRS in group A

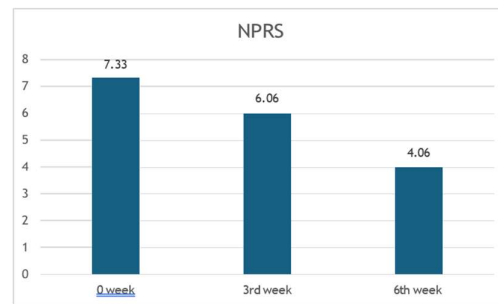


Chart 6: Graph of NPRS in group B

Table 5: Comparative within-Group Analysis of NPRS Outcomes in Group B Participants

NPRS	Mean $\pm$ SD	F value	p value	x1-x2	x2-x3	x3-x1
0 th week	7.33 $\pm$ 0.89	58.52	0.04	0.04	0.001	0.001
3 rd week	6.06 $\pm$ 0.79					
6 th week	4.06 $\pm$ 7.93					

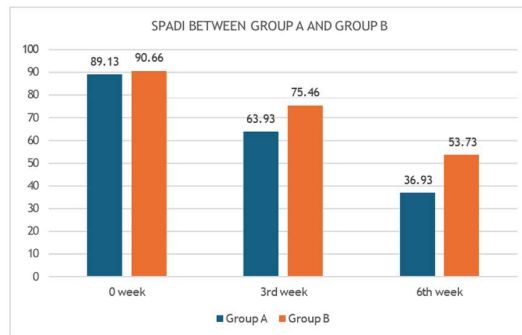


Chart 7: Graph of SPADI between group A and B

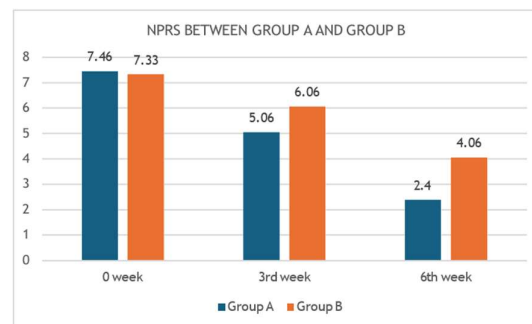


Chart 8: Graph of NPRS between group A and B

Table 6: Comparative between-Group Analysis of SPADI Outcomes in Group A and group B Participants

SPADI	Group A	Group B	t value	p value
0 th week	89.13 $\pm$ 7.68	90.66 $\pm$ 9.83	0.4750	0.6389
3 rd week	63.93 $\pm$ 6.32	75.46 $\pm$ 3.39	6.22	0.001
6 th week	36.93 $\pm$ 4.87	53.73 $\pm$ 4.87	9.44	0.001

Table 7: Comparative between-Group Analysis of NPRS Outcomes in Group A and group B Participants

NPRS	Group A	Group B	t value	p value
0 th week	7.46 $\pm$ 1.06	7.33 $\pm$ 0.89	0.3638	0.7188
3 rd week	5.06 $\pm$ 0.77	6.06 $\pm$ 0.79	3.46	0.001
6 th week	2.4 $\pm$ 0.63	4.06 $\pm$ 0.79	5.72	0.001

The study compared two groups of participants with shoulder pain and disability, showing comparable baseline demographics (age ~31–32 years, height ~166 cm, weight ~65 kg, BMI ~23 kg/m²; all $p > 0.05$) and similar initial SPADI (shoulder pain and disability index, higher scores indicate worse pain/disability) and

NPRS (numeric pain rating scale, 0–10) scores around 89–91 and 7.3–7.5, respectively. Both groups experienced significant within-group improvements over 6 weeks ($p < 0.001$ for most comparisons), with SPADI decreasing to 36.93 in Group A and 53.73 in Group B, and NPRS dropping to 2.4 in Group A versus 4.06 in Group B.

However, between-group analyses revealed that Group A achieved significantly greater reductions in both SPADI and NPRS at 3 and 6 weeks ($p < 0.001$), while baseline differences were non-significant ($p > 0.6$), indicating superior pain relief and functional improvement in Group A compared to Group B.

DISCUSSION

This randomized controlled trial compared scapular strengthening exercises (Group A) with cervical strengthening exercises (Group B) in patients with Shoulder Impingement Syndrome (SIS), assessing pain (NPRS) and disability (SPADI) over 6 weeks. Both groups showed significant within-group reductions in NPRS and SPADI scores at 3 and 6 weeks compared to baseline, confirming the effectiveness of scapular strengthening (SSE) and cervical strengthening (CSE) for managing SIS pain and disability. Between-group comparisons revealed significantly greater improvements in Group A at both time points, indicating superior outcomes with scapular-focused training.

These results align with evidence highlighting the pivotal role of scapular kinematics in SIS. Altered scapular motion and scapulothoracic weakness contribute to subacromial impingement, rotator cuff overload, and persistent symptoms, often worsened by cervical-related postural and neuromuscular deficits [3, 4]. Multiple

studies support SSE superiority: Tauqeer *et al.* (2024) found scapular strengthening plus manual therapy yielded greater pain and function gains in chronic SIS [33]. Ravichandran *et al.* (2020) systematic review reported consistent SPADI improvements with scapulothoracic programs [34]. Zhong *et al.* (2024) meta-analysis showed scapular stabilization superior to traditional rehabilitation for pain and SPADI reductions [35].

SSE restores scapulothoracic rhythm, optimizes serratus anterior and lower/middle trapezius coordination, reduces subacromial stress, and interrupts the pain-dysfunction cycle—explaining Group A's larger gains [26, 32, 35, 36, 38]. Group B showed meaningful but lesser improvements, consistent with cervical contributions to shoulder pathology. Zoroglu and Başar (2022) noted reduced deep cervical flexor endurance in SIS [42]. Zedan *et al.* (2018) linked cervical exercises to better shoulder proprioception via cervicoscapular connections [43].

CSE improves postural alignment, cervical stability, and indirect shoulder mechanics [27, 31, 44], but remains less targeted than SSE, which directly corrects primary scapular dyskinesis (insufficient upward rotation, excessive anterior tilt/internal rotation), enhancing glenohumeral congruence and impingement risk reduction [26, 27]. Progressive SSE likely drove

greater muscle adaptation, endurance, motor learning, and functional carryover for daily tasks [36, 38, 44-55].

CONCLUSION

The present study shows that both scapular strengthening and cervical strengthening protocols effectively reduce pain and improve function in individuals with Shoulder Impingement Syndrome. Scapular strengthening yielded superior gains in pain relief and disability reduction over the 6-week intervention. Therefore, scapular strengthening should be considered a core component in SIS rehabilitation and prevention, while cervical strengthening serves as a valuable adjunct, particularly for patients with concurrent neck dysfunction.

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