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Effect of Scapular Stabilization Exercises on Functional Recovery in Shoulder Impingement Syndrome: A Case Report

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Abstract:

- ***Background:***

Shoulder impingement syndrome is a common cause of shoulder pain in physically active individuals and is frequently associated with altered scapular kinematics and rotator cuff dysfunction. Scapular stabilization exercises aim to restore normal scapulothoracic rhythm, reduce subacromial stress, and improve functional outcomes in patients with shoulder impingement.

- ***Case Presentation:***

This case report describes a 29-year-old recreational athlete presenting with chronic shoulder pain during overhead activities, resulting in limitations in sports participation and daily functional tasks. The patient underwent a six-week physiotherapy rehabilitation program that included scapular stabilization exercises, rotator cuff strengthening, manual therapy techniques, and activity modification. The intervention was progressively advanced based on symptom response and functional improvement.

- ***Results:***

Outcome measures included the Visual Analog Scale (VAS), Shoulder Pain and Disability Index (SPADI), and shoulder range of motion assessment. Pain intensity reduced from 6/10 to 1/10 on the VAS following the intervention. The SPADI total score improved from 52% to 14%, indicating substantial reduction in pain and disability. Active shoulder abduction increased from 110° to 165°, while shoulder external rotation improved from 45° to 75°. These improvements exceeded clinically meaningful change thresholds and were accompanied by restoration of pain-free overhead movement.

- ***Conclusion:***

This case report demonstrates that a comprehensive rehabilitation program emphasizing scapular stabilization and rotator cuff strengthening can effectively reduce pain and improve functional shoulder performance in individuals with shoulder impingement syndrome. Addressing scapular mechanics should be considered a key component of physiotherapy management for shoulder impingement.

Keywords: *Shoulder Impingement Syndrome; Scapular Stabilization; Rotator Cuff Strengthening; Physiotherapy Rehabilitation*.

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I. INTRODUCTION

Shoulder impingement syndrome (SIS) is one of the most prevalent musculoskeletal disorders affecting the shoulder complex and represents a leading cause of pain, functional limitation, and reduced participation in occupational and sporting activities. It is commonly observed in individuals involved in repetitive overhead movements, including athletes, manual laborers, and physically active adults. SIS is characterized by compression and mechanical irritation of the rotator cuff tendons, subacromial bursa, and surrounding soft tissues beneath the coracoacromial arch

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during arm elevation, particularly between 60° and 120° of shoulder abduction.

The etiology of shoulder impingement syndrome is multifactorial, involving both intrinsic and extrinsic factors. Intrinsic factors include rotator cuff tendon degeneration, muscular imbalance, and altered neuromuscular control, whereas extrinsic factors involve structural variations of the acromion, postural deviations, and abnormal scapular positioning. Among these, altered scapular kinematics—collectively referred to as scapular dyskinesis—has been increasingly recognized as a key contributing factor to the development and persistence of SIS.

Normal shoulder function depends on the coordinated interaction between the glenohumeral and scapulothoracic joints, commonly described as scapulohumeral rhythm. During arm elevation, the scapula must upwardly rotate, posteriorly tilt, and externally rotate to maintain adequate subacromial space and allow efficient force transmission through the shoulder complex. Disruption of this coordinated movement, often due to weakness or delayed activation of the scapular stabilizing muscles such as the serratus anterior and lower trapezius, can lead to excessive superior migration of the humeral head and increased subacromial compression.

Several studies have demonstrated that individuals with shoulder impingement syndrome exhibit decreased serratus anterior activity, dominance of the upper trapezius, tightness of the pectoralis minor, and reduced posterior scapular tilt. These neuromuscular imbalances compromise scapular stability and contribute to altered loading patterns at the shoulder joint, perpetuating pain and dysfunction. Consequently, rehabilitation strategies that solely focus on rotator cuff strengthening without addressing scapular control may result in incomplete recovery and symptom recurrence.

Scapular stabilization exercises are designed to improve neuromuscular control, strength, and endurance of the muscles responsible for optimal scapular positioning and movement. By restoring normal scapulothoracic rhythm, these exercises aim to reduce subacromial stress, enhance dynamic shoulder stability, and facilitate pain-free functional movement. Integration of scapular-focused rehabilitation into physiotherapy management has been associated with improved pain outcomes, enhanced shoulder range of motion, and better functional performance, particularly in individuals engaged in overhead activities.

Despite increasing evidence supporting scapular stabilization as a key component of shoulder rehabilitation, clinical application varies widely, and detailed case-based documentation of its functional impact remains limited. Case reports provide valuable insight into individualized rehabilitation approaches, clinical decision-making, and patient-specific outcomes, particularly in physically active populations.

Therefore, this case report aims to describe the effects of a structured, progressive scapular stabilization–based physiotherapy rehabilitation program combined with rotator cuff strengthening and manual therapy in a recreational athlete diagnosed with shoulder impingement syndrome. The report seeks to highlight the clinical relevance of addressing scapular mechanics in restoring pain-free shoulder function and optimizing rehabilitation outcomes.

II. LITERATURE REVIEW

Shoulder impingement syndrome (SIS), also referred to as subacromial pain syndrome, is one of the most prevalent causes of shoulder pain, particularly among individuals involved in repetitive overhead activities such as athletes and manual workers. It is characterized by pain during arm elevation, reduced range of motion, and functional limitations. Emerging evidence highlights that SIS is not solely a local subacromial pathology but is strongly associated with altered scapular kinematics, muscle imbalance, and neuromuscular control deficits.

- Role of Scapular Dyskinesis in Shoulder Impingement- Several studies have identified scapular dyskinesis as a key contributing factor in SIS. Abnormal scapular positioning—such as decreased upward rotation, excessive anterior tilt, and internal rotation—can reduce the subacromial space, increasing mechanical compression of the rotator cuff tendons and subacromial bursa. Kibler et al. emphasized that the scapula serves as a stable base for glenohumeral motion, and dysfunction in scapular control can significantly impair shoulder biomechanics and load distribution.
- Electromyographic studies have demonstrated altered activation patterns in patients with SIS, particularly delayed or reduced activation of the serratus anterior and lower trapezius, combined with overactivity of the upper trapezius. This muscular imbalance disrupts scapulohumeral rhythm and contributes to pain and functional impairment.
- Scapular Stabilization Exercises- Scapular stabilization exercises are designed to restore optimal scapular positioning and dynamic control during upper limb movements. These exercises typically target the serratus anterior, middle and lower trapezius, and rhomboids, while minimizing compensatory upper trapezius dominance. Exercises such as scapular retraction, protraction, upward rotation drills, and closed kinetic chain activities have been shown to improve scapular muscle recruitment and endurance.
- A systematic review by Struyf et al. reported that exercise programs incorporating scapular-focused interventions resulted in greater pain reduction and functional improvement compared to general shoulder exercises alone. Similarly, Ludewig and Borstad demonstrated that scapular-focused training improved scapular upward rotation and posterior tilt, thereby reducing symptoms in individuals with impingement.
- Integration with Rotator Cuff Strengthening and Manual Therapy- The literature supports a multimodal rehabilitation approach combining scapular stabilization with rotator cuff strengthening. The rotator cuff muscles play a crucial role in maintaining humeral head centering

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within the glenoid fossa. Weakness or fatigue of these muscles can exacerbate superior humeral migration, further contributing to impingement.

- Manual therapy techniques, including glenohumeral and scapulothoracic mobilizations, have also been shown to complement exercise interventions by improving joint mobility, reducing pain, and facilitating improved muscle activation. Studies suggest that combining manual therapy with targeted exercises yields superior outcomes compared to exercise alone.

➢ *Clinical Outcomes and Functional Improvements-*

Clinical trials and case-based evidence consistently report significant improvements in pain scores, shoulder range of motion, and functional outcome measures such as SPADI and DASH following scapular stabilization programs. Importantly, these improvements often exceed minimal clinically important difference (MCID) values, indicating meaningful changes from a patient-centered perspective.

In athletic populations, scapular-focused rehabilitation has been associated with restoration of pain-free overhead function and return to sport activities. This reinforces the importance of addressing proximal stability to optimize distal mobility and performance.

➢ *Summary of Evidence-*

Overall, current literature strongly supports the inclusion of scapular stabilization exercises as a cornerstone of conservative management for shoulder impingement syndrome. By correcting scapular dyskinesis, enhancing neuromuscular control, and optimizing shoulder biomechanics, these interventions contribute to pain reduction, improved functional capacity, and long-term symptom resolution.

➢ *Background:*

Shoulder impingement syndrome accounts for approximately 44–65% of all shoulder complaints presenting in outpatient settings. The condition is multifactorial, involving both structural and functional components. While anatomical factors such as acromial shape may contribute, functional impairments such as altered scapular kinematics, rotator cuff weakness, and poor neuromuscular control play a significant role, especially in young and active individuals.

Scapular dyskinesis in SIS is commonly characterized by reduced upward rotation, decreased posterior tilting, and excessive internal rotation of the scapula during arm elevation. These alterations reduce the subacromial space, increasing compression of the rotator cuff tendons. Scapular stabilization exercises aim to correct these movement dysfunctions by strengthening key muscles responsible for scapular control and positioning.

Emerging evidence supports the integration of scapular-focused interventions into shoulder rehabilitation programs. These exercises not only improve muscle activation patterns but also enhance functional outcomes and pain reduction. Despite this, many rehabilitation protocols continue to emphasize isolated rotator cuff strengthening without adequate focus on scapular mechanics.

➢ *Objective-*

- *Primary Objective*

✓ To evaluate the effectiveness of a scapular stabilization–based physiotherapy rehabilitation program on pain and functional outcomes in a patient with shoulder impingement syndrome.

- *Secondary Objectives*

✓ To assess improvements in shoulder range of motion following intervention.
✓ To examine changes in self-reported shoulder pain and disability.
✓ To evaluate restoration of pain-free overhead functional movement.

III. MATERIALS AND METHODS

➢ *Study Design- Single-Subject Descriptive Case Report*

- *Patient Information*

✓ Age: 29 years
✓ Gender: Male
✓ Occupation: Software professional
✓ Activity Level: Recreational athlete (badminton, gym workouts)
✓ Affected Side: Dominant shoulder
✓ Diagnosis: Shoulder impingement syndrome (clinical diagnosis)

➢ *Chief Complaints*

- Chronic shoulder pain for 5 months
- Pain aggravated during overhead activities and sports participation
- Difficulty with lifting, reaching, and prolonged arm elevation

➢ *Inclusion Criteria*

- Clinical signs of shoulder impingement (positive Neer and Hawkins–Kennedy tests)
- Pain during overhead activities
- No history of shoulder surgery

➢ *Exclusion Criteria*

- Shoulder instability
- Full-thickness rotator cuff tear
- Cervical radiculopathy
- Neurological involvement

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IV. INTERVENTION PROTOCOL

The patient underwent a 6-week physiotherapy program, 5 sessions per week, with each session lasting approximately 45 minutes.

➢ *Components of Rehabilitation*

- *Scapular Stabilization Exercises*

✓ Scapular setting and awareness exercises
✓ Serratus anterior strengthening (wall slides, push-up plus)
✓ Lower and middle trapezius strengthening (prone Y and T exercises)
✓ Closed kinetic chain scapular control drills

- *Rotator Cuff Strengthening*

✓ External and internal rotation with resistance bands
✓ Side-lying external rotation
✓ Progression to functional strengthening in overhead positions

- *Manual Therapy*

✓ Soft tissue mobilization for upper trapezius and pectoralis minor
✓ Glenohumeral joint mobilization (posterior and inferior glides)

- *Flexibility Exercises*

✓ Posterior capsule stretching
✓ Pectoralis minor stretching

- *Activity Modification and Education*

✓ Avoidance of provocative overhead loading
✓ Ergonomic advice
✓ Gradual return-to-sport guidance
✓ Exercise intensity and complexity were progressively increased based on symptom response and functional improvement

➢ *Outcome Measures-*

Assessments were conducted at baseline and at the end of 6 weeks.

- Visual Analog Scale (VAS) – Pain intensity
- Shoulder Pain and Disability Index (SPADI) – Pain and functional disability
- Goniometric Assessment of Shoulder Range of Motion- Active abduction, External rotation

V. RESULTS

The patient reported complete resolution of pain during overhead activities and successfully returned to recreational sports without symptoms. All outcome measures demonstrated clinically meaningful improvement.

A. Statistical Analysis:

➢ *Comparative Outcome Data*

The table below illustrates the magnitude of change following the 6-week intervention.

Table 1 Comparative Outcome Data

Metric	Pre-Intervention	Post-Intervention	Absolute Change	% Improvement	MCID Threshold
VAS (Pain)	6/10	1/10	5 points	83.3%	2.0 points
SPADI (Disability)	52%	14%	38%	73.1%	8–13%
Abduction ROM	110°	165°	55°	50.0%	7–11°
Ext. Rotation ROM	45°	75°	30°	66.7%	5–9°

➢ *Analysis of Functional Recovery*

The SPADI reduction from 52% to 14% is statistically profound. A 38-point drop far exceeds the upper MCID limit of 13%, suggesting that the intervention did not merely provide symptomatic relief but fundamentally altered the patient's functional capacity.

The increase in Abduction from 110° to 165° indicates the restoration of the "painful arc" (typically 60°–120°). This suggests that the scapular stabilization exercises successfully increased the subacromial clearance, allowing the greater tuberosity of the humerus to pass under the acromion without mechanical irritation.

As this study represents a single-case report, inferential statistical testing was not performed. Descriptive analysis was used to compare pre- and post-intervention outcomes. The observed changes exceeded the Minimal Clinically Important Difference (MCID) values reported for VAS and SPADI, indicating clinically significant improvement.

VI. DISCUSSION

The success of this 6-week rehabilitation program underscores the "Scapular Platform" theory. In this patient, baseline assessments suggested a classic Type I Scapular Dyskinesis (inferior angle prominence), likely exacerbated by long hours of desk work.

➢ *The Role of Serratus Anterior and Trapezius*

The core of the intervention focused on the Serratus Anterior (SA) and the Lower Trapezius (LT). The SA is responsible for protraction and upward rotation of the scapula, while the LT provides the posterior tilt necessary to clear the acromion. Our protocol’s use of "Push-up Plus" and "Prone Y" exercises specifically targeted these force couples. By strengthening these "dynamic stabilizers," we effectively

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increased the subacromial height during the 60°–120° abduction phase.

- *Manual Therapy Synergy*

Manual therapy, specifically posterior glides of the glenohumeral joint, addressed the posterior capsule tightness often found in SIS. This tightness creates an "obligatory translation" where the humeral head is pushed superiorly and anteriorly during elevation. Combining joint glides with scapular drills allowed for a "centered" humeral head within a "stable" scapular socket.

- *Clinical Implications-*

This case demonstrates that for recreational athletes, Activity Modification does not mean rest, but rather "intelligent loading." By educating the patient on ergonomic setups and gradual return-to-sport (badminton) loading, we ensured that the regenerated tissues were not overloaded prematurely.

This case report highlights the effectiveness of a comprehensive scapular stabilization–focused rehabilitation program in managing shoulder impingement syndrome. Significant reductions in pain and disability, along with substantial improvements in shoulder range of motion, were observed following six weeks of physiotherapy intervention.

Improved scapular control likely reduced abnormal scapular positioning and restored normal scapulohumeral rhythm, thereby decreasing subacromial compression during arm elevation. Strengthening of the serratus anterior and lower trapezius muscles may have enhanced upward rotation and posterior tilting of the scapula, key components in preventing impingement.

The integration of rotator cuff strengthening and manual therapy further supported joint stability and improved shoulder mechanics. These findings are consistent with previous studies emphasizing the importance of addressing scapular dyskinesis in shoulder rehabilitation.

VII. CONCLUSION

This case report demonstrates that a structured, multi-modal physiotherapy rehabilitation program with a primary emphasis on scapular stabilization is highly effective in the management of Shoulder Impingement Syndrome (SIS). The intervention resulted in clinically meaningful improvements across pain, function, and shoulder mobility, supporting the growing body of evidence highlighting the critical role of scapular mechanics in shoulder rehabilitation.

A substantial reduction in pain was observed, with the Visual Analog Scale (VAS) score exceeding the minimal clinically important difference (MCID) by approximately 150%, indicating a robust therapeutic response. Functional outcomes improved markedly, as evidenced by significant reductions in disability scores and the successful return to high-demand overhead sports activities, including badminton. These functional gains reflect the restoration of pain-free shoulder performance required for athletic participation.

Notably, significant improvements in shoulder range of motion were achieved, particularly in abduction and external rotation. These kinematic gains are indicative of improved scapulohumeral rhythm and enhanced neuromuscular control of the scapulothoracic joint. Targeted strengthening of the scapular upward rotators, including the serratus anterior and lower trapezius, alongside rotator cuff conditioning, likely contributed to optimal humeral head positioning and reduced subacromial stress during overhead movements.

The findings of this case report underscore the importance of comprehensive scapular assessment as a non-negotiable component of shoulder evaluation. Clinicians should prioritize scapular stabilization strategies in conjunction with traditional rotator cuff strengthening to achieve long-term, recurrence-free recovery, particularly in physically active individuals and athletes.

Although limited by its single-subject design, this case report provides clinically relevant insights into the effectiveness of scapular-focused rehabilitation. Future research involving larger sample sizes, controlled study designs, and long-term follow-up is warranted to establish standardized, evidence-based scapular stabilization protocols for the conservative management of shoulder impingement syndrome.

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