CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

SJIF Impact Factor: 7.187

https://doi.org/10.5281/zenodo.18109991

Available online at: http://www.iajps.com *Review Article*

BRIDGING CLINICAL DIAGNOSTIC AND MANAGEMENT STRATEGIES IN SHOULDER IMPINGEMENT SYNDROME: PHYSIOTHERAPY AND RADIOLOGIC OVERVIEW

Elham Yahya Baamer[1*], Ali Hussain Al zuraya[2], Abdulsalam Mohammed Aloraini[3], Abdulaziz Ibrahim Aloraini[3]

[1] National Guard Primary Care, Specialized Polyclinic, Jeddah, Saudi Arabia

[2] Najran University - Najran - Saudi Arabia

[3] Qassim university - Buraiudh - Saudi arabia

Abstract:

Shoulder impingement syndrome (SIS) represents one of the most prevalent causes of shoulder pain, accounting for 40-64% of all shoulder-related complaints in clinical practice. This comprehensive review examines the integration of clinical diagnostic approaches with radiologic imaging modalities and physiotherapy interventions in the management of SIS. The pathophysiology involves mechanical compression of rotator cuff structures within the subacromial space, leading to inflammation, pain, and functional limitation. Diagnosis relies primarily on clinical examination, with imaging studies providing confirmatory evidence and guiding treatment planning. Conservative management through structured physiotherapy programs, including exercise therapy and manual techniques, demonstrates effectiveness in 60-90% of cases. This paper synthesizes current evidence on diagnostic strategies, radiologic evaluation methods, and evidence-based physiotherapy interventions, providing clinicians with an integrated framework for optimal patient management. Understanding the relationship between clinical presentation, imaging findings, and therapeutic approaches is essential for delivering effective, patient-centered care.

Keywords: *Shoulder impingement syndrome, subacromial pain syndrome, physiotherapy, diagnostic imaging*

Corresponding author:

Dr.Elham Yahya Baamer,

Consultant family medicine

QR CODE

Please cite this article in ***press Elham Yahya Baamer et al., Bridging Clinical Diagnostic And Management Strategies In Shoulder Impingement Syndrome: Physiotherapy And Radiologic Overview,*** *Indo Am. J. P. Sci, 2025; 12(12).*

1. INTRODUCTION:

Shoulder impingement syndrome (SIS), clinically recognized as subacromial impingement syndrome (SAIS), represents a significant burden in musculoskeletal healthcare. The condition affects a diverse population, from athletes performing repetitive overhead activities to the general population experiencing age-related degenerative changes. Current epidemiological data indicates that shoulder pain affects up to 25% of the general population at some point in their lives, with SIS accounting for approximately one-quarter of these cases (Horowitz & Aibinder, 2023).

The subacromial space, measuring typically 1.0 to 1.5 cm in width, becomes increasingly compressed during shoulder elevation and internal rotation, particularly at 90 degrees of abduction. This anatomical narrowing, combined with structural abnormalities or biomechanical dysfunction, leads to repetitive trauma of the rotator cuff tendons and subacromial bursa. The resulting inflammation and tissue damage manifest as pain, weakness, and functional limitation that significantly impact quality of life and work capacity.

Understanding SIS requires appreciation of both intrinsic and extrinsic factors contributing to the condition. The intrinsic theory emphasizes tendon degeneration preceding impingement, particularly inadequate vascularity in the supraspinatus tendon's critical zone. Conversely, the extrinsic theory focuses on structural abnormalities of the acromion and surrounding structures that mechanically compress the subacromial contents. Modern evidence suggests both mechanisms often coexist, necessitating comprehensive evaluation and individualized treatment approaches.

This review aims to bridge the gap between diagnostic methodologies and therapeutic interventions by examining the integration of clinical assessment, radiologic imaging, and evidence-based physiotherapy in the management of shoulder impingement syndrome.

2. Pathophysiology and Etiology

2.1 Anatomical Considerations

The subacromial space is bordered inferiorly by the humeral head and superiorly by the coracoacromial arch, which comprises the coracoacromial ligament, coracoid process, and the undersurface of the anterior third of the acromion. Structures within this space include the subacromial bursa, rotator cuff tendons (particularly the supraspinatus), and the long head of the biceps tendon. During shoulder elevation, these structures must pass beneath the coracoacromial arch, making them susceptible to mechanical compression.

2.2 Intrinsic and Extrinsic Factors

The pathogenesis of SIS involves both intrinsic and extrinsic mechanisms. Intrinsic factors include tendon degeneration related to inadequate vascularity, particularly in the supraspinatus tendon's hypovascular zone. This degenerative process is accelerated in older adults and individuals with systemic conditions such as diabetes mellitus or rheumatoid arthritis. Histopathological examination reveals disorganized collagen architecture and failed healing attempts within affected tendons.

Extrinsic factors involve structural abnormalities that reduce the subacromial space. Acromial morphology plays a crucial role, with the Bigliani classification system describing three types: Type I (flat), Type II (curved), and Type III (hooked). Type III acromions demonstrate increased association with impingement symptoms due to greater mechanical encroachment on the subacromial space. Additional extrinsic factors include acromioclavicular joint osteophytes, thickened coracoacromial ligament, and subacromial bursa inflammation.

2.3 Neer's Staging System

Neer's classification system describes the progressive nature of rotator cuff impingement across three distinct stages. Stage I affects patients typically younger than 25 years and involves reversible edema and hemorrhage of the rotator cuff and subacromial bursa. Stage II, occurring in patients aged 25-40 years, represents progression to irreversible changes including fibrosis and tendinitis. Stage III, common in patients over 40 years, involves complete mechanical disruption with rotator cuff tears and bony changes in the coracoacromial arch (Horowitz & Aibinder, 2023).

3. Clinical Diagnosis

3.1 History and Physical Examination

Thorough clinical evaluation remains the cornerstone of SIS diagnosis. Patients typically report insidious onset of anterolateral shoulder pain that worsens with overhead activities and at night. Pain often radiates to the lateral mid-humerus and may be accompanied by weakness and stiffness. Functional limitations in activities of daily living, particularly those requiring overhead reaching, are common presenting complaints.

Physical examination begins with visual inspection for muscle atrophy, scapular asymmetry, or postural abnormalities. Range of motion assessment often reveals painful arc between 60 and 120 degrees of abduction. Several provocative tests demonstrate high diagnostic sensitivity when used in combination. The Neer impingement test involves forced forward flexion of the internally rotated shoulder, reproducing pain through compression of the subacromial structures. The Hawkins-Kennedy test similarly produces pain through internal rotation at 90 degrees of forward flexion.

Additional examination components include assessment of rotator cuff strength through resisted external rotation and abduction testing. The empty can test specifically evaluates supraspinatus function. Scapular dyskinesis should be systematically evaluated, as abnormal scapular motion contributes to impingement pathology in many patients. The scapular assistance test and scapular retraction test help determine if scapular stabilization may improve symptoms.

3.2 Diagnostic Accuracy

The overall diagnostic sensitivity of physical examination for shoulder impingement syndrome reaches approximately 90% when multiple tests are combined. However, imaging studies are frequently obtained to confirm the diagnosis, rule out alternative pathologies, and guide treatment planning. The integration of clinical findings with imaging results provides the most comprehensive diagnostic approach.

4. Radiologic Evaluation

4.1 Plain Radiography

Standard radiographic evaluation includes anteroposterior and lateral (scapular Y) views of both shoulders. Plain films serve multiple purposes: detecting calcific tendinitis, evaluating acromial morphology, identifying bony spurs, and ruling out arthritis or fractures. The critical shoulder angle (CSA), measured on AP radiographs, assesses the extent of lateral acromial coverage and glenoid inclination. CSA values exceeding 35 degrees correlate with increased likelihood of rotator cuff pathology contributing to impingement.

The acromiohumeral distance (AHD), representing the space between the acromion and humeral head, helps identify superior migration of the humeral head associated with rotator cuff tears. Normal AHD measures 7-14 mm; values below 7 mm suggest rotator cuff pathology. Radiographic identification of acromial spurs, unfused os acromiale, or acromioclavicular joint changes provides valuable information for treatment planning.

4.2 Ultrasound Imaging

Ultrasound has emerged as a valuable diagnostic tool for SIS evaluation, offering real-time, dynamic assessment without radiation exposure. Dynamic ultrasound examination can directly visualize abnormal contact between the coracoacromial arch and rotator cuff structures during shoulder movement. High-resolution ultrasound demonstrates excellent sensitivity for detecting rotator cuff tears, with studies reporting 85.7% sensitivity for partial-thickness tears and 90% for full-thickness tears.

Subacromial bursa distension, visualized as hypoechoic fluid collection exceeding 2 mm thickness, indicates bursitis. Dynamic scanning during arm elevation can reveal impingement by demonstrating bursal thickening and reduced subacromial space. Ultrasound also facilitates image-guided interventions, including corticosteroid injections and therapeutic procedures.

4.3 Magnetic Resonance Imaging

MRI provides comprehensive evaluation of both osseous and soft tissue structures in the shoulder. T1-weighted and T2-weighted or proton density-weighted sequences with fat saturation optimally demonstrate rotator cuff pathology, labral lesions, and bone marrow changes. MRI excels in detecting early tendinopathy, partial-thickness tears, and associated pathologies such as labral tears or glenohumeral joint abnormalities.

Specific MRI parameters demonstrate prognostic value in SIS. The width of the subdeltoid bursa on coronal images correlates inversely with shoulder function and serves as an indicator of bursitis severity. The "halo sign" around the biceps tendon, indicating glenohumeral joint effusion, correlates with increased pain and reduced function. The critical shoulder angle and presence of subacromial osteophytes can be precisely measured on MRI, guiding treatment decisions.

Recent advances include abbreviated MRI protocols that reduce examination time to approximately 5 minutes while maintaining diagnostic accuracy. These accelerated sequences with deep learning image reconstruction show promise for efficient evaluation of shoulder pain while improving patient comfort and healthcare efficiency.

4.4 Comparative Imaging Modalities

Each imaging modality offers distinct advantages in SIS evaluation. Plain radiography provides cost-effective screening and excellent visualization of bony anatomy. Ultrasound offers dynamic assessment, lack of radiation exposure, and real-time guidance for interventions, though it remains operator-dependent. MRI provides comprehensive soft tissue evaluation and is considered the gold standard for rotator cuff assessment, though it involves higher cost and limited availability in some settings.

5. Physiotherapy Management

5.1 Evidence-Based Exercise Therapy

Exercise therapy represents the cornerstone of conservative SIS management, with strong evidence supporting its effectiveness as first-line treatment. Systematic reviews and meta-analyses consistently demonstrate that structured exercise programs improve pain, mobility, and function in patients with subacromial shoulder pain. Success rates of 60-90% are achievable with conservative management when initiated early and applied consistently for 3-6 months.

Exercise interventions should be individualized based on clinical findings, patient goals, and functional requirements. Comprehensive programs typically include several components: range of motion exercises to restore full shoulder mobility, rotator cuff strengthening to reestablish dynamic humeral head stabilization, and scapular stabilization exercises to correct dyskinesis and optimize biomechanics.

5.2 Scapular Stabilization Training

Scapular dyskinesis contributes significantly to shoulder impingement pathology, with prevalence rates of 64-100% among symptomatic patients. Scapular stabilization exercise training has emerged as a critical component of effective rehabilitation. Recent evidence demonstrates that adding scapular stabilization exercises to standard shoulder rehabilitation protocols produces superior outcomes in pain reduction, muscle strength improvement, and functional restoration.

A randomized controlled trial by Tugrul et al. (2024) demonstrated that patients receiving scapular stabilization exercises in addition to standard physiotherapy showed significantly greater improvements in scapular dyskinesis correction, pain reduction, and shoulder disability compared to those receiving standard treatment alone. The program focused on strengthening the serratus anterior, trapezius, and rhomboid muscles through progressive exercises including scapular setting, wall slides, and resistance band training.

Effective scapular stabilization programs progress through distinct phases. Initial exercises focus on scapular awareness and motor control, using tactile feedback to enhance proprioception. Intermediate phases incorporate strengthening exercises with progressive resistance, emphasizing proper scapular positioning throughout movement. Advanced phases integrate functional movement patterns specific to the patient's occupational or athletic demands.

5.3 Rotator Cuff Strengthening

Rotator cuff strengthening exercises aim to restore the dynamic stability mechanism essential for proper glenohumeral function. Progressive resistance exercises target the supraspinatus, infraspinatus, teres minor, and subscapularis muscles. Exercise progression follows pain-free principles, beginning with isometric contractions and advancing to isotonic exercises with gradually increasing resistance.

Recent research examining eccentric versus concentric strengthening protocols suggests both approaches yield beneficial outcomes. Eccentric training may provide additional benefits for tendon remodeling and pain reduction. Exercise dosage typically includes 2-3 sets of 10-15 repetitions, performed 3-4 times weekly, with regular progression based on patient tolerance and strength gains.

5.4 Manual Therapy Interventions

The role of manual therapy in SIS management remains an area of active investigation. While exercise therapy alone demonstrates effectiveness, some studies suggest that combining manual techniques with exercise may provide additional benefits in specific patient populations. Manual therapy techniques include joint mobilizations of the glenohumeral and scapulothoracic articulations, soft tissue mobilization, and neural mobilization.

A systematic review examining exercise therapy combined with manual physical therapy found no statistically significant superiority over exercise alone for long-term outcomes. However, individualized manual therapy may benefit selected patients, particularly those with significant movement restrictions or soft tissue dysfunction. The decision to incorporate manual therapy should be based on individual assessment findings and patient response.

5.5 Multimodal Physiotherapy Approaches
Contemporary physiotherapy management often employs multimodal approaches combining various interventions. A recent systematic review by Fernández-Rodríguez et al. (2024) examined combined physiotherapy treatments for shoulder pain. The most commonly used combination involved exercise plus manual therapy, though this combination was not statistically superior to exercise alone for most outcomes.

Additional modalities that may complement exercise therapy include:

Therapeutic Modalities: Ultrasound therapy, low-level laser therapy, and extracorporeal shock wave therapy show variable evidence for effectiveness. High-intensity laser therapy demonstrates promise for short-term pain reduction and functional improvement, though more robust long-term studies are needed.

Kinesiology Taping: Application of kinesiology tape may provide proprioceptive feedback and pain relief during exercise progression. Studies report modest improvements in pain-free range of motion with taping interventions.

Patient Education: Providing information about condition pathophysiology, activity modification, and self-management strategies enhances treatment adherence and outcomes. Ergonomic advice and posture correction training are particularly relevant for patients with work-related shoulder pain.

5.6 Home Exercise Programs
Home exercise programs play a crucial role in long-term management and prevention of recurrence. Studies demonstrate that supervised physiotherapy sessions combined with structured home exercises produce optimal results. Patients should receive clear written and visual instructions, with regular follow-up to ensure proper technique and progress program difficulty appropriately.

Research by Kromer et al. (2013) found that individualized exercises, whether performed under direct physiotherapist supervision or as part of a home program, effectively reduced pain and improved function in SIS patients. The addition of manual therapy contributed only minimally to outcome improvements, emphasizing the central importance of consistent exercise performance.

5.7 Treatment Duration and Progression
Typical physiotherapy programs for SIS extend 6-12 weeks, with initial intensive phase involving 2-3 sessions weekly, followed by transition to primarily home-based exercises. Treatment should continue for at least 3-6 months before considering surgical options, as many patients demonstrate progressive improvement throughout this period. Regular reassessment guides exercise progression and identifies patients who may require alternative interventions.

6. Integration of Diagnostic and Therapeutic Approaches

6.1 Clinical Decision-Making Framework
Effective management of shoulder impingement syndrome requires integration of clinical assessment, imaging findings, and therapeutic interventions within a comprehensive decision-making framework. Initial evaluation should establish the diagnosis through systematic physical examination, identifying contributing factors such as scapular dyskinesis, rotator cuff weakness, or capsular tightness.

Imaging decisions should be guided by clinical findings and treatment planning needs. Plain radiographs serve as appropriate initial imaging for most patients, evaluating bony anatomy and ruling out alternative diagnoses. Advanced imaging with ultrasound or MRI should be considered when clinical diagnosis remains uncertain, symptoms fail to respond to initial conservative treatment, or surgical intervention is being considered.

6.2 Treatment Algorithm
A systematic treatment approach begins with accurate diagnosis and patient education. Initial conservative management for 6-12 weeks should include:

1. Activity modification to reduce repetitive overhead motions
2. Structured exercise program emphasizing rotator cuff and scapular stabilization
3. Pain management with NSAIDs or analgesics as appropriate
4. Patient education regarding condition and self-management strategies

Patients showing inadequate response after 6-12 weeks of conservative treatment may benefit from additional interventions including corticosteroid injections or advanced physiotherapy techniques. Surgical consultation should be considered for patients with persistent significant disability after 3-6 months of optimal conservative management, or when imaging reveals structural abnormalities amenable to surgical correction.

6.3 Outcome Monitoring
Regular outcome assessment guides treatment progression and identifies patients requiring treatment modification. Standardized outcome measures including the Shoulder Pain and Disability Index (SPADI), Constant-Murley Score, and patient-specific functional scales provide objective documentation of treatment response. Pain intensity using visual analog scales, range of motion measurements, and strength testing complement these functional assessments.

7. Special Considerations
7.1 Overhead Athletes
Athletes performing repetitive overhead motions present unique management challenges. The increased forces and repetitive stresses applied to the shoulder often accelerate degenerative processes, causing impingement symptoms at younger ages compared to the general population. Sport-specific rehabilitation should incorporate movements that replicate athletic demands while progressively building strength and endurance.

Scapular dyskinesis is particularly prevalent among overhead athletes, with incidence rates of 30-70% reported in sports including baseball, tennis, swimming, and volleyball. Targeted scapular stabilization training tailored to the athlete's specific sport requirements is essential for successful return to play.

7.2 Elderly Population
Older adults with shoulder impingement often present with coexisting degenerative changes including rotator cuff tears and glenohumeral arthritis. Treatment goals may focus more on pain management and maintaining functional independence rather than complete symptom resolution. Exercise programs should be modified to accommodate comorbidities and general fitness levels, with emphasis on functional activities of daily living.

7.3 Occupational Considerations
Work-related shoulder pain in occupations requiring repetitive overhead work or prolonged awkward postures necessitates workplace ergonomic assessment and modification. Successful management requires collaboration between physiotherapists, occupational health professionals, and employers to implement appropriate accommodations and prevent recurrence.

8. Future Directions and Emerging Research
8.1 Advanced Imaging Techniques
Emerging imaging technologies including 3D motion analysis, advanced MRI sequences, and artificial intelligence-assisted image interpretation show promise for improving diagnostic accuracy and predicting treatment outcomes. Dynamic imaging modalities that visualize real-time shoulder biomechanics may enhance understanding of impingement mechanisms and guide targeted interventions.

8.2 Precision Rehabilitation
Future research directions include development of precision rehabilitation approaches that match specific interventions to individual patient characteristics and pathoanatomic findings. Machine learning algorithms analyzing clinical, imaging, and biomechanical data may enable prediction of treatment response and optimization of exercise prescription.

8.3 Novel Therapeutic Modalities
Ongoing research investigates novel treatment approaches including platelet-rich plasma injections, stem cell therapies, and advanced physical modalities. While early results show promise for some interventions, current evidence remains insufficient to recommend these treatments over established conservative approaches. Well-designed randomized controlled trials are needed to establish efficacy and identify appropriate patient populations.

9. CONCLUSION:
Shoulder impingement syndrome represents a common and often complex clinical condition requiring integrated diagnostic and therapeutic approaches. Accurate diagnosis relies primarily on systematic clinical examination, with imaging studies providing confirmatory evidence and guiding treatment decisions. Conservative management through structured physiotherapy programs emphasizing exercise therapy, particularly scapular stabilization and rotator cuff strengthening, demonstrates effectiveness in the majority of patients.

Successful outcomes depend on early recognition, accurate diagnosis, and implementation of individualized treatment programs addressing specific biomechanical and anatomical factors contributing to symptoms. The integration of clinical assessment, appropriate imaging evaluation, and evidence-based physiotherapy interventions within a comprehensive management framework provides the foundation for optimal patient care. Continued research examining precision rehabilitation approaches and novel therapeutic modalities will further enhance our ability to treat this prevalent condition effectively.

REFERENCES:

1. Fernández-Rodríguez, T., Férnandez-Rodríguez, A., Pérez-Montilla, J. J., Fernández-Espínola, C., Adsuar, J. C., & Carlos-Vivas, J. (2024). Which multimodal physiotherapy treatment is the most effective in people with shoulder pain? A systematic review and meta-analyses. *Healthcare*, *12*(13), 1267. https://doi.org/10.3390/healthcare12131267
2. Horowitz, E. H., & Aibinder, W. R. (2023). Shoulder impingement syndrome. *Physical Medicine and Rehabilitation Clinics of North America*, *34*(2), 311-334. https://doi.org/10.1016/j.pmr.2022.12.003
3. Kibler, W. B., & Sciascia, A. (2010). Current concepts: Scapular dyskinesis. *British Journal of Sports Medicine*, *44*(5), 300-305. https://doi.org/10.1136/bjsm.2009.058834
4. Kromer, T. O., de Bie, R. A., & Bastiaenen, C. H. (2013). Physiotherapy in patients with clinical signs of shoulder impingement syndrome: A randomized controlled trial. *Journal of Rehabilitation Medicine*, *45*(5), 488-497. https://doi.org/10.2340/16501977-1142
5. Kromer, T. O., Kohl, M., & Bastiaenen, C. H. G. (2024). Factors predicting long-term outcomes following physiotherapy in patients with subacromial pain syndrome: A secondary analysis. *BMC Musculoskeletal Disorders*, *25*(1), 579. https://doi.org/10.1186/s12891-024-07686-6
6. Lewis, J. S. (2009). Rotator cuff tendinopathy/subacromial impingement syndrome: Is it time for a new method of assessment? *British Journal of Sports Medicine*, *43*(4), 259-264. https://doi.org/10.1136/bjsm.2008.052183
7. Liaghat, B., Pedersen, J. R., Husted, R. S., Pedersen, L. L., Thorborg, K., & Juhl, C. B. (2023). Diagnosis, prevention and treatment of common shoulder injuries in sport: Grading the evidence—A statement paper commissioned by the Danish Society of Sports Physical Therapy (DSSF). *British Journal of Sports Medicine*, *57*(7), 408-416. https://doi.org/10.1136/bjsports-2022-106674
8. Michener, L. A., Walsworth, M. K., & Burnet, E. N. (2004). Effectiveness of rehabilitation for patients with subacromial impingement syndrome: A systematic review. *Journal of Hand Therapy*, *17*(2), 152-164. https://doi.org/10.1197/j.jht.2004.02.004
9. Page, M. J., Green, S., McBain, B., Surace, S. J., Deitch, J., Lyttle, N., Mrocki, M. A., & Buchbinder, R. (2016). Manual therapy and exercise for rotator cuff disease. *Cochrane Database of Systematic Reviews*, *2016*(6), CD012224. https://doi.org/10.1002/14651858.CD012224
10. Roddey, T. S., Olson, S. L., & Grant, S. E. (2002). The effect of pectoralis muscle stretching on the resting position of the scapula in persons with varying degrees of forward head/rounded shoulder posture. *Journal of Manual & Manipulative Therapy*, *10*(3), 124-128. https://doi.org/10.1179/106698102790819247
11. Steuri, R., Sattelmayer, M., Elsig, S., Kolly, C., Tal, A., Taeymans, J., & Hilfiker, R. (2017). Effectiveness of conservative interventions including exercise, manual therapy and medical management in adults with shoulder impingement: A systematic review and meta-analysis of RCTs. *British Journal of Sports Medicine*, *51*(18), 1340-1347. https://doi.org/10.1136/bjsports-2016-096515
12. Tugrul, E., Duzgun, I., & Eraslan, L. (2024). Scapular stabilization exercise training improves treatment effectiveness on shoulder pain, scapular dyskinesis, muscle strength, and function in patients with subacromial pain syndrome: A randomized controlled trial. *Journal of Bodywork and Movement Therapies*, *37*, 101-108. https://doi.org/10.1016/j.jbmt.2023.11.005
13. Varacallo, M. A., El Bitar, Y., Sina, R. E., & Mair, S. D. (2024). Rotator cuff syndrome. In *StatPearls*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK531506/
14. Wen, M., Hu, X., & Bao, G. (2025). Scapular dyskinesis-based exercise therapy versus multimodal physical therapy for subacromial impingement syndrome in young overhead athletes with scapular dyskinesis: A randomized controlled trial. *BMC Sports Science, Medicine and Rehabilitation*, *17*(1), 204. https://doi.org/10.1186/s13102-025-01254-8
15. Zhong, Z., Zang, W., Tang, Z., Pan, Q., Yang, Z., & Chen, B. (2024). Effect of scapular stabilization exercises on subacromial pain (impingement) syndrome: A systematic review and meta-analysis of randomized controlled trials. *Frontiers in Neurology*, *15*, 1357763. https://doi.org/10.3389/fneur.2024.1357763