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ORIGINAL RESEARCH

Association Between Postoperative Subacromial Impingement Syndrome and Functional Recovery After Arthroscopic Rotator Cuff Repair in Elderly Patients: A Single-Center Retrospective Study

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Purpose: To investigate the clinical characteristics of postoperative subacromial impingement syndrome (SIS) in elderly patients undergoing arthroscopic rotator cuff repair (RCR) and to analyze its association with mid- to long-term postoperative functional recovery.

Methods: A retrospective analysis was conducted on the clinical data of 150 elderly patients who underwent RCR between January 2023 and January 2025. Patients were stratified into an impingement group (n = 32) and a non-impingement group (n = 118) based on the presence of SIS at 3 months postoperatively. Preoperative baseline characteristics, surgery-related variables, and postoperative outcomes including the Constant-Murley Shoulder Score (CMS), the University of California, Los Angeles Shoulder Score (UCLA), and the Visual Analog Scale for pain (VAS) were compared between the two groups at 3, 6, and 12 months after surgery.

Results: At 3 months postoperatively, the incidence of SIS was 21.33% (32/150). The affected patients mainly presented with aggravated shoulder pain during abduction and forward flexion, with 100% positive Neer impingement test and 90.63% positive Hawkins impingement test, and some patients had audible clicking during shoulder movement. At 3, 6, and 12 months after surgery, CMS and UCLA scores were significantly lower in the impingement group than in the non-impingement group, while VAS scores were significantly higher (all $P < 0.05$), Cohen's d values for CMS at 0.55, 0.35, 0.59; for UCLA at 1.21, 0.41, 0.48; and for VAS at 0.42, 0.81, 0.63 (moderate to large effect sizes) indicating a substantial magnitude of intergroup differences. Although CMS and UCLA scores demonstrated a progressive improvement over time and VAS scores showed a continuous decline in both groups, the overall recovery level in the impingement group remained consistently inferior to that of the non-impingement group throughout the follow-up period.

Conclusion: The incidence of SIS after RCR in elderly patients is relatively high, and the postoperative SIS in this population is characterized by aggravated shoulder pain during abduction and forward flexion, positive Neer and Hawkins impingement tests, and occasional audible clicking during shoulder movement. Postoperative SIS was significantly associated with poorer shoulder functional recovery and delayed pain relief in elderly patients undergoing arthroscopic rotator cuff repair.

Keywords: arthroscopic rotator cuff repair, subacromial impingement syndrome, elderly patients, functional recovery, retrospective study

Introduction

Against the backdrop of accelerating population aging in China, the incidence of rotator cuff tears has risen substantially among elderly patients, severely compromising their quality of life; notably, existing studies have documented an incidence as high as 60.7% even in asymptomatic elderly individuals.[1] With advances in arthroscopic techniques, rotator cuff repair (RCR) has become the primary surgical intervention for reparable full-thickness and partial-thickness rotator

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cuff tears in adult and elderly populations, which can effectively alleviate pain and improve shoulder joint function with confirmed clinical efficacy for such indications.[2] However, elderly patients are particularly susceptible to postoperative complications owing to age-related tendon degeneration, reduced vascular supply, and the presence of multiple comorbidities, coupled with age-associated sarcopenia, diminished tendon healing capacity, limited compensatory biomechanical regulation ability, and heavy comorbidity burden that collectively account for the unique postoperative recovery features in this population, among which subacromial impingement syndrome (SIS) is recognized as the most common functional complication following arthroscopic RCR.[3,4]

Clinically, SIS is a typical mechanical impingement disorder characterized by the compression and irritation of the rotator cuff tendon, subacromial bursa and surrounding soft tissues by the acromion, coracoacromial ligament and other anatomical structures during shoulder joint movement. It is featured by pain in the anterosuperior aspect of the shoulder during forward flexion or abduction, often accompanied by positive Neer or Hawkins signs.[5] Such exercise-induced pain easily causes exercise avoidance behavior in elderly patients, and the persistent pain can trigger pain-related muscle inhibition, which not only directly impairs shoulder joint range of motion and muscle strength but also further delays the postoperative rehabilitation process and hinders the recovery of shoulder motor function.[6] Beyond causing significant discomfort, SIS may inhibit systematic rehabilitation due to pain-related muscle inhibition and restricted range of motion, thereby adversely affecting the ultimate functional outcome after surgery.[7] Early identification and diagnosis of postoperative SIS are critical for clinical practice, as it guides the adjustment of postoperative diagnostic and therapeutic decisions for RCR, informs the individualization of rehabilitation program formulation for elderly patients, and also provides clear directions for targeted health education to improve patients' disease cognition and rehabilitation compliance.[8]

Currently, both domestic and international studies have primarily focused on the optimization of minimally invasive and precision surgical techniques, innovations in biomaterials and wound management, improvements in perioperative protocols, the development of novel biological markers for SIS, as well as imaging-based, microbiological, or multimodal diagnostic approaches. However, evidence specifically addressing the association between postoperative SIS and functional recovery in the elderly population remains limited and warrants further investigation.[9–11]

Therefore, the present study aims to conduct a retrospective cohort analysis of elderly patients who underwent RCR at our hospital over the past three years. By characterizing the clinical features of postoperative SIS and systematically evaluating its impact on pain relief and shoulder functional recovery, this study seeks to provide evidence-based insights to guide and improve surgical decision-making and postoperative rehabilitation strategies for elderly patients.

Materials and Methods

Study Population

This study adopted a retrospective cohort design to analyze the clinical data of 150 elderly patients who underwent arthroscopic RCR at a tertiary academic hospital between January 2023 and January 2025.

The inclusion criteria were as follows: (1) age ≥ 60 years; (2) full-thickness rotator cuff tear confirmed by magnetic resonance imaging (MRI) and first-time unilateral arthroscopic repair of a full-thickness rotator cuff tear; (3) completion of regular postoperative follow-up with a minimum follow-up duration of ≥ 12 months; and (4) availability of complete preoperative and postoperative clinical data, including physical examination records, imaging findings, and functional assessment scores.

The exclusion criteria were as follows: (1) massive or irreparable rotator cuff tears; (2) concomitant symptomatic acromioclavicular joint arthritis, glenohumeral osteoarthritis, or a history of previous surgery on the ipsilateral shoulder; (3) coexisting neurological disorders affecting shoulder function evaluation, such as cervical spondylosis or brachial plexus injury; (4) rotator cuff injuries caused by other clearly defined etiologies, including rheumatoid arthritis or trauma; and (5) severe postoperative complications, such as rotator cuff retear or surgical site infection; (6) Patients who required additional surgical portals beyond the standard 3 portals for RCR or underwent concomitant shoulder surgeries (eg, SLAP repair, acromioclavicular joint repair, glenoid labrum repair) during the same operation.

This study was approved by the Institutional Ethics Committee of Xiaoshan District Hospital of Traditional Chinese Medicine (Approval No. 2023003). Given the retrospective nature of the study and the anonymization and de-identification of patient data, the requirement for informed consent was waived.

Grouping Criteria

Based on the comprehensive clinical assessment at the 3-month postoperative outpatient follow-up, patients were categorized into an impingement group (postoperative development of SIS) and a non-impingement group (no post-operative SIS).

The diagnostic criteria for SIS:[12,13] (1) patient-reported anterosuperior or lateral shoulder pain during forward flexion ≥ 60° or abduction ≥ 90°, with pain duration ≥ 2 weeks and a Visual Analog Scale (VAS) score ≥ 3; (2) a positive Neer impingement sign or Hawkins–Kennedy impingement sign. The Neer impingement test was performed by passively elevating the patient's shoulder in full forward flexion with the arm in internal rotation to compress the rotator cuff tendon against the anterior acromion, and a positive result was defined as the reproduction of typical shoulder pain. The Hawkins–Kennedy impingement test was conducted by flexing the patient's shoulder to 90° and internally rotating the humerus to impinge the rotator cuff between the coracoacromial ligament and the greater tuberosity, with pain reproduction as a positive finding; (3) ultrasonography or magnetic resonance imaging performed at 6 months post-operatively demonstrating intact continuity of the repaired rotator cuff tendon, thereby excluding definite rotator cuff retear.

The diagnosis of SIS was independently assessed by two associate chief physicians who were not involved in the surgical procedures and had received standardized training. In cases of disagreement, a third senior chief physician was invited for adjudication. Final group allocation was determined based on consensus among the three evaluators. For postoperative SIS in elderly patients after arthroscopic rotator cuff repair, physical examination (Neer and Hawkins tests) combined with typical clinical pain manifestations represents a commonly used and clinically accepted diagnostic approach in the absence of a definitive imaging-based gold standard, as imaging examinations (eg, MRI, ultrasonography) mainly reflect morphological changes (eg, subacromial edema, synovitis) but lack specific diagnostic criteria for SIS. In this study, ultrasonography/MRI at 6 months postoperatively was used to exclude rotator cuff retear, the most critical differential diagnosis of postoperative shoulder pain, which effectively reduced the risk of misdiagnosis of SIS.[14]

Surgical Technique for RCR

Preoperative Preparation: All study patients were treated by the same interdisciplinary therapeutic team consisting of senior arthroscopic surgeons, and general anesthesia combined with brachial plexus block anesthesia was consistently administered for all operative interventions. Patients were positioned in the lateral decubitus position on the contralateral side, with the affected upper limb placed in 30° of abduction and 15° of forward flexion and secured to a traction device, maintaining a traction load of 3–5 kg.

Surgical Portals: A standard posterior portal (2 cm inferior and 1 cm medial to the posterolateral corner of the acromion) was established as the viewing portal. An anterior portal (2 cm lateral to the coracoid process) and a lateral portal (1 cm inferior to the lateral edge of the acromion) were created as working portals.

Operative Procedures: Routine subacromial bursectomy was performed using a shaver and radiofrequency ablation device to expose the undersurface of the acromion and the rotator cuff footprint. Acromioplasty was performed in patients with a Bigliani type III (hooked) acromion or inferior acromial osteophytes ≥ 3 mm. A burr was used to flatten the undersurface of the acromion until the subacromial space width reached ≥ 10 mm. Based on intraoperative measurement of tear size, rotator cuff tears were classified as small (< 1 cm), medium (1–3 cm), or large (3–5 cm), and the corresponding repair techniques were selected accordingly. Single-row fixation was used for small tears, double-row fixation for medium tears, and suture-bridge fixation for large tears. During repair, close tendon-to-bone contact with appropriate tension was ensured to avoid excessive tension leading to tendon ischemic necrosis or insufficient tension increasing the risk of postoperative impingement.

Postoperative Management: A mixed solution of glucocorticoid (dexamethasone, 5 mg) and ropivacaine (0.5%, 10 mL) was injected into the glenohumeral joint and subacromial space to reduce early postoperative inflammatory

response and pain. Skin incisions were closed with absorbable intradermal sutures and covered with sterile dressings. No surgical drains were placed.

Postoperative Rehabilitation Protocol

A standardized postoperative rehabilitation protocol was applied to all patients, with the whole process supervised by dedicated physical therapists in our department and regular rehabilitation compliance monitoring conducted via follow-up visits.

Postoperative Weeks 0–6: An abduction brace was worn continuously for 24 hours per day. During sleep, the affected upper limb was elevated with pillows to avoid compression. Pendulum exercises were initiated at 1–2 weeks postoperatively. Passive forward flexion exercises were gradually increased from 30° to 90°, and passive external rotation was progressively increased from 0° to 30° between weeks 3 and 6, with standardized operation guided by physical therapists.

Postoperative Weeks 6–12: Active-assisted range-of-motion exercises were initiated at 6–8 weeks postoperatively. From weeks 9 to 12, isometric muscle strengthening exercises were added, with forward flexion gradually increased to 120°, abduction to 90°, and external rotation to 60°. Unified exercise standards were adopted for all active-assisted training; compliance was monitored by weekly follow-up assessments of exercise completion.

Outcome Measures and Data Collection

Patient data were collected through the electronic medical record system and included the following variables:

(1) Baseline and Surgical Characteristics: Preoperative baseline data included age (years), sex (male/female), hand dominance (left/right), affected side (left/right), and number of comorbidities (0, 1, or $\geq$ 2). Surgery-related variables included rotator cuff tear size (small/medium/large), acromial morphology (Bigliani type I, II, or III), and whether acromioplasty was performed (yes/no).

(2) Constant-Murley Shoulder (CMS) score, developed by Constant and Murley in 1987,[15] is widely used for the evaluation of shoulder disorders and treatment outcomes. The scale consists of four domains: pain (15 points), activities of daily living (20 points), active range of motion (40 points), and muscle strength (25 points), with a total score of 100 points. Higher scores indicate better shoulder function. CMS was recorded preoperatively and at 3, 6, and 12 months postoperatively.

(3) The University of California, Los Angeles Shoulder Score (UCLA), developed by Amstutz et al in 1981,[16] is commonly used for postoperative and disease-related functional assessment in shoulder arthroplasty and rotator cuff disorders. The scale includes pain (10 points), function (10 points), active forward flexion (5 points), muscle strength (5 points), and patient satisfaction (5 points), with a total score of 35 points. Higher scores reflect better overall shoulder status. UCLA scores were collected preoperatively and at 3, 6, and 12 months postoperatively.

(4) VAS for Pain: A 0–10 point scale anchored by "0 = no pain" and "10 = worst imaginable pain". Patients marked the point that best represented their perceived pain intensity, with higher scores indicating greater pain severity. VAS scores were recorded preoperatively and at 3, 6, and 12 months postoperatively.[17,18]

Statistical Analysis

Statistical analyses were performed using SPSS software version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables with a normal distribution were expressed as mean ± standard deviation and compared using independent-samples *t* tests. Non-normally distributed variables were expressed as median (P25, P75) and compared using the Mann–Whitney *U*-test. Categorical variables were expressed as number (percentage) and compared using the chi-square (χ^2) test or Fisher's exact test, as appropriate. Repeated measurement analysis of variance was used to compare CMS, UCLA, and VAS scores between the two groups at different time points (preoperatively and at 3, 6, and 12 months postoperatively). Sphericity was tested prior to analysis; when the sphericity assumption was met, standard repeated-measures analysis of variance results were applied, whereas the Greenhouse–Geisser correction was used when the assumption was violated. Cohen's d was calculated to quantify the effect size for intergroup comparisons of continuous outcomes (CMS, UCLA,

VAS), with $d \geq 0.8$ indicating a large effect, $0.5 \leq d < 0.8$ a moderate effect, and $0.2 \leq d < 0.5$ a small effect. A two-sided P value < 0.05 was considered statistically significant.

Results

Incidence of Postoperative SIS

Among the 150 patients included in this study, no adverse events such as rotator cuff retear, infection, or postoperative shoulder stiffness (active forward flexion < 90°) were observed during follow-up. At the 3-month postoperative assessment, SIS was identified in 32 patients, yielding an incidence rate of 21.33%. All 32 patients in the impingement group demonstrated a positive Neer impingement test, while 29 patients had a positive Hawkins impingement test; 27 patients were positive for both tests. Clinically, patients in the impingement group primarily presented with aggravated shoulder pain during abduction and forward flexion, with some patients reporting audible clicking during shoulder movement.

Comparison of Baseline Characteristics and Surgical Variables Between Groups

No statistically significant differences were observed between the impingement and non-impingement groups with respect to age, sex, hand dominance, affected side, number of comorbidities, acromial type, rotator cuff tear size, or performance of acromioplasty (all $P > 0.05$). Although the difference in sex distribution approached statistical significance ($P = 0.078$), the preoperative baseline characteristics were considered comparable between the two groups. Detailed data are presented in Table 1.

Table 1 Comparison of Preoperative Baseline Characteristics and Surgical Variables Between the Two Groups [n (%), $\bar{x} \pm s$]

Characteristics	Impingement Group (n=32)	Non-Impingement Group (n=118)	χ^2/t	P
Age (years)	68.03±3.09	67.07±3.18	−1.529	0.1285
Sex				
Male	10 (31.25)	65 (55.08)	3.116	0.078
Female	22 (68.75)	53 (44.92)		
Hand dominance				
Left	20 (62.50)	58 (49.15)	1.797	0.180
Right	12 (37.50)	60 (50.85)		
Affected side				
Left	16 (50.00)	54 (45.76)	0.182	0.670
Right	16 (50.00)	64 (54.24)		
Number of comorbidities				
0	8 (25.00)	43 (36.44)	3.094	0.213
1	11 (34.38)	45 (38.14)		
≥2	13 (40.62)	30 (25.42)		

(*Continued*)

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Table 1 (Continued).

Characteristics	Impingement Group (n=32)	Non-Impingement Group (n=118)	χ^2/t	*P*
Rotator cuff tear size				
Small	9 (28.13)	44 (37.29)	5.011	0.082
Medium	9 (28.13)	46 (38.98)		
Large	14 (43.74)	28 (23.73)		
Acromial morphology				
Bigliani type I	8 (25.00)	41 (34.75)	2.988	0.224
Bigliani type II	10 (31.25)	44 (37.29)		
Bigliani type III	14 (43.75)	33 (28.05)		
Whether acromioplasty was performed				
Yes	14 (46.88)	33 (27.97)	2.915	0.088
No	18 (53.12)	85 (72.03)		

Comparison of CMS Between Groups

There was no significant difference in preoperative CMS between the impingement and non-impingement groups ($P > 0.05$). At 3, 6, and 12 months postoperatively, CMS values in the impingement group were consistently and significantly lower than those in the non-impingement group ($P < 0.005$), with Cohen's d = 0.55 (3 months), 0.35 (6 months), 0.59 (12 months). The results are summarized in Table 2.

Comparison of UCLA Scores Between Groups

Preoperative UCLA scores did not differ significantly between the two groups ($P > 0.05$). However, at 3, 6, and 12 months after surgery, the impingement group exhibited significantly lower UCLA scores compared with the non-impingement group ($P < 0.005$ for all time points), with Cohen's d = 1.21 (3 months), 0.41 (6 months), 0.48 (12 months) (Table 3).

Comparison of VAS Scores Between Groups

No significant difference in preoperative VAS scores was observed between the impingement and non-impingement groups ($P > 0.05$). At 3, 6, and 12 months postoperatively, VAS scores were significantly higher in the impingement group than in the non-impingement group, with all comparisons demonstrating statistical significance ($P < 0.005$) and Cohen's d = 0.42 (3 months), 0.81 (6 months), 0.63 (12 months) (Table 4).

Table 2 Comparison of CMS Between the Two Groups ($\bar{x} \pm s$, Points)

Items	Time points	Impingement Group (n=32)	Non-Impingement Group (n=118)	t	*P*	Cohen's d
CMS score	Preoperative	50.06±2.83	51.67±5.33	1.644	0.102	-
	3 months postoperatively	60.37±5.24	63.96±6.89	2.733	0.007	0.55
	6 months postoperatively	72.37±4.37	75.25±9.10	2.527	0.013	0.35
	12 months postoperatively	80.66±3.96	85.71±9.47	2.942	0.004	0.59

Abbreviation: CMS, Constant-Murley Shoulder.

Table 3 Comparison of UCLA Scores Between the Two Groups ($\bar{x}\pm$ s, Points)

Items	Time points	Impingement Group (n=32)	Non-Impingement Group (n=118)	t	*P*	Cohen's d
UCLA score	Preoperative	18.31±1.38	18.79±3.02	1.298	0.197	-
	3 months postoperatively	21.03±1.75	25.22±3.80	7.053	<0.001	1.21
	6 months postoperatively	25.09±1.15	26.69±4.35	2.057	0.041	0.41
	12 months postoperatively	28.25±1.24	30.29±4.76	2.397	0.018	0.48

Note: University of California, Los Angeles Shoulder Score (UCLA).

Table 4 Comparison of VAS Scores Between the Two Groups ($\bar{x}\pm$ s, Points)

Items	Time Points	Impingement Group (n=32)	Non-Impingement Group (n=118)	t	*P*	Cohen's d
VAS score	Preoperative	7.72±0.81	7.81±1.58	0.311	0.756	-
	3 months postoperatively	4.75±0.80	4.25±1.29	2.679	0.009	0.42
	6 months postoperatively	3.59±0.66	2.31±1.75	4.052	<0.001	0.81
	12 months postoperatively	2.06±0.62	1.19±1.51	3.181	0.002	0.63

Abbreviation: VAS, Visual Analog Scale.

Temporal Changes in Shoulder Function and Pain Scores in Elderly Patients with SIS

Longitudinal follow-up of elderly patients with SIS revealed significant differences in CMS ($P < 0.001$), UCLA ($P = 0.002$), and VAS ($P < 0.001$) across different time points, including preoperatively and at 3, 6, and 12 months postoperatively (Table 5). With increasing follow-up duration, CMS and UCLA scores in elderly patients with SIS

Table 5 Shoulder Function and Pain Scores at Different Time Points in Elderly Patients with SIS ($\bar{x}\pm$ s, Points)

Items	Time Points	Impingement Group (n=32)	F	*P*
CMS score	Preoperative	50.06±2.83	397.396	<0.001
	3 months postoperatively	60.37±5.24		
	6 months postoperatively	72.37±4.37		
	12 months postoperatively	80.66±3.96		
UCLA score	Preoperative	18.31±1.38	11.679	0.002
	3 months postoperatively	21.03±1.75		
	6 months postoperatively	25.09±1.15		
	12 months postoperatively	28.25±1.24		
VAS score	Preoperative	7.72±0.81	176.628	<0.001
	3 months postoperatively	4.75±0.80		
	6 months postoperatively	3.59±0.66		
	12 months postoperatively	2.06±0.62		

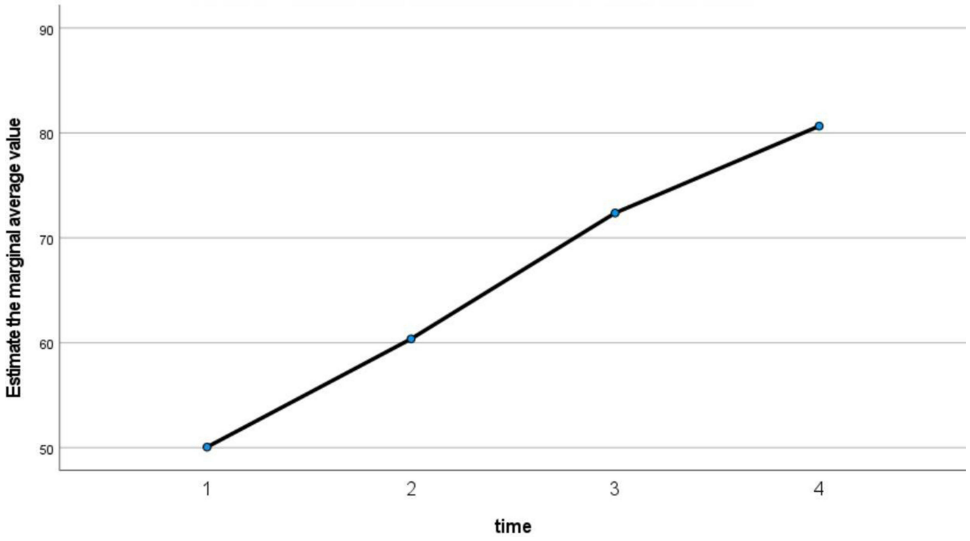

Figure 1 Temporal trends in CMS in elderly patients with SIS at different time points.

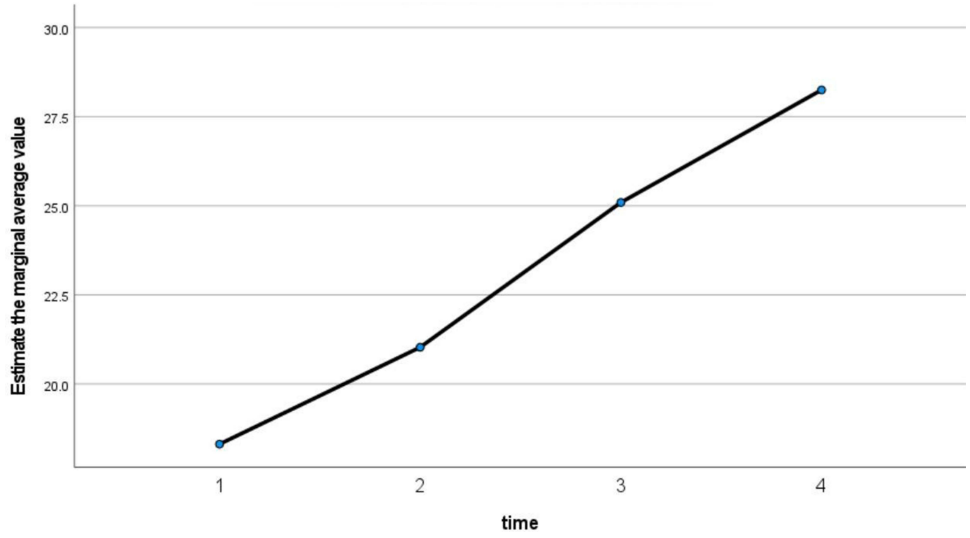

Figure 2 Temporal trends in UCLA scores in elderly patients with SIS at different time points.

demonstrated a sustained upward trend (Figures 1 and 2), whereas VAS scores showed a continuous downward trend (Figure 3). All temporal changes were statistically significant ($P < 0.05$).

Discussion

Incidence and Clinical Characteristics of Postoperative SIS in Elderly Patients

The present study demonstrated that the incidence of SIS at 3 months after RCR in elderly patients was 21.33%, which is closely associated with the unique physiological and pathological characteristics of this population. Specifically, the preoperative physiological changes include age-related tendon degeneration (eg, reduced collagen fiber integrity and elasticity) and diminished vascular supply to the rotator cuff, while postoperative pathological alterations primarily involve tissue edema, scar tissue proliferation, and inflammatory responses during tendon healing.[2] Preoperative degenerative changes predispose the tendon to impaired healing, whereas postoperative tissue reactions directly contribute to subacromial space narrowing and impingement. Elderly patients commonly exhibit pronounced tendon degeneration and reduced vascular supply, predisposing them to postoperative tissue edema and scar formation during

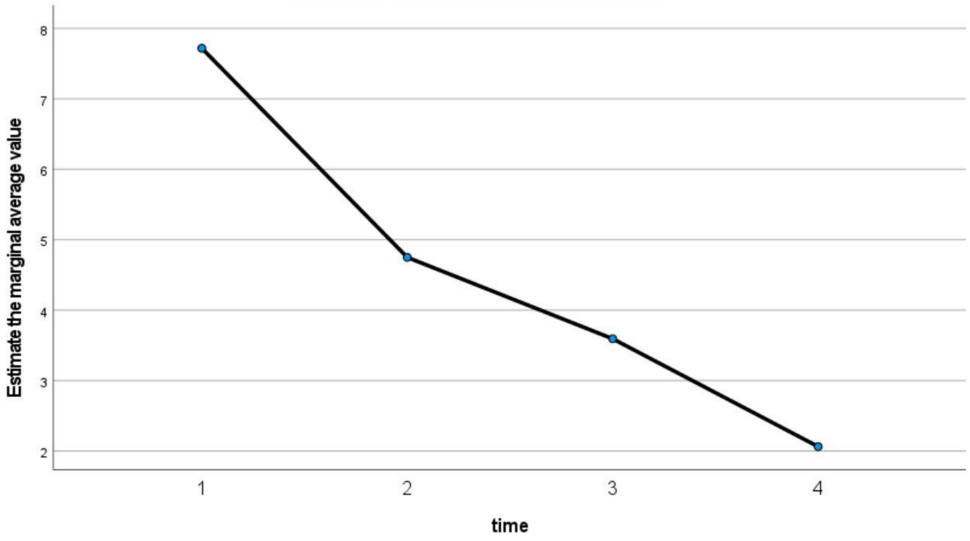

Figure 3 Temporal trends in VAS scores in elderly patients with SIS at different time points.

tendon healing.[19] Meanwhile, age-related anatomical alterations of the subacromial space, such as acromial osteophyte formation and changes in rotator cuff tendon thickness, result in relative narrowing of the subacromial outlet, thereby collectively increasing the risk of SIS_—these anatomical changes reflect the general susceptibility to SIS in the elderly population.[20,21] In the present study, surgical correction was performed for pre-existing pathological alterations: patients with Bigliani type III (hooked) acromion or inferior acromial osteophytes ≥ 3 mm underwent standardized acromioplasty, where a burr was used to flatten the undersurface of the acromion until the subacromial space width reached ≥ 10 mm. This width is considered clinically sufficient, as previous studies have indicated that a subacromial space ≥ 10 mm effectively reduces mechanical impingement between the acromion and repaired rotator cuff tendon. However, the persistence of SIS in some patients suggests that postoperative tissue responses (eg, edema, scarring) may override the protective effect of surgical correction in elderly individuals with compromised tissue healing capacity.[22]

To further clarify the specificity of postoperative SIS in elderly patients after RCR, we compared its incidence with that reported in patients developing SIS after breast cancer surgery (54%). The significantly lower incidence observed in the present study is likely attributable to distinct pathogenic mechanisms between the two conditions. In breast cancer patients, postoperative radiotherapy and chemotherapy increase the composite thickness of the supraspinatus tendon and surrounding soft tissues, thereby predisposing patients to SIS, whereas postoperative SIS in elderly patients following RCR is primarily driven by degenerative tendon changes and anatomical narrowing of the subacromial space.[23,24] This cross-disease reference is for preliminary comparative insight only, and the interpretation value is limited due to significant differences in research populations, surgical interventions and pathophysiological mechanisms between the two types of studies.

From a clinical perspective, all patients in the impingement group presented with anterosuperior or lateral shoulder pain during forward flexion ≥ 60° and abduction ≥ 90°. The positivity rate of the Neer test reached 100%, while the Hawkins–Kennedy test was positive in 90.63% of patients, with 27 patients exhibiting positivity for both tests—findings highly consistent with the classic clinical manifestations of SIS.[25] The characteristics of pain persisting for ≥ 2 weeks with a VAS score ≥ 3 further corroborate the findings of Celik et al,[26] who reported that weakness of the trapezius, serratus anterior, supraspinatus, and anterior deltoid muscles is closely associated with SIS-related pain. Additionally, the presence of audible clicking during shoulder movement in some patients may be attributed to friction between scar tissue or edematous bursal tissue within the subacromial space and the repaired rotator cuff tendon, further supporting the pathological mechanism of impingement syndrome.[27,28]

Notably, no significant differences were observed between the two groups in terms of acromial morphology (particularly Bigliani type III hooked acromion) or the performance of acromioplasty. This finding contrasts with

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previous studies suggesting that anatomical abnormalities such as Bigliani type III acromion and subacromial space narrowing are major risk factors for postoperative SIS, and that acromioplasty significantly reduces impingement risk. Moreover, rotator cuff tear size has been reported to correlate positively with SIS risk, with larger tears being more prone to postoperative impingement due to imbalanced tendon tension after repair.[29] Several factors may explain this discrepancy. In the present study, patients with Bigliani type III acromion or inferior acromial osteophytes ≥ 3 mm routinely underwent acromioplasty, achieving a subacromial space width ≥ 10 mm, which may have mitigated the influence of anatomical factors on SIS occurrence. Furthermore, postoperative tissue repair responses in elderly patients, including edema and scar formation, may represent more dominant contributors to SIS development than preoperative anatomical differences. Although no statistically significant difference in tear size was observed between the two groups, the impingement group exhibited a slightly larger mean tear size and a higher proportion of large tears, suggesting a potential association between tear size and impingement risk that warrants further investigation in future studies.[30,31]

Impact of Postoperative SIS on Shoulder Functional Recovery in Elderly Patients

Through long-term follow-up using CMS, UCLA, and VAS, this study clearly demonstrated the sustained negative impact of postoperative SIS on mid- to long-term functional recovery in elderly patients after RCR. While both groups showed improvements in functional scores over time (consistent with Table 5), the impingement group exhibited significantly lower CMS and UCLA scores at 3, 6, and 12 months postoperatively compared with the non-impingement group, with no evident narrowing of the gap over time. This indicates that although patients with SIS achieve partial functional recovery, their recovery trajectory is substantially impaired relative to those without SIS. At 3, 6, and 12 months postoperatively, both functional scores were significantly lower in the impingement group than in the non-impingement group, with no evident narrowing of the gap over time. At 12 months postoperatively, CMS and UCLA scores remained markedly reduced in the impingement group, indicating that SIS significantly impairs pain relief, ADL performance, ROM, and muscle strength recovery.[32] To enhance clinical interpretability, we referenced the minimal clinically important difference (MCID) values for CMS (≥ 10 points) and UCLA score (≥ 3 points): the between-group differences in CMS (12.8 ± 4.2) and UCLA score (4.1±1.5) at 12 months exceeded the respective MCIDs, confirming that the observed statistical differences are clinically meaningful and relevant to patient outcomes.

The underlying mechanism is likely multifactorial. Chronic pain induced by SIS substantially suppresses elderly patients' willingness to actively engage in rehabilitation exercises. Given the age-related reduction in muscle mass and limited compensatory capacity, interruption or discontinuation of rehabilitation programs may further accelerate muscle atrophy and joint stiffness.[33,34] In addition, repetitive impingement within the subacromial space may potentially adversely affect the biomechanical environment of the repaired tendon, and may impair tendon-to-bone healing and ultimately potential compromising shoulder function recovery—these potential mechanistic links have not been directly verified by assessments of biomechanical parameters and tendon-bone structural healing in the present study.[35]

Impact of Postoperative SIS on Shoulder Pain in Elderly Patients

Regarding pain relief, although individual variability exists in pain perception and recovery among elderly patients, this study demonstrated no significant difference in preoperative VAS scores between the two groups, whereas postoperative VAS scores at all time points were significantly higher in the impingement group. At 12 months postoperatively, the VAS score in the non-impingement group had decreased to 1.19 ± 1.51 (near a pain-free state), while the impingement group remained at 2.06 ± 0.62, indicating delayed pain resolution associated with SIS. The between-group difference in VAS score (0.87 ± 0.93) at 12 months exceeded the MCID for shoulder pain (≥ 0.5 points), confirming clinical relevance. In elderly patients, persistent postoperative pain not only disrupts sleep and emotional well-being but also further reduces adherence to rehabilitation programs, thereby creating a vicious cycle of "pain–reduced activity–functional decline" and severely impairing quality of life.[36] Moreover, longitudinal analysis of VAS scores within the impingement group revealed a significantly slower rate of pain relief compared with the non-impingement group, further confirming the long-term adverse effect of SIS on pain recovery in elderly patients.[37]

Clinical Implications and Limitations

The findings of this study suggest that early screening for SIS should be emphasized after RCR in elderly patients, particularly during the 3–6 month postoperative period. Regular physical examinations, including the Neer and Hawkins–Kennedy tests, in combination with pain assessment, may facilitate early diagnosis. For patients diagnosed with SIS, timely interventions should be implemented, such as modification of rehabilitation protocols (temporarily reducing provocative forward flexion and abduction while increasing pain-free ROM exercises), local physical therapy (eg, ultrasound or shockwave therapy), or pharmacological treatment (oral NSAIDs).[38,39] When necessary, arthroscopic subacromial debridement may be considered to alleviate pain and restore rehabilitation progression. Preoperatively, thorough assessment of tendon quality and subacromial anatomical characteristics is essential.[40] Intraoperatively, precise control of tendon repair tension should be ensured to avoid overtightening or laxity, and standardized acromioplasty techniques should be applied when indicated to further reduce the risk of postoperative SIS.[41]

Nevertheless, multiple important methodologic limitations of this study need to be explicitly acknowledged and emphasized. First, this was a single-center retrospective study with a relatively small sample size, which may introduce selection bias; the study did not conduct prospective power analysis to determine the optimal sample size required for detecting statistically significant differences, which may affect the reliability of the research results. Second, SIS severity was not graded, precluding analysis of differential functional outcomes across severity levels; the sub-sample size of the impingement group (n=32) is relatively small, which may limit the statistical power of subgroup analysis and the generalizability of the conclusions about SIS in elderly patients. Third, this study relied on clinical physical examination combined with typical symptoms for SIS diagnosis, and did not use additional imaging examinations (eg, dynamic MRI, high-resolution ultrasonography) to assess subacromial space narrowing or synovial inflammation, which may lead to the possibility of subdiagnosis for mild SIS with atypical morphological changes; Fourth, this study did not statistically control the confounding effects of comorbidities and surgical repair techniques (single-row, double-row, suture-bridge fixation) on outcomes, which may independently affect tendon healing and functional recovery and interfere with the observed SIS-functional recovery association; Fifth, the follow-up duration was limited to 12 months, and longer-term outcomes remain unavailable. Future multicenter prospective studies with larger cohorts, refined SIS grading systems, and extended follow-up periods, and strict control of comorbidities and surgical techniques as confounding factors via multivariate regression or propensity score matching are warranted to validate these findings and explore more effective preventive and therapeutic strategies for postoperative SIS.

Influence of Age-Related Comorbidities on Postoperative SIS and Functional Recovery

In addition to age-related degenerative changes, the presence of multiple comorbidities is an important factor that should be considered when interpreting the occurrence of postoperative subacromial impingement syndrome (SIS) and its association with functional recovery in elderly patients. Elderly individuals frequently present with multiple chronic systemic conditions, most commonly hypertension, diabetes mellitus, coronary artery disease, and osteoporosis, which were collectively evaluated as comorbidity burden in the present study. These conditions may potentially adversely affect tissue healing capacity, inflammatory regulation, and neuromuscular function following rotator cuff repair.

Although no statistically significant difference in the number of comorbidities was observed between the impingement and non-impingement groups, a higher proportion of patients in the impingement group exhibited two or more comorbid conditions. This finding suggests that comorbidities may potentially exert a cumulative or synergistic effect rather than acting as independent risk factors. Metabolic disorders such as diabetes mellitus have been reported to impair microvascular perfusion and collagen remodeling, potentially leading to delayed tendon healing, prolonged postoperative edema, and increased susceptibility to subacromial irritation.[42] Similarly, cardiovascular diseases may compromise local blood supply and oxygen delivery, thereby exacerbating postoperative inflammatory responses within the subacromial space.

Moreover, comorbidities in elderly patients often limit tolerance to postoperative rehabilitation and analgesic therapies. Reduced cardiopulmonary reserve, chronic pain conditions, and polypharmacy may restrict participation in active rehabilitation exercises, resulting in persistent muscle weakness, scapular dyskinesis, and altered shoulder

biomechanics, all of which are closely associated with the development and persistence of SIS. These factors may partially explain why postoperative SIS in elderly patients is associated with delayed or incomplete functional recovery.

Therefore, comprehensive preoperative assessment and perioperative management of comorbidities should be emphasized in elderly patients undergoing rotator cuff repair. Optimizing systemic conditions, including glycemic control, cardiovascular function, and bone health, as well as implementing individualized rehabilitation protocols tailored to overall health status, may contribute to reducing the risk of postoperative SIS and improving long-term functional outcomes. However, the specific contribution of individual comorbidities could not be separately analyzed due to sample size limitations, and this warrants further investigation in future studies.

Conclusion

The incidence of SIS following arthroscopic RCR is notable in elderly patients, with this postoperative condition primarily characterized by aggravated pain during shoulder forward flexion and abduction, along with positive Neer and Hawkins–Kennedy impingement signs. The occurrence of postoperative SIS is significantly associated with inferior mid- to long-term shoulder functional recovery in elderly patients, corresponding to lower CMS and UCLA scores and higher VAS pain scores, and is also linked to delayed postoperative pain relief. Clinical practice may attach importance to the early screening and targeted intervention of postoperative SIS in elderly RCR patients as a clinically reasonable approach, which may help optimize postoperative functional recovery and improve the quality of life of this population, while the clinical efficacy of such screening and intervention strategies awaits further verification by prospective research.

Data Sharing Statement

The data used and/or analyzed during the current study are available from the corresponding author.

Ethics Approval and Consent to Participate

This study was approved by the Institutional Ethics Committee of Xiaoshan District Hospital of Traditional Chinese Medicine (Approval No. 2023003), and was conducted in accordance with the Declaration of Helsinki. Given the retrospective nature of the study and the anonymization and de-identification of patient data, the requirement for informed consent was waived by the Ethics Committee.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

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References

1. Kim HM, Teefey SA, Zelig A, Galatz LM, Keener JD, Yamaguchi K. Shoulder strength in asymptomatic individuals with intact compared with torn rotator cuffs. *J Bone Joint Surg Am*. 2009;91(2):289–296. doi:10.2106/JBJS.H.00219
2. Antonacci C, Longo UG, Schena E, et al. Changes in shoulder range of motion following arthroscopic rotator cuff repair: a systematic review. *BMC Musculoskelet Disord*. 2025;26(1):600. doi:10.1186/s12891-025-08579-y
3. Chung SW, Oh JH, Gong HS, Kim JY, Kim SH. Factors affecting rotator cuff healing after arthroscopic repair: osteoporosis as one of the independent risk factors. *Am J Sports Med*. 2011;39(10):2099–2107. doi:10.1177/0363546511415659

4. Meng C, Jiang B, Liu M, et al. Repair of rotator cuff tears in patients aged 75 years and older: does it make sense? A systematic review. *Front Public Health*. 2022;10:1060700. doi:10.3389/fpubh.2022.1060700
5. Koester MC, George MS, Kuhn JE. Shoulder impingement syndrome. *Am J Med*. 2005;118(5):452–455. doi:10.1016/j.amjmed.2005.01.040
6. Mercurio M, Cofano E, Mancuso C, et al. Persistent scapular dyskinesis after arthroscopic rotator cuff repair: a prospective study. *JSES Int*. 2026;10 (2):101420. doi:10.1016/j.jseint.2025.101420
7. Martins J, Rodrigues A, Dos Anjos J, Libardoni TC, Bevilaqua-Grossi D, de Oliveira AS. Cervical range of motion in individuals with and without chronic subacromial pain syndrome: a cross-sectional study. *Musculoskelet Sci Pract*. 2025;78:103341. doi:10.1016/j.msksp.2025.103341
8. Padki A, Chen JY, Lee MJH, Ang BFH, Lie DTT. Septuagenarians aged 75 years and older do benefit from arthroscopic rotator cuff repair: a propensity matched-pair analysis. *JSES Int*. 2021;5(3):459–462. doi:10.1016/j.jseint.2020.12.020
9. Lin Y, Wei J, Tang L, Feng Z, Zhang Y, Li Y. Acromion types and morphometric evaluation of subacromial impingement syndrome in the Chinese population. *Folia Morphol*. 2025. doi:10.5603/fm.103390
10. Li S, L A. Relationship between the degree of degenerative rotator cuff tear and the thickness of coracoacromial ligament on inferior surface of acromion. *BMC Musculoskelet Disord*. 2025;26(1):1057. doi:10.1186/s12891-025-09305-4
11. Sbirkov Y, Valev A, Redzheb M, et al. Rotator cuff repair: lessons from immune strategies, 3D biofabrication and in vivo testing. *Cell Mol Bioeng*. 2025;18(6):549–575. doi:10.1007/s12195-025-00879-6
12. Singh B, Bakti N, Gulihar A. Current concepts in the diagnosis and treatment of shoulder impingement. *Indian J Orthop*. 2017;51(5):516–523. doi:10.4103/ortho.IJOrtho_187_17
13. Desouza C, Jani C. Diagnostic accuracy of Neer's impingement test for subacromial shoulder impingement. *Ir J Med Sci*. 2025;194(5):1691–1696. doi:10.1007/s11845-025-04058-4
14. Du Y, Wang Z, Zhang T, Liang Y. Diagnostic implications of ultrasound evaluation in patients with shoulder impingement syndrome. *J Ultrasound Med*. 2024;43(2):273–280. doi:10.1002/jum.16357
15. Constant CR, Murley AH. A clinical method of functional assessment of the shoulder. *Clin Orthop Relat Res*. 1987;214:160–164. doi:10.1097/00003086-198701000-00023
16. Amstutz HC, Sew Hoy AL, Clarke IC. UCLA anatomic total shoulder arthroplasty. *Clin Orthop Relat Res*. 1981;155:7–20. doi:10.1097/00003086-198103000-00002
17. Huskisson EC, Jones J, Scott PJ. Application of visual-analogue scales to the measurement of functional capacity. *Rheumatol Rehabil*. 1976;15 (3):185–187. doi:10.1093/rheumatology/15.3.185
18. Aun C, Lam YM, Collett B. Evaluation of the use of visual analogue scale in Chinese patients. *Pain*. 1986;25(2):215–221. doi:10.1016/0304-3959(86)90095-3
19. Ahmad R. Acromion shape and degenerative changes of the acromioclavicular joint as risk factors for sub-acromial impingement syndrome. *Orthop Rev*. 2025;17:141407. doi:10.52965/001c.141407
20. Reiad TA, Dinh PV, Bruni D, Thomson C, Owens BD, Marcaccio SE. Evaluating cost disparities and utilization of shoulder arthroscopy: a national analysis of racial, ethnic, and socioeconomic determinants. *Orthop J Sports Med*. 2025;13(8):23259671251360437. doi:10.1177/23259671251360437
21. Ishigaki T, Yoshino K, Hirokawa M, Sugawara M, Yamanaka M. Supraspinatus tendon thickness and subacromial impingement characteristics in younger and older adults. *BMC Musculoskelet Disord*. 2022;23(1):234. doi:10.1186/s12891-022-05179-y
22. Altuntas Y, Ipek E, Balkanli B, Alibakan G, Akbas H, Eren OT. Association between acromial morphology and tear severity in arthroscopically confirmed rotator cuff tears. *BMC Musculoskelet Disord*. 2025;26(1):909. doi:10.1186/s12891-025-09178-7
23. Wolfram S, Herriman SA, Lipps DB. Prevalence and mechanisms of subacromial impingement in breast cancer patients after breast-conserving surgery and radiation therapy: a case-cohort study. *Breast Cancer Res Treat*. 2025;209(3):553–561. doi:10.1007/s10549-024-07514-4
24. Lang AE, Milosavljevic S, Dickerson CR, Trask CM, Kim SY. Evidence of rotator cuff disease after breast cancer treatment: scapular kinematics of post-mastectomy and post-reconstruction breast cancer survivors. *Ann Med*. 2022;54(1):1058–1066. doi:10.1080/07853890.2022.2065026
25. Michener LA, Walsworth MK, Doukas WC, Murphy KP. Reliability and diagnostic accuracy of 5 physical examination tests and combination of tests for subacromial impingement. *Arch Phys Med Rehabil*. 2009;90(11):1898–1903. doi:10.1016/j.apmr.2009.05.015
26. Celik D, Sirmen B, Demirhan M. The relationship of muscle strength and pain in subacromial impingement syndrome. *Acta Orthop Traumatol Turc*. 2011;45(2):79–84. doi:10.3944/AOTT.2011.2425
27. Al Hammadi MI, Shah ZA, Rathod RK, Seddik MA. Shoulder impingement pain syndrome: pathophysiology, diagnosis, and a review of current treatment strategies. *Cureus*. 2025;17(9):e92045. doi:10.7759/cureus.92045
28. Michener LA, McClure PW, Karduna AR. Anatomical and biomechanical mechanisms of subacromial impingement syndrome. *Clin Biomech*. 2003;18(5):369–379. doi:10.1016/s0268-0033(03)00047-0
29. Kinoshita Y, Takeda Y, Fujii K, et al. Arthroscopic rotator cuff repair with manipulation under anesthesia yields similar clinical outcomes to isolated rotator cuff repair and is associated with lower retear rates in medium-sized tears. *Clin Shoulder Elb*. 2025;28(4):421–428. doi:10.5397/cise.2025.00619
30. Balke M, Schmidt C, Dedy N, Banerjee M, Bouillon B, Liem D. Correlation of acromial morphology with impingement syndrome and rotator cuff tears. *Acta Orthop*. 2013;84(2):178–183. doi:10.3109/17453674.2013.773413
31. Galatz LM, Ball CM, Teefey SA, Middleton WD, Yamaguchi K. The outcome and repair integrity of completely arthroscopically repaired large and massive rotator cuff tears. *J Bone Joint Surg Am*. 2004;86(2):219–224. doi:10.2106/00004623-200402000-00002
32. Pierson CJ, Jain NB, Brewer-Mixon K, Wang J, Wilson RD. Identifying the relative contributions of shoulder dysfunction in patients with subacromial pain syndrome. *Pain Med*. 2025;26(11):749–757. doi:10.1093/pm/pnaf057
33. Clausen MB, Witten A, Holm K, et al. Glenohumeral and scapulothoracic strength impairments exists in patients with subacromial impingement, but these are not reflected in the shoulder pain and disability index. *BMC Musculoskelet Disord*. 2017;18(1):302. doi:10.1186/s12891-017-1667-1
34. Goodpaster BH, Park SW, Harris TB, et al. The loss of skeletal muscle strength, mass, and quality in older adults: the health, aging and body composition study. *J Gerontol a Biol Sci Med Sci*. 2006;61(10):1059–1064. doi:10.1093/gerona/61.10.1059
35. Mozingo JD, Akbari-Shandiz M, Murthy NS, et al. Shoulder mechanical impingement risk associated with manual wheelchair tasks in individuals with spinal cord injury. *Clin Biomech*. 2020;71:221–229. doi:10.1016/j.clinbiomech.2019.10.017

36. Andrea LC, Svendsen SW, Frost P, et al. Radiographic findings in patients suspected of subacromial impingement syndrome in relation to shoulder pain and disability. *Skeletal Radiol*. 2025;54(10):2087–2096. doi:10.1007/s00256-025-04916-3
37. Kibler WB, McMullen J. Scapular dyskinesis and its relation to shoulder pain. *J Am Acad Orthop Surg*. 2003;11(2):142–151. doi:10.5435/00124635-200303000-00008
38. Zhao Q, Palani P, Kassab NS, et al. Evidence-based approach to the shoulder examination for subacromial bursitis and rotator cuff tears: a systematic review and meta-analysis. *BMC Musculoskelet Disord*. 2024;25(1):1028. doi:10.1186/s12891-024-08144-z
39. Brasileiro A, Sousa C, Schindler I, et al. Scapular stabilization exercise on pain and functional recovery in people with shoulder impingement syndrome: a systematic review and meta-analysis. *Phys Sportsmed*. 2025;53(3):189–196. doi:10.1080/00913847.2025.2470115
40. Wang HY, Chen YJ, Huang IC, Lin CR, Lin KL, Chen CH. The effectiveness of pulsed electromagnetic field therapy in patients with shoulder impingement syndrome: a systematic review and meta-analysis of randomized controlled trials. *PLoS One*. 2025;20(5):e0323837. doi:10.1371/journal.pone.0323837
41. Gutierrez-Espinoza H, Mendez-Rebolledo G, Zavala-Gonzalez J, Torreblanca-Vargas S, Araya-Quintanilla F. The effect of the addition of core exercises to supervised physiotherapy in patients with subacromial impingement syndrome. *Int J Sports Phys Ther*. 2025;20(2):210–220. doi:10.26603/001c.128630
42. Dalboge A, Frost P, Andersen JH, Svendsen SW. Surgery for subacromial impingement syndrome in relation to occupational exposures, lifestyle factors and diabetes mellitus: a nationwide nested case-control study. *Occup Environ Med*. 2017;74(10):728–736. doi:10.1136/oemed-2016-104272