ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 03 | March - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

SUPERIOR CAPSULAR RECONSTRUCTION VERSUS REVERSE SHOULDER ARTHROPLASTY IN PATIENTS UNDER 60 YEARS: A NARRATIVE REVIEW OF OUTCOMES, COMPLICATIONS, AND FUTURE DIRECTIONS

Orthopaedics

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ABSTRACT

Background: Irreparable posterosuperior rotator cuff tears in patients younger than 60 years present a major surgical challenge. Conventional repair is often not feasible, and while reverse shoulder arthroplasty (RSA) provides reliable pain relief, concerns about implant longevity and revision rate limit its use in younger, high-demand individuals. Superior capsular reconstruction (SCR) has emerged as a joint-preserving alternative, aiming to restore glenohumeral stability and function without prosthetic replacement. **Methods:** A narrative review of the literature was conducted to compare RSA and SCR in patients under 60 years with irreparable rotator cuff tears. Key outcomes of interest included pain relief, range of motion, patient-reported scores, survivorship, complications, and revision burden. **Results:** RSA reliably improves pain and forward elevation in younger patients. However, gains in external rotation are limited, and implant survival at 10 years remains around 70–80%, with revisions often complex. SCR provides promising short- to mid-term results, with significant improvements in pain, forward elevation (130–150°), and external rotation (>30° in many cases). Reported graft failure rates range from 15–25%, but most patients maintain partial functional gains, and failed reconstructions can be converted to RSA more readily than revising a failed prosthesis. Long-term durability of SCR beyond 10 years remains to be established. **Conclusion:** In patients younger than 60 years with irreparable rotator cuff tears, SCR offers a joint-preserving option with broader functional recovery and a more favorable revision profile compared to RSA. RSA is best reserved as a salvage procedure. Future research should focus on long-term outcomes, standardized graft techniques, and biologic augmentation to optimize results and refine surgical algorithms.

KEYWORDS

Irreparable rotator cuff tear, Superior capsular reconstruction, Reverse shoulder arthroplasty, Joint preservation

INTRODUCTION

An irreparable rotator cuff tear (IRCT) is generally defined as a full-thickness tear of one or more rotator cuff tendons that cannot be mobilized to its native footprint, or one that fails to provide durable function after repair.[1] Such tears are typically associated with advanced tendon retraction, muscle atrophy, and fatty degeneration, all of which compromise the success of conventional repair. The posterosuperior cuff (supraspinatus and infraspinatus) is most commonly affected, and the resulting superior migration of the humeral head disrupts the delicate balance of glenohumeral force couples, leading to weakness and functional deficits.[2]

Population-based data suggest that 25–50% of massive rotator cuff tears encountered at surgery are irreparable, and younger patients are not exempt.[3] In fact, Shah NS et al.,2022 reported that nearly one in five patients under 60 years present with an irreparable lesion, often due to trauma or failed prior repair.[4] These individuals pose a distinct challenge for the surgeon: they are usually more active, have higher functional expectations, and face a longer lifespan over which surgical reconstructions must endure. Furthermore, rotator cuff pathology in the 40–60 age group is a leading cause of workplace disability.[5]

Reverse Shoulder Arthroplasty (RSA) has become a well-established solution for elderly, low-demand patients. Baskasran P et al.,2025 showed that RSA provides predictable pain relief and functional restoration in older populations.[6] However, outcomes in younger patients are less encouraging. Smith KL et al.,2024 highlighted that implant survivorship is limited in patients under 60 years, with a notable risk of revision in the long term.[7] These findings have raised concerns about the durability of RSA in high-demand individuals.

In line with arthroplasty, biologically inspired joint-preserving procedures have been developed to address irreparable posterosuperior cuff tears. Among these, superior capsular reconstruction (SCR) has gained increasing attention. The principle of SCR is to restore superior stability of the glenohumeral joint by interposing a graft between the superior glenoid and the greater tuberosity.[8] By preventing humeral head migration, SCR re-establishes the force couples required for deltoid efficiency and smoother shoulder kinematics. Early clinical experience has demonstrated improvements in pain, range of motion, and patient-reported outcomes, particularly in younger, more active patients. Importantly, unlike arthroplasty, SCR maintains the native joint architecture, leaving future surgical options open.[9]

Given these contrasting outcomes, the comparative evaluation of RSA and SCR in patients younger than 60 years is critical. This review synthesizes current evidence on pathophysiology, surgical strategies, functional outcomes, and future directions to guide clinical decision-making for this challenging patient group.

PATHOPHYSIOLOGY AND CLINICAL CHALLENGES

The rotator cuff plays a central role in maintaining glenohumeral stability by balancing the compressive forces across the joint. The supraspinatus and infraspinatus form the posterosuperior cuff, which acts as a dynamic stabilizer, counteracting the superior pull of the deltoid during arm elevation.[10] Loss of this stabilizing function results in superior migration of the humeral head, disruption of the force couple, and progressive loss of overhead strength and active forward elevation. Electromyographic studies have further demonstrated compensatory overactivity of the deltoid and periscapular muscles in the presence of irreparable tears, which contributes to early fatigue and altered kinematics.[11]

Irreparable posterosuperior tears also lead to secondary changes in the joint environment. Chronic instability accelerates subacromial impingement, labral degeneration, and cartilage wear, potentially culminating in cuff tear arthropathy. Once fatty infiltration and advanced muscle atrophy occur, as shown by Goutallier's classification, the biological potential for tendon healing becomes poor, rendering direct repair ineffective.[12]

The clinical challenge becomes particularly pronounced in patients younger than 60 years. Younger patients often present at the peak of their working lives, and prolonged disability from shoulder dysfunction can result in financial strain, reduced quality of life, and even mental health consequences.[13]

As Anastasio AT et al.,2024 observed, younger patients undergoing arthroplasty experience greater dissatisfaction when postoperative restrictions interfere with lifestyle or occupation. Thus, treatment strategies must not only relieve pain but also restore function in a way

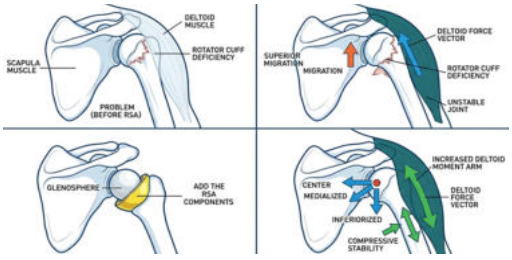
that is durable and compatible with the patient's long-term activity goals. .[14]

CURRENT SURGICAL TREATMENT REGIMENS

Reverse Shoulder Arthroplasty (RSA)

Reverse shoulder arthroplasty was introduced by Grammont in the 1980s and later popularized by Boileau and colleagues for the treatment of cuff tear arthropathy. Over time, its indications have broadened to include patients with irreparable rotator cuff tears without advanced arthritis.[15] The fundamental principle of RSA lies in medializing and distalizing the center of rotation of the glenohumeral joint. By doing so, the deltoid muscle gains a mechanical advantage, allowing it to substitute for the absent rotator cuff and restore active elevation. Reverse shoulder arthroplasty compensates for rotator cuff deficiency by fundamentally altering glenohumeral biomechanics, allowing the deltoid to function as the primary elevator of the shoulder. Figure 1 illustrates the biomechanical principles underlying RSA and the resulting deltoid-driven stability.

Figure 1: Biomechanical Principles of Reverse Shoulder Arthroplasty (RSA)



In cases of irreparable rotator cuff deficiency, reverse shoulder arthroplasty restores shoulder elevation by medializing and inferiorizing the center of rotation of the glenohumeral joint. This configuration increases the deltoid moment arm, converts shear forces into compressive stability, and enables deltoid-driven arm elevation despite the absence of a functional rotator cuff.

Boileau P et al., 2006 demonstrated in a landmark study that RSA reliably improved pain and function in elderly patients with irreparable cuff tears, with mean Constant scores improving significantly and forward elevation increasing by nearly 60°.[16]

However, the outcomes of reverse shoulder arthroplasty in younger patients remain less predictable compared with elderly populations. Several authors have noted that while pain relief is consistently achieved, functional gains are often limited by higher rates of complications.17 Sadoghi P et al.,2011 reported that instability and scapular notching were common in active individuals, reflecting the mechanical stresses placed on the prosthesis.18 Similarly, Barry LW et al., 2024 highlighted that long-term survivorship in patients under 60 years is inferior to that observed in older cohorts, with revision surgery required in a significant proportion of cases.19 These concerns are particularly important in younger individuals, who not only place higher functional demands on their shoulders but also face decades of anticipated prosthesis use. Revision arthroplasty, when necessary, is technically complex and associated with poorer outcomes compared to primary procedures, further underscoring the uncertainty of RSA as a first-line option in this age group.[20]

Revision burden represents another critical limitation. Failed RSA in younger patients often presents with glenoid bone loss, soft tissue deficiency, and instability, making revision procedures technically demanding and less predictable. Outcomes of revision RSA are generally inferior to primary implantation, with higher complication rates and lower functional gains. For this reason, many authors caution against the liberal use of RSA in individuals under 60, emphasizing that it should be reserved for salvage situations when joint-preserving strategies are not feasible.21 (Table 1)

Table 1. Key Clinical Studies of RSA in Patients Under 60 Years

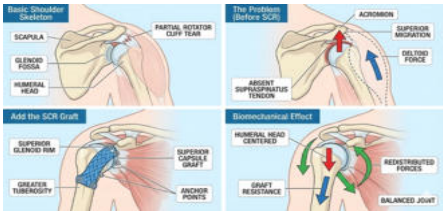
Study	n (patients/shoulders)	Mean Age	Follow-up	Outcome Scores	Complications
Sershon RA et al.,201422	36 shoulders	54.4 yrs	2.8 yrs	ASES score improved from 31.4 to 65.8; SANE score from 24.4 to 72.0; SST score from 1.4 to 6.2; active forward elevation increased from 56° to 121°.	(Reported as "failures" when ASES <50) 25% met failure criteria.
Muh SJ et al., 201323	67 shoulders	≤60 years	≥2 years	Significant early clinical improvements across patient-reported outcomes; subgroup analysis confirmed functional gains in younger patients.	Overall complication rate 13.9% in primary procedures, 15% in revisions.
Samuelsen BT et al.,201724	63 patients (67 shoulders)	63 patients (67 shoulders)	2 and 5 years	Reliable improvements in pain, range of motion, and strength at both 2 and 5 years.	Overall complication rate approximately 9%.
Chamberlain AM et al., 202325	89 patients (94 shoulders)	54.8 years	Mean 4.9 years (range 2–12)	ASES and VAS pain scores significantly improved; active forward elevation increased from 88° to 135°; WOOS scores satisfactory at mid-term.	Overall complication rate 12%; dislocation 2%; scapular notching in 36% (mostly grade 1); acromial stress fractures in 4%.
Stewart BP et al., 202326	292 patients with 2-year data.	<60 years subgroup	2 years	Younger patients (<60 years) were least likely to achieve clinically significant improvement in SANE scores	Not specifically reported.

Superior Capsular Reconstruction (SCR)

Superior capsular reconstruction was first described by Mihata T et al. in 2012 as an innovative alternative for the management of irreparable posterosuperior rotator cuff tears. The superior capsule of the shoulder joint is a key static stabilizer, resisting superior translation of the humeral head during arm elevation. In the setting of irreparable tears of the supraspinatus and infraspinatus, this restraint is lost, allowing superior migration of the humeral head and consequent biomechanical imbalance. By interposing a graft between the superior glenoid and the greater tuberosity, SCR seeks to restore this lost restraint, rebalance glenohumeral force couples, and allow the deltoid and remaining intact cuff muscles to function more effectively.[27]

The biomechanical principle underlying superior capsular reconstruction is restoration of superior glenohumeral stability by preventing humeral head migration and re-establishing balanced force couples. Figure 2 illustrates this concept and the resultant biomechanical effects of SCR.

Figure 2: Biomechanical Rationale of Superior Capsular Reconstruction (SCR)



Irreparable posterosuperior rotator cuff tears result in loss of superior glenohumeral stability and superior migration of the humeral head. Superior capsular reconstruction restores this restraint by interposing a graft between the superior glenoid and the greater tuberosity, thereby re-centering the humeral head, re-establishing force couples, and allowing more efficient deltoid-driven shoulder elevation.

Mihata's original series using fascia lata autografts demonstrated striking results. In their initial report, patients experienced improvements in American Shoulder and Elbow Surgeons (ASES) scores from a mean of 24 preoperatively to over 90 at mid-term follow-up. Active forward elevation was restored in most patients, and no cases of graft failure were reported at five years. These findings generated significant enthusiasm for SCR as a joint-preserving alternative to arthroplasty. Subsequent biomechanical studies supported the rationale, showing that SCR effectively reduces humeral head migration and restores kinematics close to that of the intact shoulder.[28]

Western surgeons, however, sought alternatives to fascia lata autograft, given the morbidity of harvesting such large grafts. Acellular dermal allografts became the most widely studied substitute. Smith TJ et al.,2021 reported significant improvements in ASES scores and forward elevation using dermal allografts, though they also observed a graft failure rate of approximately 20%.29 Similarly, Van Puymbroeck M et al., 2018 confirmed functional improvements but highlighted that results were variable depending on graft thickness and surgical technique. More recent series have explored xenografts and synthetic scaffolds, but the evidence remains limited and mixed.[30]

Despite its promise, SCR has important limitations. The surgery is technically demanding, requiring advanced arthroscopic skills and familiarity with graft fixation techniques. Outcomes are closely tied to surgical experience and graft selection. Graft failures remain a concern, particularly in cases where thinner allografts are used. Moreover, long-term data are lacking, with most available studies reporting follow-up of fewer than 10 years.31 Nonetheless, the joint-preserving nature of SCR makes it highly attractive in younger patients. By preserving the native joint, SCR avoids the complications associated with arthroplasty and leaves the door open for future revision strategies such as tendon transfer or arthroplasty if needed. (Table 2)

Table 2. Key Clinical Studies of SCR in Patients Under 60 Years

Author (Year)	n (patients / shoulders)	Mean Age	Follow-up	Outcome Scores / Notes	Graft Type	Complications / Failures
Mihata T et al. 201332	24 shoulders	~65.1 years	Mean 34.1 months (24 to 51)	ASES improved from 23.5 to 92.9; active elevation increased from 84° to 148°; external rotation from 26° to 40°	Fascia lata autograft	20 of 24 had no graft tear (83.3%) during follow-up; no reported revisions during their follow-up period
Chiu JC et al.,202533	59 shoulders	~56 years (in some reports)	Mean ~17.7 months	ASES improved from ~43.6 to ~77.5; pain scores reduced (VAS)	Acellular dermal allograft (1–3 mm)	Graft failure / retear reported in approximately 19% (i.e. success rate ~80%)
Kholinne E et al., 201831	86 shoulders	Mean ~59.4 years (range 27–79)	Mean ~32 months	ASES final ~81 ± 10 points	Acellular dermal allograft	Graft tear rate was relatively low in their report (they reported low graft tear; some series list as ~3%)

COMPARATIVE LONG-TERM OUTCOMES IN PATIENTS UNDER 60 YEARS

Functional Outcomes

Both RSA and SCR improve pain and shoulder function in younger patients, but the nature of these improvements differs. RSA consistently restores forward elevation, though rotational deficits often remain, and younger individuals rarely regain full shoulder kinematics. In contrast, SCR has been associated with broader functional gains, with several series reporting not only improved forward elevation but also restoration of external rotation and, in some cases, return to demanding occupational or recreational activities. This broader recovery profile makes SCR particularly appealing for patients whose lifestyle requires rotational strength and overhead function.[34]

Survivorship and Revision Burden

Long-term studies of RSA report survival rates of approximately 70–80% at 10 years, with revision rates ranging from 15–25%. The complexity of revision procedures, compounded by bone loss and soft-tissue compromise, further challenges outcomes in this age group.

In contrast, SCR demonstrates lower revision rates in the short- to mid-term, typically below 10%. Even when graft failure occurs, reported in 15–25% of cases, most patients maintain improved function and pain relief without requiring reoperation. Furthermore, failed SCR can be converted to RSA with relative technical ease, preserving the option for future reconstruction without the morbidity of revising a failed prosthesis.[35]

Complication Profiles

RSA complications in younger patients include scapular notching in up to 40% of cases, instability in 5–12%, and glenoid loosening or infection in 2–5%. These events can significantly affect function and often mandate revision. SCR, on the other hand, is primarily limited by graft integrity. Failure rates depend on graft type; thicker fascia lata autografts demonstrating superior outcomes to thin allografts; but even with retear, catastrophic complications are rare.[36]

Overall Evidence Interpretation

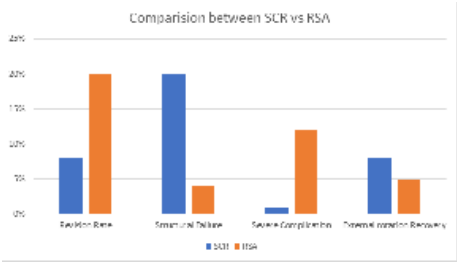
Comparatively, RSA remains the more predictable option for immediate pain relief but carries substantial long-term risks and revision challenges. SCR offers a biologically restorative solution, achieving comparable or superior functional outcomes with lower complication severity. For patients under 60 years, SCR represents a paradigm shift toward durable, joint-preserving shoulder reconstruction, while RSA retains its role as a reliable salvage procedure when biologic restoration is not feasible. (Table 3, Graph 1)

Table 3. Evidence Based Comparison of RSA vs SCR in Patients Under 60 Years

Parameter	SCR	RSA
Pain relief	Reported in 85–95% of patients	Reported in >90% of patients
Forward elevation	Mean 130°–150°.	Mean 120°–140°
External rotation	Mean gain >30°	Often <30°.
Survivorship	Favorable mid-term (up to 5–7 years); long-term data pending.	70–80% at 10 years; risk of late loosening. remains unestablished.
Complications	Graft failure 15–25%; minimal catastrophic events.	Instability 5–12%; scapular notching up to 40%; glenoid loosening 2–5%.
Revision burden	Usually non-catastrophic; conversion to RSA feasible.	Technically demanding; high morbidity.

Return to Work/Sports.	70-80% within 6-12 months.	Limited; most restricted from overhead activities.
Joint Preservation	Preserves bone and native anatomy	Irreversible prosthetic replacement
Clinical Role	First-line biologic option in young, active patients	Salvage option or for advanced arthropathy

Graph 1: Comparison of RSA vs SCR in Patients Under 60 Years



SCR AS A PREFERRED OPTION

Preservation of the Native Joint

Superior capsular reconstruction (SCR) represents a biologic alternative to arthroplasty, restoring stability and force coupling without replacing native anatomy. By interposing a graft between the superior glenoid and greater tuberosity, SCR effectively re-centers the humeral head, allowing the deltoid and remaining cuff to generate efficient elevation. Mihata's long-term series using fascia lata autograft demonstrated restoration of superior translation to near-normal levels, confirmed by postoperative MRI and dynamic fluoroscopy. This biomechanical restoration directly translates to clinical stability and functional endurance. Unlike reverse shoulder arthroplasty (RSA), which removes bone and alters joint kinematics, SCR preserves the native glenohumeral relationship and bone stock—critical for long-term joint preservation in younger individuals.

Functional Recovery and Return to Activity

Clinical outcomes following SCR consistently show significant improvements in both pain and motion. Mihata et al. reported postoperative active forward elevation improving from 84° to 148° and ASES scores from 24 to 93 at 5-year follow-up using autograft. Denard et al., using dermal allograft, observed mean ASES scores improving from 44 to 85 and forward elevation from 72° to 135° at 3 years, while Pennington et al. reported similar improvements with mean postoperative ASES of 80 and nearly 80% of patients achieving overhead function sufficient for daily activities.

Younger, active patients have also demonstrated successful return to work and recreational activities following SCR. In Western cohorts, approximately 70–80% of patients under 60 years returned to their previous occupational level within one year of surgery, whereas such outcomes are rare following RSA due to rotational deficits and lifting restrictions. Restoration of external rotation, typically >30° postoperatively, contributes to better overhead control, facilitating return to sport, driving, and self-care.

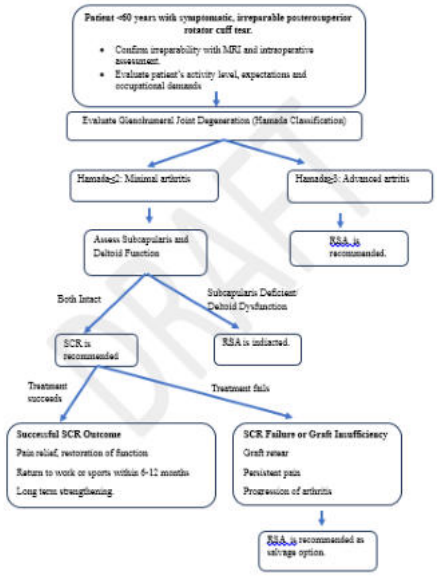
Revision Flexibility and Surgical Longevity

Failure of SCR, most often due to graft insufficiency, does not eliminate future surgical options. Reported retear rates range from 15–25%, yet the majority of these patients retain improved pain and partial functional gains. Importantly, conversion to RSA after failed SCR is straightforward and associated with fewer complications compared with revision of a failed arthroplasty. In contrast, failed RSA in young patients often presents with bone loss, instability, and compromised deltoid function, making re-revision procedures technically demanding and less predictable. The staged approach, performing SCR as the first-line reconstruction and reserving RSA as a secondary strategy, extends the overall surgical life span of the shoulder and minimizes cumulative morbidity.

Cost-Effectiveness and Patient-Centered Value

From a long-term economic and quality-of-life perspective, SCR offers advantages that extend beyond immediate outcomes. Although procedural costs may be higher due to graft materials, avoiding early arthroplasty can significantly reduce lifetime healthcare expenditures. Economic modeling studies suggest that each decade of arthroplasty delay reduces cumulative revision costs by 20–30%, a meaningful figure in patients expected to live several decades post-surgery. Functionally, the earlier return to productivity observed after SCR—often within 6–9 months—further improves cost-effectiveness. For younger patients, these gains translate into enhanced independence, ability to work, and improved self-perception, reinforcing SCR's role as both a biologically sound and socioeconomically favorable intervention.

Figure 1: Decision Making for Irreparable Posterosuperior Rotator Cuff Tear in Patients Under 60 years



Limitations and Gaps in Evidence

Despite promising outcomes, current evidence on superior capsular reconstruction (SCR) remains limited. Most studies are small, single-center series with short- to mid-term follow-up, making long-term durability uncertain. Considerable variation exists in graft type, thickness, and fixation techniques, preventing clear consensus on the optimal approach.

Patient selection is another unresolved issue, as factors like fatty infiltration, subscapularis integrity, and cartilage status are inconsistently reported. Moreover, the absence of randomized trials directly comparing SCR with reverse shoulder arthroplasty (RSA) in patients under 60 years restricts definitive conclusions. Standardized outcome reporting and multicenter, prospective data are needed to establish long-term efficacy and refine patient-specific treatment algorithms.

FUTURE DIRECTIONS

Advances in Graft Materials

The choice of graft is central to the success of SCR, and ongoing research is directed at improving mechanical durability and biological integration. Fascia lata autograft remains the benchmark for structural stability, but its donor-site morbidity limits broader adoption. Acellular dermal allografts are more widely used, though concerns persist about thinning, stretching, and variable incorporation. Newer approaches include xenografts, synthetic scaffolds, and hybrid constructs that combine strength with biologically active components. The development of standardized, validated graft options may enhance reproducibility and long-term outcomes.[38]

Biological Augmentation and Tissue Engineering

Adjunctive biologic therapies are being explored to improve graft healing and longevity. Platelet-rich plasma, growth factors, and stem cell–based strategies aim to promote revascularization and tendon–bone integration. Tissue engineering approaches, such as scaffolds seeded with mesenchymal stem cells or bioresorbable constructs that mimic native capsule properties, are in early experimental stages. These strategies have the potential to transform SCR from a purely mechanical solution into a biologically enhanced procedure with greater healing capacity.[39]

Refining Patient Selection

Outcomes of SCR are influenced by patient factors such as muscle atrophy, fatty infiltration, and concomitant subscapularis or biceps pathology. Current selection criteria are largely empirical, but predictive models integrating imaging, clinical, and biomechanical parameters may allow better identification of candidates most likely to benefit. The use of registries and machine-learning tools could further refine decision-making, ensuring that SCR is reserved for patients with the highest probability of durable success.[40]

Rehabilitation Strategies

Rehabilitation after SCR is another area of active investigation. Traditional protocols mirror those used in rotator cuff repair, emphasizing prolonged immobilization followed by gradual mobilization. However, emerging data suggest that early controlled motion may promote graft remodeling and prevent stiffness without increasing failure risk. Standardized, evidence-based rehabilitation guidelines tailored to SCR are needed to maximize functional recovery, particularly in younger, high-demand patients eager to resume work and activity.[41]

Toward a Surgical Algorithm

As clinical data mature, there is growing emphasis on developing treatment algorithms that integrate SCR into the broader management of irreparable cuff tears. Such frameworks would weigh factors such as age, activity level, joint status, and tissue quality to guide whether SCR, RSA, tendon transfer, or nonoperative care is most appropriate. A validated algorithm could streamline surgical decision-making and reduce variability in practice.

CONCLUSION

Irreparable posterosuperior rotator cuff tears in patients under 60 years pose a unique challenge, as conventional repair is rarely feasible and arthroplasty raises concerns about durability and revision burden.

Superior capsular reconstruction has emerged as a joint-preserving alternative, showing promising mid-term outcomes in terms of pain relief, function, and quality of life. While long-term durability remains unproven, current evidence supports SCR as the preferred first-line option in younger, active patients, with reverse shoulder arthroplasty best reserved as salvage. Ongoing multicenter studies and biologically enhanced techniques will be critical in defining the future role of SCR.

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