Review Article

Arthroscopic superior capsular reconstruction of the shoulder: a narrative review

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Contributions: (I) Conception and design: All authors; (II) Administrative support: All authors; (III) Provision of study materials or patients: All authors; (IV) Collection and assembly of data: All authors; (V) Data analysis and interpretation: All authors; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

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Abstract: Irreparable rotator cuff tears (IRCTs) in young and considerably active patients are difficult to treat because it is mostly associated with poor outcome which may lead to a painful and dysfunctional shoulder. Most of the IRCTs are encountered in massive size rotator cuff tears which associated with high failure rate following surgical repair. Thus, the IRCTs was considered challenging for its poor healing rate following repair which may induce the arthritic changes. Since the advent of arthroscopic superior capsular reconstruction (ASCR) of the shoulder in 2013, it has gained its popularity. The procedure has become the most popular option for joint-preserving shoulder surgery for patients with IRCTs. It works by providing a static restraint to the superior humeral head migration to optimize the rotator cuff force couples, hence improving joint kinematics. The acceptance of superior capsular reconstruction has made it rapidly evolving in terms of a wider variety of procedures and broader surgical indications. Despite the enthusiasm and widely acceptance towards the procedure, there are still many queries that exist regarding the best indications, surgical technique particularly graft of choice, the long-term outcome, and the complication and risk of the superior capsular reconstruction (SCR). This narrative review provide the current evidence of SCR in an attempt to provide a state-of-the-art knowledge.

Keywords: Irreparable rotator cuff tears (IRCTs); superior capsular reconstruction

Submitted Aug 18, 2020. Accepted for publication Jan 08, 2021.
doi: 10.21037/atm-20-5925
View this article at: http://dx.doi.org/10.21037/atm-20-5925

Introduction

Irreparable rotator cuff tears (IRCTs) are difficult to treat for it is mostly associated with massive tear size. The increase in rotator cuff tear size and patient age are reported to be associated with the poor outcome and higher failure rate following surgical repair (1). The massive IRCTs are reported to have 79% retear rate following primary surgical repair (2). Hence, the IRCTs was considered as challenging case due to its rate of poor healing, which is often later associated with arthritic changes (3). In the literature, various joint-preserving surgical options for the treatment of massive irreparable rotator cuff tears (MIRCT) have been reported such as debridement procedures, long head bicep tenotomies (4), tuberoplasties (5), partial repairs (6), and tendon transfers (7). Over the past few years, the biological augmentation of rotator cuff repairs using patch graft (8) with or without

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scaffolds has increased in utilization. However, the biological augmentation cannot withstand the test of time because limitations exist in terms of durability and indications. Tendon transfer using latissimus dorsi tendon has also serve as an option for MIRCTs with the benefit of having greater external rotation motion. However unlike the SCR, the indication of latissimus dorsi tendon transfer was limited to the patient without pseudo-paralysis (9,10). Reverse shoulder arthroplasty is a treatment option for IRCTs but there are concerns regarding its longevity, especially in the young population (11). Thus, joint-preserving surgery such as SCR (12) under arthroscopic guidance with fascia lata autograft (13-18) and allografts (19-22) has been advocated for the younger population with IRCTs.

Arthroscopic SCR (ASCR) is probably the most popular topic in shoulder surgery nowadays. This enthusiasm for SCR indicates the difficulty of the problem it is intended to address: an IRCT in the patient that is poorly suited for an alternative procedure. SCR has been first introduced in 2013 by Mihata *et al*. (23). Theoretically, it works by providing a superior static restraint to the superior migration of the humeral head. The premise of the procedure is to optimize the rotator cuff force couples, thus improving joint kinematics (24). SCR represents a valuable additional tool for the shoulder surgeon and not a universal solution for every challenging rotator cuff tear. Many questions still exist regarding the best indications, surgical technique, the long-term outcome, the complications, and the risk of the procedure. This study reviews the current evidence of SCR in an attempt to provide a state-of-the-art knowledge.

We present the following article in accordance with the Narrative Review reporting checklist (available at http://dx.doi.org/10.21037/atm-20-5925).

The biomechanics of superior capsule of the shoulder

The rotator cuff tendon provides a dynamic stability to the glenohumeral joint, which restraints the superior migration of the humeral head when the deltoid muscle is activated. The muscles at the coronal plane (the deltoid and the supraspinatus muscle) and the transverse plane (the infraspinatus, the teres minor, and the subscapularis muscle) work synergistically to provide a balanced force couple. Disruption to the balanced force couple caused by a large rotator cuff tear or MIRCT will result in the proximal migration of the humeral head (25). In addition, this will decrease the efficiency of the biomechanics of the glenohumeral joint because it requires more force to abduct and elevate the arm. When it continuously occurs, this will lead to the deterioration of the shoulder joint function that leads to fixed humeral head migration, further extension of the tear, and eventually the end stage, that is, rotator cuff arthropathy.

In our clinical practice, the choice of SCR has been overlooked because the superior capsule function was ignored in the past (26). Further biomechanics and anatomic studies have reported that the superior capsule transmits force from the rotator cuff muscles and serves as a passive glenohumeral joint stabilizer (24,27,28). In MIRCT, the humeral head migrates proximally at active elevation. Superior capsule reconstruction is performed to restore shoulder joint stability, hence allowing normal joint kinematics and functional outcome (29-32).

Surgical indications

Medium-term or long-term follow-up studies on the outcome of this relatively new procedure are limited. Most published studies that reported its outcomes are with either without control group or technically driven, which makes it difficult to recognize which patients benefit more from SCR. Thus, the indication for SCR remains indefinite as to which patients are best indicated for this procedure. The surgical indication and contraindication used in our institution are presented in *Table 1*.

Besides the abovementioned indications and contraindication, patients with pseudoparalysis with associated superior glenohumeral instability are not ideal candidates for reverse shoulder arthroplasty because of young age, and desired activity level may also serve as a good candidate for SCR (34,35). Above all, patients with severe fatty infiltration [Goutalier (36) stage 4] may have less predictable outcomes after rotator cuff repair, even if the tissue is considered repairable. Therefore, these patients may also be candidates for SCR. Adversely, patients with substantial medical comorbidities or poor bone quality (risk of anchor pullout) and those unwilling to comply with postoperative rehabilitation regime are not appropriate candidates for SCR.

Preoperative assessment

History and physical exam

The initial workup for SCR candidate patients is similar with any surgical procedure to treat rotator cuff tears.

Table 1 Surgical indications and contraindications of SCR

Indications of SCR	Contraindication of SCR
(I) Massive rotator cuff tear with medial retraction on preoperative magnetic resonance imaging	(I) Severe bone deformity (Hamada classification type 5)
(II) Minimum evidence of significant bony deformity caused by glenohumeral joint arthritis (33)	(II) Severe superior migration of the humeral head that is not corrected by arm traction
(III) Irreducible rotator cuff tear after arthroscopic reduction trial	(III) Irreparable subscapularis
(IV) Intact deltoid muscle after preoperative physical examination	(IV) Cervical nerve and axillary nerve palsy

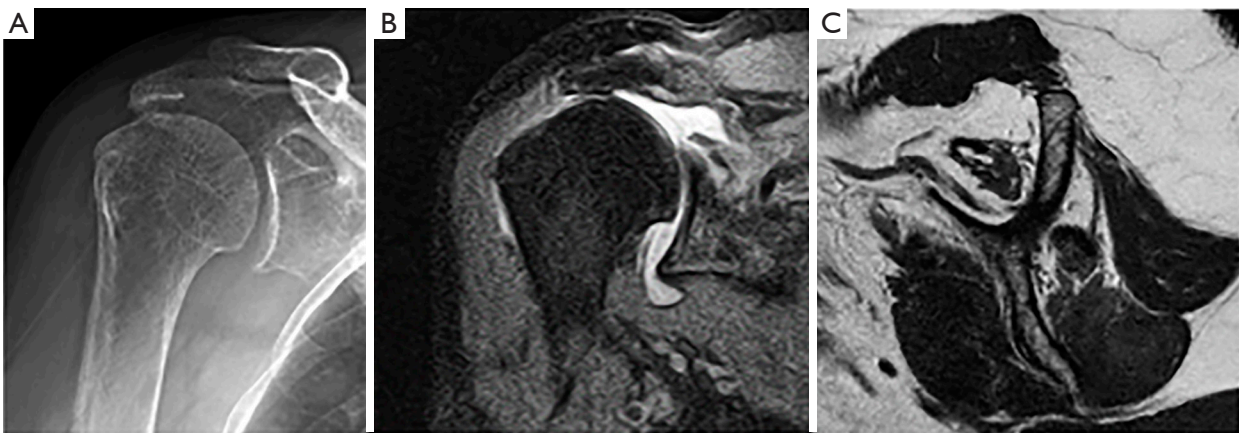

Figure 1 Radiologic assessment showing proximal humeral migration, decreased acromiohumeral distance, and minimal arthritic changes at the glenohumeral joint (A), T2-weighted MRI in coronal plane showing massive rotator cuff tear retracted at the glenoid level (B) and T1-weighted MRI in sagittal plane showing stage III fatty infiltration of the rotator cuff muscle (C).

A thorough physical examination for all patients should be performed on both shoulders to assess the status of muscle atrophy. The presence of pseudoparalysis, which is an inability to actively raise the arm above 90° with a full painless passive motion, should be recorded (37). It is important to note why a patient is having pseudoparalysis, because this is multifactorial, including weakness, severe superior humeral head migration, and significant pain. The cause of pseudoparalysis, together with imaging and intraoperative findings, may have an impact on surgical decision making (38).

Because a concomitant subscapularis repair may be needed at the time of SCR, it is also important to assess the status of subscapularis muscle strength. The repairability of the subscapularis tendon in the presence of a tear is also found to be a prognostic factor of SCR because an irreparable subscapularis tear will have less postoperative muscle strength than those with intact or repairable subscapularis (39,40). All possible sources of pain should be documented, including the palpation of the long head of the biceps tendon and acromioclavicular joint. An assessment into the cervical spine pathology should not be missed.

Imaging assessment

Preoperative imaging assessment using standard shoulder plain radiographs will provide information regarding the presence of arthritic changes of the shoulder joint, the degree of proximal humeral migration, and the acromiohumeral distance (*Figure 1*). The acromiohumeral distance is best evaluated on an X-ray taken with the beam tilted 20° caudally in anteroposterior projection (41). Magnetic resonance imaging (MRI) may provide information regarding the involved tendons, tear size, and fatty infiltration according to Goutallier's index (36,42). A detailed assessment on the fatty infiltration of the rotator cuff muscle should be noted on MRI scan. Expert opinion indicated that rotator cuff tears with severe chronicity with respect to the corresponding

fatty infiltration "can be arthroscopically repaired" (43). An increased fatty infiltration of the infraspinatus muscle was shown to have a negative effect to the prognosis of SCR (44). However, the status of fatty infiltration of the supraspinatus muscle did not indicate any relationship with the prognosis of SCR. Studies have reported that MRI is not a reliable predictor of rotator cuff repairability (45,46). Nevertheless, it is unclear as to what extent that MRI can predict the success of rotator cuff tear repair.

Table 2 Surgical sequences of SCR

1. Diagnostic arthroscopy
2. Graft harvesting and preparation
3. Acromioplasty
4. Assessment of rotator cuff tear
5. Glenoid site preparation
6. Graft shuttling and fixation at the glenoid side
7. Humeral-site preparation and fixation
8. Remnant bursal coverage or rotator cuff repair

Surgical technique

SCR was usually performed with a designated surgical sequence to ease and control the surgical timing (*Table 2*).

The SCR requires a long learning curve in time and patience. SCR was usually performed for approximately 135–150 minutes with the help of an experienced and dedicated team (first assistant, arthroscopy work; second assistant, graft work) as can be seen in the surgical time frame. The first assistant will assist with the arthroscopic work while the second assistant will work on the graft preparation. According to our experience, the surgical time checklist provided an orchestrated work from all team members to control the surgical time (*Table 3*).

Diagnostic arthroscopy

For SCR, a direct lateral portal was used as the main viewing portal in a standard beach chair position. A

Table 3 SCR surgical time frame

Allocated time (minutes)	ASCR with fascia lata autograft (mesh)	
	Main table work	Back table work
10–15	Diagnostic arthroscopy and rotator cuff tear assessment	
12	Graft harvesting	Graft cleaning
10	Acromioplasty	Graft sizing and suturing
7	Glenoid site preparation	
5	Glenoid anchoring	
6	Glenoid anchors limbs' suturing to graft	Graft to surgeon
10–15	Graft shuttling	
7	Glenoid knot tying	
7	Humeral-site preparation	
5	Medial row humeral anchoring	
12	Medial row humeral anchors limbs' suturing to the graft	
12	Medial row knot tying	
12	Remnant bursal coverage/rotator cuff repair	
10	Lateral row anchoring	
15	Donor site irrigation and closure	
Total time: 135–150		

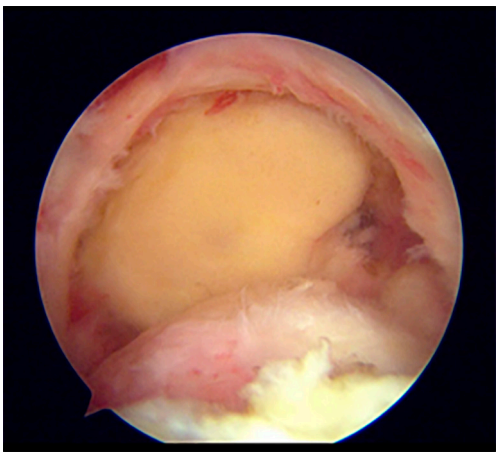

Figure 2 Diagnostic arthroscopy of a right shoulder (beach chair position) viewing from a direct lateral portal showing a massive irreparable rotator cuff tear after adequate release.

standard diagnostic arthroscopy was performed to confirm the status of the articular cartilage and the subscapularis integrity. The subscapularis integrity is important as the presence of it will associated with the clinical outcomes and complication rates following SCR (47). More importantly, detailed assessment of the rotator cuff tears should be performed after meticulous removal of the degenerative subacromial bursal tissue and articular release (*Figure 2*). To assess the repairability of the tendon, a retriever was usually used to grasp the tendon edge and reduce it to the footprint through an anterolateral portal. The distance between the expected anterior glenoid anchor and the expected anterior medial row humeral anchor was measured using a probe (mediolateral graft length) (23). The distance between the expected anterior to the posterior glenoid and medial humeral anchor was also measured (anteroposterior graft length). A radiofrequency ablation device was used to mark the location for the anchor. The graft harvesting and preparation are performed once the tear has been decided to be irreducible.

Graft harvesting and preparation

An ipsilateral fascia lata graft was harvested and prepared as a double-folded, 2-layered graft. To allow space for suture and knot tying, a 5-mm length was added to the final size of the graft. It is preferred to reinforce the graft construct by inserting a single layer of polypropylene mesh (Prolene Mesh®; Ethicon Inc, NJ, USA) into the folded fascia lata graft in a sandwich fashion (*Figure 3*). A running stitch no. 2-0 polyester suture (Ethibond®) was used to seal the graft margin. At least 6-mm-thick graft was obtained during the final graft preparation. The bursal side of the graft was marked to ease the intraarticular orientation of the graft position. A pair of heavy suture was added at the humeral side of the graft to facilitate the graft shuttling and tensioning. A saline-soaked gauze was used to cover the graft while waiting for shuttling. A routine local anesthetic injection was given to the donor site after a formal closure.

Acromioplasty

A standard anterolateral acromioplasty was performed to prevent postoperative graft attrition caused by the acromion undersurface. Acromioplasty was routinely performed as supported by the result of a previous biomechanical study in the premise of reducing subacromial contact area (48).

Glenoid site preparation

The glenoid side was prepared with the combination of radiofrequency ablation device, arthroscopic shaver, and burr after graft preparation. The remaining labrum should be cleared off from the glenoid surface. The long head of the biceps was usually very frayed and tenotomized. The superior margin of the glenoid was debrided to allow at least 3 suture anchors for fixation (JuggerKnot®, 2.5 mm; Zimmer Biomet, IN, USA or Suturefix Ultra anchor®, 1.9 mm; Smith & Nephew, MA, USA) at the 10, 12, and 2 o'clock positions (*Figure 4*). Neviaser or accessory portal may be used to assist with the glenoid anchor placement. Care should be taken not to injure the cartilage enface of the glenoid. All soft suture anchors with smaller dimensions were preferred with the argument to avoid suprascapular nerve injury.

Graft shuttling and fixation

After the glenoid anchoring, the next step is perhaps the most challenging step in performing SCR, namely, graft shuttling. The lateral portal was extended to 2–2.5 cm to allow for graft shuttling with a push and pull maneuver under direct arthroscopic guidance. At this point, the posterior portal serves as the viewing portal. All sutures from the glenoid anchors were retrieved to the main working portal (direct lateral portal). Using a free needle, the graft was sutured with the glenoid anchor suture limbs externally.

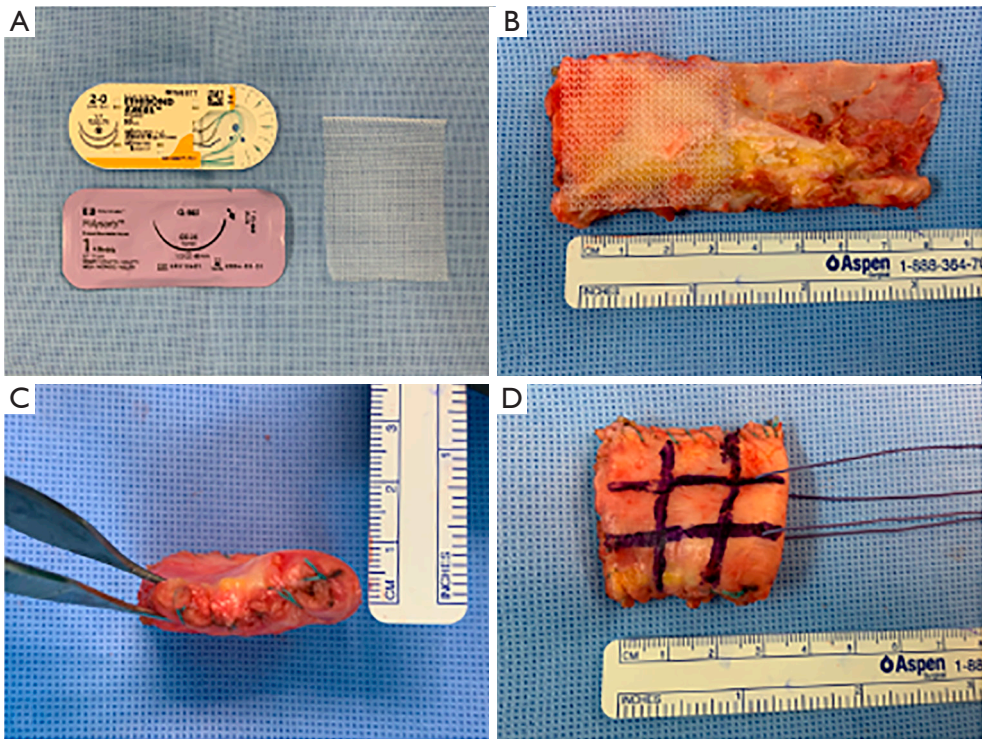

Figure 3 Graft preparation in ASCR with mesh augmentation showing 1 additional layer of polypropylene mesh (A and B) being fashioned inside the folded fascia lata (C and D).

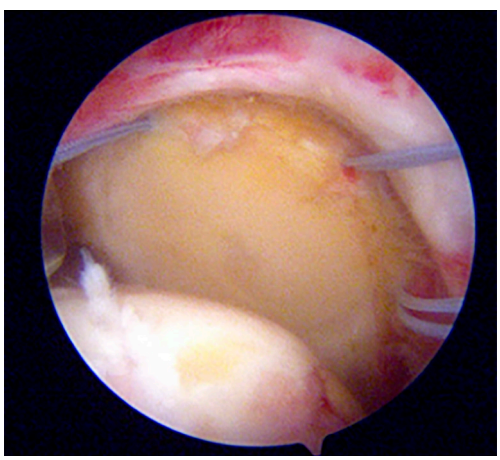

Figure 4 Three glenoid all suture anchors at the 10, 12, and 2 o'clock positions.

We do not advocate the use of an antegrade suture passer for suturing because of the risk of a broken needle tip owing to graft stiffness (from mesh reinforcement) and thickness, which was supported by a previous study (49). The graft is shuttled in by pushing the graft with a Kelly clamp by the surgeon and gently pulling the glenoid anchor suture limb by the assistant under direct arthroscopic guidance. We control the orientation of the graft by making sure that the marked side (bursal side) and the glenoid suture limb are always visible. All sutures were tied when the graft was fully seated on the glenoid. A cross-linked tie between the sutures from the 12 o'clock anchor to the 10 and 2 o'clock anchors was routinely performed.

Humeral-site preparation and fixation

Two medial anchors (Healicoil® 4.5 mm; Smith & Nephew, Andover, MA, USA) were inserted at the marked position as the medial row fixation of the humeral site. The graft was sutured to the medial row anchors using a shuttle relay technique with suture passer (Spectrum®, Conmed Linvatec, Largo, FL, USA) (*Figure 5*). The graft was tensioned and fixed (tied) at 30° shoulder abduction as recommended by a previous biomechanical study (32).

Remnant bursal coverage or rotator cuff repair

After the medial row knot tying at the humeral site, the remaining sutures of each limb of the medial row anchors were not discarded. The remaining bursal tissue was on top of the fascia lata graft ("over-the-top") as a biological augmentation (*Figure 6*) (50). This was also recommended by a previous study to increase the mechanical strength of the construct (35,51). This is the main concern of the author because a previous work showed that the most common graft failure is the humeral site because of the shear forces between the humerus and the undersurface of the acromion (15,50). The SCR construct was completed with the fixation of the knotless suture limbs attached to the lateral row using 2 knotless anchors (Footprint Ultra® 4.5mm; Smith & Nephew, Andover, MA, USA).

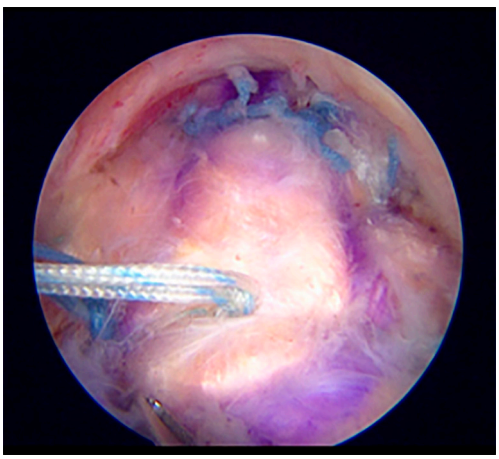

Figure 5 The graft fixed at both the glenoid and greater tuberosity sites.

Postoperative rehabilitation and protocol

In principle, the rehabilitation of a SCR is similar with the rehabilitation after MIRCT or large IRCT. After the surgery, all patients were placed in a shoulder abduction brace (in 30° to 45° abduction) for 6 weeks and started performing pendulum exercises for 3 weeks. After gaining range of motion after surgery, strengthening exercises for the periscapular muscles and rotator cuff were taught by a dedicated physiotherapist at 3 months after surgery. To date, there has been no studies compared the postoperative protocols after SCR. Recent systematic review showed that most of the current studies will have 3 phases of rehabilitation which consist of sling immobilization phase which ranged from 0 to 6 weeks postoperative, the active range of motion phase which ranged from 3 to 12 weeks postoperative and the strengthening phase which ranged from 6 weeks to 6 months postoperative (52). Previous studies describe that the risk of retear following large size rotator cuff repair is higher when early mobilization (53,54). For this reason, delayed mobilization can be plausibly suggested after SCR rather than early mobilization to decrease graft failure rate. In our institution, a routine shoulder plain radiograph and MRI scans at 3, 6, and 12 months postoperatively were performed in all patients. MRI was preferred over ultrasonography for its accuracy in assessing graft integrity (55) (*Figure 7*).

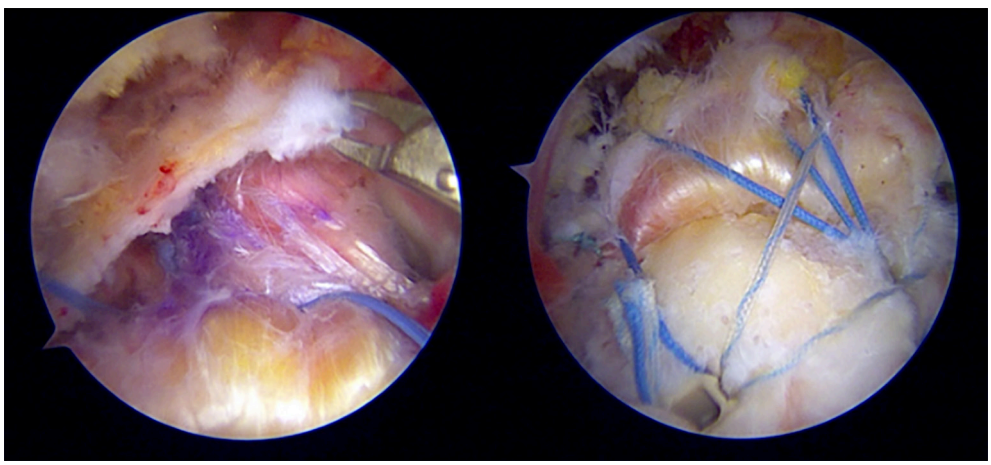

Figure 6 SCR procedure showing reconstructed capsule was superimposed by the remnant bursal tissue (50). SCR, superior capsular reconstruction.

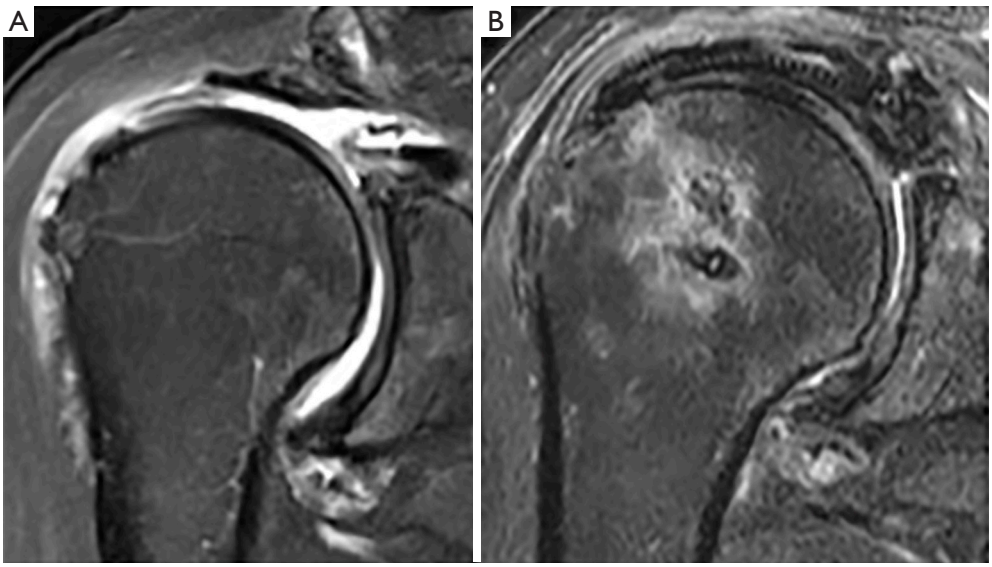

Figure 7 Preoperative T2-weighted MRI in coronal plane of a massive rotator cuff tear (A) and 12 months postoperatively (B) showing an intact graft.

Discussion

Surgical outcome

The functional outcome and graft tear rate after ASCR are variably reported owing to the differences in patient characteristics, surgical technique, and the definition of healing failure, which were limitedly reported (15). Perhaps the most compelling outcome for most surgeons was the graft failure rate that corresponds to the functional outcome and the extent that the surgical technique, particularly graft type, will affect the functional outcome.

Kholinne *et al*. (50) reported that the overall graft tear pattern was found at the medial row of humeral site (57.8%), which resembles type 2 failure as described by a previous report (15,19). Mihata *et al*. (23) reported 92±11 points American Shoulder and Elbow Surgeons (ASES) score and graft tear rate of 16.7% at a mean follow-up of 34 months for 24 shoulders. De Campos Azevedo *et al*. (13) reported that postoperative simple shoulder test, subjective shoulder value, and constant score were 8.6±3.5, 70%±23%, and 64±18, respectively, and graft tear rate of 9% at a 2-year follow-up for 22 shoulders. Lim *et al*. (15) reported 73±10 points ASES score and graft tear rate of 29% at a mean follow-up of 15 months for 31 shoulders. Lee *et al*. (14) reported 84±5 points ASES score and graft tear rate of 36% at a mean follow-up of 24.8 months for 32 patients. However, this study used dermal allografts and fascia lata autografts with no descriptions on allocation. Furthermore, the humeral-site graft fixation used single-row technique that may influence the failure rate, which occurred mostly at the humeral site. Dermal allograft has also been used as the graft source in several studies (19-21). Hirahara *et al*. (20) reported 8 patients with 86±12 points ASES score and graft tear rate of 25% at a minimum follow-up of 2 years. Denard *et al*. (19) reported 59 patients with 77±22 points ASES score and graft tear rate of 55% at the mean follow-up of 17.7 months. However, the results of graft integrity from 2 studies mentioned earlier may be underestimated because only 62.5% and 33% of patients underwent MRI confirmation, respectively. Pennington *et al*. (21) in a short-term study of 88 patients reported 81±10 points ASES score and graft tear rate as 3%. Despite the low graft tear rate, the study included younger patients (mean, 59.4; range, 27–79 years).

The summary of results of SCR from the previous significant literatures is presented in *Table 4* (reproduced with permission) (56). Graft integrity was similarly reported despite the type of graft used in the surgical technique (*Table 5*) (56). The failure rate of the graft was 10% and 12.9% for autograft and allograft, respectively. Perhaps the most interesting thing was the reoperation rate, which was higher in the cases that used allograft (8.2%) than those that used autograft (3.1%). Of all 32 patients who had reoperations, the common reoperations were conversion to reverse shoulder arthroplasty (10 patients from allograft)

Table 4 Summary of results of superior capsular reconstruction (56)

Parameters	Mihata (16) (2018)	de Campos Azevedo (13) (2018)	Lim (15) (2019)	Rosales-Varo (17) (2019)	Yoon (18) (2018)	Lee (14) (2018)	Hirahara (20) (2017)	Pogorzelski (22) (2017)	Denard (19) (2018)	Pennington (21) (2018)
Graft (thickness)	TFL auto (6–8 mm)	TFL auto (5–8 mm)	TFL auto (≥6 mm)	Hamstring auto (NA)	5 TFL auto (NA); 1 allo (2 mm)	Most TFL auto (~6 mm) A few allo (NA)	Dermal allo [1.5 mm (n=1), 3.5 mm (57)]	Dermal allo (3 mm)	Dermal allo [1 mm (n=5), 2 mm (n=2), 3 mm (57)]	Dermal allo (3 mm)
No. of patients [shoulders]	NA [100]	22 [22]	31 [31]	8 [8]	6 [6]	32 [36]	8 [8]	16 [16]	59 [59]	86 [88]
Age, y, mean ± SD (58)	66.9 (43–82)	64.8±8.6 (47–77)	65.3 (44–85)	59.66 (55–63)	59.5±4.18 (53–65)	60.9±6.2	61.33 (47–78)	52±7 (including LDT group)	62.0±8.7	59.4 (27–79)
Follow-up, mo, mean ± SD (58)	48 (24–88)	>24 (except 1 case)	15 (12–24)	12	27.33±7.58 (18–36)	24.8±6.9	32.38 (25–39)	26 (6–92) (including LDT group)	17.7 (12–29)	NA (16–28)
Pain VAS										
Pre	NA	NA	6±1.2	NA	3.65±1.86 (0.67–5.6)	5.8±1.2	6.25±1.56 (4–8.5)	NA	5.8±2.2	4.03±2.54
Post	NA	NA	2.5±1.2*	NA	1.63±1.85 (0–4.33)*	2.3±1.0 (torn)* 0.8±0.8 (intact)*	0.38±1.06 (0–3)*	Significant improvement*	1.7±2.1*	1.51±1.21*(1 y), 1.24*(2 y)
ASES (0–100)										
Pre	36±19	NA	54.4±17.9	NA	60.4±12.2 (45.6–78.3)	50.3±9.1	41.75±12.71 (25–58)	NA	43.6±18.6	52.22±19.29
Post	92±12*	NA	73.7±10.8*	NA	81.6±17.6 (54.4–100)*	84.0±5.0*	86.50±12.66 (63–100)*	Significant improvement*	77.5±22.0*	81.56±10.21* (1 y), 85.3*(2 y)
AHD, mm										
Pre	NA	6.4±3.3	5.3±2.2	5.25 (3–7)	4.79±2.25 (1.82–7.1)	5.0±2.1 mm	4.50±2.25 (1.7–7.9)	NA	6.6±3.0 (n=57)	7.1
Post	NA	7.1±2.5	6.4±2.3*	8.18 (6–10.5)*	3.75±2.75 (1.3–7.5)	6.6±2.1 (torn), 8.9±2.0 (intact)*	7.70±2.08* (4.6–11.0)	NA	6.7±3.0 (n=44)	9.7* (1 y) 9.9* (2 y)
Graft tears or failure, n (%)	5 (5%)	2 (9%)	9 (29%)	0 (0%)	1 (17%)	13 (36%)	2 (25%)	1 (6%)	11 (55%) (n=20)	3 (3%)
Reoperations, n (%)	4 (4%)	1 (5%)	0 (0%)	0 (0%)	0 (0%)	13 (36%)	1 (13%)	1 (6%)	11 (19%)	1 (1%)

*Statistically significant change (P<0.05). NA, not available; allo, allograft; auto, autograft; TFL, tensor fascia lata; LDT, latissimus dorsi transfer; ASES, American Shoulder and Elbow Surgeons score; VAS, visual analog scale; AHD, acromiohumeral distance.

Table 5 Comparisons of graft integrity and reoperations rate between autograft and allograft in SCR (56)

Parameters	Autograft	Allograft	Overall
Graft tears			
Number of cases/articles	160/4	132/4	334/10
Total count (%)	16 (10.0%)	17 (12.9%)	47 (14.1%)
Details	7: medial row	10: humeral site	21: humeral suture side
	2: lateral row	4: midsubstance tear	4: medial glenoid side
	7: N	2: glenoid side	4: midsubstance tear
		1: N	7: medial row
			2: lateral row
			9: N
Reoperations			
Number of cases/articles	160/4	171/4	374/10
Total count (%)	5 (3.1%)	14 (8.2%)	32 (8.6%)
Details	3: arthroscopic debridement and lavage because of infection	10: rTSA	10: rTSA
	2: arthroscopic capsular release because of severe contracture	1: incision and drainage	1: incision and drainage
		1: open tenodesis of biceps	3: arthroscopic debridement and lavage
		2: revision SCR	2: arthroscopic capsular release
			1: open tenodesis of biceps
			2: revision SCR
			13: revision surgery because of graft tears

rTSA, reverse total shoulder arthroplasty; SCR, superior capsular reconstruction; N, not recorded.

and revision surgery (2 patients from autograft and 1 patient from allograft). Majority of the published articles were with small patient numbers when outcomes were reported and being retrospectively conducted in nature. A recent systematic review showed that SCR resulted in significant improvement in patient-reported outcome measures and range of motion with the mean follow-up of the included studies were ranging from 6 to 48 months (52). However, as there were various surgical technique modifications performed in the SCR, there were not studies comparing the outcome based on the surgical technique. Up to date, the longest follow up study was reported by Mihata *et al*. who described arthroscopic SCR using fascia lata autograft with 5 year follow-up (59). In this mid-term follow up, the study describe that SCR provide improvement of the functional score and ROM with a low rate of graft failure rate (10%) and high rates of return to activity (recreational sport and work).

SCR is a promising procedure for treating irreparable rotator cuff tears patients. The acceptance of superior capsular reconstruction has made it rapidly evolving in terms of a wider variety of procedures and broader surgical indications. Minimizing the graft failure rate is important for achieving good clinical outcomes following SCR. Despite the favorable and consistent outcomes reported by many researchers in the field, studies still report that outcomes are variable and largely depend on graft integrity. Future research comparing the type of graft used in SCR with a long term follow up may add a valuable contribution to the knowledge of the surgical outcome of SCR.

Summary

The management of patients with IRCTs still remains challenging despite the effort to treat with SCR. The mainstay of the challenge is imminent when patients

are thought to be too young for the prosthetic joint replacement. Reports of studies after SCR are increasing, which mostly described encouraging results. However, with respect to functional restoration of the shoulder joint as the endpoint of the procedure, we hope to see long-term outcomes of this procedure.

Acknowledgments

Funding: None.

Footnote

Reporting Checklist: The authors have completed the Narrative Review reporting checklist. Available at http://dx.doi.org/10.21037/atm-20-5925

Conflicts of Interest: Both authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/atm-20-5925). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Cite this article as: Kholinne E, Jeon IH. Arthroscopic superior capsular reconstruction of the shoulder: a narrative review. Ann Transl Med 2021;9(3):268. doi: 10.21037/atm-20-5925

