Superior Capsular Reconstruction With Autologous Fascia Lata Using a Single Lateral-Row Technique Is an Effective Option in Massive Irreparable Rotator Cuff Tears

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Purpose: The purpose of this study was to evaluate clinical and radiologic outcomes of arthroscopic superior capsular reconstruction (ASCR) with fascia lata autograft in patients with irreparable rotator cuff tears (IRCTs) performed using a single lateral-row fixation technique. **Methods:** We studied a retrospective case series of patients with large or massive IRCTs for ASCR with fascia lata autograft. Clinical outcomes were evaluated using the Visual Analog Scale (VAS) and the Constant score. Healing of the graft was assessed by magntic resonance imaging or ultrasound. Acromiohumeral distance was evaluated by radiographs. **Results:** Thirty-one patients with an average age of 61 years and an average follow-up of 35 months (24-51 months) underwent ASCR with fascia lata autograft. There was a significant improvement in VAS (7.7-0.7), Constant score (36.0-78.7), forward elevation (115°-171°), external rotation (33°-50°), strength (0.3 kg-2.3 kg), and acromiohumeral distance (6.1 mm-8.6 mm) ($P < 0.001$). Graft failure was present in 13.8% of patients, as shown by magnetic resonance imaging (26 patients) or ultrasound (3 patients). Patients with failed ASCR showed worse Constant scores (68.5.8 vs 80.2, $P = 0.007$), worse VAS (2.5 vs 0.4, $P = 0.00002$), worse external rotation (20° vs 54°, $P = 0.004$), lower acromiohumeral distance (5mm vs 9mm, $P = 0.007$), and a high association with the presence of os acromiale (χ^2 $P = 0.003$). No revision or subsequent surgical procedures were required. **Conclusions:** ASCR, with autologous fascia lata and single lateral row configuration, is an effective option in irreparable rotator cuff tears and results in clinical and radiologic improvement. **Level of Evidence:** Level IV, retrospective case series.

Rotator cuff tears (RCTs) have a prevalence of 20% in the general population.[1] Patients who fail conservative treatment are indicated for surgery. Of these, up to 12% of tears are considered irreparable,[2] and a high percentage of technically reparable massive RCT have low healing rates, especially in patients older than 60 years of age.[3]

Irreparable rotator cuff tears (IRCTs) can be identified preoperatively by the radiologic criteria that have been described in previous publications: by radiology, considering the Hamada classification of rotator cuff arthropathy[4]; by magnetic resonance imaging (MRI), noting tendon retraction according to Patte classification[5]; or by muscle fatty infiltration, according to Goutallier[6,7]; the tangent sign[8]; or Thomazeau on MRI.[7] They can also be identified intraoperatively by a retracted tendon or poor tissue quality after tendon liberation procedures, which do not allow for suture of the tendon to the footprint without tension, defining it as irreparable.[2,9]

Currently, several surgical options have been described for this clinical situation, including biceps tenotomy,[10,11] debridement,[12,13] partial repair,[14-18] interposition patch,[19-22] tendinous transfers,[23-29] subacromial

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balloon,[30-32] reverse total shoulder arthroplasty,[33-36] and arthroscopic superior capsular reconstruction (ASCR), with either fascia lata, as described in the first publication of this technique by Mihata in 2013,[37] or with dermal allograft, as described by Hirahara in 2017.[38]

Recommended surgical options vary based on patient age and activity level. Reverse total shoulder arthroplasty has a high complication rate and is preferred in older patients.[39-41] Partial repair[15,16] and debridement[13] results deteriorate quickly. Because of this, for young and active patients, options are more limited.

There is a current tendency to use a double-row configuration for the rotator cuff repair,[42] and most of the ASCR techniques follow the same concept, using a double-row repair technique for the attachment of the graft to the humeral footprint.[43] However, the superior capsule covers up to 34% of the medial aspect of the humeral footprint on the greater tuberosity.[44,45] Because the ASCR's purpose is only to recreate the biomechanical function of the superior capsule and not to replicate the rotator cuff insertion, a single-row repair technique should suffice because it manages to cover 46%-52.7% of the footprint, as previously described by Meier[46] and Brady.[47] In our private health care system, implants and grafts are not covered by insurance. By removing the lateral row, using a total of 4 anchors and using fascia lata instead of a commercial graft, costs can be reduced dramatically, making this a more accessible surgical option for patients.

The use of a fascia lata graft to the bone has long been documented, beginning with Kernwein in 1938.[48] In 2002, Sano showed growth and incorporation of the fascia into a bony footprint.[49] Hirahara demonstrated the first clinical series of ASCR with a dermal allograft in 2017.[38] Several studies have shown good results with ASCR using either fascia lata or dermal allograft and a lateral double-row technique[37,50-59] or a lateral single-row technique.[51]

The purpose of this study was to evaluate clinical and radiologic outcomes of arthroscopic superior capsular reconstruction with fascia lata autograft in patients with irreparable rotator cuff tears performed with a single lateral-row fixation technique

Our hypothesis was that patients with IRCT undergoing an ASCR with fascia lata autograft and a single lateral-row technique have high healing rates and good clinical outcomes.

Methods

This is a retrospective case series of consecutive patients with large or massive IRCTs that underwent surgery between October 2016 and January 2019 by the same surgical team at least 3 months of conservative treatment that failed.

Indications for ASCR were: IRCT with or without pseudoparalysis (forward active elevation less than 90°); without shoulder stiffness or anterosuperior escape; radiographic Hamada classification rotator cuff arthropathy[4] 1-3; MRI noting tendon retraction, type 3, according to Patte classification[5]; or supraspinatus muscle fatty infiltration, grades 3 or 4, according to Goutallier[6,7]; a positive tangent sign[8]; or type 3 atrophy according to Thomazeau on MRI.[7] Patients could also be identified as having irreparable damage intraoperatively by the presence of a retracted tendon or poor tissue quality after tendon liberation procedures that did not allow for suture of the tendon to the footprint without tension.[2,9]

Patients with Hamada classification rotator cuff arthropathy 4 and 5 were not included and were, instead, indicated for a reverse total shoulder arthroplasty. Patients with infraspinatus muscle fatty infiltration grades 3 or higher according to Goutallier and with an infraspinatus tendon that did not reach its footprint after tendon liberation were indicated for a tendon transfer. Patients with fatty infiltration grades 3 and 4 but with a tendon that reached the infraspinatus footprint received an ASCR nevertheless.

Contraindications included axillary nerve paralysis, previous shoulder infections, Hamada rotator cuff arthropathy classifications 4 and 5, irreparable subscapularis, and fixed anterosuperior escape of the humeral head.

Patient assessment was performed by the same main surgeons involved in all surgeries (JFA, BU); the data used are those recorded during last follow-up. Patients were typically evaluated monthly until 6 months, then at 12 months and yearly after the first year. Physical examination included passive and active range of motion in elevation and internal rotation and external rotation with arm at the side and abducted using a goniometer. Preoperative and postoperative clinical evaluations were performed using the Constant score and the Visual Analog pain Scale (VAS).[60-63] Strength measurement was performed using a standard analog spring balance attached to the distal forearm, with the arm in 90° of elevation in the scapular plane, with a straight elbow, and in pronation (palm facing the floor); the average of 3 subsequent attempts of 5 seconds of resisted elevation was recorded.

Radiologic study included shoulder radiographs (true anteroposterior, axillar and outlet views) and shoulder MRI (Phillips SmartPath dStream; 1.5 Tesla, Baltimore, MD). Images were acquired in sagittal oblique (T1-weighted and intermediate-weighted fat-saturated), coronal oblique (T2-weighted and T2-weighted fat-saturated), and axial (T1-weighted and intermediate weighted fat-saturation) sequences. Some patients were referred from other institutions with their MRIs, and those images were not retaken at our institution. All images were evaluated by both senior surgeons (JFA, BU) and a musculoskeletal radiologist (JCV).

Tendon retraction was evaluated according to Patte classification,[5] and muscular fatty infiltration was evaluated according to Goutallier[6] for all tendons and according to Thomazeau[7] for supraspinatus.

Healing of the graft was assessed after surgery, preferably by MRI according to the Sugaya[64] classification or by ultrasound when MRI was not attainable. MRIs were programed to be taken at the 1-year follow-up but were taken earlier in patients with more symptoms or later in patients who were unable to pay for the examination at the time. Radiographs included for acromiohumeral distance (AHD) measurements correspond with the 1-year follow-up.

Patients were classified for presence of rotator cuff tear arthropathy according to the Hamada classification, preoperatively and yearly after surgery. AHD was assessed on true anteroposterior radiographs preoperatively and at 1 year postoperatively. Lesion size, graft thickness, graft size, presence of biceps injury, and presence of subscapularis injury were recorded intraoperatively.

Patients who underwent surgery between October 2016 and January 2019 were reviewed retrospectively, with a minimum follow-up of 24 months; 32 patients were included. One patient was lost to follow-up 3 months after surgery. The 31 patients with complete follow-up were evaluated clinically and radiologically.

Approval of the Ethics and Scientific Committee of the State Health Care System was obtained for this study. Informed consent was obtained from all participants in this study.

Surgical Technique

The patient was positioned in lateral decubitus position under general and braxial plexus anesthesia. Shoulder arthroscopy was performed through posterior, anterior and lateral standard portals with a rigid anterior cannula and a 10 mm Passport Canula (Arthrex, Naples, FL) laterally. The status of the subscapularis and biceps tendons was evaluated. If the long head of the biceps was present, a biceps tenotomy was performed, and the subscapularis was repaired if necessary.

The remnant infraspinatus was liberated and mobilized over its footprint without tension, and the extension of the coverage was noted. The remaining defect was used for measuring the size of the defect that needed to be covered by the graft, from the anterior border of the mobilized infraspinatus to the posterior edge of the bicipital groove and from the glenoid to the lateral margin of the humeral footprint, adding 10 mm in the mediolateral plane as described by Mihata.[37] Measurements were made with a marked arthroscopic probe or an arthroscopic ruler.

Graft harvest was performed from the ipsilateral thigh with a longitudinal lateral approach over the trochanter. Depending on the thickness of the fascia lata, which was measured with a ruler at the proximal end of the graft after initial liberation, the length of the distal dissection of the graft had to be adjusted to allow a 2- to 4-layer preparation to achieve the recommended minimum thickness of 6 mm. The average graft was a single 12 x 3 cm fascia lata strip with initial thickness of 2 mm, prepared into a 3-layer graft of 4 x 3 cm and a final thickness of 6 mm. The graft was then sutured with isolated 2.0 Vicryl (J&J Medical, New Brunswick, NJ) stitches in each corner and 1 or 2 free stitches on free edges between corners. Alternatively, a continuous suture around the entire edge was used to facilitate manipulation into the subacromial space because sometimes after graft insertion through the cannula, the free edges of the different layers twist and make visualization difficult.

The glenoid upper-neck surface and the humeral footprint were prepared with radiofrequency, shaver and a rasp to expose cortical bone, preserving the superior labrum. Two single-loaded 3.5 mm titanium

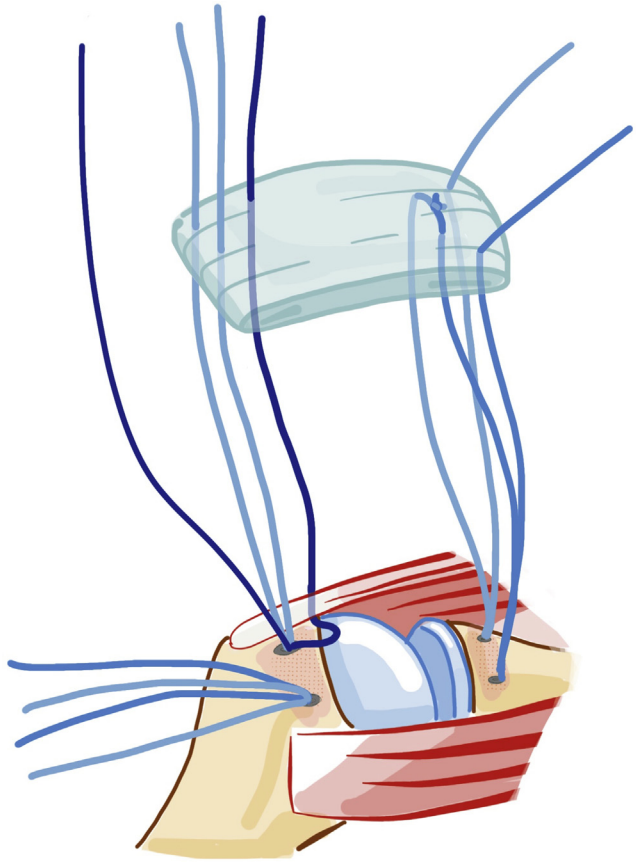

Fig 1. Anchor placement. Drawing of a right shoulder, anterior view. One of the sutures of the posterolateral (posterior humeral) anchor is used for repair of the infraspinatus (dark blue suture). One end is passed through the tendon before graft insertion, and the other end is passed through the graft, medially to posterolateral mattress stitch.

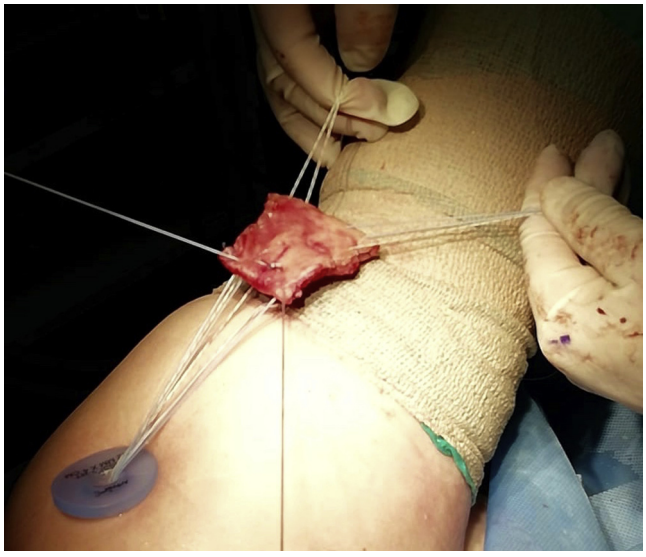

Fig 2. Right shoulder, lateral decubitus. Prepared graft with all sutures in place. The 2 medial sutures that will serve as a pulley mechanism are tied over the center of the medial side of the graft.

corkscrew anchors (Arthrex, Naples, FL) were placed on the anterior and posterior ends of the glenoid footprint through the Nevasier portal and either the anterior portal or an auxiliary anterior portal above the coracoid process. Two 5.5 mm double-loaded titanium corkscrew anchors were placed on the humeral footprint (Fig 1). The distance between the anchors was measured, and the graft was marked accordingly to later place the sutures through these marks. The same construct was used regardless of the graft's size.

All sutures were retrieved through the lateral cannula, taking special care not to tangle them. It is advised to put the scope in the lateral cannula and check for entangled sutures, which might result in failing to pass the graft later on. The 2 central medial stitches were passed through the graft and tied together; then the most anterior and posterior medial sutures were passed at 5 mm of the margin of the graft. This allowed for a pulley mechanism to later pass the graft into the subacromial space (Fig 2).

Sutures of the anterolateral anchor were passed through the anterolateral corner of the graft in a mattress configuration or a modified Masson-Allen configuration. The 2 ends of 1 of the sutures of the posterolateral anchor were passed in a mattress configuration through the posterolateral aspect of the graft (Fig 1). One end of the remaining suture of the double-loaded anchor was passed through the infraspinatus to allow infraspinatus repair. The other end was passed through the posterior margin of the graft to allow a side-to-side mattress stich between the infraspinatus and the graft (Fig 1).

Once all the sutures were in place (Fig 2), the lateral cannula was cut open with scissors while protecting the sutures with a blunt instrument, leaving the cannula in place. The opened cannula allowed for easier passage of the graft. The graft was pushed through the cannula with a grasper at the same time traction was applied to the pulley system of the medial anchors. Medial sutures were retrieved through the Nevasier portal to facilitate knot tying. Care was taken to have good visualization for tying the medial knot and cutting the sutures.

The arm was placed in 20° of flexion, 30° of abduction and neutral rotation, and the rest of the sutures were tied. The posterolateral suture through the infraspinatus was retrieved through the lateral portal and tied, restoring the tendon to its footprint. Then 1 or 2 side-to-side sutures were added between the graft and the infraspinatus tendon (Fig 3). The graft should not be sutured to the subscapularis because that may cause stiffness. The cannulas were removed, and the portals were closed.

Postoperative Rehabilitation Protocol

Patients' arms were put in slings for 6 weeks, and they were asked to perform scapular motion elbow flexion-extension exercises. At 6 weeks, they were allowed to begin progressive active shoulder elevation and rotations. Thereband and load exercises were initiated at 3 months, and patients returned to work at 6 months.

Results

Between October 2016 and January 2019, 32 patients underwent ASCR; 1 was lost to follow-up at 3 months, but 31 completed follow-up between 24 and 51

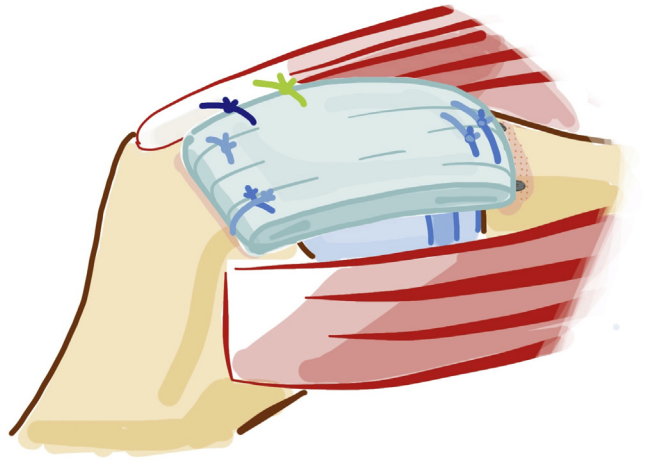

Fig 3. Drawing of a right shoulder, anterior view. Final construction with side-to-side sutures between infraspinatus tendon and graft. One of the sutures of the posterolateral (posterior humeral) anchor is used for repair of the infraspinatus (dark blue suture). A second side-to-side suture with Fiberwire (Arthrex, Naples, FL) is added between the infraspinatus tendon and the graft (green suture) after the graft is in place.

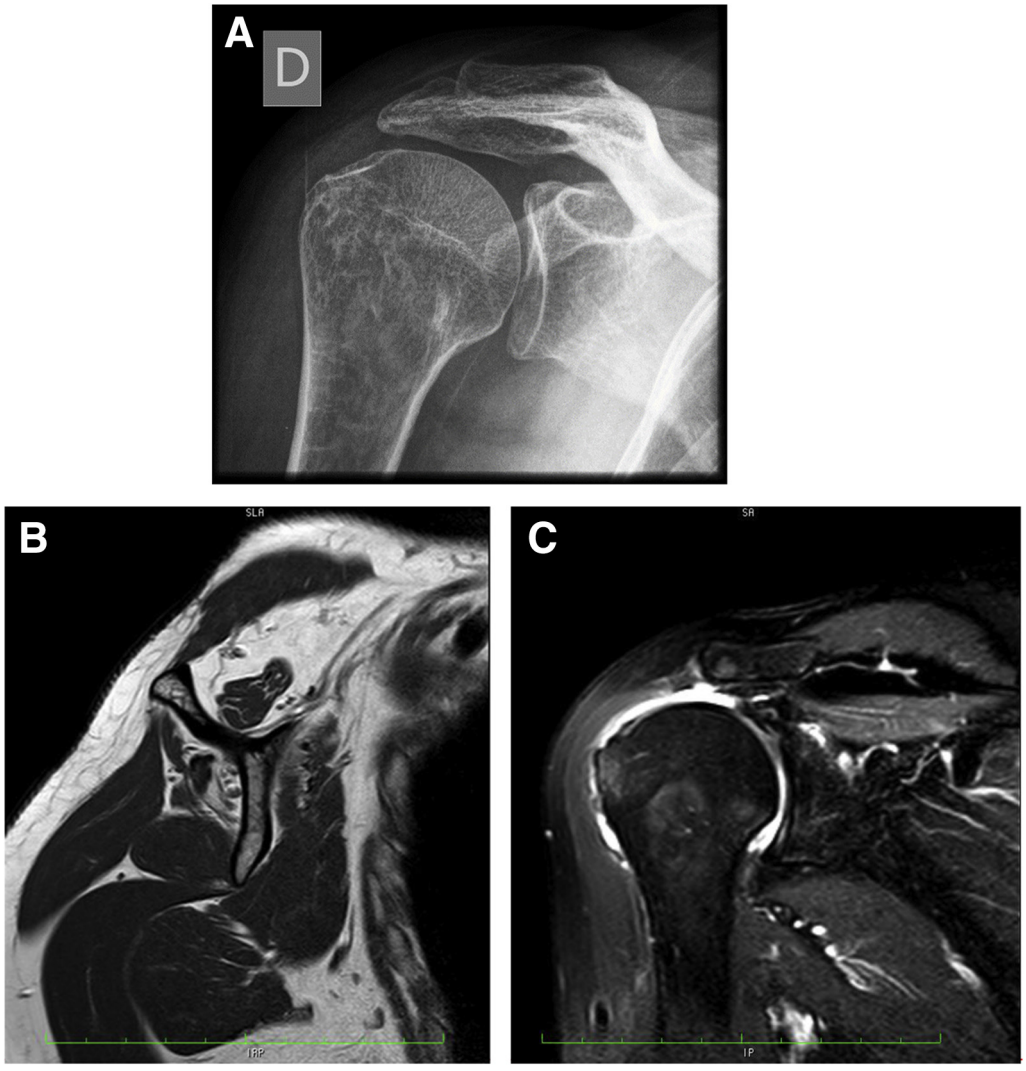

Fig 4. (A) Preoperative anteroposterior radiograph of a right shoulder showing lowered acromiohumeral distance. (B) Preoperative MRI, T1-weighted fast spin echo (TE 10 TR 600) sagittal oblique view of a right shoulder showing muscle atrophy and infiltration of the supraspinatus and infraspinatus muscles. (C) Preoperative MRI, T2-weighted fast spin echo fat saturation (TE 60 TR 3200) coronal oblique view of a right shoulder showing tendon retraction and reduced acromiohumeral distance. (D) Postoperative anteroposterior radiograph of a right shoulder showing acromiohumeral distance improvement and anchor placement after arthroscopic superior capsular reconstruction. (E) Postoperative MRI, T2-weighted fast spin echo (TE 80 TR 4100) coronal oblique view of a right shoulder showing a healed graft. (F) Postoperative MRI, intermediate weighted fast spin echo (TE 30 TR 4500) sagittal oblique view of a right shoulder showing a healed graft in continuity with the infraspinatus tendon.

months postoperatively, with an average of 35 months. The patients included 22 women and 9 men between 47 and 76 years of age, the average age being 61 years; the average body mass index (BMI) of 31.4, range 23.1-48.9.

All patients had preoperative radiographs and MRIs (Fig 4A,B,C) and postoperative radiographs (Fig 4D). The AHD increased from a preoperative average of 6.1 mm (range 2-11 mm) to a postoperative average of 8.6 mm (range 2-12mm), $P < 0.001$ (Fig 4A,D) (Table 1). Eleven patients presented preoperatively with Hamada classification 1, 17 patients with Hamada classification 2 and 3 patients with Hamada classification 3.

Of the 31 patients, 29 were re-evaluated for healing of the graft postoperatively, and 26 were evaluated by MRI between 6 and 22 months postoperatively, with an average of 10.5 months (Fig 4E,F); 3 patients were evaluated by a shoulder ultrasound; 2 patients rejected MRI because of claustrophobia; and 1 did not fit in the available MRI machines. Two patients could not be re-evaluated radiologically due to oncologic pathology and the SARS-Covid-19 pandemic, but both had good clinical results and no pain. Of 26 patients who underwent MRI, 4 showed a tear of the graft (Fig 5A,B), accounting for a graft tear rate of 15.4% (4/26). All 4 patients presented with a

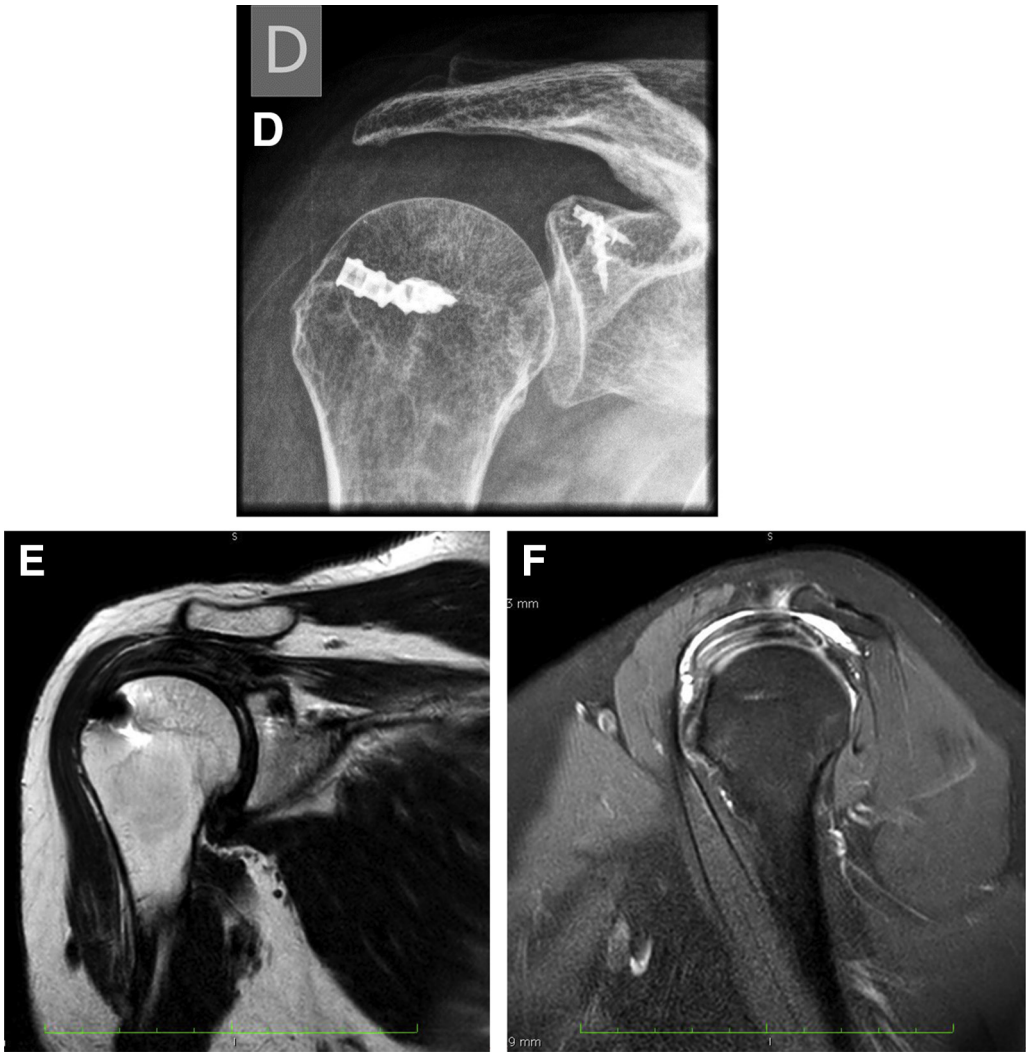

Fig 4. Continued

nontraumatic tear of the humeral side of the graft, 2 at 6 months, 1 at 7 months and 1 at 12 months after surgery. According to Sugaya's classification, 4 patients presented with Sugaya 1; 10 with Sugaya 2; 8 with Sugaya 3; 2 with Sugaya 4; and 2 with Sugaya 5.

All 3 patients evaluated by ultrasound showed an intact graft on the humeral side at 12, 14 and 36

Table 1. Pre- and Postoperative Clinical and Radiologic Outcomes

	Preoperative Average Median (Range)	Postoperative Average Median (Range)	*P* Value
Acromiohumeral distance	6.1 mm 6.0 mm (2-11 mm)	8.6 mm 9.0 mm (2-12 mm)	<0.001
Constant score	36.0 30.0 (18-60)	78.7 77.0 (59-93)	<0.001
Pain	7.7	0.7	<0.001
Visual Analog Scale	8.0 (5-10)	0.0 (0-5)	
Forward elevation	115 95 (45-170)	171 180 (135-180)	<0.001
External rotation	33 30 (0-80)	50 60 (0-80)	<0.001
Strength	0.3 kg 0.0 (0-3.0)	2.3 kg 2.0 (0-8.0)	<0.001

NOTE. There was postoperative improvement in AHD, Constant score, pain, range of motion and strength after ASCR.

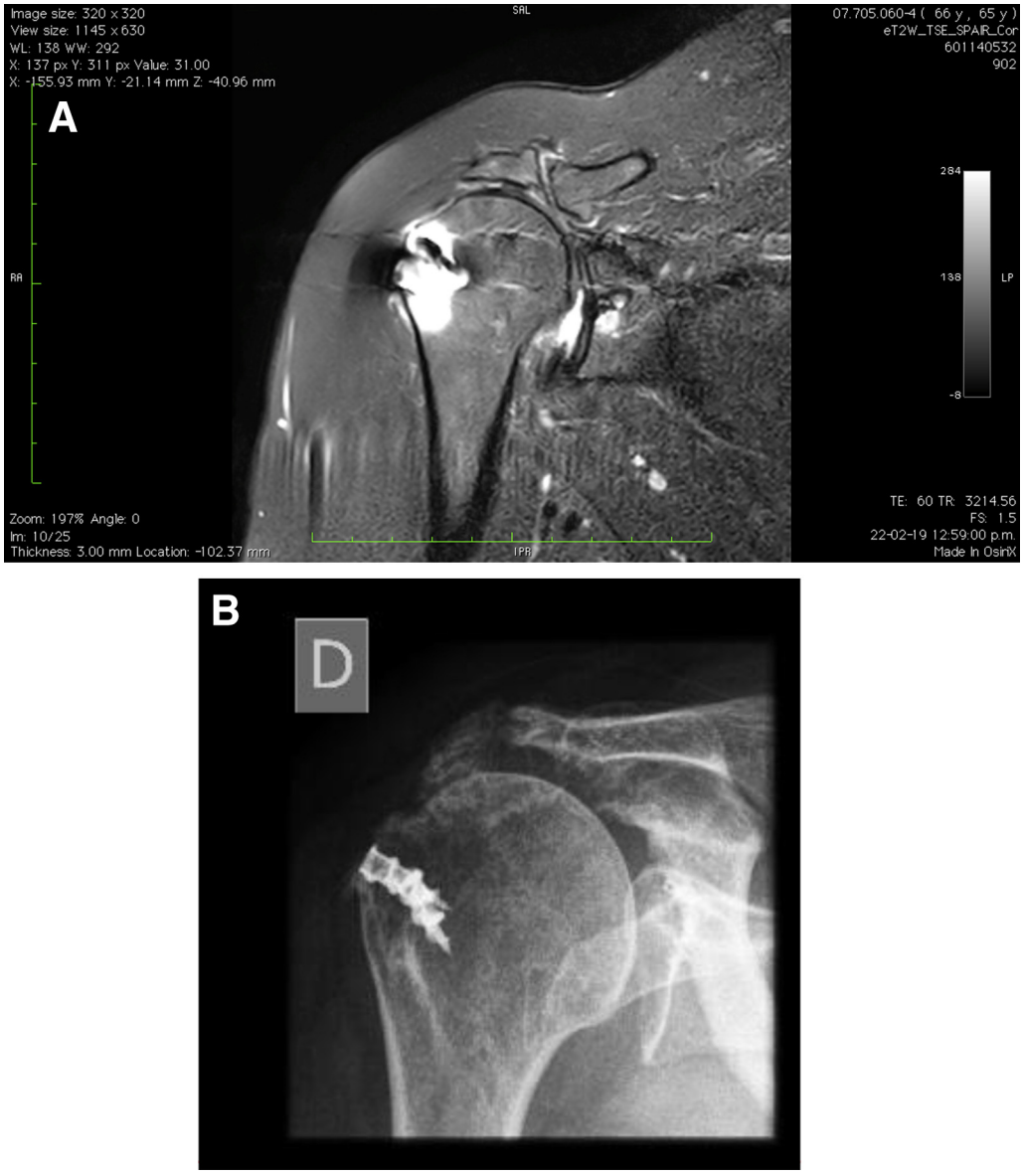

Fig 5. (A) Postoperative MRI, T2-weighted fast spin echo fat saturation (TE 60 TR 3200) coronal oblique view of the right shoulder of a patient with a torn graft and os acromiale. (B) Postoperative anteroposterior radiograph of the same patient as in Fig 5G, with a torn graft and os acromiale. Acromiohumeral distance HD is decreased.

months (average 21 months). Because of the restrictions of this imaging technique, the glenoid side of the graft could not be evaluated, but all 3 patients maintained their increase in AHD. Including these 3 patients, the tear rate in 29 patients who underwent postoperative imaging was 13.8% (4/29).

There was a significant decrease in postoperative pain, from an average VAS of 7.7 (range 5-10) to an average of 0.7 (range 0 to 5). All patients but 1, who had a torn graft, reached minimal clinically important difference (MCID) of 1.5 and a substantial clinical benefit of 2.5.[62] Patient acceptable symptom state (PASS) under 1.7[62] was reached by 93% of patients, with 2 patients reporting VASs of 3 and 5.

There was a statistically significant increase in the Constant score from a preoperative average of 36.0 (median of 30.0, range 18-60) to a postoperative Constant score average of 78.7 (median of 77.0, range 56-93), $P < 0.001$ (Table 1). All patients showed improvement in their scores over the MCID of 10.4,[65] with an average improvement of 43. Preoperatively, 38% of patients presented with Constant scores over the PASS of 42[66]; postoperatively, 100% of patients showed values over PASS.

There was a significant increase in active forward elevation, from a mean of 115° (range 45°-170°) to a mean of 171° (range 135°-180°) (Table 1), achieving an MCID of 10°[67] in 97% (30/31), with 1 patient

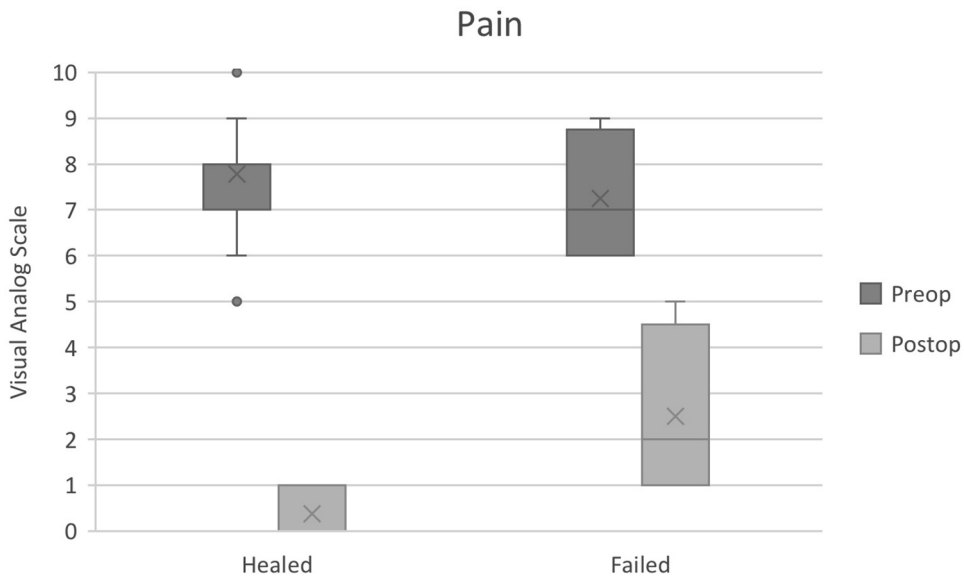

Fig 6. Pain (Visual Analog Scale [VAS]). Comparison between healed and failed groups. Patients with healed grafts reported less pain (VAS) as compared to those who presented a tear of the graft (0.4 vs 2.5, $P < 0.001$).

maintaining forward elevation of 170° postoperatively. Significant increases were also noted in strength (0.3 kg to 2.3 kg) (Table 1) and active external rotation (33° to 55°) with MCID 10°[67] achieved in 81%.

Patients with failed ASCR showed worse VAS (2.5 vs 0.4, $P = 0.00002$) (Fig 6), worse Constant scores (68.5 vs 80.2, $P = 0.007$) (Fig 7), worse external rotation (20° vs 54°, $P = 0.004$) (Fig 8), lower AHD (5 mm vs 9 mm, $P = 0.0003$) (Fig 9) (Table 2) and a high association with the presence of os acromiale (χ^2 $P = 0.003$). Fatty infiltration of the infraspinatus grades 3 and 4 preoperatively correlated with higher postoperative pain ($P = 0.013$) and a tendency toward worse external rotation ($P = 0.053$) and lower Constant scores ($P = 0.055$). We found no correlation between BMI and clinical outcomes.

The long head of the biceps tendon was absent in 4 patients; 2 patients presented with a dislocated biceps, 1 patient presented with a split tendon, 1 patient had a SLAP (superior labral tear from anterior to posterior) 2, 1 patient had a SLAP 3, and the remaining patients presented with various levels of fraying and partial tears. Tenotomy was performed in all cases with a present biceps tendon.

Complications

All complications are listed in Table 3. One patient presented with a postoperative hematoma in the donor-site area, which did not require drainage and resolved spontaneously in 3 weeks, and 2 patients presented with pain at the donor site (VAS 4/10) with no associated limping. The pain was manageable with

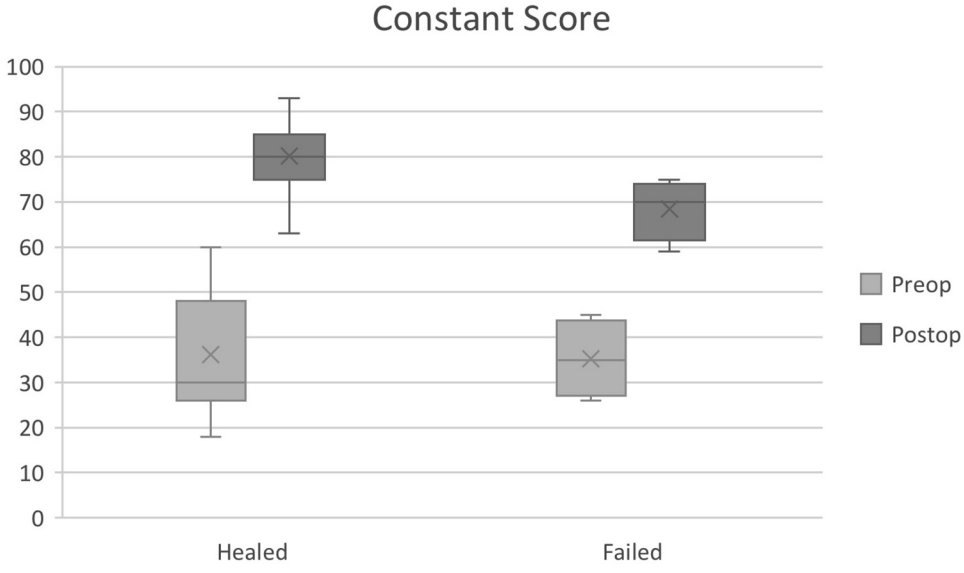

Fig 7. Constant score. Comparison between healed and failed groups. Patients with healed grafts showed better constant scores (80.2 vs 68.5, $P = 0.007$).

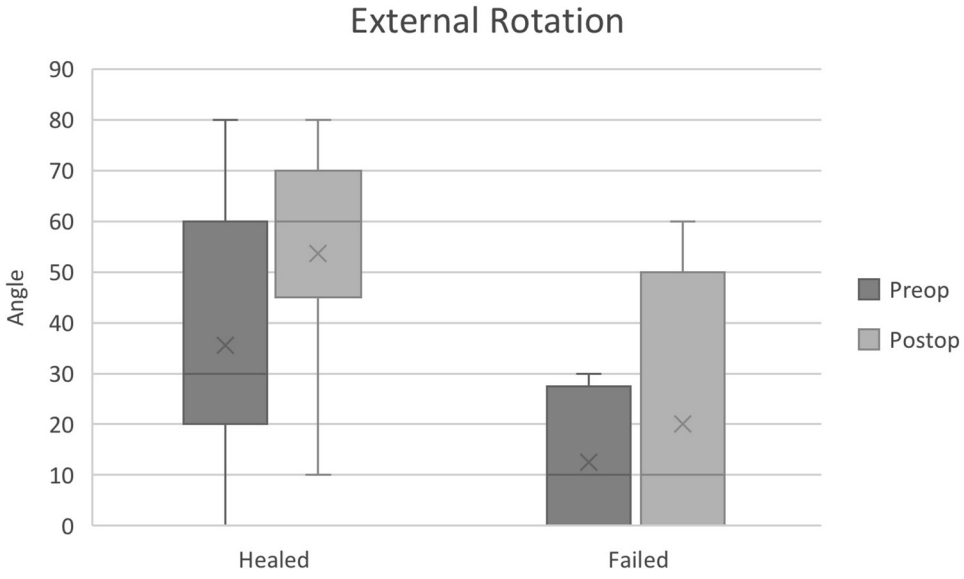

Fig 8. External rotation. Comparison between healed and failed groups. Patients with healed grafts gained more external rotation compared to those with torn grafts (54° vs 20°, $P = 0.004$).

medication and remitted after 1 month. Both patients described it as tolerable when compared with the shoulder's preoperative pain. No donor-site muscular hernias were noted. No donor-site or shoulder infections occurred. No patients presented shoulder stiffness as a complication (passive range of motion under 100° of forward flexion).

One patient had a fall at 4 months postoperatively. A follow-up radiograph showed no fractures, but the posterolateral humeral anchor had protruded 3 mm compared to postoperative radiographs. An ultrasound showed graft continuity, so normal postoperative rehabilitation was continued. At the 1-year follow-up, the patient showed a healed graft on MRI, with a Sugaya type 3 image. The patient remains asymptomatic and with full function (VAS 0, Constant score 74).

No patient required a revision surgery or subsequent surgical procedures due to pain or function in the same shoulder.

Discussion

This cohort of patients with IRCT undergoing ASCR with fascia lata autograft and a single lateral-row technique showed a healing rate of 84.6% and clinically significant improvements in pain and function.

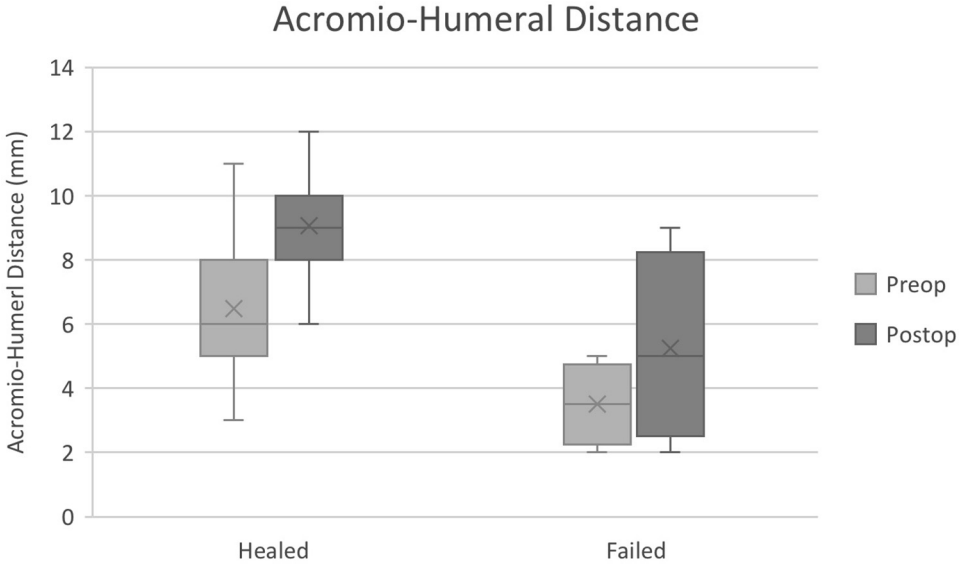

Fig 9. Acromiohumeral distance. Comparison between healed and failed groups. There is an increase in acromiohumeral distance postoperatively in patients with healed grafts (9.1 mm vs 5.3 mm, $P < 0.001$).

Table 2. Comparison Between Healed (27 Patients) and Failed (4 Patients) Groups

	Preoperative Average Median (Range)			Postoperative Average Median (Range)		
	Healed	Failed	*P* Value	Healed	Failed	*P* Value
AHD	6.5 mm	3.5 mm	0.014	9.1 mm	5.3 mm	0.0003
	6.0 mm (3-11 mm)	3.5 mm (2-5 mm)		9.0 mm (6-12mm)	5.0 mm (2-9 mm)	
Constant score	36.2	35.3	0.89	80.2	68.5	0.007
	30.0 (18-60)	35.0 (26-45)		80.0 (63-93)	70.0 (59-75)	
Pain	7.8	7.3	0.42	0.4	2.5	0.00002
VAS	8.0 (5-10)	7.0 (6-9)		0.0 (0-1)	2.0 (1-5)	
Forward elevation	112	131	0.40	172	170	0.77
	90 (45-170)	133 (90-170)		180 (135-180)	170 (160-180)	
External rotation	36	13	0.07	54	20	0.004
	30 (0-80)	10 (0-30)		60 (10-80)	10 (0-60)	

NOTE. Only outcomes that showed differences between patients with healed grafts and torn grafts are included.
AHD, acriohumeral distance; VAS, Visual Analog Scale.

Several clinical series show the clinical and radiologic results of ASCR with fascia lata or with dermal allograft.[68] Published series report failure rates of of 3.4% to 55% with dermal allograft and between 4.5% and 29% for fascia lata autograft.[43,68,69] With a graft tear rate on MRI of 15.4% (4/26 MRIs), our results are similar to those reported in previous publications, but they should be interpreted with caution based on the limited duration of follow-up imaging (average 9.5 months for MRI and 21 months for ultrasound) as well as loss to follow-up. Published clinical series with longer follow-up show failure of 21% at 3 years[59] and 10% at 10 years.[57]

All patients included in this study improved regarding pain. Patients with healing of the graft reported less pain (VAS) as compared to those who presented a tear of the graft (0.4 vs 2.5, $P < 0.01$) (Fig 6) (Table 2). These results are similar to those presented by Mihata[3,7] Campos Azevedo,[53] Denard,[50] Burkhart,[55] and Pennington.[52]

All patients improved their Constant scores. Our series showed a significant difference between healed patients and those with graft failure (80.2 vs 68.5, $P < 0.01$) (Fig 7) (Table 2). These results are similar to those presented by Lee[51] but differ from those presented by Lim.[54]

All patients showed improved range of motion, even those with elevation under 90° preoperatively (Fig 10) (Table 1). The increase in forward elevation in patients with a torn graft could be explained in part by the partial repair of the infraspinatus tendon and in part by the centering effect of the superior capsule on the humeral head, allowing for efficient use of the force couples between internal and external rotators. A torn graft could still be acting as a spacer, and even if is no longer serving that function, the improvement in range of motion persists after reabsorption of a subacromial balloon spacer.[70]

There was a significant increase in elevation and external rotation in the postoperative period, achieving MCID in 97% and 81%, respectively. Patients who failed gained less external rotation ($P = 0.004$) (Fig 9) (Table 2). These results are similar to those presented by Campos Azevedo in 2020[59]; that study showed a significant difference in external rotation at 90° of abduction.

We have seen that in Hamada 3 (lower AHD), rerupture appears more commonly ($P = 0.01$). These patients report more postoperative pain ($P = 0.01$) (Table 2), contrary to results presented by Burkhart[56] and similar to the findings by Denard.[50]

We found 3 patients with os acromial (9.4% of our series); the general prevalence is 1.9% to 12.5% in the Caucasian population.[71] Of these patients, 2 presented with a tear of the graft, which is significantly higher than the expected tear rate in our sample (χ^2, $P = 0.003$) (Fig 5A,B). This increased tear rate should be interpreted with caution based on the small number of patients and the lack of a clear mechanism that would explain this result. However, until more information is available, we consider this to be a relevant factor at the time of decision making regarding the indication for surgery. Patients with os acromiale might find greater benefit in a different procedure such as a reverse total shoulder arthroplasty, which is not affected by its presence.[72,73]

Table 3. Postoperative Complications

Complications in 31 patients	Number (Percentage)
Superficial infection	0
Deep infection	0
Donor-site hematoma	1 (3.2%)
Donor-site pain	2 (6.5%)
Donor site muscular hernia	0
Neurologic lesions	0
Revision surgery	0
Rotator cuff arthropathy Hamada 4-5	0

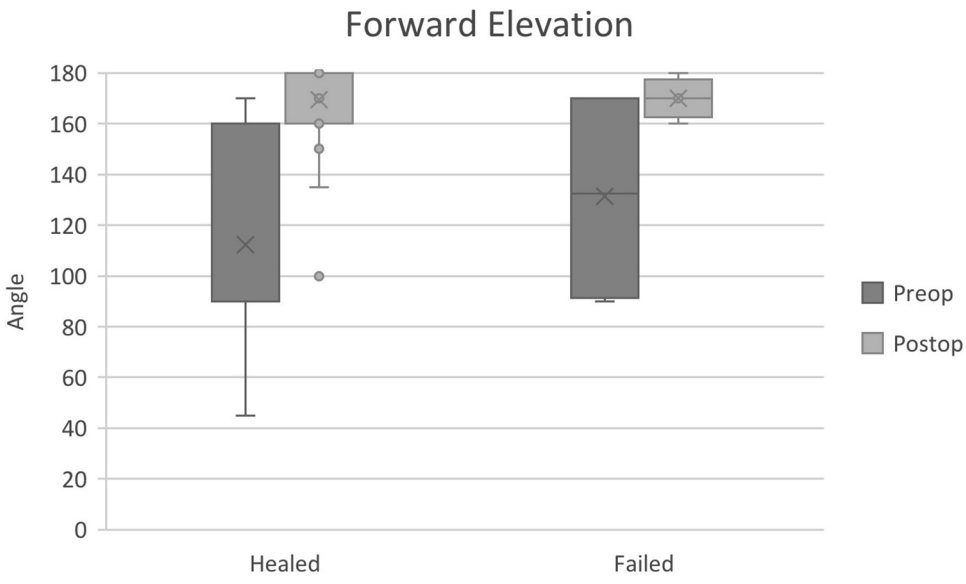

Fig 10. Forward elevation. Comparison between healed and failed groups. All patients gained forward elevation postoperatively with no significant difference regarding healing of the graft (172° vs 170°, $P = 0.77$).

We found no correlation between BMI and clinical outcomes, as opposed to previous studies with similar average BMIs.[74]

There is also an improvement of AHD postoperatively (Fig 9), as shown in previous studies by Mihata[37] and Campos Azevedo,[59] which showed smaller AHD in patients with graft tears, as expected and described by Mihata.[37] It is important to recognize that patients who presented with a graft tear had a lower AHD preoperatively (Table 2). We do not routinely perform acromioplasty in our RCT surgery, so we do not perform it in our patients during ASCR. Thus, the postoperatively measured AHD is due to graft placement and partial tendon repair, not due to acromioplasty.

Fatty infiltration of the infraspinatus grades 3 and 4 preoperatively appears to influence results, showing more postoperative pain ($P = 0.013$) and a tendency for worse external rotation ($P = 0.053$) and lower Constant scores ($P = 0.055$). Because of these factors, we have been shifting toward tendinous transfers around the shoulder (latissimus dorsi and inferior trapezius transfers for posterosuperior tears; combined transfers for subscapularis and posterosuperior tears) to improve outcomes in these patients. Nowadays, ASCR is reserved for patients with irreparable tears of the supraspinatus that are associated with infraspinatus up to Goutallier 1 and 2 with reparable subscapularis. Therefore, in patients with a posterosuperior tear, the decision between ASCR or tendon transfer is determined by the repairability of the infraspinatus.

Despite the clinical appeal of viewing a single image as a predictor of rotator cuff tear characteristics, such as reparability or outcome from surgery, the reliability of the Goutallier classification has not been high,[75-78] and this has been taken in account when defining a tear as irreparable. Despite these drawbacks, we find the Goutallier classification to be a useful tool for anticipating the need for ASCR during surgery. However, the final decision of whether to categorize a rotator cuff tear as irreparable or not always comes after diagnostic arthroscopy or even after extensive tendon liberation and an attempt to repair the torn tendons.

The presence of an affected but reparable subscapularis, with fatty infiltration grades I or II according to the Goutallier[6] classification, did not alter the clinical or radiologic results as shown in some of the previous literature.[79]

Failure of the RCSA does not necessarily lead to revision, granting the possibility of rescue surgery in the event of symptomatic failure.

Limitations

This study is a retrospective case series without control cases. Although the protocol followed was clear, the images were obtained at different institutions, which may affect measurements. MRI follow-up was performed between 6 and 22 months postoperatively, depending on patient access to imaging. Radiologic and clinical evaluations were made by the same surgical team, which could affect the objectivity of the evaluations.

We had a small number of patients, thus the power of the study is low. Titanium anchors were used, and that artifact may have adversely affected imaging interpretation, not allowing visualization of the graft attachment to the footprint along its entire extent.

Conclusions

ASCR with autologous fascia lata and single lateral-row configuration is an effective option in irreparable rotator cuff tears that results in clinical and radiologic improvement.

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