Original Article

Arthroscopic Superior Capsule Reconstruction With Fascia Lata Autograft And In-Situ Biceps Tendon Augmentation: Feasible Outcomes After Minimum Two-Year Follow-Up

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Purpose: To investigate the preliminary functional and radiographic outcomes after arthroscopic superior capsule reconstruction (SCR) with long head of biceps tendon (LHBT) augmentation for irreparable rotator cuff tears (RCTs). **Methods:** Retrospective review of medical records was conducted in patients receiving unilateral SCR with fascia lata autograft and LHBT augmentation for irreparable RCTs between January 2016 and March 2019. LHBT was adopted when the integrity was intact or partial tear was less than 50% in width. We used all-suture anchors for folded graft patch fixation with 2 in supraglenoid fossa and another 2 plus two knotless anchors via compression suture-bridging technique in greater tuberosity. Reinforced fixation with side-to-side suture was added between infraspinatus tendon and graft patch, and between proximal LHBT and graft to improve force coupling. Clinical and radiographic outcomes including magnetic resonance imaging analysis at 2-year follow-up were investigated and compared with preoperative status. **Results:** Consecutive 18 patients (mean age, 66.1 years) were included. Mean active forward elevation significantly improved from 75.6° to 157.2° ($P < .0001$), and external rotation from 33.3° to 53.3° ($P < .01$). Mean acromiohumeral distance increased from 6.1 ± 2.5 mm to 8.5 ± 2.1 mm ($P < .001$). The American Shoulder and Elbow Surgeons score improved from 33.8 ± 5.6 to 93.4 ± 5.92 points ($P < .00001$). Comparable outcomes were found in patients with intact LHBT and those with partial tear. Nine patients had partial tear of graft patch (5, tuberosity side; 4 posterior glenoid); 2 patients had complete tear (tuberosity side) showing inferior outcomes. **Conclusions:** The index surgery restored superior glenohumeral stability and function of the shoulder with irreparable RCTs. Despite high incidence of partial graft tear, favorable outcomes suggest SCR with biceps tendon augmentation is a feasible treatment for irreparable RCTs. **Level of Evidence:** Level IV, therapeutic case series.

Despite recent advancement in surgical instruments with technical refinement, management of irreparable rotator cuff tears (RCTs) remains controversial. Although many researchers have classified the severity of RCTs based on their size and location,[1-3] the lesion is generally considered irreparable when direct tendon-to-bone repair and healing is not possible.[4] Impaired tendon mobility caused by severe retraction and muscle atrophy prohibits direct repair of the torn tendons and accounts for variable outcomes and uncertain durability after partial repairs.[5] Given that up to 30% of RCTs can be categorized as irreparable[6] and the reported failure rate is as high as 90% for treatment of massive RCTs,[7] innovative surgical approaches arise with ongoing challenges, and shoulder surgeons are cautioned to optimize those treatment modalities in properly

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selected candidates withal. The technique of superior capsule reconstruction (SCR) using folded autologous fascia lata (FL) was originally proposed by Mihata et al.[8,9] for treatment of irreparable RCTs without arthropathy. Biomechanical research[8] and clinical data[9] revealed FL patch graft completely restored superior stability of the glenohumeral joint with functional recovery. Favorable outcomes have triggered shoulder surgeons to embrace SCR and raised general concerns in graft options[10] and technique modification.[11] Long head of biceps tendon (LHBT) has been increasingly used as an alternative in reconstructing the superior capsule through variable transposition techniques. Whereas favorable outcomes supported the role of transposed biceps tendon for restoring glenohumeral stability in irreparable RCTs,[12,13] widespread application could be limited by uncertain availability and quality of LHBT in preoperative planning when the biceps tendon was used alone. Therefore we followed a modified technique of SCR using FL autograft and in situ LHBT augmentation.[14] The purpose of this study was to investigate the preliminary functional and radiographic outcomes after arthroscopic SCR with LHBT augmentation for irreparable RCTs. We hypothesized that LHBT could serve as a useful augment in SCR using FL autograft to achieve feasible clinical and radiographic results after primary outcome survey.

Material and Methods

Approval of ethics committee from Institutional Review Board was obtained for this study. Retrospective review of medical records was conducted in patients who received unilateral superior capsule reconstruction for irreparable RCTs between January 2016 and March 2019. The eligible criterion was irreparable RCTs involving supraspinatus and infraspinatus tendons and available LHBT. Irreparability of RCTs was confirmed during arthroscopy after release. Condition of the biceps tendon was arthroscopically probed and availability for suture augmentation was confirmed. Exclusion criteria consisted of subscapularis tendon tear involving more than upper one third, LHBT tear involving more than one half width, glenohumeral arthritis (Hamada stage IV or V), and concomitant neuromuscular disorders.

Clinical Evaluation

All patients underwent physical examination and measurement of shoulder function before surgery, at 3, 6 and 12 months after surgery, and yearly thereafter. Average follow-up was 30.1 months (range, 24 to 41). Preoperative and postoperative 2-year functional data and radiographs were collected and reviewed by one of the co-authors (Y-H.C.), who was blinded to the patients' demographics. Active range of motion was evaluated including elevation, abduction, and external rotation with a goniometer. Active internal rotation was originally recorded as the highest level of the vertebral body that the patients' thumb tip could reach without suffering pain and then was converted to a 5-point scale.[15] Functional assessment included an objective measurement using a subjective functional survey using the American Shoulder and Elbow Surgeons (ASES) score with a maximum of 100 points,[9] the University of California at Los Angeles (UCLA) score with a maximum of 35 points,[16] a patient-self reported disability score using the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) questionnaires with a maximum of 100 points,[17] and a patient-rated functional scoring using the Single Assessment Numeric Evaluation (SANE) method from 0% to 100%.[18] Pain scores were recorded using a 10-point visual analog pain scale (VAS). Clinically significant measures in patient-level metric including minimal clinically important difference (MCID) and patient acceptable symptom state (PASS) was performed based on a cohort analysis in 63 patients receiving arthroscopically rotator cuff repair at 2-year follow-up. The MCID and PASS for ASES, UCLA, QuickDASH, SANE, and VAS pain scores were established.[19]

Radiographic Assessment

Preoperative and postoperative radiographs were obtained in 2 projections: anteroposterior (AP) view with arm in neutral rotation, and lateral view in scapular plane. Acromiohumeral distance (AHD) was measured in AP view from the top of the humeral head in a vertical line to undersurface of the acromion. All patients were categorized according to the status of acromiohumeral space and glenohumeral joint using Hamada classification.[20] Preoperative magnetic resonance imaging (MRI) was arranged to evaluate the severity of rotator cuff tear and muscular fatty infiltration. Collin classification system was used to describe the extent of RCTs based on the subdivided 5 components.[21] The Goutallier classification was used to grade the percentage of fatty infiltration in rotator cuff muscle from grades 1 to 5.[22] MRI evaluation in 2-year follow-up also included graft integrity and thickness based on 6 zones of the graft patch, which was categorized in direction of the shoulder (anterior or posterior) and location of the graft (humeral, mid-portion, or glenoid side). Image interpretation was mainly based on oblique coronal proton density and T2-weighted images with fat suppression. Any full-thickness discontinuity across both bursa and articular sides of the graft patch was considered as a zone of complete tear. All the image analyses were confirmed by 1 orthopaedist (C-H.C.) and 1 radiologist (C-T.W.) among the co-authors, who were blinded to the patients' demographic data. All the image analyses was reported with the consensus of the 2 observers and confirmed by the surgeon (A.C-Y.C.).

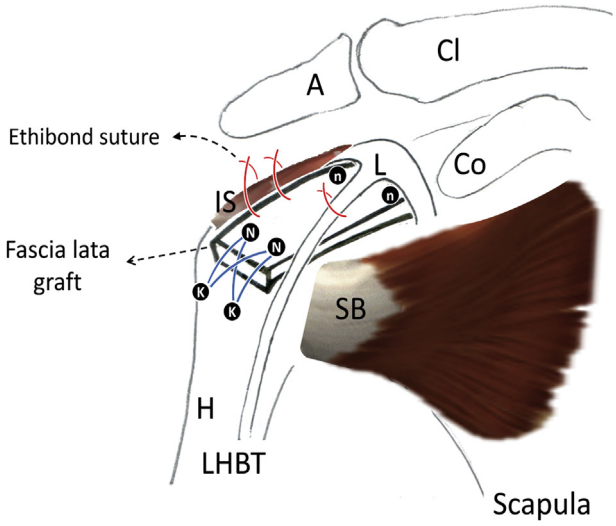

Figure 1. Drawing picture of superior capsule reconstruction using fascia lata graft and biceps tendon augmentation in the right shoulder with irreparable rotator cuff tear. A, acromion; Cl, clavicle; Co, coracoid process; L, superior glenoid labrum; IS, infraspinatus; SB subscapularis; LHBT, long head of biceps tendon; H, humerus; n, 1.4 mm Iconix suture anchor; N, 2.3 mm Iconix suture anchor; K, Reelx knotless anchor.

Surgical Technique

All the surgery was performed with patients under general anesthesia and based on a previously described surgical technique.[14] Autologous FL graft of 5 × 15 cm^2 in size was harvested from lateral thigh with the patient in lateral decubitus position. After suture approximation and proper dressing of the donor site, the patient was changed to beach-chair position. Standard arthroscopic portals were established including posterior, posterolateral, lateral, anterior and Neviaser portals with the pump pressure set between 30 to 50 mm Hg; thorough inspection was undertaken to confirm the status of articular cartilage, irreparable rotator cuff tear and availability of LHBT. Subscapularis tendon was repaired in case of upper one-third tear with 2.3-mm Iconix all-suture anchors (Stryker Endoscopy, San Jose CA). We performed subacromial bursectomy to remove pathological tissue and to facilitate subsequent graft passage and debrided the supraglenoid fossa and the greater tuberosity (GT) to expose cortical bone. The FL graft was folded and firmly sutured to become a 3 × 5 cm^2 patch with thickness of 6 to 8 mm and then was introduced through the anterolateral portal and passed beneath the LHBT until the short side of the rectangular graft patch reached supraglenoid fossa and was securely fixed using two 1.4 mm Iconix all-suture anchors. With the shoulder in 30° flexion and abduction, the lateral one-fourth of the graft patch was fixed to the GT in compression suture-bridging technique using two 2.3-mm Iconix all-suture anchors and two 4.5-mm Reelx anchors (Stryker Endoscopy). The proximal LHBT was then identified by probing and incorporated to the anterosuperior portion of the graft patch with Ethibond suture (Fig 1). Posterior border of graft patch and residual infraspinatus were closed with Ethibond suture for full coverage of the rotator cuff defect.[14] After wound closure with 3-0 nylon, an abduction pillow brace was applied to keep the shoulder in 45° abduction.

Postoperative Protocol

The surgical arm was immobilization in 45° abduction brace for 4 weeks followed by Codman exercise and gentle assisted forward elevation for 3 months. Active motion was prohibited until full passive elevation was reached and started at least 4 months after SCR surgery. For patients with insufficient motion of internal rotation, passive stretch began at least 6 months after surgery. Resistant exercise was allowed at 9 months after surgery.

Statistical Analysis

Descriptive statistics were calculated for bivariate analyses. The Wilcoxon signed rank test was used to identify differences between preoperative and postoperative scores. In comparison between groups of intact repair and re-tear, the Mann-Whitney and Fisher exact tests were performed for non-normally distributed data and categorical data, respectively. $P < .05$ indicated statistical significance.

Results

Among a total of 48 patients who underwent superior capsule reconstruction using FL autograft, LHBT was available and sutured to FL graft as an in situ augmentation in 21 patients. In the remaining 27 patients, LHBT was either absent or too severely damaged to be suitable for augmentation. Three of the 21 patients were excluded because of ipsilateral elbow fracture, moving aboard, and passing away, respectively, within 2 years after the index surgery. Finally, 18 patients with more than 2 years' follow-up were enrolled in this study. There were 9 male and 9 female patients with a mean age of 66.1 ± 4.9 years at the time of surgery (Table 1). Duration of symptoms averaged 12.7 ± 19.8 months. Plain radiographs in AP projections revealed 11 patients of grade 1, 6 patients of grade 2, and 1 patient of grade 3 according to Hamada classification. Regarding location of rotator cuff involvement based on Collin classification, 11 were of type C; 6, type B; and 1, type C. Fatty infiltration of each rotator cuff muscle was categorized using Goutallier classification. In supraspinatus, all were in grade 3 (N = 11) or 4 (N = 6). In infraspinatus, 11 were in either grade 1 or 2; 6, in grade 3; 1, in grade 4. In subscapularis, only 2 patients were grade 2, most of the other 16 patients were either normal or mild streaking. Mild fatty

Table 1. Patient Characteristics

No.	Sex	Age (yr)	Job	Duration of Symptom (mo)	Surgery	Hamada	Collin	Goutallier (SSP/ISP/SB/TM)	Biceps tendon condition
1	F	72	None	84	Primary	1	C	4/2/1/0	Intact
2	F	67	None	3	Primary	2	C	4/4/1/0	Subluxation
3	M	70	None	2	Primary	1	C	3/2/0/0	Subluxation
4	M	59	Manual worker	24	Primary	1	C	3/3/2/0	Subluxation
5	F	57	None	3	Primary	2	D	3/2/0/0	Partial tear
6	M	64	Manual worker	2	Primary	1	D	3/3/2/0	Subluxation
7	M	73	Manual worker	5	Primary	2	E	4/3/1/1	Partial tear
8	M	67	Farmer	6	Primary	1	C	3/1/0/0	Intact
9	F	68	None	30	Revision	2	D	3/1/0/0	Partial tear
10	F	69	Householder	8	Primary	2	C	4/3/0/0	Partial tear
11	F	63	None	5	Primary	1	C	4/3/0/0	Intact
12	M	61	Manual worker	3	Primary	1	C	3/1/0/0	Subluxation
13	F	67	None	13	Primary	3	C	4/3/1/1	Partial tear
14	M	69	Officer	4	Primary	2	C	3/2/0/0	Partial tear
15	M	69	None	5	Primary	1	D	3/1/0/0	Subluxation
16	F	69	None	5	Primary	1	C	3/2/0/0	Partial tear
17	M	69	None	2	Primary	1	D	3/2/0/0	Subluxation
18	F	57	None	24	Revision	1	D	3/1/0/0	Subluxation

Hamada, Hamada classification of massive rotator cuff tear[20]; Collin, Collin classification for rotator cuff tears[21]; Goutallier, Goutallier classification of rotator cuff muscle fatty degeneration[22]; SSP, supraspinatus; ISP, infraspinatus; SB, subscapularis; TM, teres minor.

streaking of teres minor muscle was noted only in 2 patients whereas no remarkable fatty infiltration was noted in the other 16 patients. LHBT was identified by probing the proximal intraarticular and intra-groove portion during arthroscopy; 3 were intact and 7 were partial tear; and the remaining 8 were subluxed with mildly fraying change.

Clinical outcomes

Functional scores were improved from 33.8 (range, 22-44) to 93.3 (range, 82-100) by ASES, from 11.2 (range, 5-18) to 30.7 (range, 24-35) by UCLA, and from averaged 48.0 (range, 40.9-59.1) to 3.1 (range, 0-11.4) by QuickDASH. The differences in all 3 scoring systems were statistically significant ($P < .001$). SANE and VAS scores were significantly improved from 25 (range, 10-45) to 90.8 (range, 80-100) and from 4.6 (range, 3-6) to 0.4 (range, 0-2) respectively with both P values $< .001$. Assessment of active shoulder motion exhibited significant improvement in all 3 directions: forward flexion from 75.6° (range, 20°-160°) to 157.2° (range, 90°-180°) with a P value $< .001$; external rotation from 33.3° (range, 0°-60°) to 53.3° (range, 20°-90°) with a P value $= .002$; internal rotation (points) from 2.4 (range, 2-4) to 4.2 (range, 2-4) with a P value $< .001$. There were no perioperative infection, neurovascular injury or donor site complications in all 18 patients. The MCID calculated using the anchor method was 20.1 (11-28) for ASES, 10.9 (3-17) for UCLA, 20.2 (11.3-36.4) for QuickDASH, 34.3 (20-50) for SANE, and 1.6 (0-3) for VAS pain. The PASS, calculated from satisfaction anchors was 82.4 (71-88) for ASES, 21.1 (16-25) for UCLA, 26 (18.2-31.8) for QuickDASH, 82.4 (70-90) for SANE, and 1.7 (0-3) for VAS pain score. Table 2 presented 100% of patients achieved the thresholds of MCID in all 5 assessment scoring methods. Regarding UCLA and QuickDASH, 100% of patients achieved PASS; 90% achieved PASS in ASES and 94% achieved PASS in SANE and VAS scores.

Table 2. MCID and PASS for each specific outcome assessment

N = 18	MCID (percentage of patients achieving MCID)	PASS (percentage of patients achieving PASS)
ASES	20.1 ± 5.1 (100%)	82.4 ± 6.4 (90%)
UCLA	10.9 ± 3.7 (100%)	21.1 ± 2.9 (100%)
QuickDASH	20.2 ± 6.4 (100%)	26 ± 3.9 (100%)
SANE	34.3 ± 8.7 (100%)	82.4 ± 4.8 (94%)
VAS	1.6 ± 1.0 (100%)	1.7 ± 0.8 (94%)

MCID, minimally clinically important difference; PASS, patient acceptable symptom state; ASES, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form Score Quick Disabilities of the Arm, Shoulder and Hand; UCLA, University of California at Los Angeles score; QuickDASH, Quick Disabilities of the Arm, Shoulder and Hand; SANE, Single Assessment Numeric Evaluation; VAS, visual analog pain scale.

Outcome comparison revealed patients with intact LHBT had comparable clinical outcomes to those with partial tear of LHBT. The difference was insignificant in ASES, UCLA, QuickDASH, SANE and VAS scores with P values = .256, .494, .140, .382, and .275, respectively, whereas the AHD of the intact group was significantly higher with a P value = .004 (Table 3).

Radiographic Outcomes

Plain radiographs in AP projection showed a significant increase in average AHD from 6.1 mm (range,

Table 3. Outcome comparison in patients with intact biceps and partially torn biceps

	Intact group (N = 11)	Partial tear group (N = 7)	*P* Value
ASES	94.1 ± 5.1	92.0 ± 7.0	0.256
UCLA	30.5 ± 3.4	30.4 ± 4.0	0.494
QuickDASH	2.1 ± 3.3	4.6 ± 5.1	0.140
SANE	90.5 ± 4.7	91.3 ± 6.0	0.382
VAS	0.4 ± 0.5	0.6 ± 0.8	0.275
AHD	9.7 ± 0.9	6.6 ± 2.1	0.004*

ASES, American Shoulder and Elbow Surgeons score; VAS, visual analog pain scale; AHD, acromiohumeral distance.
*$P < .05$ indicated significant difference.

0-9.8) before surgery to 8.5 mm (range, 3.8-10.4) at 2-year follow-up with a *P* value < .001. None had progression of glenohumeral arthrosis. Comparison of muscle fatty infiltration on MRI according to Goutallier classification between preoperative status and 2-year follow-up exhibited a significant decrease from 3.3 (range, 3-4) to 3.0 (range, 2-4) in supraspinatus and from 2.2 (range, 1-4) to 1.8 (range, 1-3) in infraspinatus with *P* values = .005 and.002, respectively. No significant difference was noted in subscapularis between preoperative survey of 0.4 (range, 0-2) and 2-year follow-up of 0.4 (range, 0-2) with a *P* value = .166. In the survey of graft integrity and tear location, there were 7 patients (39%) showing intact graft continuity without radiographic tear (Fig 2). Partial-thickness articular or bursal tears were noted in 9 patients (50%) and defined as partial graft tear. In the remaining 2 patients (11%), full-thickness tear with loss of graft continuity was noted in any of the 6 zones and defined as a complete tear. Among 6 zones for analysis, graft tear was most commonly seen in anterior GT followed by posterior GT, posterior mid-portion, and anterior glenoid areas. Inter-group comparisons among those with intact graft, partial tear, and complete tear in terms of ASES, UCLA, QuickDASH, SANE, and VAS scores did not exhibit significant difference between either of the 2 groups (Table 4). Significant difference was found only in AHD between partial tear group and complete tear group (*P* = .001). There was no significant difference between the intact group and the partial tear group.

Discussion

The most important finding of this study is that SCR using FL autograft and in situ LHBT augmentation resulted in favorable outcomes for patients with irreparable RCTs. Shoulder function of 2-year follow-up was significantly improved according to our clinical surveys. Goutallier grading showed improved fatty atrophy in supraspinatus and infraspinatus muscle that was compatible with Mihata's study[9]; however, further quantitative study in longer survey is mandatory to better clarify the role of LHBT augmentation in SCR surgery. Comparable outcomes were achieved by using either intact LHBT or partial torn LHBT, whereas better restoration of AHD was found with intact LHBT. Partial tears of the graft patch were commonly found according to radiographic analysis at 2-year follow-up. The difference in functional assessment and VAS scores was not significant between patients with intact and partially torn graft patches. Although significantly higher AHD was noted in the partial graft tear group than in the complete tear group, the case number in the latter might be too small to draw a definite conclusion.

The role of superior capsule is increasingly recognized to maintain a stable fulcrum of glenohumeral motion in

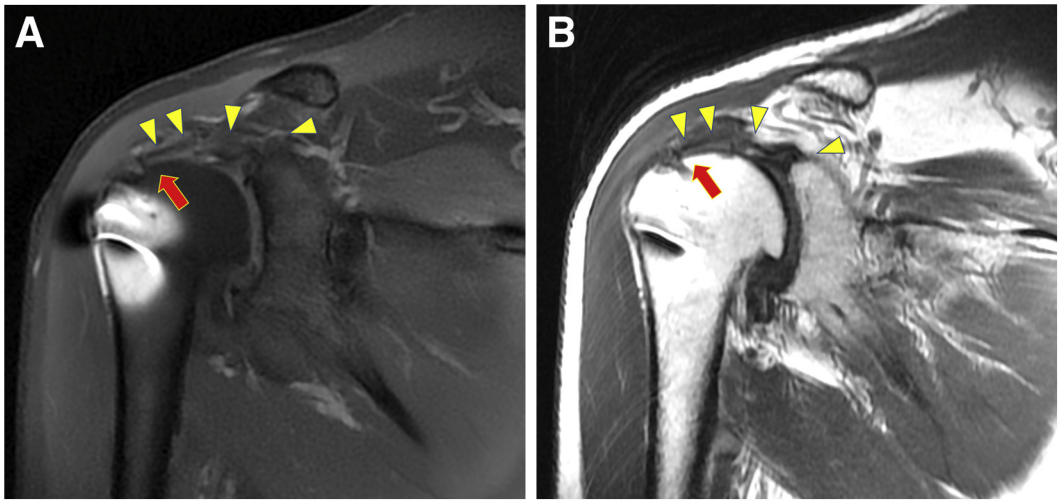

Figure 2. MRI of right shoulder on 2-year follow-up. Oblique coronal proton density with and without fat saturation reveals continuous fibers of the graft (*arrow* and *arrowhead*) from the anastomosis to the fixation screws. (A) With fat saturation. (B) Without fat saturation.

Table 4. Outcome comparison based on integrity of fascia lata graft

	No tear (N = 7)	Partial tear (N = 9)	Complete tear (N = 2)
ASES	96.9 ± 2.6	91.6 ± 6.0	85.0 ± 4.2
p-value	0.055	0.104	0.547
UCLA	31.7 ± 2.8	29.9 ± 3.9	28.5 ± 4.9
p-value	0.157	0.334	0.126
Quick-DASH	1.3 ± 1.2	3.3 ± 4.9	8.0 ± 4.8
p-value	0.156	0.123	0.003
SANE	92.9 ± 3.9	89.9 ± 5.9	87.5 ± 3.5
p-value	0.137	0.303	0.064
VAS	0.3 ± 0.5	0.6 ± 0.7	0.5 ± 0.7
p-value	0.695	0.466	0.838
AHD	9.5 ± 1.2	8.7 ± 1.5	4.0 ± 0.2
p-value	0.128	0.001*	0.071

ASES, American Shoulder and Elbow Surgeons score; VAS, visual analog pain scale; AHD, acromiohumeral distance.
* $P < .05$ indicated significant difference.

the presence of rotator cuff dysfunction.[23] The results of a recent biomechanical study based on 7 cadavers suggest the superior capsule not only serves as a subacromial spacer but also works as a stabilizer in all directions of the glenohumeral joint.[24] Superior capsule reconstruction was originally proposed by Mihata et al.[9] using folded FL autograft in the treatment of irreparable RCTs. Favorable outcomes draw common attention and raise general concerns about graft utilization and technique refinement.[25] We modify the original technique by using LHBT as an augment to FL autograft patch. The rationales are threefold. First, LHBT is rich in tenocytes that may imitate the physiologic demands of rotator cuff tendon and thus has been considered a suitable graft for augmentation in RCT repair and capsular reconstruction.[26] Second, LHBT works as a stabilizer of glenohumeral joint and is readily available in most patients. A combination of LHBT with FL graft patch may provide an additional stabilizing effect against anterior translation and improve force coupling.[27] Third, the FL graft patch is further secured at the glenoid side in the index surgery by suturing to the proximal LHBT instead of the subscapularis tendon, which may cause concerns of shoulder stiffness because of closure of the rotator interval.[28]

However, common criticisms still exist regarding underestimated LHBT lesions with resulting pain source when dealing with RCTs arthroscopically.[29] In a clinical report from Mihata et al.[30] containing 100 cases receiving SCR for irreparable RCTs, up to 76 cases had pathology in LHBT. This study stated clinical outcome of SCR was not affected whereas partial and complete tears of LHBT were just left alone. In our study, patients with intact and partial tear of the LHBT underwent the same augmented SCR surgery; outcome comparison showed no significant difference between 2 groups of patients in terms of VAS, AHD, and graft tear rate. Recently, the surgery using LHBT alone as an alternative graft for SCR has been reported through variable transposition techniques and showed comparable outcomes to the technique using FL autograft, whereas the precondition is the presence of intact LHBT.[31] In our report, both LHBT with normal structure and that with less than 50% tear could be considered useful in augmentation for SCR with comparable outcomes. Because tendon integrity is hard to be fully surveyed from preoperative images, we prefer to use LHBT as an augment instead of a single graft for SCR whenever available through meticulous arthroscopic examination during surgery.

Regardless of graft materials, continuity maintenance of the graft patch and graft-to-bone healing are crucial in restoration of superior stability and shoulder function following SCR.[32,33] Based on our 6-zone evaluation of graft integrity on coronal and sagittal planes of MRI, up to 61% of patients exhibited one or more zones of graft tear in 2-year follow-up. The tear rate is higher than that in other studies of SCR using FL autograft[9,34,35] because we included the cases with partial tear (only anterior or posterior) and complete tear (both anterior and posterior) at any of 3 locations on the graft patch (glenoid side, mid-portion, or tuberosity side). Functional outcomes were comparable among 3 groups, and all improved regardless of graft tear in our study. One recent publication also reported most graft tear was minor after arthroscopic SCR using fascia lata and symptoms improved even with disruption of the capsule reconstruction.[35] Graft tear was more common in the tuberosity site and least commonly found in the glenoid site in our series. Favorable graft healing with a low tear rate in the glenoid end could be majorly attributed to suture reinforcement between the graft patch and the proximal part of LHBT.

Limitations

There are several limitations to this study. First, this report is based on a retrospective review with a small sample size and short-term follow-up. Second, there is

neither a control group nor randomization in patient recruitment. Because the surgical decision is only finalized according to arthroscopic inspection ahead of reconstruction procedures, we present the index technique as augmentation instead of substitution or comparison to the original SCR surgery. Third, image reading is empirically determined by two of the coauthors; reporting bias is not fully assessed. Further validation in radiographic analysis is mandatory to better clarify the functional relevance and enhance clinical application. Finally, all the surgery in this report was performed by a single surgeon, which may have biased the outcome analysis.

Conclusion

The index surgery restored superior glenohumeral stability and function of the shoulder with irreparable RCTs. Despite high incidence of partial graft tear, favorable outcomes suggest SCR with biceps tendon augmentation is a feasible alternative treatment for irreparable RCTs.

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