ACTA ORTHOPAEDICA et TRAUMATOLOGICA TURCICA
www.aott.org.tr

Research Article

Early clinical outcomes of arthroscopic long head of biceps tendon transposition repair versus complete repair for massive rotator cuff tears

Xiaoyu Dong[1,*], Jiang Deng[2], Buyu Wang[3], Feifei Li[3], Shiqiang Ruan[1], Fan Bai[2]

[1]Department of Orthopedic Ward Third, the Third Affiliated Hospital of Zunyi Medical University, Zunyi, China
[2]Department of Orthopedic Ward One, the Third Affiliated Hospital of Zunyi Medical University, Zunyi, China
[3]Department of Orthopedics, the Third Affiliated Hospital of Zunyi Medical University, Zunyi, China

ARTICLE INFO

Article history:
Submitted July 1, 2025
Received in revised form July 9, 2025
Last revision received form September 25, 2025
Accepted September 26, 2025
Publication date May 18, 2026

Keywords:
Arthroscopic long head of biceps tendon
Complete repair
Early clinical outcome
Massive rotator cuff tear
Transposition repair

ORCID iDs of the authors:
X.D. 0009-0003-0903-1997;
J.D. 0009-0009-2403-0128;
B.W. 0009-0000-1766-0337;
F.L. 0009-0005-1279-4279;
S.R. 0009-0003-2784-7017;
F.B. 0009-0001-6640-7765.

ABSTRACT

Objective: Massive rotator cuff tears (mRCTs) have high re-tear rates and poor functional outcomes after traditional repair. This study compared early clinical outcomes after an arthroscopic tear with long head of biceps tendon (LHBT) transposition vs. complete repair (CR).

Methods: In this study, a retrospective case series was completed in 45 patients with mRCTs that were confirmed via magnetic resonance imaging (MRI) and that underwent either LHBT transposition (n=21; mean age, 58.5 ± 8.6 years) or CR (n=24; mean age, 55.2 ± 8.4 years) between May 2019 and December 2021. Outcome measures included acromiohumeral distance (AHD), Visual Analog Scale, constant score (CS), University of California, Los Angeles (UCLA) score, and forward elevation. Re-tear rates were measured via postoperative MRI and clinical findings.

Results: The groups were similar with respect to perioperative variables (all $P > .05$). At both 6 months and 12 months, the LHBT group had significantly greater AHD (7.76 ± 0.56 mm vs. 7.31 ± 0.74 mm, $P=.028$; 7.16 ± 0.56 mm vs. 6.50 ± 1.04 mm, $P=.014$). Visual Analog Scale scores were lower in the LHBT group at 6 months (2.95 ± 0.50 vs. 3.88 ± 1.33, $P=.031$), 12 months (1.67 ± 0.58 vs. 2.79 ± 1.59, $P=.022$), and final follow-up (1.19 ± 0.40 vs. 2.04 ± 1.85, $P=.018$). Functional scores were improved with CS and UCLA scores being higher in the LHBT group at both 12 months and follow-up ($P=.029$-$.034$). The rate of re-tear was lower with LHBT (19.1% vs. 58.3%, $P=.014$).

Conclusion: Arthroscopic LHBT transposition provides better pain relief, functional recovery, structural preservation, and lower re-tear rates compared to CR. Therefore, LHBT transposition is a clinically appropriate alternative, especially in patients who are at high risk of re-tear.

Level of Evidence: Level III, Therapeutic Study.

Introduction

Massive rotator cuff tears (mRCTs), which consist of a large amount of tendon disruption, are some of the most complex shoulder pathologies representing shoulder injuries with high rates of re-tear and shoulder dysfunction. Massive rotator cuff tears are defined as mRCTs with a max diameter ≥ 5 cm or tears involving 2 or more tendons.[1] The shoulder joint is the most mobile in the body, depending heavily on the rotator cuff and joint capsule stabilization.[2] Structural disruption of the rotator cuff or joint capsule significantly affects the biophysics of normal motion and contributes to disability. Non-surgical management can relieve pain temporarily, but rarely regains satisfactory functionality.[3]

A variety of surgical techniques have been developed to manage mRCTs, including arthroscopic debridement, long head of biceps tendon (LHBT) dissection or fixation, partial rotator cuff repair, graft augmentation, subacromial prosthesis, tendon transfers, superior capsule reconstruction (SCR), and reverse shoulder arthroplasty.[4-11] However, traditional complete repair (CR) with MCP is often rejected because of high rates of tendon retraction, elevated repair tension, and fatty degeneration, with reported re-tear rates as high as 80%-94%.[12] Therefore, potentially alternative or adjunctive methods need to be developed that will provide a more durable biomechanical stabilization to identify better clinical outcomes.

Long head of biceps tendon transposition with mRCT has surfaced as a biologic augmentation and reconstructive option. By maintaining the vascularized and mechanically robust act of the LHBT and integrating into the construct of the tear repair, transposition of the LHBT has shown potential for improved superior capsulectomy stability, additional acromiohumeral distance (AHD), and reducing superior humeral head migration. These factors are associated with improved postoperative shoulder function with lower rates of re-tear. Furthermore, transposition of the LHBT has the advantages of not deriving graft-harvest morbidity, potentially a simpler intervention, and lower costs when compared to traditional SCR.

Recent literature (2022-2024) supports the advantages of transposing the LHBT with mRCTs. Kawashima et al[13] examined that LHBT transposition resulted in similar functional outcomes with partial repair, along with maintaining AHD, and reduced

*First author, the Third Affiliated Hospital of Zunyi Medical University.

Corresponding author:
Jiang Deng dengjiang4002@163.com

Content of this journal is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

Cite this article as: *Dong X, Deng J, Wang B, Li F, Ruan S, Bai F. Early clinical outcomes of arthroscopic long head of biceps tendon transposition repair versus complete repair for massive rotator cuff tears. Acta Orthop Traumatol Turc., 2026; 60(3), 0500, doi: 10.5152/j.aott.2026.25500.*

risk of re-tear. Wan et al[14] in a meta-analysis of 253 patients found that LHBT transposition improved forward flexion, external rotation, and AHD compared to other methods, significantly reduced the odds of re-tear, and improved overall function of the shoulder repair. Sanchez et al[15] described successful anterior cable reconstruction with the use of LHBT, while achieving lower functional outcomes for re-tear and improved early functional recovery. Overall findings suggest LHBT transposition as a clinically relevant alternative for patients with mRCTs or irreparable cuff tears.

Based upon the background, the present study sought to utilize a retrospective operative report to compare the early clinical outcomes of arthroscopic LHBT transposition repair compared to arthroscopic CR in adults with mRCTs. The hypothesis was that LHBT transposition would result in superior pain relief, function, and structural restoration with continued simplicity of the technique and lower costs compared to CR.

Materials and methods

Study design and ethical approval

This was a retrospective, non-randomized study involving 45 patients with mRCTs, all operated on by the same senior surgeon in the Department of Joint Surgery at the Third Affiliated Hospital of Zunyi Medical University, between May 2019 and December 2021. It is acknowledged that this fact does indicate a retrospective study design, and the potential for selection bias has been considered, which is involved in retrospective design when interpreting the results. The study protocol was approved by the Ethics Committee of the Zunyi Medical Hospital, and written informed consent was obtained from all participants prior to surgery.

Patient selection

Eligibility for inclusion was established by clinical examination, imaging studies, and verification during surgery with arthroscopy. Pre-operative magnetic resonance imaging (MRI) was completed in a 3.0 Tesla MRI machine (Siemens, Germany), using a shoulder coil, with the following sequences to assess the shoulder in axial, sagittal, oblique, and coronal oblique planes: T1-weighted, T2-weighted, and proton density fat-suppressed sequences. Diagnostic criteria for mRCTs were clinically defined as full-thickness mRCTs of at least 5 cm in the largest dimension and/or involving 2 or more tendons, confirmed on MRI, and verified during surgery arthroscopically. Patients were included if they demonstrated no tension or abnormal attachment point at the LHBT on physical examination, were followed for at least 12 months postoperatively, and could comply with rehabilitation protocols. Exclusion criteria were superior labrum anterior and posterior (SLAP) lesions or ruptured biceps tendon, significant glenohumeral osteoarthritis, previous surgery on the affected shoulder, significant shoulder pathology, malignant wasting diseases or significant malnutrition, any fracture around the shoulder, or injury that would prevent rehabilitation, and inability to undergo follow-up due to either being lost to follow-up or death.

HIGHLIGHTS

- Long head of biceps tendon showed greater acromiohumeral distance (AHD) at 6 months/1 year and a lower re-tear rate in massive rotator cuff tears (mRCTs).
- Long head of biceps tendon achieved better shoulder range of motion, pain relief, and functional scores.
- Long head of biceps tendon transposition repair improves pain, function, AHD, and reduces re-tears in mRCTs.

Surgical techniques

All surgeries were performed under general anesthesia with the patient positioned in the beach-chair position. In the LHBT transposition repair group, the approach began with arthroscopic debridement of the biceps and synovial tissue and debridement of the subacromial bursa. The LHBT shape, rotator cuff tear pattern, and the labral form were assessed. Next, the acromion was polished and the greater tuberosity reshaped, and then the torn tendon was mobilized. The next step was placing a threaded rivet anterior to the supraspinatus footprint; the LHBT was transposed and fixed to the supraspinatus attachment. The remaining supraspinatus tendon was sutured to the LHBT in an edge-to-edge manner and fixed with double-row fixation to restore the footprint coverage of the tendon. In the CR group, an arthroscopic debridement, subacromial bursa removal, acromioclavicular polishing, and reshaping of the greater tuberosity followed. The torn supraspinatus tendon was then repaired directly to the footprint with double-row fixation without LHBT transposition.

Postoperative rehabilitation

Both groups had standardized rehabilitation. Just after surgery, the arm was put in a shoulder abduction brace, and the patients were instructed to perform isometric contractions of the shoulder muscles and active movements of their elbow, wrist, and fingers to promote circulation and avoid thrombosis. For the first 4-6 weeks of rehabilitation, the shoulder range of motion was restricted to protect the repair. Passive range-of-motion exercises were initiated at 6 weeks postoperatively; active range-of-motion exercises at 12 weeks; and then progressive strengthening exercises as tolerated. Re-tear was defined based on postoperative MRI findings and corroborated with clinical signs such as persistent pain, weakness, or functional deterioration. Final classification was based on combined clinical and imaging assessment.

Outcome measures

Postoperative outcomes included AHD, Visual Analog Scale (VAS), constant score (CS), University of California, Los Angeles (UCLA) score, operative time, the number of rivets used, intraoperative loss of blood, volume of postoperative drainage, and length of hospital stay. The assessment of re-tear was based on clinical findings and MRI results. Clinically, re-tear would be suspected in the presence of recurrent pain, decrease in function, or weakness. Magnetic resonance imaging was read at 6 months and 12 months, and all MRIs were prepped according to the same protocol prior to the first imaging day. Re-tear was diagnosed if the tendon was not continuous, if there was a fluid signal intensity at the site of repair, or if there was retraction compared to immediately postoperative images.

Statistical analysis

A post-hoc power analysis based upon effect sizes obtained from similar published studies indicated that having a minimum of 20 patients per group would provide at least 80% power to detect a clinically significant difference in functional scores, with an alpha of .05. Data analysis was performed with SPSS 20.0 (IBM Corp., Armonk, NY, USA). Continuous variables were represented as mean ± SD and compared using an independent samples *t*-test or Mann–Whitney *U*-test, based on the distribution of data. Categorical variables were analyzed using the Chi-square test or Fisher's exact test. Multivariate logistic regression analysis was performed to adjust for confounding variables such as age, tear size, and duration of symptoms. Statistical significance was set at $P < .05$.

Results

Comparison of general clinical information

The cohort comprised 21 males and 24 females with an average age of 56.76 ± 8.54 years. The LHBT group contained 21 cases (9 males, 12 females; average age 58.52 ± 8.57 years), whereas the CR group contained 24 cases (12 males, 12 females; average age 55.21 ± 8.39 years). All patients had follow-up for > 12 months, with the LHBT group demonstrating an average follow-up duration of 25.38 ± 9.20 months and the CR group having an average follow-up duration of 23.25 ± 9.62 months. For the LHBT group, 6 patients had left-sided, and 15 patients had right-sided involvement; for the CR group, 7 patients had left-sided, and 17 patients had right-sided involvement of the shoulder. The duration of preoperative pain showed significant differences, with the LHBT duration being greater than CR (12.57 ± 17.58 vs. 9.04 ± 14.03 months, P=.954). General patient characteristics are summarized in Table 1.

The surgical approach and intraoperative details are presented in Figures 1 and 2.

Comparison of perioperative situations

Perioperative variables are presented in Table 2. Operative time, intraoperative blood loss, postoperative drainage output, rivets used, and length of stay in hospital were comparable between the 2 groups (all P > .05). Postoperative complications were tracked during inpatient stay and at 1 week, 3 months, 6 months, 12 months, and final follow-up. Complications were defined as: infection—clinical signs of erythema, swelling, purulent discharge, and/or positive bacterial culture; stiffness—passive range of motion in at least 2 planes was restricted > 30° compared to the contralateral side; nerve injury—persistent motor or sensory deficit in the axillary, suprascapular, or musculocutaneous nerve distribution for greater than 3 months. Infection, clinically significant stiffness, or nerve injury was noted in neither group.

Imaging data comparison

The changes in AHD are shown in Table 3. Preoperatively, AHD was not significantly different between groups (5.85 ± 0.44 vs. 6.03 ± 0.59 mm, P=.257), nor was it significantly different at 1-week postoperatively (9.03 ± 0.40 vs. 8.82 ± 0.55 mm, P=.143). There was a gradual decrease in AHD in both groups on follow-up, but at 6 months (7.76 ± 0.56 vs. 7.31 ± 0.74 mm, P=.028) and 12 months (7.16 ± 0.56 vs. 6.50 ± 1.04 mm, P=.014), AHD for the LHBT group was still significantly greater. At the final follow-up, 4 of the 21 patients (19.05%) in the LHBT group had partial re-tears without any functional impairments, while 14 of the 24 patients in the CR group had re-tears, with 3 surgical failures. The re-tear rate was significantly lower in the LHBT group (P=.014), while the surgical failure rate was not significantly different between groups (P=.236) (Table 4). Representative MRI and arthroscopic images are provided in Figure 2.

Table 1. General preoperative demographics in the long head of biceps tendon and complete repair groups

Items	LHBT group (n=21)	CR group (n=24)	$t/Z/\chi^2$	P
Age (years)	58.52 ± 8.57	55.21 ± 8.39	1.310	.197
Gender (Male/Female)	9 : 12	12 : 12	0.230	.767
Affected shoulder (left/right)	6 : 15	7 : 17	0.002	1.000
Duration of pain (months)	12.57 ± 17.58	9.04 ± 14.03	−0.058	.954
Follow-up (months)	25.38 ± 9.20	23.25 ± 9.62	0.756	.454

Values are presented as mean ± SD or count. No statistically significant differences were found between the groups at baseline (P > .05).
CR, complete repair; LHBT, long head of biceps tendon.

Shoulder joint movement and function comparison

Functional results are presented in Table 5 and Figures 3 and4. Biometrics at 6 months indicated that the LHBT group had a lower VAS score (2.95 ± 0.50 vs 3.88 ± 1.33, P=.031). At 12 months, the VAS remained significantly lower (1.67 ± 0.58 vs. 2.79 ± 1.59, P=.022), and remained lower at final follow-up (1.19 ± 0.40 vs. 2.04 ± 1.85, P=.018).

Constant score was significantly greater in the LHBT group at 12 months (76.86 ± 6.70 vs. 71.46 ± 10.13, P=.029) and final follow-up (78.33 ± 5.05 vs. 72.42 ± 10.27, P=.021). University of California, Los Angeles scores were also slightly in favor of LHBT at all measured intervals: 6 months (25.05 ± 1.63 vs. 23.63 ± 2.36, P=.033), 12 months (30.95 ± 1.56 vs. 29.04 ± 2.35, P=.034), and final follow-up (31.95 ± 1.53 vs. 30.04 ± 2.01; P=.027).

In terms of range of motion, forward elevation was superior in the LHBT group at 6 months (156.33 ± 6.84° vs 151.25 ± 9.27°, P=.041), at 12 months (162.10 ± 6.98° vs. 155.17 ± 12.16°, P=.037), and at final follow-up (164.10 ± 6.95° vs. 156.83 ± 13.76°, P=.032). External rotation was also statistically significantly improved at 12 months (6.10 ± 1.73 vs. 4.58 ± 1.91, P=.029) and final follow-up (7.81 ± 1.40 vs. 6.08 ± 2.54, P=.026). Internal rotation was similar at 12 months (6.10 ± 1.48 vs. 5.46 ± 1.74, P=.218) but favored the LHBT at final follow-up (7.52 ± 1.40 vs. 5.92 ± 2.47, P=.017).

Discussion

In this study, there were no statistically significant differences in intraoperative time, blood loss, postoperative drainage, number of rivets, or length of hospital stay between the LHBT transposition repair and CR groups. However, patients who underwent LHBT transposition had better functional improvement and lower re-tear rates; these results are likely due to the biomechanical and biological advantages of this technique. Compared to other SCR methods, reconstruction with LHBT transposition requires less time for graft preparation and is associated with no donor-site morbidity. Previous reports showed that SCR often requires 2 or 3 rivets for glenoid-side fixation and at least 5 rivets for the humeral-side fixation using

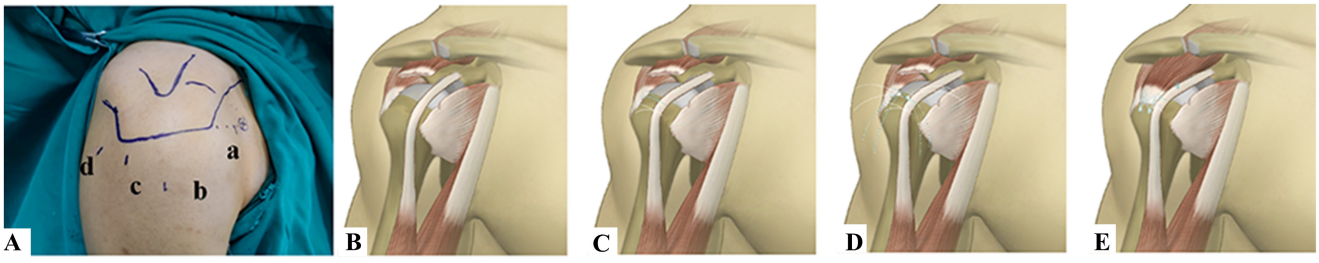

Figure 1. Design diagram of surgical approach in the right shoulder with the patient in the beach-chair position. (A) "a" = anterolateral approach, "b" = lateral approach, "c" = posterolateral approach, "d" = posterior approach. (B) right shoulder with massive rotator cuff tear (mRCT). (C) right shoulder LHBT transposition fixation. (D) right shoulder mRCT repair. (E) schematic diagram of right shoulder reconstruction.

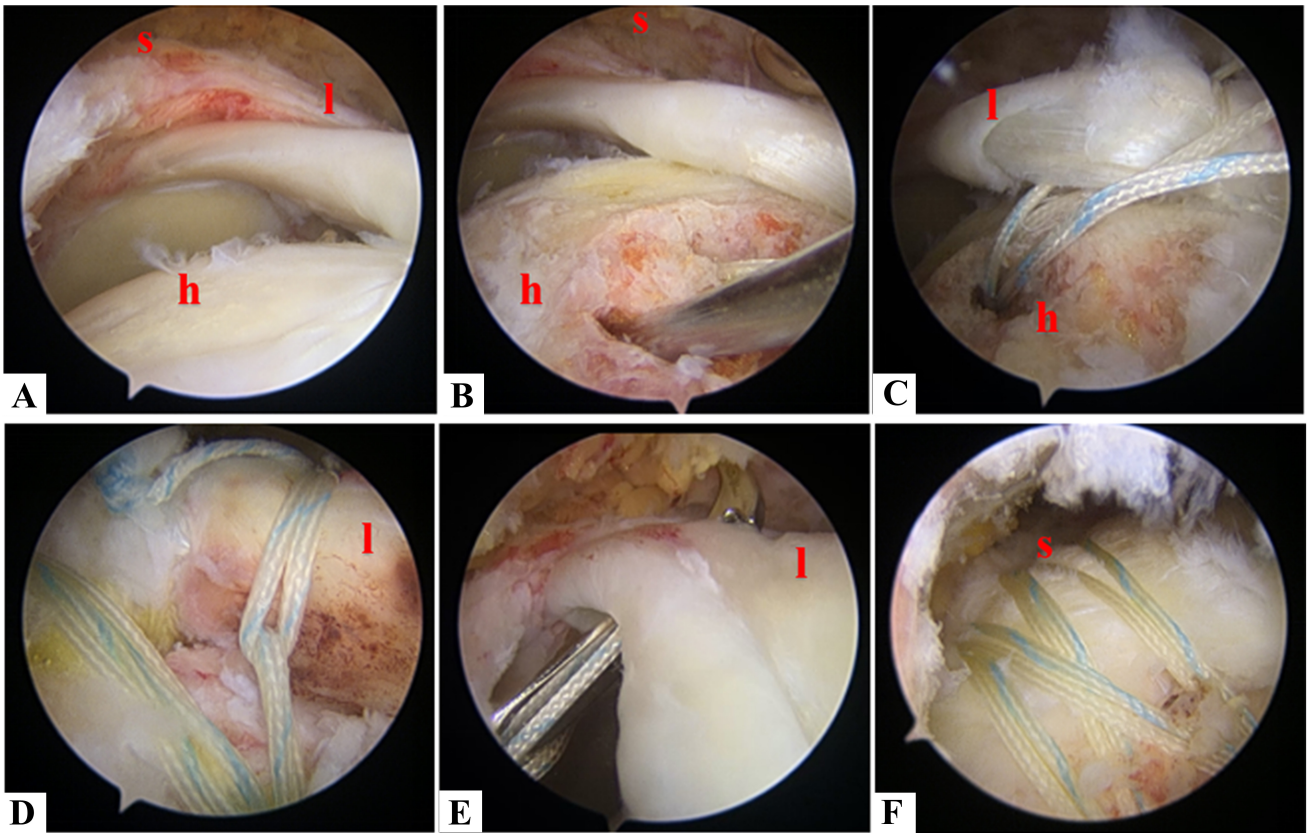

Figure 2. Arthroscopic images of the right shoulder: (A) mRCT. (B) LHBT transposition rivet implantation. (C) LHBT transposition. (D) LHBT fixation. (E) supraspinatus–LHBT side-to-side suture. (F) reconstruction of mRCT. Abbreviations: h, humeral head; l, long head of biceps tendon; s, supraspinatus.

Table 2. Perioperative situations in the long head of biceps tendon group and the complete repair group

Items	LHBT group (n=21)	CR group (n=24)	*t*	*P*
Operation time (mins)	123.10 ± 28.04	121.92 ± 29.79	0.43	.966
Number of rivets (piece)	4.10 ± 0.70	4.33 ± 1.20	0.832	.416
Intraoperative blood loss (mL)	34.76 ± 11.23	32.08 ± 11.79	−0.735	.462
Postoperative drainage volume (mL)	20.95 ± 9.70	19.38 ± 8.76	0.579	.569
Hospitalization time (d)	6.90 ± 1.09	7.17 ± 1.20	−0.608	.546

Data are shown as mean ± SD. No significant differences were observed in perioperative parameters between groups ($P > .05$).
CR, complete repair; LHBT, long head of biceps tendon.

Table 3. Acromiohumeral distance in the long head of biceps tendon group compared to the complete repair group

Items	LHBT group (n=21)	CR group (n=24)	*t*/*Z*	*P*
Before surgery	5.85 ± 0.44	6.03 ± 0.59	−1.149	.257
After surgery	9.03 ± 0.40	8.82 ± 0.55	1.463	.143
6 months after surgery	7.76 ± 0.56	7.31 ± 0.74	2.267	.028
1 year after surgery	7.16 ± 0.56	6.50 ± 1.04	0.560	.014

Values are expressed as mean ± SD. Significant differences were observed at 6 months postoperatively ($P < .05$).
AHD, acromiohumeral distance; CR, complete repair; LHBT, long head of biceps tendon.

Table 4. Re-tear in the long head of biceps tendon group versus the complete repair group

Items	LHBT group (n=21)	CR group (n=24)	χ^2	*P*
Nothing	17	10		
Part	4	11	7.394	.02
Invalid	0	3		
Re-tear	4 (19.05%)	14 (58.33%)	7.202	.014
Invalid	0 (0.00%)	3 (12.5%)	2.812	.236

Values are counts (percentages). Statistical comparison performed using the chi-square test. The LHBT group showed significantly lower re-tear rates ($P < .05$).
CR, complete repair; LHBT, long head of biceps tendon.

a double-row technique,[16,17] whereas the LHBT group in this study used an average of 4.10 ± 0.70 rivets. Chillemi et al[18] introduced a bone-tunnel fixation model, which also avoids rivets; however, they note that this method may not be suitable for osteoporotic patients due to an increased risk of failure.

Biomechanical advantages of fixation of the LHBT to the greater tuberosity, while keeping the distal integrity intact, provide static stabilization of the humeral head similar to an autologous graft. Experimental models showed that functional outcomes were

Table 5. Functional outcomes (mean ± SD) at each follow-up point

Parameter	Time point	LHBT group (n=21)	CR group (n=24)	*P*
VAS	6 mo	2.95 ± 0.50	3.88 ± 1.33	<.05
	12 mo	1.67 ± 0.58	2.79 ± 1.59	<.05
	Final FU	1.19 ± 0.40	2.04 ± 1.85	<.05
CS	12 mo	76.86 ± 6.70	71.46 ± 10.13	<.05
	Final FU	78.33 ± 5.05	72.42 ± 10.27	<.05
UCLA	6 mo	25.05 ± 1.63	23.63 ± 2.36	<.05
	12 mo	30.95 ± 1.56	29.04 ± 2.35	<.05
	Final FU	31.95 ± 1.53	30.04 ± 2.01	<.05
FE (°)	6 mo	156.33 ± 6.84	151.25 ± 9.27	<.05
	12 mo	162.10 ± 6.98	155.17 ± 12.16	<.05
	Final FU	164.10 ± 6.95	156.83 ± 13.76	<.05
ER (points)	12 mo	6.10 ± 1.73	4.58 ± 1.91	<.05
	Final FU	7.81 ± 1.40	6.08 ± 2.54	<.05
IR (points)	12 mo	6.10 ± 1.48	5.46 ± 1.74	>.05
	Final FU	7.52 ± 1.40	5.92 ± 2.47	<.05

Data are presented as mean ± SD. Significant improvements in pain, shoulder function, and range of motion were observed in the LHBT group ($P < .05$).
CR, complete repair; CS, constant score; ER, external rotation; FE, forward elevation; FU, follow-up; IR, internal rotation LHBT, long head of biceps tendon mo,months; UCLA, University of California, Los Angeles; VAS, Visual Analog Scale.

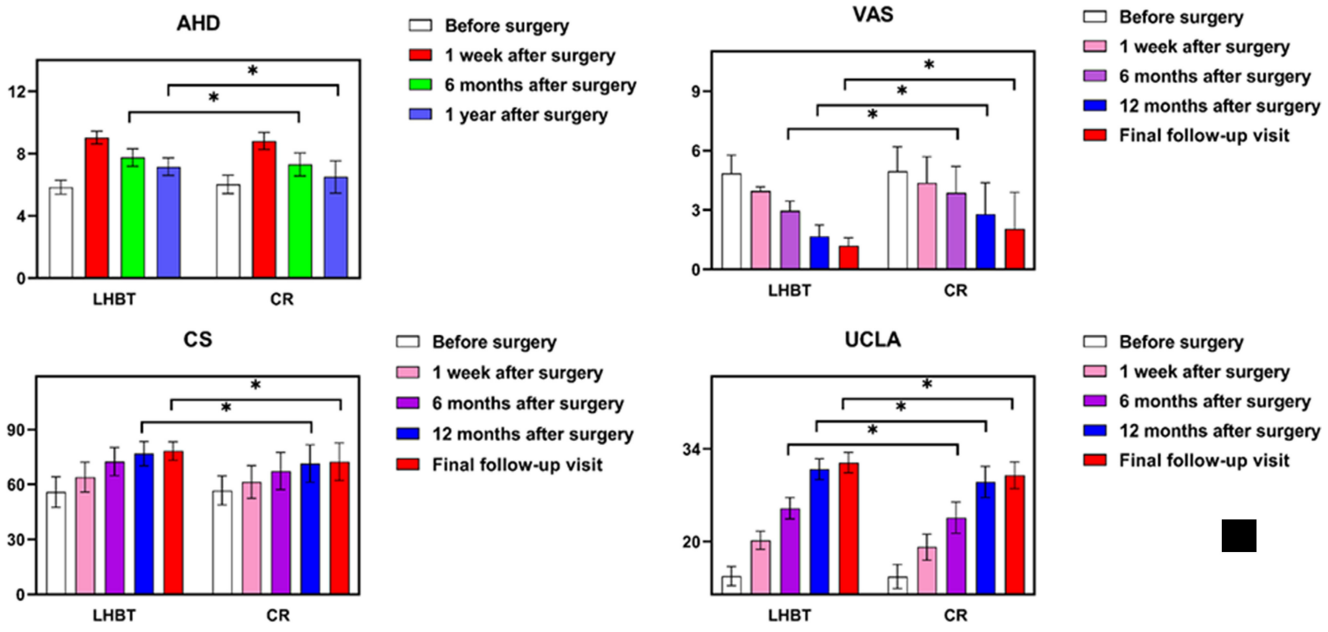

Figure 3. Comparison of AHD, VAS, CS, and UCLA scores between LHBT and CR groups at 6 months, 12 months, and final follow-up. Values are mean ± SD. *$P < .05$ vs. CR group.

impacted when the superior capsule was completely excised, as there were significant displacements of the humeral head across multiple planes of motion.[19] As a result, the superior capsule is important for shoulder stabilization, and its loss is a significant factor in mRCTs. In cadaveric studies on massive rotator cuff tears, deltoid muscle forces increased 122%, and subacromial contact pressures represented a 296% increase compared to intact capsules.[20] Clinical trials—based on models of supraspinatus reconstruction with LHBT—have also demonstrated decreased deltoid abduction forces and decreased subacromial pressures compared to unrepaired rotator cuff tears. Additionally, biomechanical results showed that LHBT reconstruction was over twice as strong a muscle as the latissimus dorsi transfer.[21] Kim et al[22] demonstrated similar effects following LHBT fixation to the greater tuberosity with partial cuff repair, and increased subacromial height after surgery as well.

Acceptable levels of both clinical and biomechanical success were noted with alternative techniques, including the snake technique[23] and the box technique.[24,25] Re-tear rates in the present-day LHBT group were 19.05%, which is lower than the range of 20%-94% previously reported,[12] and every re-tear was small and functionally inconsequential. Keeping the proximal LHBT likely provided stability to the shoulder, especially by limiting anterior humeral migration while maintaining greater AHD—therefore decreasing the risk of subacromial injury while minimizing rotator tear risk.

Functionally, the entire LHBT cohort achieved a follow-up VAS of 1.27 ± 0.45, with earlier reports demonstrating a VAS score decreased from 3.7 ± 2.0 to 1.6 ± 1.7 postoperatively.[26] The increases in postoperative AHD, CS, and UCLA scores were statistically significant and reached a plateau at 12 months, demonstrating durability. Likewise, Kocaoglu et al[27] demonstrated a significant comparison between LHBT transposition and autologous fascia lata patch repair for forward flexion. In the current study, the final forward flexion averaged 164.10° ± 6.95°, which is similar to previously published literature. Complications of bicipital origin, including "Popeye's sign" biceps cramping and strength loss following distal transection,[28-30] were not observed in this cohort because the distal tendon was maintained. Newer findings suggest that fixation methods can also affect

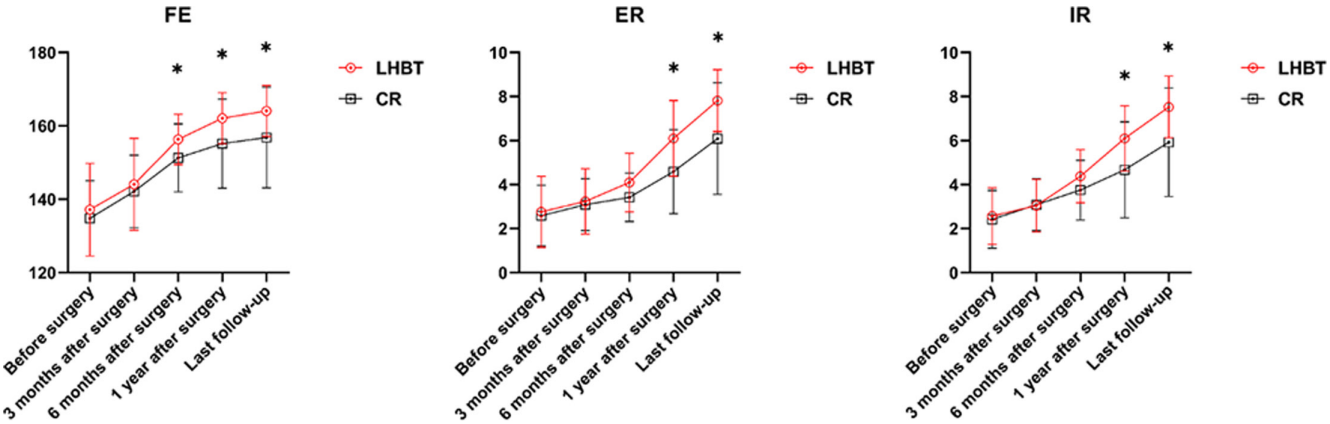

Figure 4. Comparison of FE, ER, and IR between LHBT and CR groups at 6 months, 12 months, and final follow-up. ER, external rotation; FE, forward elevation; IR, internal rotation. Values are mean ± SD. *$P < .05$ vs. CR group.

complications; specifically, forked-eyelet screws decreased the risk of Popeye's, in spite of traditional eyelet screws being used.[31] This emphasizes the potential opportunity to optimize fixation technique following the LHBT procedure.

Furthermore, alternative options should also be discussed. In a recent study comparing arthroscopic SCR vs. reverse shoulder arthroplasty in patients who presented with massive irreparable cuff tears, both methods produced clinical benefit, but each also had unique risks and indications.[32] These findings confirmed that anterior LHBT transposition is a viable alternative treatment, especially in patients in whom SCR or arthroplasty are not an optimal choice.

In this retrospective study, arthroscopic transposition repair of the LHBT had superior early clinical outcomes than CR, including greater pain relief, shoulder function, AHD, and lower re-tear rates. There was no significant difference in operative time, blood loss, or hospital stay between procedures. The present results support that, in select patients with massive rotator cuff tears, LHBT transposition repair may be a reasonable surgical option, especially in patients who have acceptable integrity of the LHBT and a high risk of re-tear with CR.

Future studies using larger sample sizes and longer follow-up periods are needed to verify these results and continue to refine patient selection.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of the Third Affiliated Hospital of Zunyi Medical University (Approval No.: (2021)-303; Date: 11.10.2021).

Artificial Intelligence Usage Statement: The authors declared that no Artificial Intelligence tool was used in the preparation of the manuscript.

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – X.D., F.B., J.D.; Design – X.D., F.B., J.D.; Supervision – X.D.; Data Collection and/or Processing – X.D., F.B., B.W., F.L, S.R.; Analysis and/or Interpretation – X.D., J.D.; Literature Search – X.D.; Writing – X.D.; Critical Review – X.D., F.B., J.D.

Declaration of Interests: The authors have no conflict of interest to declare.

Funding: This work was supported by the National Natural Science Foundation of China (81660367); Zunyi Science and Technology Bureau Zunyi First People's Hospital joint Science and Technology Research and Development Fund project (Zun City Kehe HZ character (2019) 180); Guizhou Science and Technology Plan Project (Basic of Guizhou -ZK[2021] General 393); Science and Technology Fund Project of Guizhou Provincial Health Commission (gzwkj2021-259); Guizhou Science and Technology Plan Project (Fruit-lc [2022]029).

References

1. Kucirek NK, Hung NJ, Wong SE. Treatment options for massive irreparable rotator cuff tears. *Curr Rev Musculoskelet Med*. 2021;14(5):304-315. [CrossRef]
2. Culham E, Peat M. Functional anatomy of the shoulder complex. *J Orthop Sports Phys Ther*. 1993;18(1):342-350. [CrossRef]
3. Zingg PO, Jost B, Sukthankar A, Buhler M, Pfirrmann CW, Gerber C. Clinical and structural outcomes of nonoperative management of massive rotator cuff tears. *J Bone Joint Surg Am*. 2007;89(9):1928-1934. [CrossRef]
4. Shang X, Chen J, Chen S. A meta-analysis comparing tenotomy and tenodesis for treating rotator cuff tears combined with long head of the biceps tendon lesions. *PLOS One*. 2017;12(10):e0185788. [CrossRef]
5. Castricini R, Familiari F, De Gori M,et al. Tenodesis is not superior to tenotomy in the treatment of the long head of biceps tendon lesions. *Knee Surg Sports Traumatol Arthrosc*. 2018;26(1):169-175. [CrossRef]
6. Malahias MA, Kostretzis L, Chronopoulos E, Brilakis E, Avramidis G, Antonogiannakis E. Arthroscopic partial repair for massive rotator cuff tears: does it work? A systematic review. *Sports Med Open*. 2019;5(1):13. [CrossRef]
7. Bailey JR, Kim C, Alentorn-Geli E, et al. Rotator cuff matrix augmentation and interposition: A systematic review and meta-analysis. *Am J Sports Med*. 2019;47(6):1496-1506. [CrossRef]
8. Wright MA, Abboud JA, Murthi AM. Subacromial balloon spacer implantation. *Curr Rev Musculoskelet Med*. 2020;13(5):584-591. [CrossRef]
9. Cartucho A. Tendon transfers for massive rotator cuff tears. *EFORT Open Rev*. 2022;7(6):404-413. [CrossRef]
10. Altintas B, Scheidt M, Kremser V, et al. Superior capsule reconstruction for irreparable massive rotator cuff tears: does it make sense? A systematic review of early clinical evidence. *Am J Sports Med*. 2020;48(13):3365-3375. [CrossRef]
11. Valenti P, Zanjani LO, Schoch BS, Kazum E, Werthel JD. Mid- to long-term outcomes after reverse shoulder arthroplasty with latissimus dorsi and teres major transfer for irreparable posterosuperior rotator cuff tears. *Int Orthop*. 2021;45(5):1263-1271. [CrossRef]
12. Broida SE, Sweeney AP, Gottschalk MB, Woodmass JM, Wagner ER. Clinical outcomes of latissimus dorsi tendon transfer and superior capsular reconstruction for irreparable rotator cuff tears: a systematic review. *Eur J Orthop Surg Traumatol*. 2022;32(6):1023-1043. [CrossRef]
13. Wan RW, Luo ZW, Yang YM, et al. Long head of biceps tendon transposition for massive and irreparable rotator cuff tears: a systematic review and meta-analysis. *World J Orthop*. 2023;14(11):813-826. [CrossRef]
14. Kawashima K, Terabayashi N, Asano H, Akiyama H. Arthroscopic long head of the biceps transposition for superior capsular augmentation results in comparable clinical outcomes to arthroscopic partial repair for irreparable rotator cuff tears. *Arthrosc Sports Med Rehabil*. 2022;4(2):e425-e434. [CrossRef]
15. Shin K-H, Jang I-T, Han S-B. Outcomes of superior capsular reconstruction using the long head of the biceps tendon in large to massive rotator cuff tears: a meta-analysis and systematic review. *J Clin Med*. 2024;13(4):1052. [CrossRef]
16. Sanchez G, Rossy WH, Lavery KP,et al. Arthroscopic superior capsule reconstruction technique in the setting of a massive, irreparable rotator cuff tear. *Arthrosc Tech*. 2017;6(4):e1399-e1404. [CrossRef]
17. Petri M, Greenspoon JA, Millett PJ. Arthroscopic superior capsule reconstruction for irreparable rotator cuff tears. *Arthrosc Tech*. 2015;4(6):e751-e755. [CrossRef]
18. Chillemi C, Mantovani M, Gigante A. Superior capsular reconstruction of the shoulder: the ABC (Arthroscopic Biceps Chillemi) technique. *Eur J Orthop Surg Traumatol*. 2018;28(6):1215-1223. [CrossRef]
19. Ishihara Y, Mihata T, Tamboli M, et al. Role of the superior shoulder capsule in passive stability of the glenohumeral joint. *J Shoulder Elbow Surg*. 2014;23(5):642-648. [CrossRef]
20. Adams CR, DeMartino AM, Rego G, Denard PJ, Burkhart SS. The rotator cuff and the superior capsule: why we need both. *Arthroscopy*. 2016;32(12):2628-2637. [CrossRef]
21. Berthold DP, Muench LN, Dyrna F, et al. Comparison of different fixation techniques of the long head of the biceps tendon in superior capsule reconstruction for irreparable posterosuperior rotator cuff tears: A dynamic biomechanical evaluation. *Am J Sports Med*. 2021;49(2):305-313. [CrossRef]
22. El-Shaar R, Soin S, Nicandri G, Maloney M, Voloshin I. Superior capsular reconstruction with a long head of the biceps tendon autograft: A cadaveric study. *Orthop J Sports Med*. 2018;6(7):2325967118785365. [CrossRef]
23. Kim DS, Yeom J, Park J, Cha J. L-shape superior capsular augmentation technique using biceps tendon: the biceps L-shape shifting technique. *Arthrosc Tech*.;9(6):e703-e709. [CrossRef]
24. Kim D, Um J, Lee J, Kim J. Improved clinical and radiologic outcomes seen after superior capsule reconstruction using long head biceps tendon autograft. *Arthroscopy*. 2021;37(9):2756-2767. [CrossRef]
25. Fandridis E, Zampeli F. Superior capsular reconstruction with double bundle of long head biceps tendon autograft: the "box" technique. *Arthrosc Tech*. 2020;9(11):e1747-e1757. [CrossRef] 10.1016/j.asmr.2020.09.024
26. Kim JH, Lee HJ, Park TY, Lee JU, Kim YS. Preliminary outcomes of arthroscopic biceps rerouting for the treatment of large to massive rotator cuff tears. *J Shoulder Elbow Surg*. 2021;30(6):1384-1392. [CrossRef]
27. Kocaoglu B, Firatli G, Ulku TK. Partial rotator cuff repair with superior capsular reconstruction using the biceps tendon is as effective as superior capsular reconstruction using a tensor fasciae latae autograft in the treatment of irreparable massive rotator cuff tears. *Orthop J Sports Med*. 2020;8(6):2325967120922526. [CrossRef]
28. Zhao X, Jia J, Wen L, Zhang B. Biomechanical outcomes of superior capsular reconstruction for irreparable rotator cuff tears by different graft materials-a systematic review and meta-analysis. *Front Surg*. 2023;9:939096. [CrossRef]
29. Virk MS, Nicholson GP. Complications of proximal biceps tenotomy and tenodesis. *Clin Sports Med*. 2016;35(1):181-188. [CrossRef]
30. Lu Y, Zhu YM, Jiang CY. [Clinical follow-up study of combined tenodesis for long head of biceps tendon lesion with massive rotator cuff tear]. *Zhonghua Yi Xue Za Zhi*. 2011;91(23):1591-1594. Chinese.
31. Caliskan E, Buyukdoğan K, Eren I, Birsel O, Aslan L, Demirhan M. Does biceps tenodesis screw with forked eyelet decrease the risk of Popeye deformity when compared to traditional closed eyelet screws? *Acta Orthop Traumatol Turc*. 2025;59(2):73-78. [CrossRef]
32. Kendirci AŞ, Chodza M, Şahin K, Bayram S, Kızılkurt T, Erşen A. Arthroscopic superior capsular reconstruction versus reverse shoulder arthroplasty in patients with massive irreparable rotator cuff tears: a comparative clinical study. *Acta Orthop Traumatol Turc*. 2023;57(4):161-168. [CrossRef]