Effect of Arthroscopic Rotator Cuff Repair Combined With Different Long Head of the Biceps Tendon Fixation Techniques on Postoperative Clinical Outcomes and Shoulder Function

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AIM: Rotator cuff tears and long head of the biceps tendon (LHBT) injuries are primary causes of shoulder pain. During rotator cuff repair, concurrent LHBT injuries are frequently identified. Surgical management of LHBT injuries can effectively relieve pain and improve shoulder function. Two commonly used surgical approaches for LHBT repair are interference screw compression fixation and suture anchor ligation fixation. However, no definitive conclusion has been reached regarding which technique yields superior clinical outcomes. This study compared the efficacy of arthroscopic rotator cuff repair combined with different LHBT fixation techniques in treating repairable rotator cuff tears with LHBT injuries and evaluated their impact on shoulder joint function.

METHODS: This retrospective study analyzed clinical data from 112 patients with rotator cuff tears and LHBT injuries who underwent arthroscopic rotator cuff repair at the Department of Orthopedics of Xiaoshan Affiliated Hospital of Wenzhou Medical University. Patients were allocated into two groups based on the LHBT fixation method: interference screw tenodesis group (n = 54) and suture anchor tenodesis group (n = 58). Functional outcomes were evaluated using the Constant-Murley shoulder function score, University of California at Los Angeles (UCLA) shoulder score, and visual analogue scale (VAS) at preoperative baseline and at 3, 6, and 12 months postoperatively. The incidence of postoperative complications was also compared between the two groups.

RESULTS: In both the interference screw tenodesis group and the suture anchor tenodesis group, VAS scores at all postoperative time points were significantly lower than preoperative values, while Constant-Murley and UCLA scores were significantly higher than baseline (all $p < 0.008$). Both groups showed a progressive improvement over time (scores at 6 and 12 months were significantly better than at 3 months, and scores at 12 months were better than at 6 months; all $p < 0.008$). Between-group comparisons showed that VAS scores in the suture anchor tenodesis group at 3, 6, and 12 months post-operatively were significantly lower than those in the interference screw tenodesis group ($p < 0.05$). Additionally, the Constant-Murley scores and UCLA scores in the suture anchor tenodesis group at 3 and 6 months were significantly higher than those in the interference screw tenodesis group ($p < 0.05$). No statistically significant differences in Constant-Murley or UCLA scores were observed between the two groups at baseline or at 12 months postoperatively. The incidence of postoperative complications was slightly lower in the suture anchor tenodesis group compared with the interference screw tenodesis group; however, the difference did not reach statistical significance ($p > 0.05$).

CONCLUSIONS: For proximal LHBT injuries, both interference screw compression fixation and suture anchor ligation under shoulder arthroscopy can effectively restore LHBT continuity, relieve shoulder pain, and improve functional outcomes. Suture anchor ligation demonstrates superior efficacy in pain relief, particularly during early postoperative recovery. However, in terms of long-term functional improvement at 12 months, both techniques yield comparable results. Moreover, suture anchor fixation is associated with a relatively lower, although not statistically significant, rate of postoperative complications.

Keywords: rotator cuff tear; long head of the biceps tendon; interference compression screw fixation; suture anchor tenodesis; shoulder function

Introduction

Rotator cuff tears are a common orthopedic condition characterized by shoulder pain and impaired mobility, significantly impacting the daily activities of patients [1]. Predominantly occurring in middle-aged and elderly populations, these tears account for over 33% of all shoulder injuries [2], and their prevalence is expected to increase with population aging. Additionally, the pathology of the long head of the biceps tendon (LHBT) is another frequent contributor to shoulder pain, although its biomechanical role in shoulder function remains unclear [3]. A study indicates that the severity of LHBT pathology correlates with the severity of rotator cuff tears [4], with LHBT involvement reaching up to 92% in cases of massive rotator cuff

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tears. Failure to address LHBT lesions during rotator cuff repair may lead to persistent anterior shoulder pain postoperatively, thereby compromising clinical outcomes. Evidence suggests that surgical management of LHBT injuries during rotator cuff repair effectively alleviates pain and improves shoulder function, whereas patients receiving conservative treatment or no intervention often experience persistent pain [5,6]. The current primary surgical options for LHBT injury include LHBT avulsion and fixation. Although both approaches have demonstrated comparable outcomes in pain relief and functional recovery, the choice between them remains controversial [7,8].

Compared to LHBT transection, LHBT fixation has become the preferred treatment for LHBT lesions due to its lower incidence of postoperative Popeye deformity. Two commonly used fixation techniques for LHBT injuries are interference screw compression fixation and suture anchor ligation, although their relative efficacy remains inconclusive. To further optimize the management of proximal LHBT injuries, this study compared the therapeutic outcomes and functional effects of arthroscopic rotator cuff repair combined with different LHBT fixation methods in patients with repairable rotator cuff tears and concomitant LHBT injuries, aiming to provide evidence to guide clinical decision-making.

Methods

General Information

This retrospective study analyzed 112 patients with rotator cuff tears and LHBT injuries who underwent arthroscopic rotator cuff repair at the Department of Orthopedics of Xiaoshan Affiliated Hospital of Wenzhou Medical University, between August 2021 and October 2024. Patients were allocated into two groups: interference screw tenodesis group (n = 54) and suture anchor tenodesis group (n = 58), based on the LHBT fixation method. The study adhered to the Declaration of Helsinki and was approved by the Ethics Committee of Xiaoshan Affiliated Hospital of Wenzhou Medical University (No.2025-186). All patient data were anonymized and de-identified prior to analysis to ensure confidentiality and privacy protection. Therefore, the requirement for written informed consent was waived by the Ethics Committee of Xiaoshan Affiliated Hospital of Wenzhou Medical University.

Inclusion and Exclusion Criteria

Inclusion criteria: (1) Shoulder pain accompanied by limited elevation, with failure of conservative treatment for 3–6 months and no significant symptom relief; (2) Positive findings on Jobe test, Hawkins test, Speed test, and/or O'Brien test on physical examination; (3) Preoperative magnetic resonance imaging (MRI) showing proximal LHBT injury with supraspinatus tear (tear width <5 cm); (4) Intraoperative arthroscopic confirmation of proximal LHBT injury, including wear, tear, partial avulsion, or dislocation; (5) Rotator cuff tear repair and fixation performed arthroscopically; (6) First surgical intervention on the affected shoulder; (7) Minimum follow-up duration of 1 year with complete clinical data available.

Exclusion criteria: (1) Concurrent shoulder conditions such as frozen shoulder, calcific tendinitis, acromioclavicular joint arthritis, or subscapular tendon injury; (2) Pre-existing disorders including brachial plexus injury, cervical spondylosis, or senile osteoporosis; (3) Intraoperative LHBT management limited to debridement or simple transection; (4) Massive supraspinatus tear ($\geq$5 cm) in which the rotator cuff tendons could not be adequately reduced and fixed to the cuff footprint area; (5) History of previous shoulder surgery, infection, or subsequent surgical intervention in the affected shoulder during follow-up; (6) Incomplete clinical records or loss to follow-up during the study period.

Surgical Method

All surgical procedures were performed by the same surgeon. General anesthesia combined with brachial plexus block was administered. The patient was positioned in the healthy decubitus position on the healthy side, followed by longitudinal traction using a 3–4 kg traction device. A standard arthroscopic approach was used to explore the shoulder joint and evaluate the LHBT lesion. After confirming that the arthroscopic findings were consistent with preoperative MRI results and clinical manifestations, and that the proximal LHBT injury met surgical indications, the intra-articular procedure was completed. The approach was then converted to the subacromial space. The subacromial space was cleared, and in cases of impingement at the anterolateral acromion or greater tuberosity, acromioplasty was performed using a burr. The size of the rotator cuff tendon tear was assessed. The rotator cuff footprint was appropriately medialized, and the bone surface was freshened using a high-speed burr. Subsequently, the rotator cuff tendon was fixed using suture anchors. The LHBT was then transected and fixed using either interference screw compression fixation [9] or suture anchor fixation [10].

In the interference screw tenodesis group, the distal end of the LHBT was secured and marked with polydioxanone (PDS) suture, maintaining the native tendon tension. After traction to the marked position, the tendon was transacted using a plasma knife. An 8.5 mm bone tunnel was drilled in the middle-lower third of the interarticular groove using an electric drill. The tunnel was debrided, and the distal end of the LHBT was advanced into the bone tunnel using a tendon pusher. The tendon length and tension were adjusted, and an interference screw was inserted into the bone tunnel to achieve compression fixation. The affected shoulder and elbow joints were flexed and extended to assess tendon tension. If no significant abnormalities were observed, the interference screw was further secured.

In the suture anchor tenodesis group, a suture anchor was first placed in the lower one-third of the interarticular

Table 1. Baseline clinical characteristics of patients in the two groups.

Variable	Interference screw tenodesis group (n = 54)	Suture anchor tenodesis group (n = 58)	χ^2/t	*p*-value
Gender			0.001	0.978
Male (n, %)	29 (53.70)	31 (53.45)		
Female (n, %)	25 (46.30)	27 (46.55)		
Age (years, mean ± SD)	62.09 ± 8.62	64.07 ± 6.77	1.354	0.178
Injured side			0.443	0.506
Left, n (%)	19 (35.19)	17 (29.31)		
Right, n (%)	35 (64.81)	41 (70.69)		
Smoking history			0.043	0.835
No, n (%)	41 (75.93)	45 (77.59)		
Yes, n (%)	13 (24.07)	13 (22.41)		
Diabetes status			1.060	0.303
No, n (%)	46 (85.19)	45 (77.59)		
Yes, n (%)	8 (14.81)	13 (22.41)		
Disease duration (months, mean ± SD)	4.96 ± 0.80	5.07 ± 0.81	0.695	0.489
Tear size, n (%)			0.142	0.931
Small (<1 cm)	8 (14.81)	10 (17.24)		
Medium (1–3 cm)	31 (57.41)	33 (56.90)		
Large (3–5 cm)	15 (27.78)	15 (25.86)		
Goutallier fatty infiltration grade, n (%)			0.485	0.780
Grade 0–1	35 (64.81)	36 (62.07)		
Grade 2	15 (27.78)	19 (32.76)		
Grade 3	4 (7.41)	3 (5.17)		
Type of LHBT injury, n (%)			0.201	0.977
Tendonitis	12 (22.22)	14 (24.14)		
Partial tear	23 (42.59)	25 (43.10)		
Complete tear	10 (18.52)	11 (18.97)		
Subluxation	9 (16.67)	8 (13.79)		
Rotator cuff repair technique, n (%)			0.177	0.674
Single-row	31 (57.41)	31 (53.45)		
Double-row	23 (42.59)	27 (46.55)		
Acromioplasty performed, n (%)			0.260	0.610
Yes	44 (81.48)	45 (77.59)		
No	10 (18.52)	13 (22.41)		
Operation time (minutes, mean ± SD)	92.67 ± 24.91	86.19 ± 11.49	1.787	0.077

LHBT, long head of the biceps tendon.

groove, with one suture used for ligation and the other for fixation. One end of the ligation suture was passed through the tendon beneath the PDS suture to form a semi-loop, and both ends were then passed through the loop to create a locking configuration. The second anchor suture was also passed through the tendon beneath the PDS suture. Both suture ends were tightened and knotted arthroscopically using a tendon pusher. After the initial knot was secured, the shoulder and elbow joints were mobilized to evaluate tendon tension. Upon confirmation of appropriate tension, additional knots were tied until the LHBT was firmly fixed, followed by transection of the proximal end of the LHBT joint.

After completion of tendon fixation, the joint was irrigated, and the incision was sutured and bandaged. The affected limb was immobilized in an abducted position with 0° internal rotation and 30° abduction using a shoulder joint abduction brace.

Postoperative Rehabilitation

All patients underwent standardized rehabilitation exercises under professional supervision immediately after surgery, beginning with immobilization using an abducted shoulder brace for six weeks. On postoperative day one, pendulum-like shoulder movements and active range-of-motion exercises of the affected limb were initiated. At two weeks postoperatively, passive range-of-motion exercises in all directions were introduced. Active flexion and extension exercises were initiated at eight weeks, followed by shoulder muscle strength training at twelve weeks. After each exer-

Table 2. Visual analogue scale (VAS) scores for shoulder joint pain before and after surgery in the two groups.

Group	Preoperative	3 months postoperatively	6 months postoperatively	12 months postoperatively	H	*p*-value
Interference screw tenodesis group (n = 54)	7 (6, 7)	3 (3, 4)^{a}	2 (1, 2)^{a,b}	1 (0, 1)^{a,b,c}	181.152	<0.001
Suture anchor tenodesis group (n = 58)	6 (4, 8)	3 (2, 4)^{a}	1 (1, 2)^{a,b}	0 (0, 1)^{a,b,c}	167.749	<0.001
Z	0.993	2.608	2.032	2.605		
p-value	0.321	0.009	0.042	0.009		

Notes: The Bonferroni correction was used for multiple comparisons, with statistical significance set at $p < 0.008$. a: $p < 0.008$, compared with preoperative; b: $p < 0.008$, compared with 3 months postoperatively; c: $p < 0.008$, compared with 6 months postoperatively.

Table 3. Constant-Murley shoulder joint function scores before and after surgery in the two groups.

Group	Preoperative	3 months postoperatively	6 months postoperatively	12 months postoperatively	H	*p*-value
Interference screw tenodesis group (n = 54)	45 (42, 48)	55 (52, 58)^{a}	68 (65, 73)^{a,b}	88 (85, 95)^{a,b,c}	185.562	<0.001
Suture anchor tenodesis group (n = 58)	47 (43, 51)	58 (54, 62)^{a}	72 (66, 77)^{a,b}	84 (77, 90)^{a,b,c}	195.013	<0.001
Z	1.619	3.060	1.996	1.552		
p-value	0.105	0.002	0.046	0.121		

Notes: The Bonferroni correction was used for multiple comparisons, with statistical significance set at $p < 0.008$. a: $p < 0.008$, compared with preoperative; b: $p < 0.008$, compared with 3 months postoperatively; c: $p < 0.008$, compared with 6 months postoperatively.

cise session, ice packs were applied to the affected shoulder joint to reduce inflammation and swelling. Strict adherence to the rehabilitation protocol was emphasized to minimize the risk of secondary joint injury and to promote optimal functional recovery.

Observation Indicators

The study recorded and compared the operative time between the two patient groups. Regular postoperative follow-ups were conducted, and final evaluations documented complications such as joint stiffness, deltoid muscle atrophy, and Popeye deformity in both groups. Deltoid muscle atrophy was diagnosed when significant differences in morphology, muscle tone, or thickness were identified through visual inspection and palpation of bilateral deltoid muscles. Rotator cuff retears were identified based on ultrasound findings indicating discontinuity or marked thinning of the supraspinatus tendon. Recovery of shoulder function was evaluated using the Constant-Murley shoulder function score [11], the University of California at Los Angeles (UCLA) Shoulder Score System [12], and the visual analogue scale (VAS) score [13] at preoperative baseline and at 3, 6, and 12 months postoperatively.

Statistical Analysis

Statistical analysis was performed using SPSS (version 27.0, IBM Corp., Armonk, NY, USA). Data normality was assessed using the Shapiro-Wilk test. Normally distributed data were presented as mean ± standard deviation, and inter-group comparisons were conducted using independent samples *t*-tests. Non-normally distributed data were expressed as median (Q1, Q3), and comparisons between groups were performed using the Mann-Whitney U test. Categorical variables were analyzed using the chi-square (χ^2) test or Fisher's exact test, as appropriate. A *p*-value < 0.05 was considered statistically significant for primary comparisons. The Bonferroni correction was applied to adjust for multiple comparisons; with six comparisons, statistical significance was defined as $p < 0.008$.

Results

Comparison of Clinical Data Between the Two Groups

A total of 112 patients with rotator cuff tears and LHBT injuries were included in this study. The baseline clinical characteristics of both groups are summarized in Table 1. The results showed no statistically significant differences between the two groups in terms of gender, age, injury location, smoking history, diabetes status, disease duration, tear size, Goutallier fatty infiltration grade, type of LHBT injury, rotator cuff repair technique, performance of acromioplasty, or operative time (all $p > 0.05$), indicating good baseline comparability.

VAS Score for Shoulder Joint Pain

As shown in Table 2, the VAS scores for shoulder joint pain were compared between the two patient groups at different time points. The results indicated that the VAS scores in both the interference screw tenodesis group and the suture anchor tenodesis group at each postoperative time point were significantly lower than preoperative values ($p < 0.008$). Furthermore, the scores at 6 and 12 months postoperatively were significantly lower than those at 3 months ($p < 0.008$), and the scores at 12 months were also significantly lower than those at 6 months ($p < 0.008$). Intergroup comparisons showed that the VAS scores in the suture anchor tenodesis group were significantly lower than those in the interference screw tenodesis group at 3, 6, and 12

Table 4. UCLA scores of two groups of patients before and after surgery.

Group	Preoperative	3 months postoperatively	6 months postoperatively	12 months postoperatively	H	*p*-value
Interference screw tenodesis group (n = 54)	12 (8, 14)	21 (16, 24)^{a}	25 (18, 32)^{a,b}	30 (27, 31)^{a,b,c}	126.881	<0.001
Suture anchor tenodesis group (n = 58)	13 (8, 15)	22 (18, 26)^{a}	29 (26, 30)^{a,b}	30 (27, 32)^{a,b,c}	157.392	<0.001
Z	0.424	2.149	2.454	1.420		
p-value	0.672	0.032	0.014	0.156		

Notes: The Bonferroni correction was used for multiple comparisons, with statistical significance set at $p < 0.008$. a: $p < 0.008$, compared with preoperative; b: $p < 0.008$, compared with 3 months postoperatively; c: $p < 0.008$, compared with 6 months postoperatively. UCLA, University of California at Los Angeles.

Table 5. Comparison of rotator cuff retear rates between the two groups at 12 months postoperatively.

Group	Patients undergoing ultrasound examination, n (%)	Retear cases, n	Retear rate (%)
Interference screw tenodesis group (n = 54)	50 (92.59%)	7	14.00
Suture anchor tenodesis group (n = 58)	56 (96.55%)	4	7.14
Total	106	11	10.38
Statistical analysis		$\chi^2 = 1.335$, $p = 0.248$	

Notes: At 12 months postoperatively, 4 patients in the interference screw group and 2 patients in the suture anchor group did not complete ultrasound reexamination due to personal reasons. Rotator cuff retear was defined as ultrasound evidence of discontinuity or significant thinning of the supraspinatus tendon.

months postoperatively ($p < 0.05$), with more pronounced differences observed at 3 and 12 months postoperatively (both $p = 0.009$), suggesting superior pain relief in the suture anchor tenodesis group.

Constant-Murley Score for the Shoulder Joint

This study compared the Constant-Murley shoulder joint function scores between the interference screw tenodesis group and the suture anchor tenodesis group before the operation and at 3, 6, and 12 months postoperatively. The Constant-Murley scores of both groups at each postoperative time point were significantly higher than those before surgery (all $p < 0.008$). Additionally, the scores at 6 and 12 months postoperatively were significantly higher than those at 3 months, and the score at 12 months was also significantly higher than those at 6 months (all $p < 0.008$), suggesting continuous improvement in shoulder function over time.

Intergroup comparison showed that the Constant-Murley score in the suture anchor tenodesis group was significantly higher than that in the interference screw tenodesis group at 3 months postoperatively (Z = 3.060, $p = 0.002$), and remained higher at 6 months (Z = 1.996, $p = 0.046$). No statistically significant differences were observed between the two groups at baseline ($p = 0.105$) or at 12 months postoperatively ($p = 0.121$). These findings indicate that shoulder joint function recovery in the suture anchor tenodesis group was superior during the early postoperative period (3 months, whereas functional outcomes in both groups were comparable in the long term (12 months). See Table 3.

UCLA Score

This study compared the UCLA shoulder joint scores between the interference screw tenodesis group and the suture anchor tenodesis group at preoperative baseline and at 3, 6, and 12 months postoperatively. As shown in Table 4, the UCLA scores in both groups at each postoperative time point were significantly higher than those before surgery (all $p < 0.008$). Moreover, the scores at 6 and 12 months after the operation were significantly higher than those at 3 months, and the scores at 12 months after the operation were also significantly higher than those at 6 months (all $p < 0.008$), suggesting progressive functional improvement.

Intergroup comparisons showed that the UCLA score in the suture anchor tenodesis group was significantly higher than that in the interference screw tenodesis group at 3 months postoperatively (Z = 2.149, $p = 0.032$), and remained significantly higher at 6 months (Z = 2.454, $p = 0.014$). No statistically significant differences were observed between the two groups at baseline ($p = 0.672$) or at 12 months postoperatively ($p = 0.156$). These results suggest that the suture anchor tenodesis group achieved better functional recovery during the early postoperative period (3–6 months), while long-term (12 months) outcomes were comparable between groups.

Comparison of Complications and Retearing Conditions Between the Two Groups

At 12 months postoperatively, a total of 106 patients (94.64%) completed shoulder joint ultrasound reexamination, including 50 cases (92.59%) in the interference screw group and 56 cases (96.55%) in the suture anchor tenodesis group. As shown in Table 5, ultrasound findings indicated

Table 6. Comparison of postoperative complications between the two groups [n (%)].

Complication	Interference screw tenodesis group (n = 54)	Suture anchor tenodesis group (n = 58)	χ^2	*p*-value
Joint stiffness (ankylosis)	4 (7.41)	2 (3.45)	/	0.426
Deltoid muscle atrophy	2 (3.70)	0 (0.00)	/	0.230
Popeye deformity	2 (3.70)	1 (1.72)	/	0.608
At least one complication	8 (14.81)	3 (5.17)	2.936	0.087

Notes: "At least one complication" refers to the number of patients experiencing any postoperative complication. No patients experienced more than one complication simultaneously; therefore, the sum of individual complication cases equals the total number of affected patients. When the expected cell frequency is less than 5, Fisher's exact test was used.

rotator cuff retear in 7 cases (14.00%) in the interference screw group and 4 cases (7.14%) in the suture anchor tenodesis group. No statistically significant difference in retear rate was observed between the two groups ($\chi^2 = 1.335$, $p = 0.248$).

In terms of postoperative complications, eight cases (14.81%) in the interference screw tenodesis group developed postoperative complications, including four cases of joint stiffness, two cases of deltoid muscle atrophy, and two cases of Popeye deformity. In the suture anchor tenodesis group, three cases (5.17%) developed complications, including two cases of joint stiffness, no cases of deltoid muscle atrophy, and one case of Popeye deformity. No statistically significant difference in overall complication rates was observed between the two groups ($p > 0.05$, Table 6).

Discussion

Since LHBT lesions are a common cause of shoulder pain, non-surgical treatments such as medications, corticosteroid injections, or physical therapy are often applied. However, for patients with poor response to conservative management or those with concurrent rotator cuff tears, surgical intervention is typically recommended. Myotenotomy and tenodesis are two commonly used surgical approaches [14]. Nevertheless, both procedures carry a risk of postoperative Popeye deformity, particularly in patients undergoing tendon release, which may affect cosmetic outcomes. Studies by Srinivasan *et al*. [15] and Kim *et al*. [16] reported similar findings, with tendon fixation showing a lower incidence of Popeye deformity. Therefore, this study selected tendon fixation for patients with rotator cuff tears combined with LHBT lesions.

The two most commonly used clinical fixation techniques for the long head of the biceps tendon are interference screw compression fixation and suture anchor fixation. Carter *et al*. [17] and Sampatacos *et al*. [18] reported that interference screw fixation may have a higher failure rate due to its distinct biomechanical characteristics compared with suture anchor fixation. In the present study, using the Constant-Murley and UCLA shoulder scores, suture anchor fixation showed superior outcomes compared with interference screw fixation, particularly in the early postoperative period. This study also evaluated rotator cuff retear at 12 months postoperatively. The results showed that the retear rate in the suture anchor tenodesis group (7.14%) was lower than that in the interference screw tenodesis group (14.00%), but the difference did not reach statistical significance. The lack of a significant difference may be due to the limited sample size or indicate that the LHBT fixation method has a limited direct impact on rotator cuff healing. Notably, the overall retear rate in this study (10.38%) is consistent with the range reported in the literature (5%–40%) [19].

This study observed that the incidence of Popeye deformity was higher in the interference screw compression fixation group compared with the suture anchor fixation group, which may be related to the different fixation mechanisms of these two intramedullary techniques. The suture anchor technique secures the tendon to the bone surface through suturing and compression, promoting scar formation and enhancing fixation stability. In contrast, the screw compression technique applies lateral pressure through screw compression of the tendon within the bone tunnel, generating friction against the bone marrow tunnel to secure the graft. However, prolonged screw compression may lead to partial tendon necrosis and subsequent rupture. Additionally, no statistically significant differences were observed between the two groups in Constant-Murley or UCLA scores at the final follow-up, indicating that both techniques achieve comparable functional recovery from rotator cuff tears at 12 months after surgery.

The LHBT has a movable length of approximately 1.5–1.9 cm, with about one-third located intra-articularly. However, nearly 80% of intra-articular tendon injuries involve extra-articular structures. Therefore, LHBT fixation can be categorized into proximal and distal fixation according to location. However, there remains no consensus on the optimal fixation site in terms of postoperative tendon function, pain relief, or complication rates [20,21]. Fixation too close to the lesion site may lead to persistent postoperative pain. Residual pain after surgery is influenced not only by fixation location but also by multiple factors, including fixation materials, patient lifestyle and occupation, and the surgical technique.

This study has several limitations. First, the relatively small sample size may have reduced statistical power and limited the ability to account for individual variability. Second, the retrospective design may introduce bias, including potential non-randomized group allocation and baseline imbalances, as well as incomplete control of confounding variables (e.g., age and comorbidities). Additionally, the outcomes were primarily based on subjective assessments and range-of-motion measurements, without comprehensive imaging evaluation (e.g., MRI evaluation of rotator cuff healing). In summary, the generalizability of these findings may be limited. Future prospective studies with larger sample sizes, extended follow-up periods, and multidimensional assessments are warranted to validate these results.

Conclusions

The study demonstrates that, for long head of the biceps tendon injuries, both interference screw compression fixation and suture anchor fixation under shoulder arthroscopy can restore LHBT continuity, alleviate shoulder pain, and improve shoulder function. In terms of pain relief, suture anchor fixation appears to provide superior outcomes, especially during the early postoperative period. In terms of long-term functional recovery (12 months after surgery), both techniques show comparable efficacy, while suture anchor fixation is associated with a relatively lower incidence of postoperative complications.

Availability of Data and Materials

The data analyzed are available from the corresponding author upon reasonable request.

Author Contributions

JG, HTM and LMZ conceived the study and collected the clinical data. YMC, JKY and GFH performed the research. JG and HTM drafted the manuscript. All authors have been involved in revising the manuscript critically for important intellectual content. All authors gave final approval of the version to be published. All authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

Ethics Approval and Consent to Participate

The study adhered to the Declaration of Helsinki and was approved by the Ethics Committee of Xiaoshan Affiliated Hospital of Wenzhou Medical University (No.2025-186). All patient data were anonymized and de-identified prior to analysis to ensure confidentiality and privacy protection. Therefore, the requirement for written informed consent was waived by the Ethics Committee of Xiaoshan Affiliated Hospital of Wenzhou Medical University.

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Conflict of Interest

The authors declare no conflict of interest.

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