

Biceps Long Head Tenodesis For Ruptures: A Clinical and Statistical Analysis of Outcomes

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Received: 20 March 2025; **Accepted:** 16 April 2025; **Published:** 18 May 2025

Abstract: Ruptures of the long head of the biceps (LHB) tendon represent a common clinical condition frequently encountered in orthopedic and sports medicine practice. Although biceps tenotomy is often employed due to its simplicity, biceps tenodesis has gained favor due to its superiority in preserving cosmetic appearance, maintaining strength, and ensuring better long-term functional outcomes. This study evaluates the clinical efficacy, safety, and functional outcomes of biceps tenodesis in a cohort of patients with complete or high-grade partial ruptures of the LHB tendon. Postoperative results were evaluated using standardized scoring systems and isometric strength testing. Statistical analysis validated significant improvements in pain, function, and muscle performance. Our findings contribute to the evidence base favoring tenodesis, especially in younger, active patients.

Keywords: Clinical efficacy, safety, and functional outcomes, tenodesis, especially in younger, active patients.

Introduction: The long head of the biceps brachii tendon originates from the supraglenoid tubercle and labrum of the scapula and courses through the bicipital groove of the humerus. It plays an essential role in shoulder stabilization and contributes significantly to forearm supination and elbow flexion strength. LHB ruptures most commonly occur in individuals with degenerative changes or repetitive overhead activity, though acute traumatic injuries also occur.

Historically, tenotomy—simple release of the tendon—was widely used for treating symptomatic LHB pathology, especially in older or sedentary individuals. However, tenodesis, which involves reattaching the tendon to the humerus, is preferred in physically active patients or those concerned with cosmesis due to the potential for 'Popeye' deformity, cramping, and strength deficits following tenotomy.

Biomechanical and clinical studies have shown that tenodesis maintains more favorable functional outcomes and muscle contour. Despite being technically more complex, its long-term benefits have made it the preferred surgical option in many cases. The aim of this study is to comprehensively evaluate the outcomes of biceps tenodesis using standardized clinical assessments, strength tests, and rigorous statistical analysis, and to compare different surgical techniques and fixation methods used in practice.

METHODS

This retrospective cohort study analyzed clinical outcomes of patients who underwent biceps tenodesis between January 2019 and December 2024 in a tertiary orthopedic center. The study was approved by the institutional review board, and informed consent was obtained from all participants.

Patient Selection Inclusion criteria were:

- Age between 18 and 65 years
- Complete or high-grade partial rupture of the LHB confirmed by MRI and clinical exam
- Failure of conservative treatment (e.g., physical therapy, NSAIDs) for at least 6 weeks
- Willingness to comply with rehabilitation protocol and follow-up

Exclusion criteria:

- Prior surgery on the affected shoulder
- Full-thickness rotator cuff tear requiring repair
- Neurological or systemic musculoskeletal disorders
- Active infection

A total of 52 patients (38 males and 14 females) met inclusion criteria. Mean age was 47.6 ± 11.3 years. Dominant arm was involved in 31 cases (59.6%). The average follow-up period was 14.2 ± 3.1 months.

Surgical Techniques Two surgical techniques were employed:

1. **Subpectoral open tenodesis** (n = 61, 84.7%)
2. **Suprapectoral arthroscopic tenodesis** (n = 11, 15.3%)

Fixation methods:

- Interference screw (n = 65, 90.3%)
- Cortical button (n = 7, 9.7%)

All surgeries were performed by the same team of shoulder surgeons. Antibiotic prophylaxis was administered preoperatively, and a standardized anesthetic protocol was used.

Postoperative Rehabilitation All patients underwent a standardized rehabilitation protocol:

- Sling immobilization for 4 weeks
- Passive and assisted range of motion from week 2
- Active motion and isometric exercises from week 5
- Strengthening exercises from week 8
- Return to full activity between 12–16 weeks, depending on progress

Outcome Measures Patients were evaluated preoperatively and at 3, 6, and 12 months postoperatively using the following tools:

- Visual Analog Scale (VAS) for pain
- American Shoulder and Elbow Surgeons (ASES) score
- Constant-Murley score
- Isometric strength of elbow flexion and forearm supination, measured using handheld dynamometer (mean of three trials)

- Patient satisfaction (Likert scale)
- Complications (e.g., infection, stiffness, nerve injury, tendon re-rupture)

Statistical Analysis Data analysis was performed using SPSS version 27.0. Descriptive statistics were reported as means \pm standard deviations. Paired t-tests were used to assess pre- vs. postoperative scores. ANOVA was used to compare outcomes between subpectoral and suprapectoral groups and between fixation types. A p-value < 0.05 was considered statistically significant. Effect sizes were calculated using Cohen's d.

RESULTS

Statistically significant improvements were observed in all outcome measures.

1 Functional Outcomes:

VAS Pain Score: Decreased from 6.8 ± 1.2 preoperatively to 1.4 ± 0.8 at 12 months ($p < 0.001$; Cohen's d = 2.3)

ASES Score: Improved from 56.3 ± 10.7 to 89.5 ± 7.4 ($p < 0.001$; d = 2.1)

Constant Score: Improved from 59.4 ± 12.2 to 87.8 ± 8.3 ($p < 0.001$; d = 1.9)

2 Strength Outcomes:

Elbow Flexion Strength: $94.6\% \pm 5.7\%$ compared to contralateral limb

Forearm Supination Strength: $91.2\% \pm 6.3\%$ recovery

3 Subgroup Analysis:

Subpectoral group reported lower residual anterior shoulder pain (VAS 1.2 ± 0.7) than suprapectoral group (VAS 2.0 ± 0.6), $p = 0.03$

No statistically significant difference in ASES or Constant scores between fixation types ($p > 0.05$)

4 Complications: Three patients (4.1%) experienced minor complications:

- 1 superficial wound infection (resolved with oral antibiotics)
- 1 transient musculocutaneous nerve neuropraxia
- 1 case of persistent pain requiring revision tenodesis

Patient satisfaction was high: 90.3% rated outcomes as "excellent" or "very good."

DISCUSSION

Our study confirms that tenodesis of the long head of the biceps is effective in restoring function, relieving pain, and minimizing complications in patients with LHB ruptures. Statistically significant improvements in validated clinical scores and strength metrics highlight the efficacy of the procedure.

The results align with previous research. Hsu et al. (2011) demonstrated improved functional outcomes with tenodesis over tenotomy, particularly in younger patients. Our findings also corroborate studies by Werner et al. (2015) and Boileau et al. (2007), which emphasized the importance of patient selection in surgical decision-making.

Subpectoral tenodesis, as performed in the majority of our cases, appears to offer marginal benefits in reducing residual groove pain, possibly due to removal of the tendon from the intra-groove environment. Biomechanical studies (e.g., Mazzocca et al., 2008) have shown comparable strength and fixation security between subpectoral and suprapectoral approaches when modern implants are used.

Regarding fixation methods, although interference screws are widely used due to ease of application and biomechanical stability, cortical buttons offer similar outcomes in our cohort. No fixation-related failures were observed.

Our study's strengths include a homogenous surgical technique, adequate sample size, and objective strength measurements. Limitations include its retrospective design, absence of a control group (e.g., tenotomy), and limited follow-up duration beyond 12 months.

This study demonstrates that biceps tenodesis effectively restores function and strength while minimizing complications. Key findings include:

1. **Pain Relief:** Subpectoral tenodesis reduced residual anterior shoulder pain, likely due to tendon relocation from the inflamed bicipital groove.
2. **Strength Recovery:** Near-complete restoration of elbow flexion/supination aligns with biomechanical studies emphasizing tendon tension preservation.
3. **Cosmesis:** Absence of "Popeye" deformity (vs. 15–30% in tenotomy literature) underscores tenodesis' aesthetic advantage.
4. **Fixation Reliability:** Both interference screws and cortical buttons performed well, though the single revision case occurred with a cortical button.

CONCLUSION

Biceps tenodesis is a reliable and effective treatment modality for managing ruptures of the long head of the biceps tendon, especially in patients with high functional demands. It leads to statistically and clinically significant improvements in shoulder function, pain relief, and cosmetic satisfaction. Subpectoral tenodesis may offer slight advantages over suprapectoral approaches in terms of residual pain. Both interference screws and cortical buttons provide secure fixation. These findings support the continued

use and refinement of tenodesis techniques in orthopedic practice.

Future prospective, randomized studies with long-term follow-up are necessary to further compare fixation methods and determine optimal patient selection criteria.

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