

Technical Note

Arthroscopic partial Superior Capsular Reconstruction using the Long Head of the Biceps Tendon—Technique Description

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Abstract: Superior capsule reconstruction is a valuable intervention for some patients who present symptomatic irreparable posterosuperior rotator cuff tears. Superior capsule reconstruction techniques most commonly use either fascia lata autograft or dermal allograft. Both options have literature support but also present a few drawbacks such as donor site issues, potential allergic reactions, and high cost of the operation. The long head of biceps is a potential graft for rotator cuff tears and may be particularly useful in bridging the gap in irreparable massive rotator cuff tears, specifically as an alternative to more traditional superior capsular reconstruction. Long head of biceps transposition may offer unique and significant advantages over other techniques and can be an effective and valuable alternative in selected cases. The tendon's insertion into the glenoid is left intact, whereas laterally it is transferred to a more central humeral head position and sutured with anchors onto the footprint of the supraspinatus tendon acting as a superior static stabilizer of the shoulder joint. The purpose of this article is to propose a technical modification of superior capsular reconstruction using long head of the biceps tendon autograft.

Massive rotator cuff tears (RCTs) remain a challenging condition. Different treatments have been developed to manage massive RCTs such as partial repair, tendon transfers, fascia or dermal-based patches, and reverse total shoulder arthroplasty.¹⁻³

The superior capsule reconstruction (SCR) is one of the options that is known to be an effective treatment for irreparable massive RCTs, specifically in situations not suitable for an arthroplasty. The reconstruction restores superior glenohumeral stability and improve shoulder function allowing the deltoid to abduct the shoulder. Different graft techniques have been

proposed such as fascia lata autograft and dermal allografting.^{4,5} Both options have literature support but also present a few drawbacks such as donor site issues, potential allergic reactions, and high cost of the operation. Maintaining the principles of SCR, the purpose of this article is to present a cheap and technically easy modification of the original reconstruction by using the long head of the biceps tendon (LHBT).

Surgical Technique

The surgical procedure can be performed with the patient in either the beach-chair or lateral decubitus position. Standard posterior and anterior glenohumeral joint portals are made. Diagnostic arthroscopy, using a 30° arthroscope, is performed within the glenohumeral joint to assess the rotator cuff tear size and to confirm the presence of the biceps tendon. If the biceps tendon is absent or severely damaged, it cannot be transposed and incorporated into the posterosuperior rotator cuff repair construct. After that, the arthroscope is placed into the subacromial space using the same posterior portal, and a lateral subacromial portal is created. A complete subacromial bursectomy is performed to maximize visualization and to allow for inspection of the rotator cuff tissue for quality, mobility, and tear-pattern assessment.

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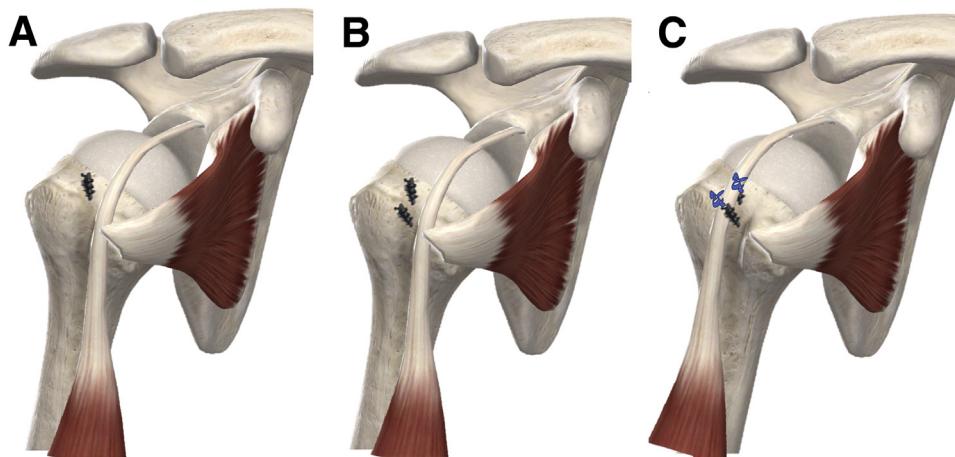


Fig 1. (A) A double-loaded anchor of the biceps is inserted into the center just lateral to the humeral head cartilage. (B) A second anchor is placed lateral to the first anchor. (C) The suture of the first anchor is passed and tied around the biceps tendon. The suture of the second anchor is passed and tied through the biceps (lasso-loop technique) with the upper arm in 20° glenohumeral abduction and 60° external rotation, so the long head of the biceps tendon is posteriorized and secure in this new position.

The rotator cuff tendon tear pattern is thoroughly evaluated by putting lateral traction on the supraspinatus and infraspinatus tendons while viewing from the Wilmington portal. We prefer to assess and repair the rotator cuff using this portal because it not only allows for complete visualization of the tear but also provides the ability to see the undersurface of the rotator cuff tear tissue so that the surgeon can appropriately incorporate any undersurface laminated tissue and residual superior capsule into the repair construct.

In the scenario of an irreparable tear, we proceed to a partial repair associated to the biceps rerouting procedure. The greater tuberosity is prepared with an arthroscopic shaver (Dyonics; Smith & Nephew, London, United Kingdom) and a new groove is made at the center of the humeral head to enhance tendon-to-bone healing.

A double-loaded suture anchor (4.5 mm; Smith & Nephew) is placed in the center of the greater tuberosity just lateral to the humeral head cartilage. One suture is used for the repair of the posterosuperior tissue of the cuff and the other suture is passed around the biceps to secure the biceps in the new groove. A second double loaded suture anchor is placed lateral to the first anchor to securely fix the biceps using the lasso-loop technique, as described by Lafosse et al.,⁶ with the upper arm in 20° glenohumeral abduction and 60° external rotation (Fig 1, Video 1).

Subsequently, other suture anchors can be used to fix the remainder of the rotator cuff. At the end of the procedure, additional free sutures are passed through the cuff and biceps to better incorporate the transposed tendon. Biceps tenotomy is not required. The tendon is simply secured to the greater tuberosity and otherwise left intact. (Figs 2-5).³⁻⁵

Postoperative Care

Shoulder joint movement is restricted during 6 weeks. Active-assisted physiotherapy and progressive

withdrawal of the brace are advised 6 weeks after surgery, focusing on full passive and active shoulder range-of-motion gains and performance of common daily activities without difficulties. No strengthening or resistance exercises are allowed before 4 months.⁷

Discussion

The recent literature supports the concept of SCR and has shown clinical improvement in patients with irreparable massive RC tears after SCR with a tensor fasciae latae (TFL) autograft and dermal allograft reconstruction.^{2-5,8,9} In a prospective observation study of 24 patients who underwent SCR with a dermal allograft, Mihata et al.^{3,4,9} found that all patients demonstrated a significant improvement in pain, range

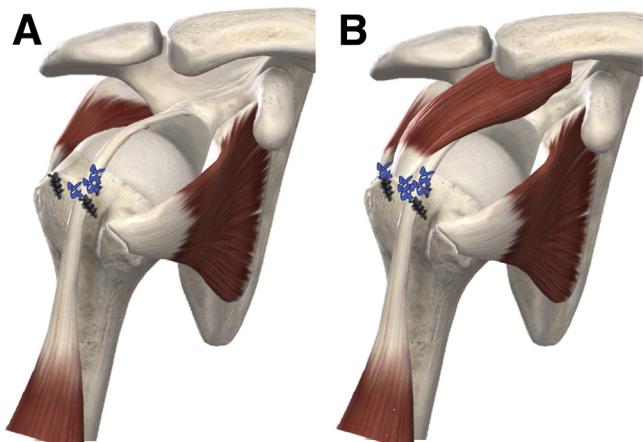


Fig 2. (A) To repair the remaining infraspinatus tendon to establish the posterior pillar, another double loaded anchor has been placed behind the transferred long head of the biceps tendon (LHBT) at a posterolateral position. (B) The sutures of the first and second anchor can be passed to repair remaining supraspinatus tendon and side-to- side, tension-free marginal repair of the LHBT with both the infraspinatus and supraspinatus tendons is performed.

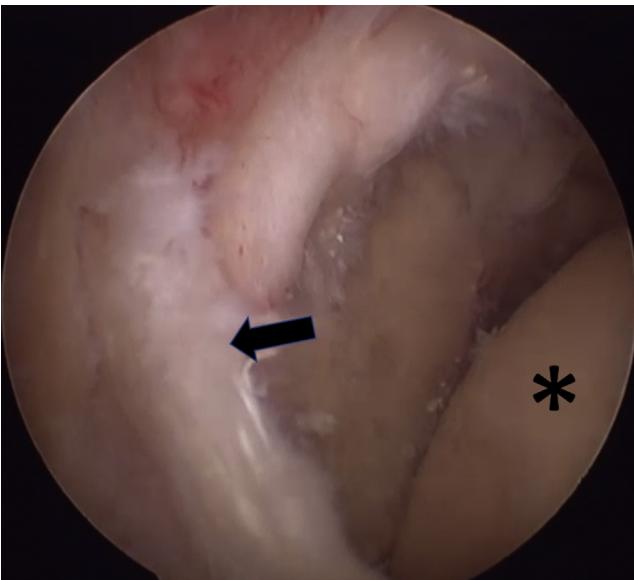


Fig 3. Black arrow: border of posterior rotator cuff tear; black asterisk: humeral head of the right shoulder and the posterior portal view.

of motion, and strength with improved American Shoulder and Elbow Surgeons and 12-Item Short Form Health Survey scores at 3-year follow-up.³ Our study proposes the use of the locally available LHB autograft for SCR. In addition, our technique uses fewer anchors and sutures than previously described TFL and dermal allograft techniques. Consequently, this will certainly decrease the overall cost of the LHB autograft procedure compared with the cost of dermal allograft reconstruction. The technique described in this report is an arthroscopic partial SCR rerouting the LHB to ensure

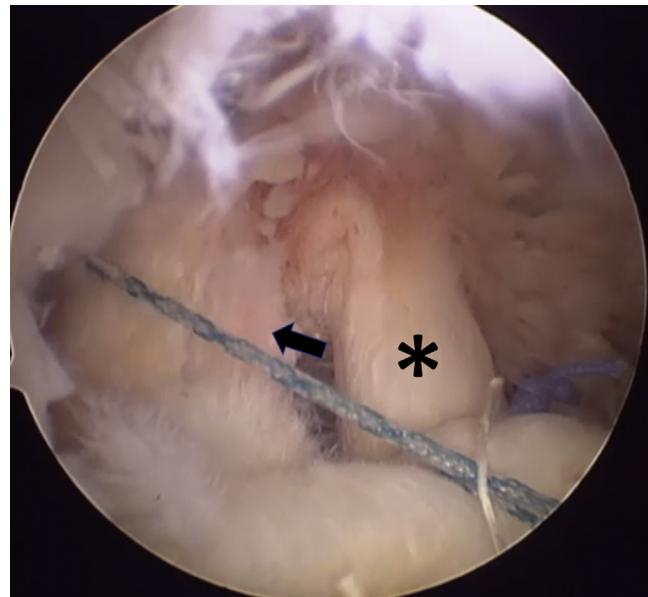


Fig 5. Black arrow: border of posterior rotator cuff tear; black asterisk: long head of the biceps tied at the center of humeral head. Note the blue white limb of the suture passed through the posterior rotator cuff tear.



Fig 4. Black arrow: anchor to the biceps, at the center of the humeral head; black asterisk: humeral head.

preservation in partially repairable massive RCT patients.

A method of repairing the rotator cuff by interpositioning the LHB between the RCT and the humeral head bone bed has also been described.¹⁰⁻¹⁸ This method uses tenotomized LHB to repair massive RCTs to prevent undue tension on the biceps tendon. However, there is a disadvantage in that the strength of the superior capsule region cannot be reinforced owing to the tenotomized LHB. Moreover, this technique cannot be performed if the cuff defect is larger than the diameter of the tenotomized biceps. We combine 2 previous surgical techniques that use the LHB, leading to the design of a technique that can be used in patients with massive RCTs, which are not completely repairable. This may be better than a simple partial repair. This technique can give downward forces to the humeral head as in the rerouting technique of the LHB. Biceps interposition may enhance the biological healing of the anterior rotator cuff by this technique. The overlap of the damaged rotator cuff with the LHB will make the superior capsule thicker and harder. The operation time is also reduced compared with previous procedures. Additionally, the technique we have described does not require that the biceps be tenotomized either before or after it has been transposed, just transposed from the bicipital groove after release the transversal ligament. We believe that the contraction of the biceps muscle in the biceps tendon not tenotomized add potential inferior force to

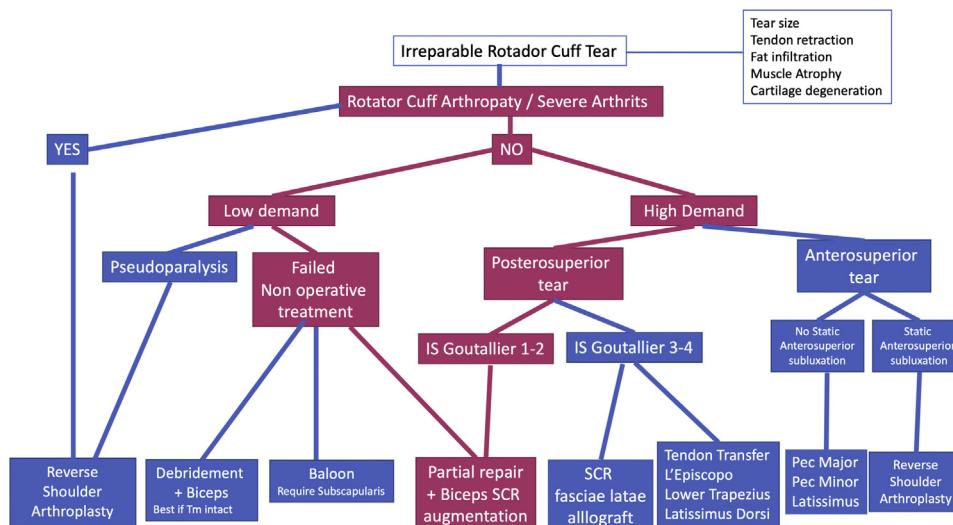


Fig 6. Summary of indications to treat the massive irreparable rotator cuff tears. In the red boxes, the best indications for the partial superior capsular reconstruction and augmentation with the long head of the biceps tendon.

the humeral head, probably contributing to increase the acromiohumeral distance (Table 1). Moreover, future biomechanical research is needed to pursue this hypothesis.

Park et al.,¹⁹ to assess an anterior cable reconstruction using autologous biceps tendon, concluded that the biceps tendon can biomechanically normalize superior migration and subacromial contact pressure, without limiting range of motion, similar to superior capsule reconstruction. They performed this biomechanical analysis in 20° glenohumeral abduction and 60° external rotation. In our technique we performed the biceps tenodesis at the center of the humeral head with the arm in this position.

Regarding the tension force that the biceps tendon is able to support, numerous biomechanical studies comparing it with the fascia latae show similar results.^{10,15} El-shaar et al.¹⁵ in a cadaveric model study,

concluded that superior capsular reconstruction with an LHBT autograft required $393.2\% \pm 87.9\%$ of the force needed for superior humeral migration in the massive RC tear condition, whereas SCR with a TFL autograft required $194.0\% \pm 21.8\%$. The LHB reconstruction group trended toward a stronger reconstruction when normalized to the torn condition.

McGough et al.¹⁰ demonstrated, using fresh-frozen cadaver, that the modulus of the LHBT is approximately 80% of the human patellar tendon and 70% of its tensile strength. When compared to the supraspinatus tendon, the LHBT demonstrated a modulus fourfold and double in tensile strength. With these results, we believe that the LHBT is able to prevent the superior migration of the humeral head, preventing the evolution of rotator cuff arthropathy and thereby minimizing the pain of these patients.

Table 1. Advantages, disadvantages, and limitations of Biceps partial SCR

Advantages

- No additional incisions and donor-site for graft harvesting
- Less expensive, lower cost
- Less technically demanding
- The blood supply and innervation of the biceps tendon is not compromised and remains intact, improving the healing potential
- No need for additional materials, specially anchors in the superior glenoid, avoiding complications

Disadvantages

- Popeye sign or cramping pain
- Pain from biceps anchor or from bicipital groove

Limitations

- Partial tear more than 30%
- Absent biceps
- Tear of the anchor biceps , SLAP III or IV

Table 2. Pearls and Pitfalls

Pearls

- Makes enough of a bone bed for LHBT and RC to be fixated biologically.
- The first anchor should be inserted at the center and just lateral to the humeral head cartilage.
- Removal of the transverse humeral ligament to mobilize the biceps tendon to the new groove at the center of humeral head.
- Additional posterosuperior anchor can be inserted at the humeral head to suture the remains infraspinatus tendon.
- Incorporation of rotator cuff tendon tissue into the biceps reinforces the repaired tissue.

Pitfalls

- Care must be taken during rotator cuff tendon release to ensure that the torn tendon can be mobilized to, at least, the medial aspect of the greater tuberosity footprint.
- The biceps tendon should not be tenotomized until the initial free suture has been passed around, through and sutured the biceps.
- Too tensioned repair of the rotator cuff can lead to poor outcome, including retear.

A limitation is that our technique needs high-quality LHBT. We recommend not using this technique in patients with a more than 30% partial tear or in cases with absent biceps. So it is important to check the quality of the LHBT anchors with preoperative magnetic resonance imaging and physical examination (Table 2).

The Popeye sign could represent another possible risk, more in terms of cosmesis than functional impairment. In addition, because this technique moves and repairs the LHBT at a side out of the biceps groove, one of our concerns was about pain or articular stiffness. However, before we decided to report the technique, our medium-term follow-up showed no such undesirable effects. With the described technique, SCR could be performed with the least technical demands only by posteriorizing and fixing the LHBT onto the greater tuberosity at the center of the humeral head.

Moreover, future research on clinical outcomes is critical to pursue and to compare the different treatment options available to treat massive rotator cuff tears. We believe that this technique should be used in low-demand patients with massive rotator cuff tears in an attempt to prevent, at least temporarily, the evolution of rotator cuff arthropathy (Fig 6).

We know that SCR is not a salvage procedure, but we believe it is an additional procedure for partial reconstruction of the superior capsule and filling the gaps in the partial repairs of the rotator cuff. Prospective and comparative studies with large cohort populations and long-term follow-up are necessary to establish the effectiveness of the technique.

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