



Anterior Capsular Reconstruction With Proximal Biceps Tendon for Large to Massive Rotator Cuff Tears

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Abstract: Massive rotator cuff tears (RCT) have traditionally been a challenging clinical problem for shoulder surgeons. A broad variety of treatment options have been proposed to address this problem, but outcomes have been as variable as the techniques themselves. Superior capsular reconstruction has been presented as a way to restore the restraining effect of the superior joint capsule and balanced force couples in massive tears of the superior rotator cuff. The purpose of this article is to propose a technical modification of the superior capsular reconstruction in large to massive RCT, and, especially in anterior L-shaped RCT, using the long head of the biceps tendon autograft to reinforce the weakest area of the anterior capsule, not as an augmentation of the rotator cuff, but as a static stabilizer of the humeral head, allowing the rotator cuff repair to heal without tension.

Large to massive rotator cuff tears (RCT) are challenging to repair, although there are several options to deal with them. Regarding these lesions, superior capsular reconstruction (SCR) was recently introduced as an effective procedure for retaining the static stability of the shoulder joint and preventing the progression to a cuff tear arthropathy. In the search for an alternative to fascia lata autografts or dermal allografts, using the locally available long head of the biceps tendon (LHBT) as an alternative graft option for SCR has become a focus of interest recently.¹⁻⁵

Understanding the geometric patterns of a RCT is essential to achieve the appropriate reduction of torn

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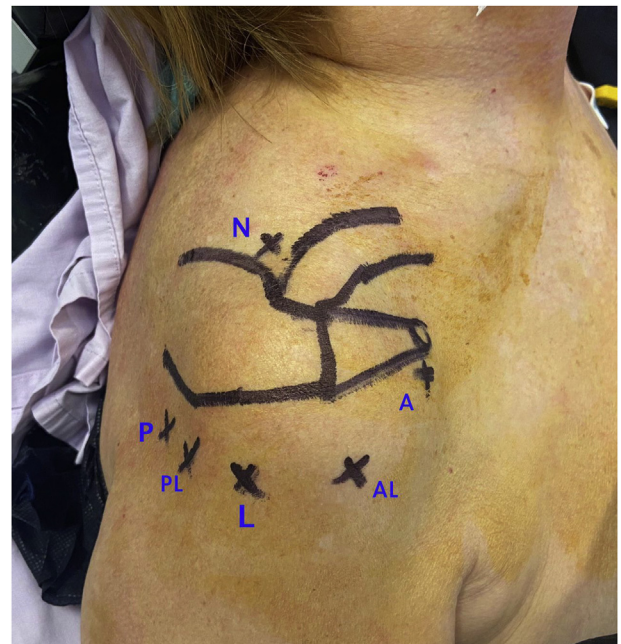


Fig 1. Standard arthroscopic portals in beach chair position for the right shoulder with posterior (P), posterolateral (PL), lateral (L), anterolateral (AL), lateral (L), and Neviaser (N) portals.

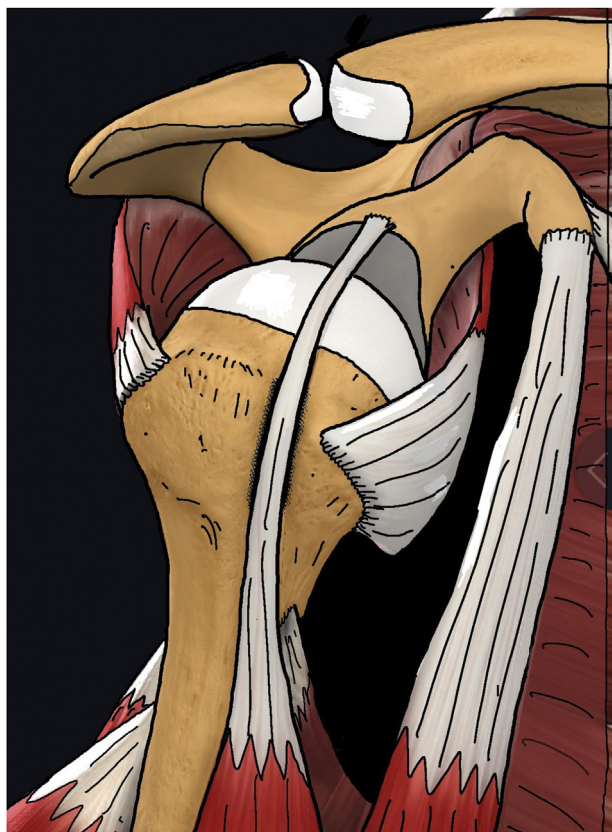


Fig 2. Right shoulder. Illustration shows the biceps after soft tissue cleaning and transverse humeral ligament release. The supraspinatus tendon has been removed to facilitate understanding of the technique.

tendons in anatomic positions. An anterior L-shaped RCT occurs when the supraspinatus tendon is detached from the rotator interval and anterior footprint and retracted posteriorly and medially. The quality of the tendon and soft tissue are often poorer than expected in preoperative examinations. The degeneration of the anterior margin of the supraspinatus tendon often hinder a stable anatomic reduction of the rotator cuff (RC) repair without tension. Occasionally, the anterior portion of an anterior L-shaped RCT becomes irreparable, resulting in an incomplete repair.

The biceps tendon is usually exposed from the defect of the anterolateral corner of the torn tendon apex and can be easily used to augment RC repair. The concept of using the autologous LHBT as a graft is appealing because it is available locally and as such, free of additional costs, theoretically less technically demanding, and potentially time-saving.

This Technical Note describes an arthroscopic SCR with autologous LHBT graft for large to massive RCT, not as an augmentation (the LHBT is not integrated into the RC repair), but as a static support structure to the tendon repair that favors its healing, at the same time that it avoids superior migration of the humeral head

Table 1. Surgical Steps, Pitfalls, and Pearls

Surgical steps	
Debridement of soft tissue around the LHBT	
Create a trough for rerouting the LHBT	
Anchor insertion in the trough to fix de LHBT	
Use two anchors with two strands:	
One lasso loop suture.	
One suture over the tendon.	
Transfer and tenodesis of LHBT	
Rotator cuff repair	
Pitfalls	
Insufficient release of the biceps can lead to breakage	
In Type III and IV Subscapularis tears the biceps is probably too degenerated and a tenotomy is preferable	
Avoid this step in patients with poor bone quality	
Doñt use all suture anchors for the risk of pullout	
Abduct the arm 30° to check the exact point to pass the sutures through the LHBT.	
Placing all sutures through the tendon could result in tissue shearing or implant failure.	
Insufficient suture technique, resulting in loss of LHBT fixation	
Not recognizing delaminated tears	
Pearls	
Cut the transverse humeral ligament to allow a tension-free transfer of the biceps.	
External rotation of the arm aids in the release of the bicipital groove.	
This trough provides stability to the LHBT graft with rotation and increases the contact area for healing biology	
Use PEEK anchors that have better fixation and provided better bone ingrowth	
Create an independent portal to introduce the medial anchor in an appropriate 45° orientation.	
If the tendon is degenerated, use a double lasso loop with the more medial anchor to avoid tearing it.	
Abduct the arm 30° in neutral rotation during suture tying, to favor the transfer of the biceps without tension and allow a view of the knot that is limited with a higher abduction.	
Tenotomy of the tendon in the bicipital groove is performed once it has been knotted to ensure adequate tension	
Make the repair viewing from the lateral portal	

LHBT: Long head of the biceps tendon.

without restricting the glenohumeral kinematics allowing the rotator cuff to heal without tension.

Surgical Technique

Patient Position, Arthroscopic Portals, and Initial Joint Exploration

Under general anesthesia, the patient is placed in beach-chair position. Usually, the following 5 standard arthroscopic portals are necessary: posterior, posterolateral, lateral, anterolateral and anterior (Fig 1). The joint is routinely examined with a 30° scope; in case of type I and II subscapularis tear,⁶ an intra-articular repair is performed. The integrity of the LHBT is also checked. The arthroscope is moved into the subacromial space through the posterior portal, and a bursectomy is performed using a shaver through the

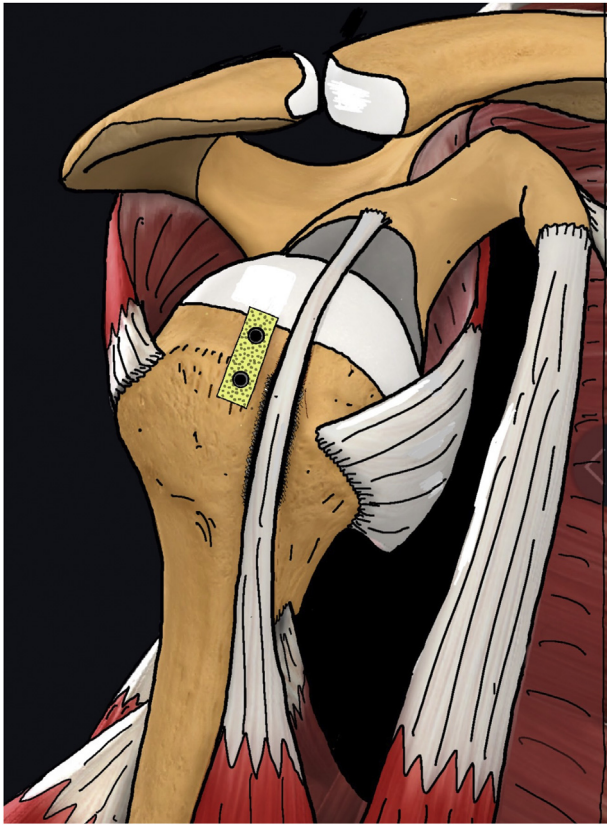


Fig 3. Right shoulder. Illustration shows bone bed preparation on the superior glenoid and the greater tuberosity in line with the bicipital groove and decorticating part of the articular cartilage to have enough space for 2 anchors.

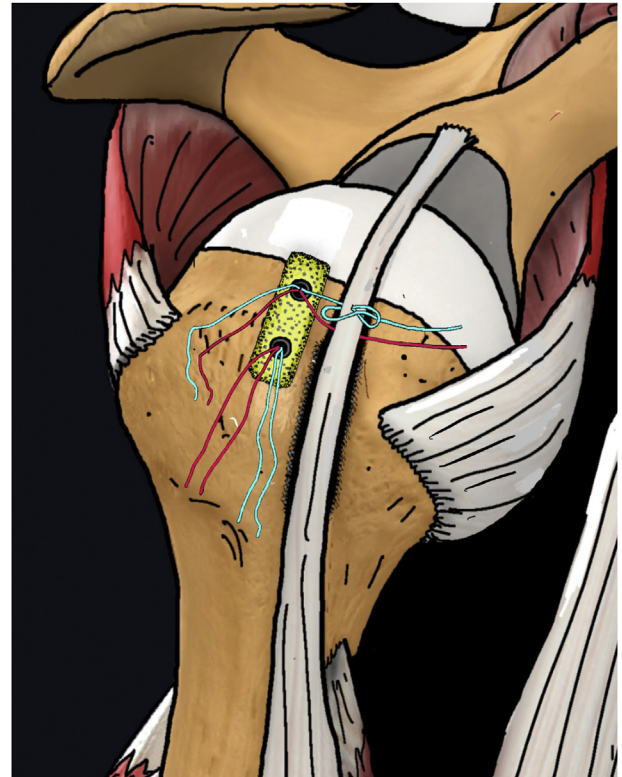


Fig 5. Right shoulder. Illustration showing appearance of the biceps tendon after having made the two types of sutures with the most medial implant: the first knot is made with the blue strand, which pierces the long head of the biceps tendon to bring it to the bony trough; the second strand is employed to secure the biceps tendon on the bony trough, wrapping it.

anterolateral portal. An evaluation of RC retraction and degeneration is also performed with a tendon grasper. Once massive posterosuperior cuff tear is confirmed, an acromioplasty is performed only for large sharp spurs.

Anterior Capsular Reconstruction (ACR) with LHBT

By keeping the arthroscope in the lateral portal, the soft tissue around the LHBT, including the transverse humeral ligament, is removed using an electrocautery

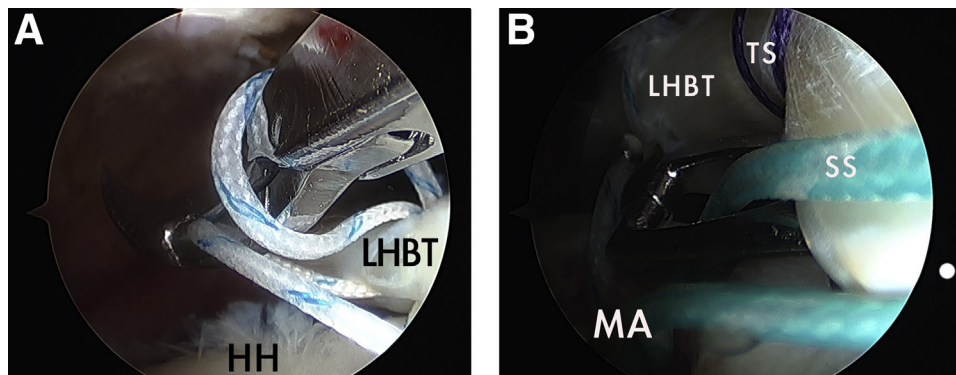


Fig 4. Arthroscopic visualization of the right shoulder from the lateral subacromial portal with the patient in the beach chair position. (A) The anterolateral portal serves as the working portal: the tip of the grasper is passed through the loop to grasp the free end of the first strand which is pulled through the loop and tightened to create the lasso loop. (B) The anterior portal serves as the working portal, and the suture retriever is passed under the biceps tendon to grasp the second strand (SS) for atraumatic suture. A traction suture (TS) can be used to facilitate the passage of the suture retriever. LHBT, long head of biceps tendon; HH, humeral head; MA, medial anchor.

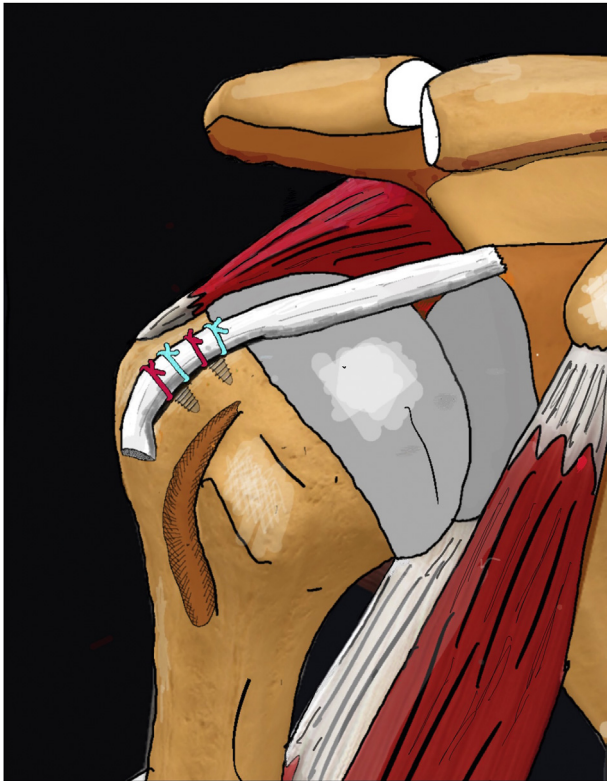


Fig 6. Right shoulder. Illustration shows the final outcome of the technique. Once all the sutures are tied, the biceps is located posterior to the bicipital groove. A tenotomy of the long head of the biceps tendon is also performed.

device (Fig 2, Video 1). The decortication of the bone bed of the footprint is performed through the anterolateral portal with a burr to create a bony trough 5 mm in depth on the greater tuberosity, centered posterior and in line with the bicipital groove (Table 1). A part of the articular cartilage is decorticated to ensure fixation with 2 implants (Fig 3).

The mobility and integrity of the LHBt should be checked with a tendon grasper. A 2-stranded anchor (Peek Zip 5.5 mm; Stryker, San Jose, CA) is inserted at the medial aspect of the footprint (Table 1). After anchor insertion, a curved soft-tissue penetrator device is introduced through the anterior portal to make a lasso loop tie with the first strand (Fig 4A) (the exact point is checked by opening the shoulder to 30° of abduction to ensure a rigid fixation); the suture of the first strand is finished with 4 or 5 knots to fix the LHBt. This first suture shifts the biceps to its new location. If the tendon is degenerated, a double lasso loop is made to avoid tearing.⁷ After the first lasso loop, performed to modify the position of the LHBt, a wraparound tie is made with the second strand (Fig 4B) to ensure successful fixation of the LHBt; it is important to tie this suture over the tendon and not through it (Fig 5). Cannulas are not routinely used by the authors, so the surgeon

must make sure to retrieve the strands with the suture manipulator through the anterior portal.

The LHBt is securely fixed again at the lateral site of the footprint with a second anchor by the anterolateral portal, in the same manner, using one lasso loop and one wraparound ties (Fig 6). All knots are performed with the arm open at 30° of abduction to favor the transfer of the biceps without tension and to allow a vision of the knot that is limited in more degrees of abduction. In this manner, the LHBt is transferred and securely fixed onto the footprint while maintaining its native insertion on the glenoid (Table 1). The free ends of the tied sutures are cut. A tenotomy of the LHBt is performed at the distal aspect of the lateral anchor (Fig 7).

Posterosuperior Rotator Cuff Repair

After finishing the arthroscopic ACR with the LHBt, RC repair is performed. Although the surgeon can always change arthroscope placement to evaluate the progression of the repair, the lateral portal is the main viewing portal during this step of the procedure. A double row repair is made with an all suture anchor (Iconix 2.3 mm; Stryker) for the medial row and a knotless anchor (ReelX 4.5 mm; Stryker) for the lateral row. For delaminated tears (Video 1), a double-layer lasso loop repair technique⁸ is used (Fig 8).

Postoperative Care

Postoperative rehabilitation initially focuses on limited and protected passive range of motion. The arm is placed in a brace that is generally maintained for

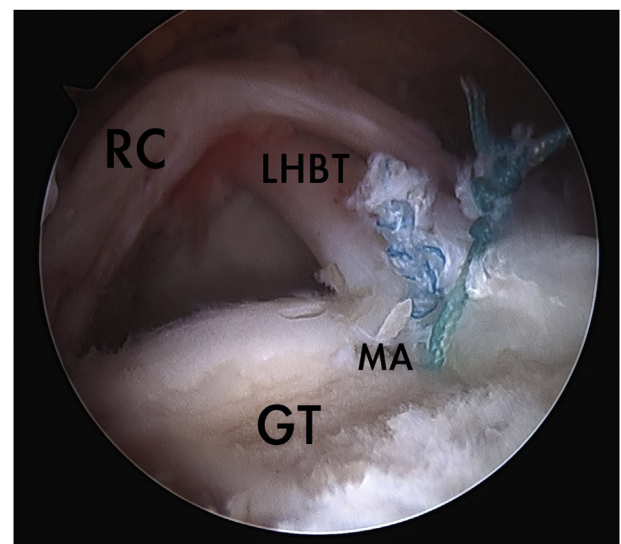


Fig 7. Arthroscopic visualization of the right shoulder from the lateral subacromial portal with the patient in the beach chair position. Image of anterior capsular reconstruction prior to rotator cuff repair. LHBt, long head of biceps tendon; GT, great tuberosity; MA, medial anchor; RC, rotator cuff.

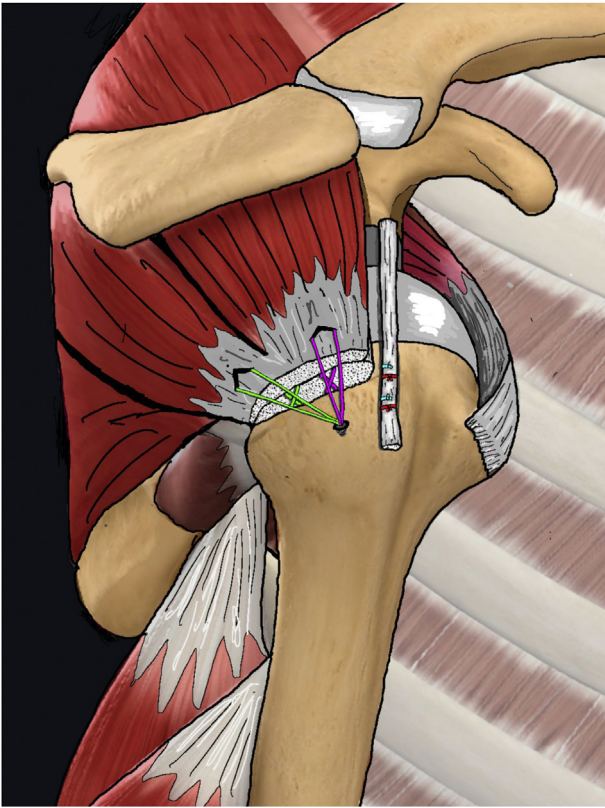


Fig 8. Right shoulder. Illustration shows the definitive appearance of the double row repair of the delaminated tear with the anterior capsular reinforcement.

6 weeks. However, active hand, wrist, and elbow exercises are allowed from the first day, and progressive passive shoulder mobilization and pendulum exercises are commenced 15 days after surgery. Active range of motion typically starts after 6 weeks after removal of the brace, and strengthening exercises start after 12 weeks.

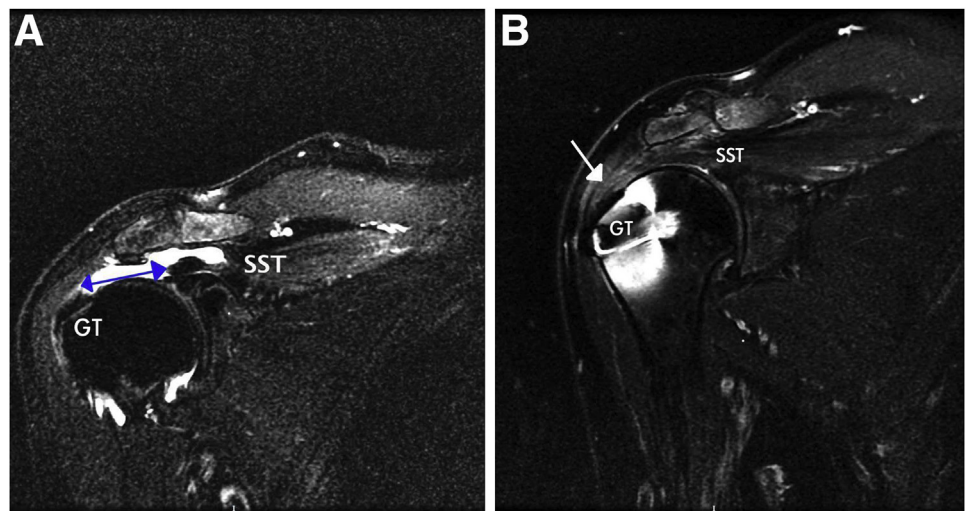
Discussion

The present technique shows an effective modification of an SCR using the LHBT to treat massive RCT avoiding the superior migration of the humeral head (Fig 9); static superior capsule is important in maintaining humeral head depression, and its effect is possibly higher than the dynamic effect of the RC muscles. The kinematic restoration of said effect is the reason why SCR techniques result in significant pain relief.

The thinnest point of the capsule attachment is located 11 mm posterior to the anterior margin of the greater tuberosity⁹. Kim et al.¹⁰ previously showed that degenerative RCT most commonly involve a region 13 to 17 mm posterior to the biceps tendon. The main goal of ACR with biceps tendon is to support structural stability to this zone of weakness, to cover the footprint of the rotator cuff tendon in chronic RCT and to promote RC healing without undue tension (Fig 8). ACR may improve RC tendon repair longevity by providing basic static ligamentous support to the dynamic tendon while helping to limit superior migration without restricting glenohumeral kinematics (Fig 10).

The concept of using the biceps tendon as a substitute in the case of massive RCT is not completely unprecedented. Unlike the technique presented here, most of the techniques previously described use the sutures employed to fix the LHBT to repair the RC.¹⁻⁵ However, a biological study regarding tendon-to-tendon repair demonstrated that tendon-to-tendon healing was not achieved except in an end-to-end anastomosis. Likewise, tendon-to-tendon healing seems not to occur between suture-tied SP and augmented biceps tendon.¹¹ The present technique uses the LHBT to restrict the superior migration of the humeral head, relieving the tension over the repair of the RCT.

Fig 9. Oblique coronal view of a T2 fatSAT series of a magnetic resonance imaging of a right shoulder. (A) Image of preoperative rotator cuff tear. Double-headed arrow in **c** indicates the greatest longitudinal dimension of the tear. (B) Two years after rotator cuff repair. White arrow demonstrates supraspinatus tendon fibers inserting onto the greater tuberosity. SST, supraspinatus tendon; GT, greater tuberosity.



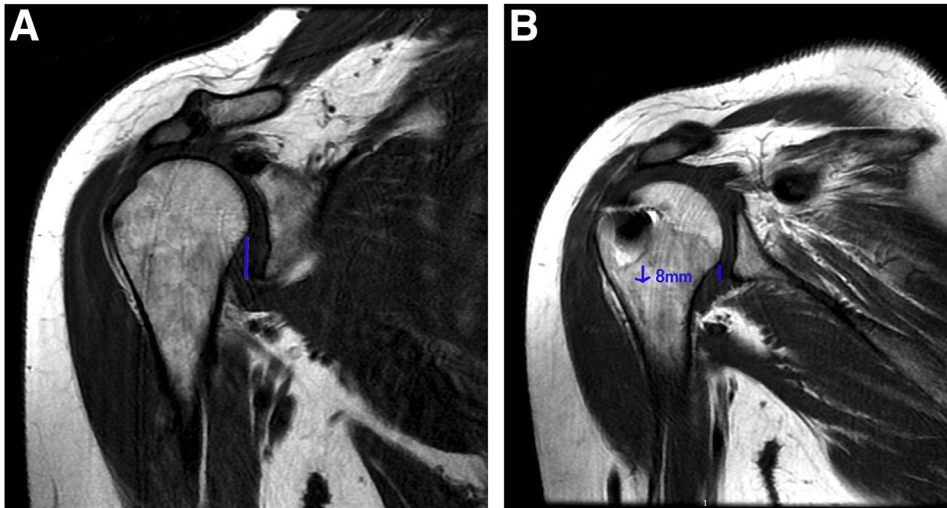


Fig 10. Oblique coronal view of a T1 series of a magnetic resonance imaging of a right shoulder. Compared with preoperative image (A), 1.5 year postoperative image (B) shows that the humeral head migrated inferiorly about 8 mm.

Another differential aspect of the present technique is that a bony trough is created to fix the biceps. This trough seems to provide biceps graft stability with rotation and would formally increase the contact area for healing biology (compared with a decorticated flat surface), which would ideally enhance graft incorporation and long-term outcomes.¹²

It is important to point out that placing sutures through the tendon could result in tissue or implant failure. These sutures should be tied over the tendon and not through it. This will prevent the tendon from tearing¹² and will improve its ability to find an equilibrium in length and tension when length is required with arm movement, for example in external rotation.

The present technique has several limitations. The main one is the need for an LHBT with relatively good quality, not excessively degenerated or partially torn. This may not always be possible in cases of chronic massive RCT or in extensive subscapularis tendon lesions. So, to perform this technique, preoperative evaluation of LHBT by magnetic resonance imaging or intraoperative thorough glenohumeral joint examination should be done. The authors of this article usually perform a tenotomy of the LHBT, unlike other recently published techniques¹³ to prevent pain, the Popeye sign could represent a possible risk, more in terms of cosmesis than functional impairment³; a tenodesis can be performed in case the patient or the surgeon wants to avoid such risk. Prospective studies with large cohort populations and long-term follow-up are necessary to establish the effectiveness of the technique.

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