Long Head of the Biceps as a Suitable Available Local Tissue Autograft for Superior Capsular Reconstruction: "The Chinese Way"

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Abstract: Massive irreparable rotator cuff tears remain a challenging condition during daily clinical practice. Irreversible fatty infiltration of muscles and excessive chronic retraction of tendons predispose to high failure rates of their surgical treatment. Superior capsular reconstruction with either fascia lata autograft or a dermal allograft patch is a newly described solution that could prevent superior humeral head migration and restore the anteroposterior shoulder muscle force couples. The purpose of this article is to propose a technical modification of superior capsular reconstruction using long head of the biceps tendon autograft. The tendon's insertion into the glenoid is left intact, whereas laterally, it is tenotomized, transferred, and sutured with anchors onto the footprint of the supraspinatus tendon acting as a superior static stabilizer of the shoulder joint. Although this surgical modification has theoretical biological advantages, could be performed with the least technical demands, and simplifies the original demanding procedure, further prospective studies with large cohort populations and long-term follow-up are necessary to establish its effectiveness.

Surgical treatment of massive irreparable rotator cuff (RC) tears remains challenging during daily clinical practice. Muscle fatty infiltration and excessive chronic tendon retraction and degeneration are the main irreversible factors predisposing to high failure rates of their direct repair.[1] Alternative treatment options such as interval slide techniques, despite their initial functional improvement, have not resulted in good healing rates and longstanding good outcomes.[2] Furthermore, recent studies with partial repairs and restoration of the anteroposterior force couple have reported unsatisfactory results in almost 50% of cases 2 years postoperatively.[3] Patch autograft or allograft application[4,5] and latissimus dorsi tendon transfer[6] have also shown mixed results, including a considerable risk of complications.

In relatively young patients with irreparable tears, with a decrease in the acromiohumeral distance but no excessive arthritic changes, Mihata et al.[7] originally described superior capsular reconstruction (SCR) using fascia lata autograft. They reported successful restoration of superior glenohumeral stability, a postoperative increase in the acromiohumeral distance, and promising clinical results.[7] More recently, to minimize possible donor-site morbidity, some authors have proposed the same surgical technique using a human acellular dermal patch.[8,9] Despite the growing interest in the use of these technologies, their price remains a potential issue in terms of socioeconomic aspects.

On the basis of the principles of SCR, the purpose of this article is to propose a technical modification of the original reconstruction using the long head of the biceps tendon (LHBT). The tendon's insertion into the glenoid is left intact, whereas laterally, it is tenotomized and sutured with anchors onto the greater tuberosity, preventing possible superior head migration.

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Surgical Technique

Preoperative Evaluation and Indications

All patients undergo careful clinical and appropriate radiologic examination of the RC including radiographs, magnetic resonance imaging, or arthro–computed tomography scanning. Possible indications for performing SCR by use of the LHBT are irreparable posterosuperior massive RC tears with Hamada stage 2 or 3 and Goutallier stage 3 or 4 muscle fatty infiltration. The supraspinatus tendon is mainly retracted and degenerated and is intraoperatively irreducible (Patte stage III) (Fig 1A). Partially or fully reparable infraspinatus and subscapularis tendon tears may also exist. The shape of the lesion is usually a retracted L or reverse L (Fig 1C). Preoperative recovery of passive range of motion of the shoulder joint is advised, and an existing LHBT with no excessive tendinitis or partial tears should be confirmed intraoperatively.

Patient Position, Arthroscopic Portals, and Initial Joint Exploration

Under general anesthesia and additional interscalene nerve block, the patient is placed in the beach-chair position. Usually, the following 6 standard arthroscopic portals are necessary: posterior, posterolateral, lateral, anterolateral, anterior, and Neviaser portals (Fig 1B). A standard posterior portal 2 cm medial and inferior to the posterolateral corner of the acromion is created, and a 30° arthroscope is introduced into the glenohumeral joint. A careful evaluation confirming the massive RC lesion, the glenohumeral cartilage condition, and the LHBT quality is obtained. Thereafter, 1 anterior arthroscopic portal through the rotator interval and 1 lateral portal (at the level of the lateral projection of the clavicle) about 1 cm below the lateral acromion are created. The latter is ideally placed under arthroscopic control by using a spinal needle inserted through the tear just above the greater tuberosity.

Subscapularis Tendon Tear Repair

According to our preferences in cases in which a reparable subscapularis lesion exists, it is initially addressed ("inside-the-box" repair).[10] To restore the stabilizing force couple in the transverse plane, the surgeon should always attempt to repair the subscapularis tendon by also preserving the portion of the superior glenohumeral–coracohumeral ligament complex ("comma sign"). The arthroscope is kept

Fig 1. (A) Preoperative imaging evaluation of a patient with a massive rotator cuff tear in the left shoulder. (A1, A2) Anteroposterior and lateral radiographic examination of left shoulder showing lateral extension of acromion (critical shoulder angle, 39°) and decreased acromiohumeral distance less than 6 mm (Hamada stage 2) (arrows). (A3) Coronal view of computed tomography arthrography showing massive retracted (Patte stage III) posterosuperior rotator cuff tear (arrow) in left shoulder. (A4) Sagittal view of same patient's examination showing grade 3 fatty infiltration of supraspinatus muscle (arrow), according to Goutallier classification. (B) Left shoulder setup in beach-chair position (superior view). The possible necessary arthroscopic portals (arrows) are posterior (P), anterior (A), lateral (L), and posterolateral (PL). An anterosuperolateral (AL) portal may be necessary in cases of subscapularis tears. A Neviaser portal may also be used during suture passage to the infraspinatus (asterisk). (C, coracoid; CA, coracoacromial ligament.) (C) Right shoulder showing massive retracted rotator cuff tear, reverse-L type (arrows indicate torn subscapularis and infraspinatus tendons; asterisk indicates torn and retracted supraspinatus tendon tear). (C1) By use of the posterior viewing portal (left shoulder, with patient in beach-chair position), the subscapularis tendon tear with the coexisting comma sign (red comma) is recognized, and the rotator interval and any adhesions are released by use of the arthroscopic shaver from the anterior portal (asterisk indicates middle glenohumeral ligament is released during subscapularis tendon mobilization). (C2) The subscapularis tendon is released from any possible adhesions, and its mobility is controlled by pulling it with a tendon grasper from the anterosuperolateral portal (arrow) (posterior intra-articular viewing portal, left shoulder, inside-the-box repair). (C3) The subscapularis tendon is repaired onto the lesser tuberosity, and the comma sign (red comma) is also restored (white and black arrows show tape and suture used for repair) (posterior intra-articular viewing portal, left shoulder, inside-the-box repair). (HH, humeral head.)

intra-articularly from the posterior portal, and by use of the already established anterior and lateral portals, any adhesions are released and the lesser tuberosity is prepared. However, an additional anterosuperolateral portal may also be necessary during subscapularis tear repair.[10] In the case of no retracted lesion (absence of comma sign) and tears involving less than the upper two-thirds of the tendon insertion, 1 suture tape (FiberTape; Arthrex, Naples, FL) is passed through the subscapularis tendon by use of a needle suture passer (NeedlePunch; Arthrex) or a lasso-loop device (Banana Lasso; Arthrex). The surgeon repairs the tendon onto the lesser tuberosity with one 4.75-mm Bio-Composite SwiveLock anchor (Arthrex), performing a SpeedFix technique (Arthrex). By use of the remaining traction suture of the anchor as well, the previous repair can be reinforced (Fig 1 C1-C3). In retracted lesions with a comma sign present, a double-row repair is preferred.

Exploration of Subacromial Space

The arthroscope is introduced into the subacromial space (Fig 2A). An additional posterolateral portal, 1 cm lateral and inferior to the posterior corner of the acromion, is established. With a motorized shaver and a radiofrequency electrocautery device (Super TurboVac 90; ArthroCare, Austin, TX), extensive bursectomy and release of the RC tendons adhesions are performed. With a tendon grasper, an evaluation of RC retraction and degeneration is also performed.

Once the irreparability of the massive posterosuperior cuff tear is confirmed, the greater tuberosity is prepared with a 5.5-mm motorized burr to enhance tendon-to-bone healing, and a concomitant acromioplasty, emphasizing the lateral aspect of the acromion and removal of anterior osteophytes, is performed.[11] The coracoacromial ligament is preserved, preventing superior migration of the humeral head.

SCR With LHBT

By keeping the arthroscope in the posterolateral portal, a 10-mm flexible PassPort cannula (Arthrex) is placed in the lateral portal to aid future suture management. Through the lateral portal, a 5.5-mm triple-loaded Bio-Corkscrew FT Suture Anchor (Arthrex) is inserted approximately in the middle of the greater tuberosity (just behind the bicipital groove) (Fig 2B1). Sequentially, using the NeedlePunch suture passer, the surgeon passes all the sutures through the intact LHBT, performing a "lasso-loop" configuration (Fig 2 B2 and C). The sutures are retrieved from the anterior or posterior working portal. With the aid of the radiofrequency cautery device, the biceps tendon is dissected and tenotomized approximately at the middle of the bicipital groove. No tenodesis is performed regarding the distal part of the LHBT. Thereafter, the sutures of the anchor are sequentially retrieved and tied through the PassPort cannula. In this manner, the LHBT is transferred and securely fixed onto the footprint of the supraspinatus tendon on the greater tuberosity. Therefore, the biceps tendon, which is natively fixed on the glenoid, acts as the autograft for SCR (Fig 2 D and E). The free ends of the tied sutures

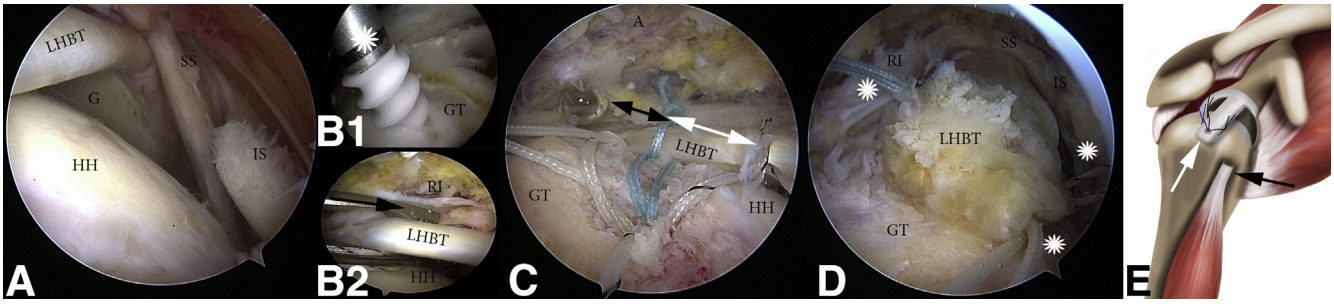

Fig 2. (A) Subacromial view from lateral arthroscopic portal (left shoulder, with patient in beach-chair position) showing massive retracted posterosuperior rotator cuff tear with concomitant tendon delamination. (G, glenoid; HH, humeral head; IS, infraspinatus; LHBT, long head of biceps tendon in good condition; SS, retracted supraspinatus.) (B1) A 5.5-mm absorbable triple-loaded suture anchor (asterisk) is inserted through the lateral portal at the footprint of the supraspinatus tendon onto the greater tuberosity (GT) (posterolateral viewing portal in left shoulder, beach-chair position). (B2) By use of the NeedlePunch suture passer through the lateral portal (arrow), the suture of the inserted anchor is passed through the intact long head of the biceps tendon (LHBT) performing a lasso-loop configuration (posterolateral viewing portal in left shoulder, beach-chair position). (HH, humeral head; RI, rotator interval.) (C) All the sutures of the 5.5-mm triple-loaded anchor are passed through the LHBT with a lasso-loop configuration (posterolateral viewing portal in left shoulder, beach-chair position). The sutures have a distance of approximately 5 mm between them (white and black arrows). (A, acromion; GT, greater tuberosity; HH, humeral head.) (D) The LHBT has been tenotomized distally, sutured (with 3 sutures [asterisks]), and sequentially transferred at the footprint of the supraspinatus (SS) tendon onto the greater tuberosity (GT) acting as the autograft for superior capsular reconstruction (view from lateral portal in left shoulder, beach-chair position). (IS, infraspinatus; RI, rotator interval.) (E) Right shoulder showing the LHBT that was tenotomized distally (black arrow), sutured, and transferred at the footprint of the supraspinatus tendon (white arrow), acting as the autograft for superior capsular reconstruction.

are not cut but are retrieved through the anterior working portal.

Repair of Posterior RC Tendons

Depending on the retraction and inelasticity of the remaining infraspinatus tendon, its partial repair is attempted. Depending on the tear size, a SpeedFix technique (for small lesions) or transosseous-equivalent configuration (SpeedBridge [Arthrex], for larger lesions) with the use of FiberTape and 4.75-mm BioComposite SwiveLock anchors is performed. Although the surgeon can always change the arthroscope placement to evaluate the progression of the repair, the posterolateral portal is the main viewing portal during this step of the procedure. In cases in which a needle suture passer (NeedlePunch) is used, the anterolateral portal with the flexible PassPort cannula is the main working portal for passing the suture tapes. Thereafter, they are mainly retrieved posteriorly. However, when a suture lasso device (Banana Lasso) is preferred, the infraspinatus tendon is penetrated and the sutures are directly retrieved from the posterior portal (Fig 3A). In addition, when a SpeedFix repair is performed, 1 suture tape and 1 knotless anchor are sufficient. In cases of a transosseous-equivalent configuration (SpeedBridge), 2 medial suture-loaded and 2 lateral knotless anchors are necessary (Figs 3C and 4).

Final Construct

The No. 2 FiberWire sutures (Arthrex) that were used for LHBT fixation are retrieved sequentially from the anterior to the lateral portal. By use of the NeedlePunch suture passer or a suture lasso device (Banana Lasso), they are passed through the infraspinatus and the retracted supraspinatus posteriorly and/or the rotator interval—"comma sign" anteriorly, providing an additional side-to-side, "tension-free" marginal repair of the RC with the LHBT (Fig 3 B1-B3, C1, and C2). In this manner, any RC tendon defect can be covered by the LHBT. Moreover, side-to-side fixation of the infraspinatus with the LHBT is expected to prevent any later posterior retraction of the tendon. Final construct evaluation with both subacromial and intra-articular views is performed (Figs 3 C1-C3, Video 1, Table 1).

Postoperative Rehabilitation

Postoperatively, the patient follows a massive RC repair rehabilitation protocol. The arm is placed in an abduction pillow at 60°, which is generally maintained for 6 weeks. However, active hand, wrist, and elbow

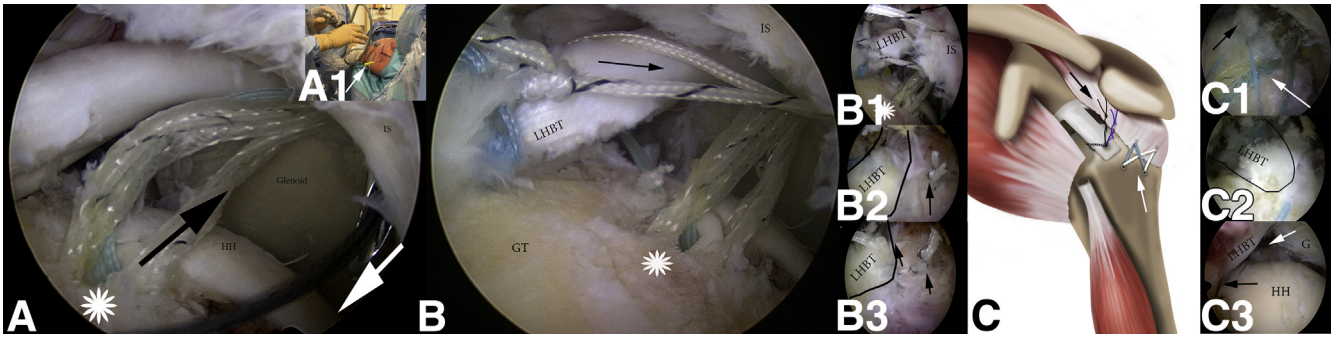

Fig 3. (A) To repair the remaining torn infraspinatus tendon, 1 loaded 4.75-mm SwiveLock (asterisk) has been placed behind the transferred long head of the biceps tendon (LHBT) (posterolateral viewing portal in left shoulder, with patient in beach-chair position). The TigerTape (Arthrex) and the blue suture (black arrow) of the anchor have already been passed through the infraspinatus tendon (IS). A suture lasso device (Banana Lasso) has been inserted through the posterior portal and has penetrated the IS (white arrow) also to retrieve the sutures of the LHBT. (HH, humeral head.) (A1) Suture lasso device (Banana Lasso) introduced from posterior arthroscopic portal (arrow) (left shoulder, with patient in beach-chair position). The arthroscope is placed in the lateral portal to control the placement of the device. (B) The white sutures and the black-and-white sutures (arrow) of the LHBT are passed through the infraspinatus tendon to perform a side-to-side repair later (asterisk indicates 4.75-mm SwiveLock anchor) (posterolateral viewing portal in left shoulder, with patient in beach-chair position). (GT, greater tuberosity.) (B1-B3) The white sutures and the black-and-white sutures (arrows) of the LHBT are tied, and a side-to-side, tension-free marginal repair of the IS with the LHBT is performed. The margins of the LHBT and the IS have been noted (posterolateral viewing portal in left shoulder in B1; lateral viewing portal in left shoulder, with patient in beach-chair position, in B2 and B3). (C) Final construct of superior capsular reconstruction using autologous LHBT, repair of IS by transosseous-equivalent technique (SpeedBridge, white arrow), and finally, side-to-side, tension-free marginal repair of IS with LHBT (black arrow). (C1) Repair of IS by transosseous-equivalent technique (SpeedBridge, white arrow) (lateral viewing portal in left shoulder, with patient in beach-chair position). The transferred LHBT is shown by the black arrow. (C2) Final arthroscopic image of aforementioned repair (C1) using anterosuperolateral viewing portal (left shoulder, with patient in beach-chair position). The margins of the LHBT and the IS have been noted. (C3) Final intra-articular image of repair from posterior portal (the black arrow indicates that after transfer of the LHBT and repair of the IS, a "watertight" construct has also been achieved; the white arrow indicates repair of the subscapularis tendon) (left shoulder, with patient in beach-chair position.) (G, glenoid; HH, humeral head.)

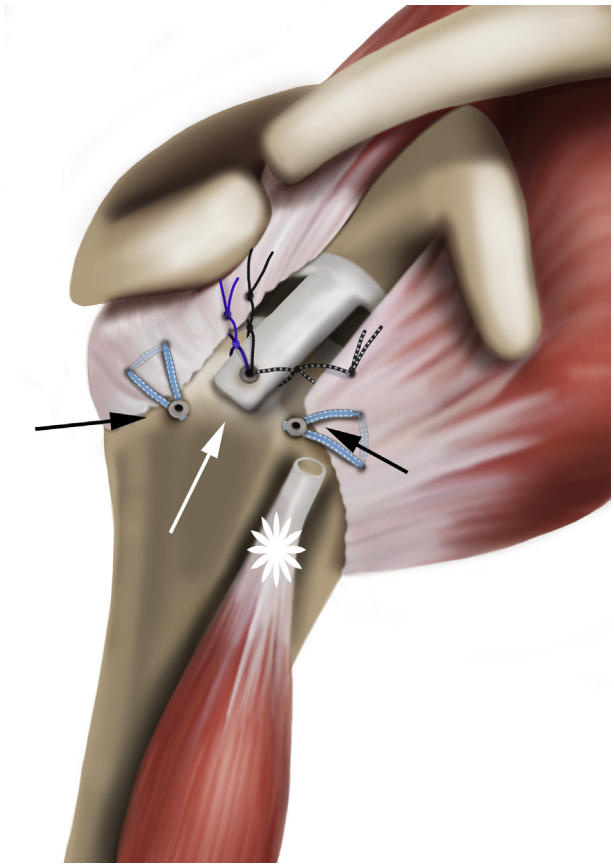

Fig 4. Final construct of superior capsular reconstruction using autologous long head of biceps tendon (LHBT) and repair of infraspinatus and subscapularis tendons by SpeedFix technique (black arrows) in patient's right side. Finally, a side-to-side, tension-free marginal repair of the LHBT with both the infraspinatus and subscapularis tendons is performed (white arrow). The distal part of the LHBT (asterisk) is left free.

exercises are allowed from the first day, and progressive passive shoulder mobilization is commenced under observation 15 days postoperatively. Active-assisted physiotherapy, hydrotherapy, and progressive withdrawal of the abduction pillow are advised 6 weeks postoperatively, 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 6 months.

Discussion

With this Technical Note, we propose a modification of the originally described SCR using the LHBT as an autograft. Compared with the method described by Mihata et al.,[7] the main principles remain the same. The LHBT's insertion onto the glenoid is carefully preserved, and its distal part into the bicipital groove is tenotomized, transferred, and fixed onto the middle part of the greater tuberosity. In addition, we attempt to restore the anterior and posterior shoulder force couples by repairing the subscapularis and infraspinatus tendons, respectively, and by performing a side-to-side marginal repair with the LHBT.

In comparison with the original technique of Mihata et al.,[7] some authors proposed replacing the fascia lata autograft with a human acellular dermal patch allograft in an effort to avoid any additional skin incisions and any donor-site morbidity.[8,9,12] They proposed modified double-row fixation of the allograft onto the glenoid and distally transosseous-equivalent techniques for the repair onto the greater tuberosity. All of them supported the marginal repair with the remaining RC tissue anteriorly and posteriorly.[8,9,12] The thickness of the allograft provided is 3.5 mm and the dimensions measure 4 × 7 cm, which can be adapted according to the lesion's size and the glenohumeral anatomy.[8,9,12] In addition, to obtain an appropriate graft, Mihata et al. harvested a section of fascia lata 2 to 3 times the size of the superior capsular defect that they further folded twice or thrice. In this way, they accomplished obtaining an autograft of 6 to 8 mm thick and with 6.1 × 3−cm mediolateral and anteroposterior dimensions.[7] We prefer to use the existing LHBT, the diameter of which, at the humeral head articular margin, is approximately 6.6 mm.[13] This value is close to the 8-mm graft thickness most recently proposed by Mihata et al.[14] Furthermore, according to published data, the mechanical properties may also be sufficient, given that the ultimate strength of the LHBT measures 32.5 ± 5.3 MPa whereas the value for the supraspinatus tendon is only 16.5 ± 7.1 MPa.[15]

Similar to several other authors, we believe that the static superior capsule is important in maintaining humeral head depression and its effect is possibly higher than the dynamic effect of the RC muscles.[9,16,17] This possible kinematic restoration is the reason SCR techniques resulted in significant pain relief.[7,9] The purpose of the aforementioned technique is to transform the LHBT into an efficient superior static stabilizer, without applying any materials on the glenoid and without any additional incisions for tendon harvesting. Furthermore, because of the control of superior head subluxation in cases with large or massive tears, SCR could protect the repaired tendons in favor of their healing process. Finally, another possible advantage is the biological aspect of using a local autograft, attached on the superior glenoid, such that its vascularization might be preserved (Table 2).

However, it should be noted that our technique has several limitations. The principal condition is the presence of an LHBT with relatively good quality, not excessively degenerated or partially torn. This may not always be possible in cases of chronic massive irreparable RC tears. In addition, the LHBT is reported to be a pain generator in patients with RC tears, and tenotomy

Table 1. Surgical Steps, Tips and Pearls, and Pitfalls of Technique

Surgical Steps	Tips and Pearls	Pitfalls
1. Intra-articular diagnostic arthroscopy—evaluation of lesion	• The necessary arthroscopic portals are as follows: posterior, anterior, lateral, and posterolateral. An anterosuperolateral portal may be necessary in cases of subscapularis tears. A Neviaser portal also may be used during suture passage to the infraspinatus. • Evaluation of the subscapularis tendon, LHBT, and posterosuperior rotator cuff tendon is performed from the posterior standard portal. • When a subscapularis tendon tear exists, it is initially repaired using the posterior portal as a viewing portal and the anterior, anterosuperolateral, and lateral portals as working portals (inside-the-box repair).	• The LHBT is excessively degenerated or torn. Thereafter, the SCR procedure with this autograft is not suitable.
2. Subacromial evaluation	• By use of lateral and posterolateral viewing portals, the posterosuperior rotator cuff lesion is evaluated (retraction and degeneration). • Using a tendon grasper, the surgeon should evaluate the condition of the LHBT and the possibility of transferring it onto the footprint of the supraspinatus tendon. • Bursectomy and cleaning of the subacromial space are performed until the spine of the scapula is reached. It is important to clearly define the limits of the superior and inferior fossa and, sequentially, the location of the tendon deficiency. • Using a 5.5-mm arthroscopic burr, the surgeon prepares the greater tuberosity and performs acromioplasty (mainly lateral, preserving the coracoacromial ligament).	• Excessive burring of the tuberosity or excessive acromioplasty with ablation of the coracoacromial ligament could increase the risk of further superior migration of the humeral head in the case of tendon healing failure. • Inadequate debridement of the cuff can result in underestimation of its mobility and of the exact tear pattern. • In these massive tears, especially in revision cases, the posterior cuff is sometimes adhered to the posterior acromion and to the subdeltoid fascia. Starting the debridement by using only the posterior viewing portal could be a potential issue. Immediate transfer of the arthroscope to the lateral viewing portal is preferred to correctly address and safely release the cuff.
3. Transfer and tenodesis of LHBT	• A 5.5-mm triple-loaded anchor is placed at the footprint of the retracted, irreparable supraspinatus tendon. • Using the NeedlePunch suture passer, the surgeon passes all the sutures through the LHBT (lasso-loop configuration). • With the radiofrequency cautery device, the surgeon dissects and tenotomizes the LHBT approximately at the middle of the bicipital groove. • The LHBT is transferred and securely fixed onto the footprint of the supraspinatus tendon on the greater tuberosity by tying the passed sutures. • The sutures should be kept for possible later side-to-side repair with the infraspinatus tendon posteriorly and/or the rotator interval anteriorly (retrieve the sutures from the anterior and/or posterior portal). • The static effect of SCR should be tested with the LHBT autograft. • No tenodesis of the distal part of the LHBT is performed.	• Anchor failure can occur as a result of low bone density in the area. The surgeon should try to position the anchor near the cartilage of the humerus. • Inappropriate placement of the sutures to the LHBT can result in a final construct that is "overly tight" or "too loose." The surgeon should place the sutures through the LHBT at the level of the humeral cartilage and ± 5 mm laterally or medially to it. During suture tying, the arm should be kept at approximately 40° of abduction, at 40° of elevation, and in neutral rotation. • The surgeon should perform the LHBT tenotomy far enough (5-10 mm) from the most lateral suture, obtaining sufficient tendon quantity. • Shearing of the LHBT can occur during tying of sutures. The surgeon should always use a lasso-loop configuration at different levels to avoid this complication.

(continued)

Table 1. Contiuned

Surgical Steps	Tips and Pearls	Pitfalls
4. Partial repair of infraspinatus tendon (SpeedFix or SpeedBridge configuration)	• For SpeedFix repair, 1 suture tape and 1 knotless anchor are used. • For a transosseous-equivalent configuration (SpeedBridge), 2 medial suture-/tape-loaded and 2 lateral knotless anchors are necessary. • The sutures and/or tapes are passed through the infraspinatus by use of either a NeedlePunch suture passer or a suture lasso device (Banana Lasso). • The 2 sutures from the LHBT can be passed through the infraspinatus tendon also. • The surgeon should fix the infraspinatus according to the chosen technique.	• An inability to recognize delaminated tears is possible. The surgeon should place the arthroscope into the lateral viewing portal and, using a tendon grasper from the anterior or anterosuperolateral portal, pull all the layers of the delaminated posterosuperior cuff. Thereafter, the accurate placement of a lasso-loop device (Banana Lasso) through the Neviaser portal is a valuable method to address these tears. • Again, at this surgical step, one possible pitfall is anchor failure resulting from low bone density in the area. The surgeon should try to position the anchor near the cartilage of the humerus. • Care should be taken with suture management. A solution is to keep the sutures of the LHBT at the anterior portal and to retrieve the sutures for the partial repair of the infraspinatus tendon posteriorly. The surgeon must be organized.
5. Final construct	• The surgeon could pass 1 suture anteriorly through the rotator interval. • The surgeon should secure the sutures of the LHBT anchor by performing a side-to-side, tension-free marginal repair of the RC with the LHBT. • Finally, a watertight construct may be achieved.	• Soft-tissue swelling and difficulties in finalizing the construct may occur. The surgeon should always respect the subdeltoid fascia and preserve low arthroscopic pump tension during the operation.

LHBT, long head of biceps tendon; SCR, superior capsular reconstruction.

Table 2. Advantages, Risks, and Limitations of SCR Using LHBT Autograft

Advantages
No additional incisions and donor-site morbidity for graft harvesting
Autograft use and possible preservation of biceps anchor vascularity
No medial preparation of glenoid for SCR and no risk of suprascapular nerve injury or possible fracture of glenoid and cartilage damage
No allograft use, limiting possible inflammatory reactions
No need for additional materials
Lower cost in terms of socioeconomic aspects
Risks
Popeye sign, esthetic discomfort, or muscle cramps of biceps distally
Pain derived from "biceps anchor" (degeneration of proximal biceps)
As in all massive tears, increased risk of postoperative stiffness (preoperative correction of passive joint range of motion is strongly advised)
Limitations
Excessive degeneration of LHBT
Torn LHBT
Rotator cuff arthropathy, Hamada stage $\geq$4

LHBT, long head of biceps tendon; SCR, superior capsular reconstruction.

or tenodesis has been proposed as an effective surgical solution. Theoretically, the use of the LHBT as an autograft for SCR could potentially augment postoperative pain. However, before we decided to report the technique, our short-term follow-up showed no such undesirable effects. The Popeye sign could represent another possible risk, more in terms of cosmesis than functional impairment. Prospective studies with large cohort populations and long-term follow-up are necessary to establish the effectiveness of the technique. With the described technique, SCR could be performed with the least technical demands only by transferring and fixing the distal part of the LHBT onto the greater tuberosity.

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