Technical Note

Biceps Smash Technique: Biceps Tendon Autograft Augmentation for Arthroscopic Rotator Cuff Reconstruction

David Endell, M.D., Katja Rüttershoff, and Markus Scheibel, M.D.

Abstract: The proportion of postoperative retears after arthroscopic rotator cuff reconstruction remains constant despite advancement of suture techniques and improved anchor implants. The commonly degenerative nature of rotator cuff tears can carry the risk of compromised tissue. Several techniques have been developed to biologically enhance rotator cuff repair, and a considerable number of autologous, allogeneic, and xenogenous augmentation methods have been described. This article introduces the biceps smash technique, an arthroscopic augmentation procedure for posterosuperior rotator cuff reconstruction using an autograft patch of the long head of the biceps tendon.

The current concepts for mechanical stabilization have proven good biomechanical and clinical results, yet cases remain in which tendon ingrowth fails and the numbers of retears persist at a considerably high level (13%-38%).[1] When performing rotator cuff repair, the surgeon needs to recognize that compromised biology is a constant challenge for reconstruction of the tendon. To biologically enhance tendon ingrowth and its mechanical stability, several techniques have been described. Autologous augmentation most prominently has been attempted through platelet-rich plasma injections; however, only a few studies were able to observe a reduction in retear rates.[1] Allograft patch procedures were able to show more favorable clinical and structural outcomes than most xenograft patch procedures.[2-5] Recently, an arthroscopic technique has been described to redirect and attach the long head of the biceps tendon (LHBT) onto the supraspinatus tendon footprint in a superior capsule reconstruction fashion before an arthroscopic rotator cuff reconstruction (ARCR) is performed.[6] Other methods using the LHBT as an autograft have been described via bridging techniques to treat massive and irreparable rotator cuff tears.[7-9]

However, the most common mode of failure of a suture bridge double-row rotator cuff reconstruction remains a tear at the myotendinous junction close to the medial row.[10] Here, a mechanical and biological augmentation of the medial row may provide improved overall primary and secondary stability and less strangulation of the medial tendon and myotendinous junction. A recent biomechanical analysis of an autologous biceps tendon mesh graft has identified biologically active scaffold material, which could aid in healing and repair-site regeneration.[11] We introduce a method to provide augmentation to the bursal side of a posterosuperior rotator cuff reconstruction using a pressed autograft patch of the LHBT: the biceps smash technique.

Technique

Biceps tendon autograft augmentation may be particularly beneficial in cases of ARCR in patients with degenerative rotator cuff thinning or delamination. However, additional graft augmentation of the medial row could also be used in a wider range of applications because it can provide enhanced tendon thickness when suturing the medial row.

From Shoulder and Elbow Surgery, Schulthess Clinic, Zurich, Switzerland (D.E., M.S.); and Center for Musculoskeletal Surgery, Charité-Universitaetsmedizin Berlin, Berlin, Germany (K.R., M.S.).

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Address correspondence to David Endell, M.D., Shoulder and Elbow Surgery, Schulthess Clinic, Lengghalde 2, 8008 Zurich, Switzerland E-mail: david.endell@kws.ch

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The surgical procedure is performed with the patient under general anesthesia while in the beach-chair position with the affected arm placed in a pneumatic arm holder. For ARCR, the standard arthroscopic portals are placed: posterior and posterolateral viewing portals, as well as lateral and anterolateral operative portals. Prior to rotator cuff reconstruction, arthroscopic biceps tenotomy is performed, as shown in Video 1. Afterward, a subpectoral incision is made, and subpectoral preparation to the sulcus bicipitalis is achieved. After placement of retractors, the biceps tendon is identified, liberated, and dislocated outside the body. Now, the proximal end is cut at the level of the insertion of the pectoralis major tendon. The shortened end of the tendon is then sutured by a Krackow stitching technique and fixated intraosseously with a metallic flip button (BicepsButton; Arthrex). The collected biceps tendon graft is inspected thoroughly for macroscopic signs of degenerative changes or inflammation (Fig 1A). A piece approximately 25 mm in length is obtained and placed into the specifically designed tendon patch press (Arthrex) (Fig 1B) for a total of 3 minutes under maximal manually applicable pressure (Fig 1C). This stamping process creates an evenly thick graft with a size of approximately 25 mm × 15 mm and a thickness of approximately 2 mm (Fig 1D, Video 1).

After the medial row of suture anchors has been placed in the usual fashion, the rotator cuff tendon is perforated twice per anchor with the use of a suture passer. In a setting of 4 shuttled suture pairs, initially the surgeon ties up to 2 of the medial suture pairs to reposition the rotator cuff onto the footprint and provide primary medial fixation. The 2 remaining suture pairs are now shuttled through the biceps tendon autograft using a suture passer (FastPass Scorpion SL Suture Passer; Arthrex) in an extracorporeal manner (Fig 2A, Video 1). The shuttled sutures are used similarly to a cable-car rail, guiding the biceps tendon graft onto the medial row of the rotator cuff. During insertion of the biceps tendon graft, it is helpful to use 2 knot pushers simultaneously to prevent twisting of the graft (Fig 2B, Video 1). The use of a cannula (PassPort Button Cannula; Arthrex) is recommended to avoid soft-tissue bridging and provide an uncomplicated graft insertion.

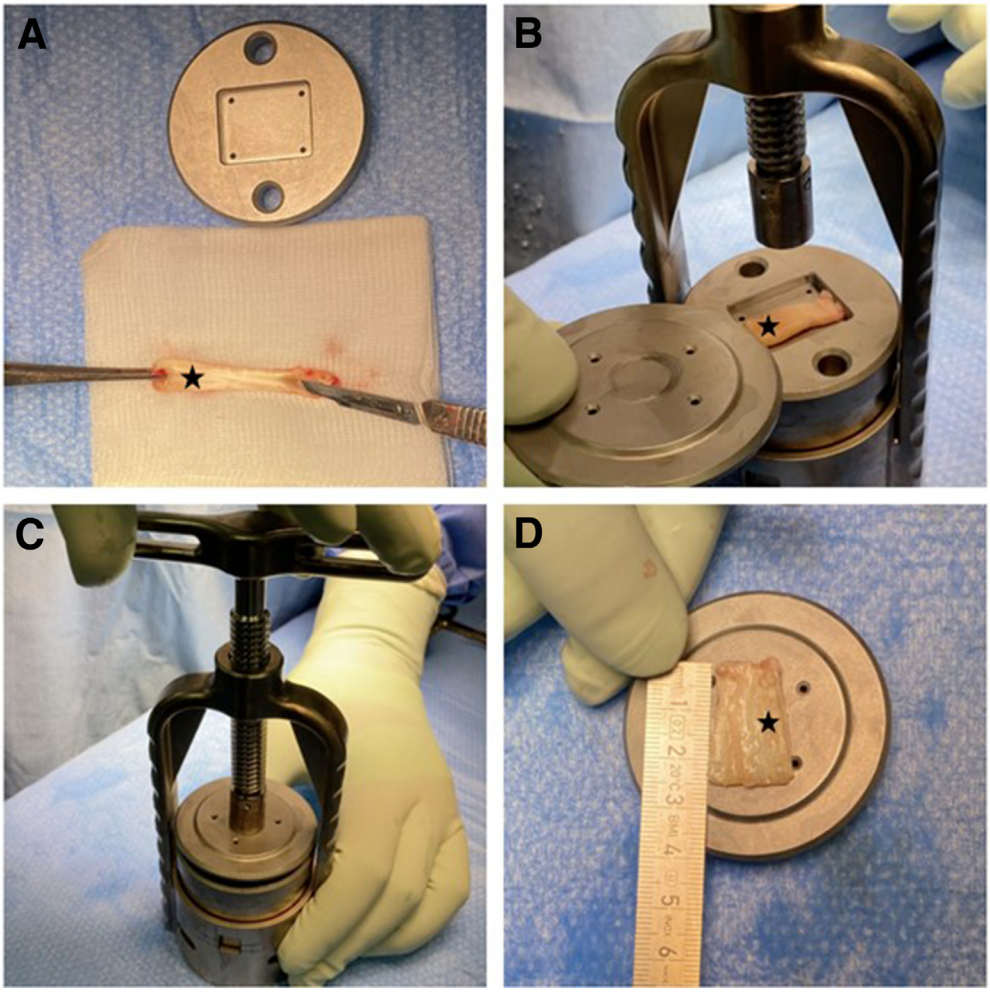

Fig 1. Step-by-step biceps tendon autograft preparation and stamping process. (A) The harvested biceps tendon (star) is shown at its initial length before tendon preparation and shortening. (B) The shortened biceps tendon graft is placed into the press. (C) The tendon press is manually tightened and left in this position for 3 minutes. (D) Final result of biceps tendon autograft (star) after biceps smash technique. The produced patch has a size of approximately 25 mm × 15 mm.

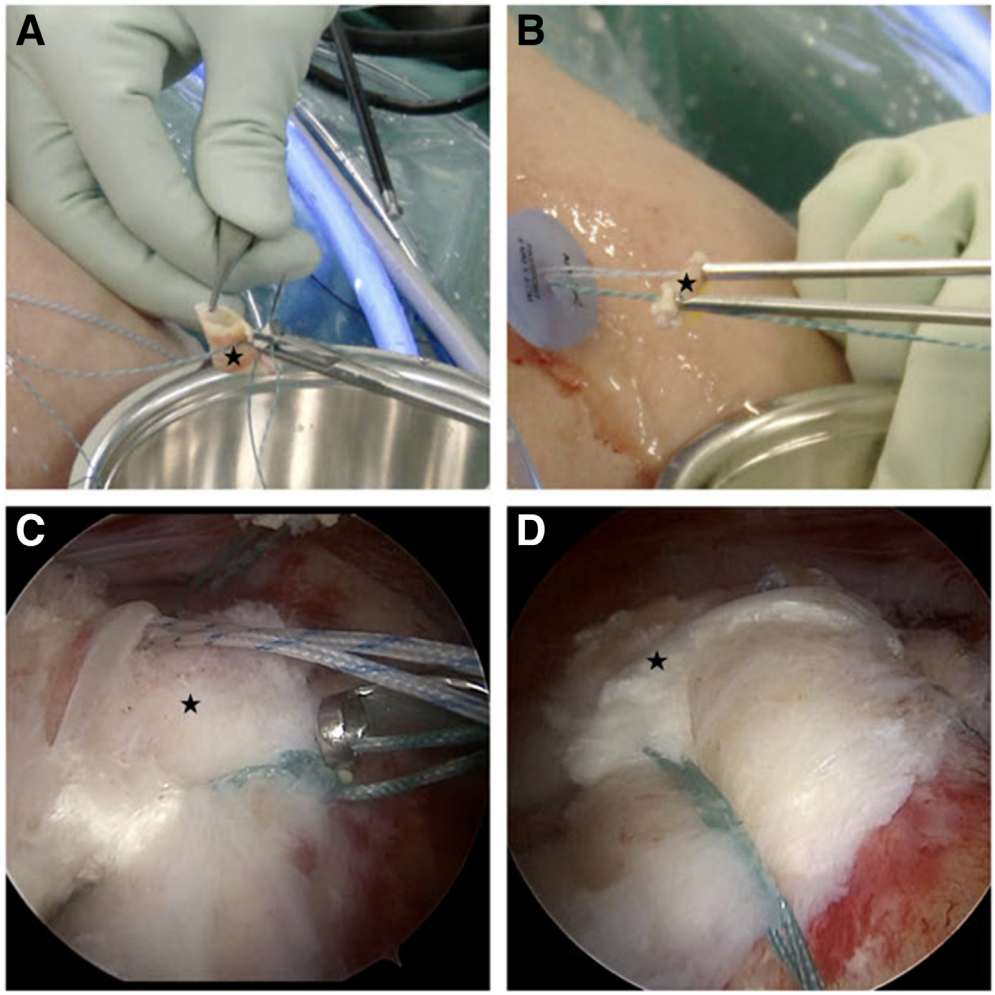

Fig 2. Step-by-step suture placement into biceps tendon autograft. (A) With the use of a suture passer, the 2 pairs of medial suture limbs are shuttled in an extracorporeal manner through the biceps tendon patch (star). (B) Dorsal view of right shoulder with patient in beach-chair position. The shuttled medial suture limbs reach from the biceps tendon autograft (star) to the blue cannula in the lateral portal. Two knot pushers will be used to place the patch intra-articularly. (C) Arthroscopic view of a right shoulder from posterolateral viewing portal. The intra-articular delivery has been performed, and the medial suture limbs are knotted onto the biceps tendon autograft (star) using a knot pusher in the lateral portal. (D) Arthroscopic view of a right shoulder from lateral portal. Final result of augmented rotator cuff reconstruction with biceps tendon autograft (star) placed superiorly onto reconstructed rotator cuff.

Arthroscopically, the graft is unfolded onto the rotator cuff and the positioning is finalized (Video 1). The medial suture limbs, which have been shuttled through the graft, are now knotted (Fig 2C). The graft's stability is assessed, and additional points of fixation can be placed via a free suture by a simple horizontal mattress stitch technique if necessary. As the final step, the suture limbs are bridged over the tendon and fixed with lateral-row anchors (ReelX STT; Stryker) (Fig 2D). Here, further tension can be applied to the augmented rotator cuff reconstruction (Video 1).

Discussion

The presented technique of augmented rotator cuff reconstruction using biceps tendon autograft is a viable option to strengthen the construct mechanically and provide autologous cellular agents for enhanced tendon healing (Table 1). Through biceps tendon autograft preparation, a patch size of 25 mm × 15 mm is possible, which allows for coverage of most of the supraspinatus footprint, where the insertion span measures, on average, 25.0 mm in the anteroposterior plane and 12.1 mm at the midtendon insertion width.[12] However, a key advantage of our method is slightly more medial placement to augment the medial row in a double-row rotator cuff reconstruction. Much like the articular-sided crescent fibers that form the rotator cable,[13] the biceps tendon autograft augmentation is placed perpendicular to the supraspinatus and infraspinatus tendons.

This autograft augmentation technique provides the advantages of a time- and cost-efficient method, which avoids the problem of both donor-site morbidity and allergic or inflammatory foreign tissue reactions (Table 2). Additional costs appear to be minimal because no further anchors are required in the double-row reconstruction and the aforementioned tendon patch press is reusable.

Several potential drawbacks and disadvantages need to be considered. This technique can only be used when viable graft is available; therefore, patients with biceps tendon inflammation or biceps tendinopathy, those who have previously undergone biceps tenotomy, and those with a previous rupture may not be viable candidates for this procedure. Techniques in which a

Table 1. Pearls and Pitfalls

Pearls
Two knot pushers should be used simultaneously to avoid twisting of the graft or shuttling sutures during graft insertion.
Additional points of graft fixation can be placed with a free suture by a simple horizontal mattress stitch technique.
The knotted medial suture limbs can be used to span the augmented rotator cuff reconstruction to achieve additional graft—to—rotator cuff contact pressure.
Adequate subacromial decompression can aid in visualization and prevent impingement of the graft augmentation.
Graft preparation in the tendon press can be performed in parallel with the main procedure.
Pitfalls
Patients with a ruptured LHBT, prior tenodesis, or LHBT tendinopathy may not be viable candidates for this autograft technique.
Proximal tenodesis of the LHBT may not provide adequate graft length and quality.
If suturing of the medial row in ARCR is not achieved prior to graft augmentation, the rotator cuff fixation can be compromised.

ARCR, arthroscopic rotator cuff reconstruction; LHBT, long head of the biceps tendon.

Table 2. Advantages and Disadvantages

Advantages
Harvest of autologous tendon tissue is performed, without additional donor-site morbidity.
The technique is an overall time- and cost-efficient technique.
Graft rejection and allergic or inflammatory foreign tissue reactions are not to be expected.
Disadvantages
After repair, an augmented rotator cuff tendon may be thicker than the initial tendon and may be prone to subacromial impingement.
The additional procedure time and the learning curve when initially performing the technique need to be recognized.

tenodesis of the LHBT is performed proximally in the intertubercular groove may not provide adequate graft length and quality. An augmented rotator cuff thickness bears a potential risk of subacromial impingement, which needs to be assessed intraoperatively once the procedure is completed. The occurrence of graft rejection is not to be expected in this setting using an autograft technique; however, the potential risks of failure to heal and autograft dislocation have to be recognized. The additional procedure time needs to be acknowledged; however, the graft stamping process can be performed in parallel with the main procedure by a surgical assistant. Clinical studies are needed to investigate the clinical and structural impact that the presented biceps tendon autograft technique can provide regarding rotator cuff healing in comparison to unaugmented rotator cuff repairs.

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