



Arthroscopic Anterior Glenoid Reconstruction Using a Distal Tibial Allograft Positioned With an Intra-Articular Guide and Secured With Double-Button Fixation

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Abstract: Recurrent shoulder instability and its role in bone loss from the anterior glenoid is well recognized throughout the literature. This technique paper presents an all-arthroscopic technique that uses distal tibial allograft and double-button suture fixation to address anterior recurrent shoulder instability. With the patient in the lateral decubitus position, we use the posterior portal to position the double-barrel drill guide tangential to the face of the glenoid, while viewing through the anterosuperolateral portal. We then use the “bullets,” which are made through two percutaneous posterior skin incisions of the double-barreled drill. This guide ensures parallel drill tunnels are created 5 mm medial to the glenoid articular surface and 1 cm apart, minimizing risk to the suprascapular nerve caused by a straying medial. We prepare a bone block from allograft distal tibia and place two drill holes to match those drilled in the glenoid vault. The allograft is then shuttled arthroscopically using looped passing wires. Once the final position is confirmed, a tensiometer is used to tension the graft in place. We then reattach the labrum to the native glenoid rim. Our technique creates a reproducible, anatomic, glenoid surface reconstruction for anterior glenoid bone loss in recurrent instability.

Introduction

Traumatic anterior shoulder instability can result in glenoid bone loss due to repetitive instability

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The authors report the following potential conflicts of interest or sources of funding: I.K.Y.L. reports personal fees from Arthrex, United States, grants from Smith and Nephew, United Kingdom, personal fees from Smith and Nephew, personal fees from Wolters Kluwer, outside the submitted work. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received December 7, 2021; accepted February 6, 2022.

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2212-6287/211742

<https://doi.org/10.1016/j.eats.2022.02.010>

episodes.¹ When significant or an “engaging Hill-Sach’s lesion”, glenoid bone loss contributes to failure of an all soft tissue Bankart repair.² Bone grafting procedures (e.g., Latarjet, bone block), are conventionally reserved for patients with 20-25% bone loss, although even patients with “subcritical bone loss” as low as 13.5% can have poor outcomes.³

The Latarjet is regarded by many as the gold standard procedure for treating instability with glenoid bone loss and is associated with a redislocation rate of only 3.2%.⁴ Despite these results, coracoid transfer is also associated with a complication rate of 30%, including graft fracture, nonunion, graft resorption, and major neurovascular injury.⁴ In addition to this, undertaking a shoulder replacement following a previous Latarjet is technically demanding because of the distorted anatomy.⁵

Distal tibial allograft (DTA) has recently emerged as a possible alternative to coracoid transfer because it entails no donor site morbidity, is relatively abundant, comprises dense cortico-cancellous bone, and closely resembles the natural curvature of the glenoid.⁶ When compared to the Latarjet procedure, DTA reconstruction

has improved glenohumeral contact areas and has significantly lower glenohumeral peak forces.⁶

While previous studies have reported on arthroscopic DTA using screws, the purpose of this technical note is to describe the arthroscopic treatment of anterior glenoid bone loss using a distal tibial allograft positioned with an intra-articular guide and secured with two double-button suture loops.

Surgical Technique

Step 1: Positioning

With the patient placed in the lateral decubitus position, the body is tilted $\sim 20^\circ$ posteriorly to ensure that the glenoid is parallel to the floor. A bean bag is used to secure the patients body, and the arm is placed in a Tenet spider arm positioning device with lateral attachment (Smith & Nephew, Andover, MA).

A posterior viewing portal is established approximately 1 cm medial and 1 cm inferior to the posterolateral border of the acromion, tangential to the glenoid articular surface to optimise the angle of approach for glenoid drilling later in the procedure. Standard antero-inferior and anterosuperolateral portals are created in the rotator interval.

Step 2: Diagnostic Arthroscopy, Fixation Preparation

Labral and bony pathology is evaluated through the anterosuperolateral portal, providing an en face view of the glenoid. The glenoid bone loss is confirmed arthroscopically, as well as its dynamic interaction with the Hill-Sachs lesion. In patients with combined glenoid and humeral bone loss, the Hill-Sachs lesion is addressed first with a remplissage procedure. Hill-Sachs's debridement, and anchor placement are performed with knot tying at the end of the procedure.

While viewing through the anterosuperolateral portal, The Bankart lesion is mobilized from the anterior glenoid neck from ~ 2 o'clock position to the ~ 7 o'clock position, revealing the underlying subscapularis muscle belly. A wide release is performed creating a pocket in order to accommodate the graft (Fig 1).

At the 4:30 position, a traction suture is placed and retrieved through a separate percutaneous anterior portal. This is to facilitate retraction of the labrum during graft passage. With wide exposure, the glenoid neck is prepared using a high-speed burr and rasp to a flat, bleeding bone surface.

Step 3: Intra-articular Drill Guide Technique

Instruments are used through the antero-inferior portal while viewing through the anterosuperolateral portal. A double barrel glenoid drill guide is then inserted through the posterior portal tangential to the face of the glenoid with the hook below the 3 o'clock



Fig 1. Patient is positioned in the lateral decubitus position with an arthroscopic view of the left shoulder from an anterosuperolateral portal demonstrating a wide release and mobilization of the anterior labrum exposing the anterior glenoid neck and the subscapularis muscle belly.

position and the arm of the hook contacting both the anterior and posterior rims of the glenoid articular surface, just inferior to the bare area (Fig 2). If the previously established posterior portal is inadequate for tangential placement of the drill guide, a second posterior portal may be established.

Two percutaneous posterior skin incisions are made, and the "bullets" of the double-barrel drill are advanced

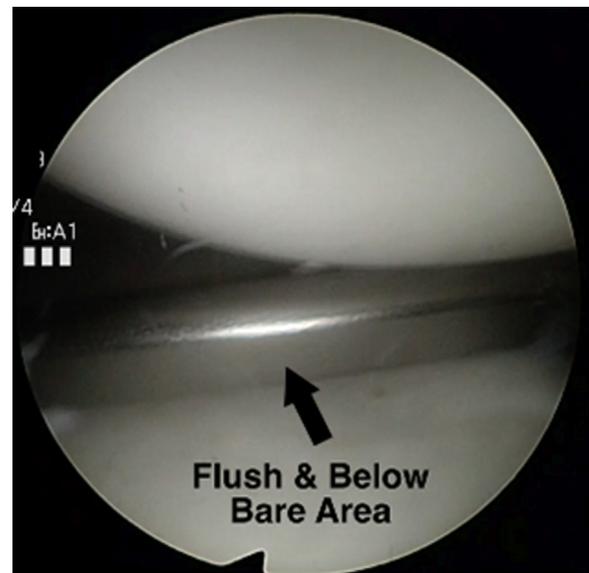


Fig 2. Patient is positioned in the lateral decubitus position with an arthroscopic view of the left shoulder from an anterosuperolateral portal, demonstrating positioning of the double-barrel guide with the arm positioned flush with the glenoid articular surface and centred over the middle of the glenoid defect, just inferior to the bare area.



Fig 3. Patient is positioned in the lateral decubitus position with an arthroscopic view of the anterosuperolateral portal of the left shoulder, demonstrating the hook of the double-barrel drill guide and the position of the glenoid tunnels with superior drill exiting the anterior glenoid neck.

through the guide, through the posterior deltoid contacting the posterior glenoid neck. Parallel tunnels are made with a 2.8-mm drill advancing through the glenoid vault and exiting the anterior glenoid neck. The double-barrel guide system ensures parallel drill tunnels are created 5 mm medial to the glenoid articular



Fig 4. Patient is positioned in the lateral decubitus position with an arthroscopic view through an anterosuperolateral portal of the left shoulder demonstrating insertion of the glenoid anchors. The glenoid anchors are inserted with the drill sleeves maintained in the glenoid vault prior to passage of the double-button suture fixation.

Table 1. Graft Preparation

Fresh frozen nonirradiated DTAs
Donors <60 years of age
Use lateral third allograft*
Cortical bone maintained along inferior, anterior, and lateral aspect
Graft should restore the anterior to posterior width of the glenoid**
Typical measurements
2 cm superior-to-inferior
10 mm anterior-to-posterior
10-15 mm medial-to-lateral
Graft should be ~15-20° away from perpendicular, creating a trapezoidal graft
A 0.5-mm sagittal saw used to make the cuts

* Provides the best matching contour to the humeral articular surface and the size estimated by preoperative CT measurements

** ~2-3 mm larger than the native size compared to normative data or to the contralateral side

surface and 1 cm apart (superior to inferior). The drill and guide are removed leaving the outer drill sleeves in the glenoid neck (Fig 3).

Two or three suture anchors (1.8-mm Q-fix mini, Smith & Nephew, Andover, MA) are placed along the native glenoid rim to repair the anterior labrum over the DTA (Fig 4). The posterior portal is used for suture management. Suture anchors are inserted prior to graft delivery and fixation to avoid inadvertent entanglement of the anchor drill with the double-button suture fixation.

Step 4: Graft Preparation and Fixation

The DTA is prepared (Table 1). Two 2.8-mm drill holes are then drilled 10 mm apart and ~5 mm from each edge, matching the drill holes created in the glenoid vault. The suture button constructs are then fed through each drill hole to rest flat on the anterior portion of the graft intraarticularly (Fig 5).

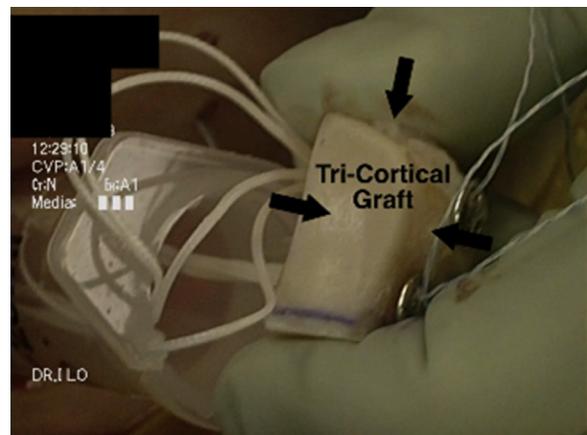


Fig 5. Patient is positioned in the lateral decubitus position with an arthroscopic view through an anterosuperolateral portal of the left shoulder, demonstrating the tricortical distal tibial allograft prepared and anterior suture buttons.

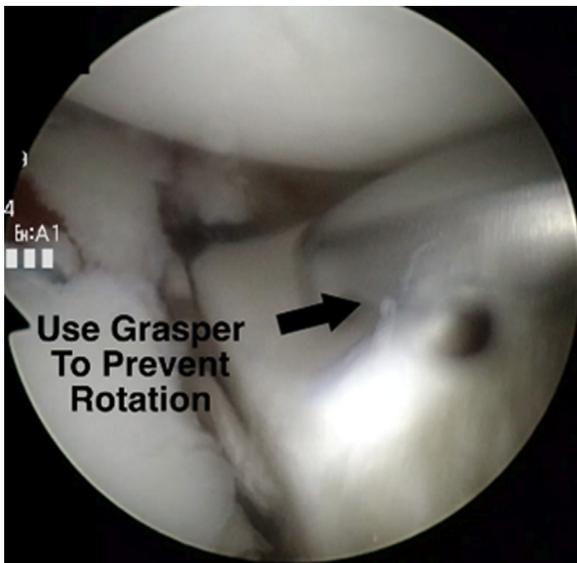


Fig 6. Patient is positioned in the lateral decubitus position with an arthroscopic view through an anterosuperolateral portal of the left shoulder, demonstrating intra-articular delivery of the distal tibial allograft.

The rotator interval is then resected to accommodate a 10-mm metal cannula. In larger grafts, the rotator interval can be enlarged to accommodate a 20-cc syringe, or the graft may be placed “percutaneously” using a metal half-pipe cannula. Looped passing wires are then fed through the outer glenoid drill sleeves from posterior to anterior and grasped through the antero-inferior cannula. The outer drill sleeves are then

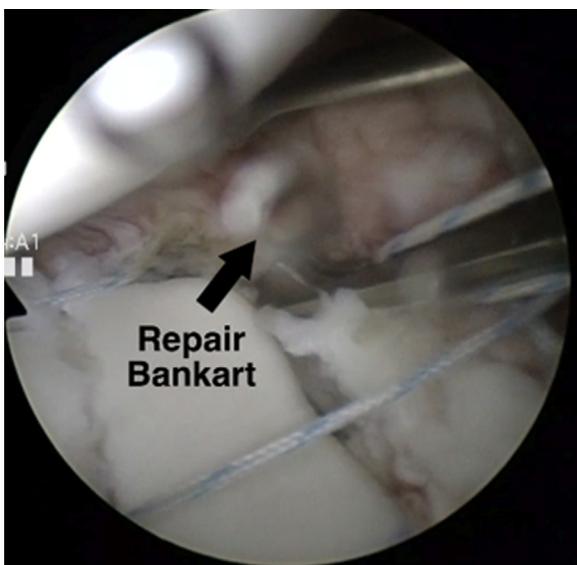


Fig 7. Patient is positioned in the lateral decubitus position with an arthroscopic view through an anterosuperolateral portal of the left shoulder, demonstrating final positioning of the distal tibial allograft and suture passage for Bankart repair making the graft extra-articular.

Table 2. Postoperative Management Protocol

0-4 weeks	Sling immobilization External rotation limited to 0°
4-8 weeks	Progressive ROM exercises*
8 weeks	Rotator cuff strengthening exercises
12 weeks - 6 months	Progressive strengthening exercises
6 months	Full return to sport**

* Includes forward elevation and external rotation.

** If postoperative CT confirmed healing of the graft.

removed. The antero-inferior cannula is then used to shuttle the button sutures using looped passing wires and out through the posterior skin incisions. The graft is then shuttled intra-articularly using a grasper to prevent malrotation (Fig 6). The labrum is retracted with traction, widening the “pocket,” and ensuring the labrum is not interposed between the graft and the anterior glenoid neck.

The bone block is provisionally reduced, and the endobutton suture loops are cut making two free ends that are passed through the eyelets of the posterior suture button. A Nice knot is tied reducing the posterior button against the posterior glenoid neck. The process is repeated with the other suture. A tensiometer is used to tighten the knots to 50 N, and the graft position is adjusted flush to the glenoid face. Because of the 30° angle of the arthroscope, the scope is rotated so that the angle of the arthroscope is parallel to the camera, minimizing parallax and ensuring a true enface view of the glenoid-graft interface. In addition, a switching stick is placed through the posterior portal to palpate the graft and glenoid face to ensure tangential reduction.

Once the final position is confirmed, each suture button is further tensioned to 100 N, multiple times alternating between superior and inferior buttons. The double endobutton sutures are then secured with three reversing half-hitches on alternating posts. The labrum is then reattached to the native glenoid rim in a standard fashion with simple sutures (Fig 7).

A standard postoperative protocol is then followed with routine follow-up (Table 2).

Discussion

Initial reports of distal tibial allograft reconstruction used an open approach and have reported good clinical and anatomic outcomes.⁷ Arthroscopic techniques have also been demonstrated to be a safe operation with improvements in functional outcomes and high levels of patient satisfaction.⁸ Most arthroscopic techniques commonly use screw fixation to bone.⁹ This technique requires the establishment of the “Halifax” portal, which is a medial pectoral portal but lateral to the conjoint tendon.⁹

Table 3. Advantages and Limitations of the Surgical Technique

Advantages	Limitations
All arthroscopic glenoid reconstruction	New surgical technique that may require operative experience and learning curve
Avoids difficult surgical exploration	Requires cadaveric graft
Avoids cumbersome and rigid screw fixation of the graft	
Allows for flexible fixation of the bone graft to naturally interface with the anterior glenoid neck	
Double barrel drill guide allows parallel tunnels to be reproducible and accurate	
Tensiometer is used to maximize compression and appropriate reduction.	
Avoids use of the “Halifax portal” ⁹	

The use of a double suture-button fixation eliminates the need for establishment of far medial portals. This “flexible” fixation can be delivered through the rotator interval, facilitating both graft delivery and graft fixation. In addition, the utilization of flexible fixation (as opposed to rigid screw fixation) allows the bone graft to naturally interface with the anterior glenoid neck with optimal contact, even if the tunnels are not colinear (Table 3). However, to optimize graft positioning, the double-barrel drill guide allows twin parallel tunnels to be drill through the glenoid vault 5 mm medial to the articular surface and 1 cm apart. These hole positions are created similarly through the DTA to facilitate initial graft positioning.

To further maximize compression and reduction, a tensiometer is used. Initial compression of 50 N is applied, so that minor adjustments in graft positioning can be made to ensure anatomic placement (Table 3). We prefer to maintain the nonviable articular cartilage of the frozen allograft, which facilitates reduction assessment. It is important to minimize parallax by rotating the scope in-line with the camera to get a true en face view of the glenoid. Further compression to 100 N is applied multiple times to the buttons, which eliminates suture slack, removes creep, and maximizes compression.

We also prefer to reattach the labrum to the native glenoid rim making the graft extra-articular. This allows coverage of the nonviable articular cartilage, restores soft tissue tensioning and the labrum height, and protects the graft from initial shear forces during the healing phase. Using these techniques initial healing rates have been reported to be ~ 89%.⁷

We describe the intraoperative surgical technique, including perioperative assessment details in Video 1.

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