Arthroscopic-Assisted Anterior Glenoid Reconstruction Using Nonrigid Fixation With Distal Tibia Osteochondral Allograft

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Introduction: Traumatic anterior glenohumeral instability events result in a capsulolabral (Bankart lesion) and/or osseous injury with subsequent attritional bone loss, particularly with recurrence. Up to 88% of patients with recurrent instability experience glenoid bone loss, which predisposes to future dislocations and subluxations, even with arthroscopic capsulolabral repair. The surgical management of glenoid bone loss includes a number of different techniques such as the Latarjet or coracoid transfer as well as other osseous and osteoarticular autografts and allografts. However, operative management of shoulder instability has increasingly shifted toward arthroscopic approaches with preservation of anatomy when possible.

Indications: Arthroscopic-assisted allograft distal tibia bone block augmentation to the anterior glenoid is indicated for revision anterior glenohumeral instability procedures with anterior bone loss and in primary cases of anterior instability with critical bone loss.

Technique: Our technique for nonrigid arthroscopic anterior glenoid reconstruction with allograft distal tibia and anterior labral repair is performed preferentially in the lateral position without necessitating patient repositioning. The preplanned tibial bone block is prepared on a back table prior to the arthroscopic procedure. After creation of portals and elevation of labral tissue, a guide and drill are used to introduce a retrograde reamer which is deployed to create a perpendicular edge for apposition of the allograft tibia. The bone block is then introduced through a rotator interval portal by pulling sutures retrograde through glenoid bone tunnels and is secured to the prepared surface medial to the liberated labrum. The articular surface of the graft and glenoid are aligned and suture-based fixation is used to compress the bone block against the native glenoid. The anterior labral tissue is then mobilized over the graft and repaired to the native glenoid when possible.

Description/Conclusion: The benefits of allograft tibia augmentation for anterior instability with glenoid bone loss include an anatomic joint surface restoration including articular cartilage, lack of donor site morbidity, and a minimally invasive arthroscopic approach. When performed arthroscopically and with nonrigid fixation, this technique permits concurrent anterior labral repair and anatomic reconstruction, safe graft passage without necessity of a far medial portal, and expeditious return to function.

Keywords: glenoid bone loss; distal tibia allograft; glenoid reconstruction; shoulder instability; suture fixation

VIDEO TRANSCRIPT

In this approach guide, we present our technique for arthroscopic distal tibia allograft (DTA) reconstruction with retrograde tunnel preparation and nonrigid suture fixation for the treatment of anterior glenoid bone loss (aGBL) and instability.

Anterior glenohumeral instability occurs with an incidence of approximately 1.7% in the general population. Osseous defects are present even in first-time dislocators, with average 6.8% bone loss after initial instability events.[2] For recurrent dislocators, bone loss occurs in up to 88% of patients with mean aGBL 22.8%. These injuries predispose to future instability, with repeat dislocation rates after nonoperative management as high as 90%, and at rates reaching 18% to 36% despite arthroscopic capsuloligamentous repair.[1,6,9,10] The likelihood of repair failure increases further when substantial or bipolar bone loss is left unaddressed.[5,8]

The surgical management of glenoid bone loss includes a number of different techniques such as the open Latarjet or coracoid transfer as well as other osseous and osteoarticular autografts and allografts. However, operative management of shoulder instability has increasingly shifted toward arthroscopic approaches given the limited morbidity.

The benefits of allograft osteoarticular distal tibia augmentation for anterior instability with glenoid bone loss include an anatomic joint surface restoration including articular cartilage, lack of donor site morbidity, and a relatively minimally invasive approach. When performed

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arthroscopically, this technique permits concurrent anterior labral repair for anatomic reconstruction. Suture-based fixation techniques, as opposed to screw fixation, allow noncollinear anterior entry and avoidance of medial anterior portals (ie, Halifax portal) that can place neurovascular structures at risk of stretch or injury. Suture fixation devices can also limit hardware prominence, obviate the issue of metal artifact on subsequent magnetic resonance imaging, and may mitigate need for implant removal to facilitate future shoulder procedures (ie, shoulder arthroplasty).

Disadvantages include that the fixation and compression strength of suture-based techniques compared with screw techniques currently are not well established and that this technique may be prohibited by availability and cost of the allograft.

The current indications for this procedure are for revision anterior instability procedures with greater than subcritical anterior bone loss and for primary cases of anterior instability with critical glenoid bone loss. Relative indications include off-track shoulders with subcritical anterior glenoid bone loss. Contraindications include advanced glenohumeral arthritis, pain as a primary complaint, and multidirectional instability in the setting of hyperlaxity.

The case in this demonstration is a 29-year-old man with recurrent anterior shoulder instability refractory to prior arthroscopic repair and Remplissage with a large Hill Sachs lesion and resultant off-track bipolar lesion. Preoperative imaging demonstrates substantial anterior glenoid bone loss with 20% aGBL on computed tomography and cystic changes at retained implant sites. This is best demonstrated on the 3D model which we obtain for preoperative planning on all our anterior glenoid augmentation cases.

Our basic equipment and setup includes the following: shoulder arthroscopy sets, a distal tibia allograft preparation set, labral repair instruments, and appropriate guides/instrumentation for positioning and securing the graft.

For this technique, we prefer to use a distal tibia bone block delivery guide and a 13-mm retrograde reamer (eg, Flipcutter, Arthrex, Naples FL, USA). A 3/4-inch malleable, hip arthroscopy sled or a large (15-mm) laparoscopic cannula is useful for graft delivery through the anterior portal. We currently use a fresh distal tibia allograft. Similar to the DTA graft preparation for posterior bone loss demonstrated in a prior technique,[4] the posterolateral aspect of the incisura is used. We use the 5° scarf cut jig, selecting the width of the graft based on our planned glenoid preparation and bone loss. It is generally 10 mm wide, 20 mm from superior to inferior, and 15 mm deep. The 4 mm drill is overreamed to prepare the graft for later fixation using a 5-mm offset guide; this can be performed prior to final osteotomy for ease of drilling. We then check the contour of the articular surface against the sizing jigs and place suture loops for later passage.

After preparing the distal tibial graft, we perform the diagnostic arthroscopy. We prefer to perform this procedure in the lateral decubitus position for improved visualization, though this technique is applicable in the beach chair.[3] We begin the procedure with the standard posterolateral portal, and an anterior rotator interval and anterosuperior portal are made under direct visualization with the assistance of a spinal needle.

It is critical when establishing the anterosuperior portal to create a direct line-of-sight by placing the spinal needle directly in line with the glenoid bone loss. An additional posterior portal is made level and in line with the posterior glenoid to permit positioning of our drill guide for appropriate trajectory. Prior labral repair sutures and anchors are removed. We elevate the scarred capsule and labrum off the anterior glenoid with a sharp elevator and electrocautery superiorly and release it at 1 to 2 o'clock, allowing more medial and superior exposure of the glenoid neck. We release the soft tissue to the base of the coracoid, medially on the neck, and inferior past 6 o'clock. At this time, retraction stitches may be passed through the labral tissue and brought out the rotator interval portal for ease of visualization. Stitch retraction as demonstrated here is after glenoid preparation.

It is important to create a perpendicular and smooth anterior glenoid neck recipient surface. We start by expanding our medial posterior portal with a capsulotomy using the electrocautery followed by a straight hemostat. The guide (in this case a double bullet offset drilling guide) is introduced through the expanded posterior portal,

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placing the guide arm flush with the glenoid and centered on the inferior quadrant of the glenoid face. The medialized incision position allows placement of the guide directly on the posterior glenoid rim.

We then drill the tunnels from posterior to anterior, visualizing the anterior glenoid neck to ensure appropriate placement of our drill holes. The pins are overdrilled to allow placement of the centering sleeve in the posterior glenoid neck. The retrograde reamer is advanced through the centering sleeves and tunnels and deployed, debriding the bone to a planned resection depth, which is matched by the same technique on the adjacent tunnel. Any residual bone may be taken down using the barrel burr anteriorly, using the retraction stitches for ease of exposure.

Having prepared the drill tunnels and glenoid face, we then pass monofilament or suture loops from posterior to anterior, through our glenoid tunnels. These are retrieved through the anterior portal, into which the large cannula or sleds may be placed to assist with graft passage. If capsulolabral repair is to be performed, placement of a central anchor in the glenoid at this time permits safe drilling with direct visualization of tunnel placement.

If an all-suture construct is preferred, loops can be passed through the drill holes with luggage tag sutures, which will later be used to guide the bone block into position. The loops are passed in a reverse fashion. The sutures are then shuttled back retrograde through the glenoid tunnels. Using alternating tension and retracting the capsule and labrum lateral, we shuttle the graft into place, using a switching stick or labral elevator to manipulate the graft and then to hold reduction of the native and graft articular surfaces.

After ensuring appropriate contour and fit, we then pass the sutures from the tunnels through the suture locking loops, and sequentially tighten the suture. This should be done while directly visualizing the reduction and compression prior to tying knots. We find that this ensures the graft is flush with the native articular surface and restores a near normal shape and volume to the articular glenoid.

If cortical buttons are to be used, we preposition 2 cortical buttons on the anterior aspect of our graft. The sutures affixing the buttons are also shuttled retrograde through the glenoid tunnels, and the graft is also shuttled into place while retracting the labral tissue. After ensuring the graft is reduced and well contoured to the native articular surface, we then pass the sutures through the posterior buttons and sequentially tighten the suture using a tensioning device, up to 100 N. Anchors are then secured with arthroscopic knots.

If there is sufficient labral tissue to accommodate a repair, we then perform a Bankart capsulolabral repair over the graft, anchoring the tissue to the native glenoid. This positions the graft extra-articular and may provide additional soft tissue support to the repair, though there is insufficient evidence at this time to determine the optimal soft tissue procedure after tibial allograft augmentation.

Postoperatively patients are maintained in an abduction sling for 6 weeks. We start Codman exercises immediately. Early scapular control is initiated in the first 2 weeks, unrestricted passive and active assist range of motion at 6 weeks, and full active range of motion is achieved by 8 weeks. We then initiate rotator cuff and parascapular strengthening exercises. Return to full push-ups and pull-ups or other sporting activities is achieved at 6 months.

In a shorter-term follow-up study, Provencher et al[7] demonstrated 89% healing rate and 3% osteolysis for distal tibia allograft with no episodes of recurrence. However, this was performed with primarily screw fixation, and there are no large cohort studies evaluating comparative performance between rigid and nonrigid fixation constructs.

While there is a learning curve to performing arthroscopic bone block augmentation of the glenoid using indirect nonrigid fixation, improved technology, instrumentation, and the use of patient-specific guides have decreased the technical demand required of the procedure, and the available technologies continue to evolve.

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