Open Posterior Glenoid Reconstruction Using a Distal Tibial Allograft

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Background: Posterior instability is less common than anterior instability but can be seen in contact athletes and posttraumatically. Distal tibial allograft reconstruction for glenoid bone loss was first described by Provencher and colleagues in 2009 and an arthroscopic technique for posterior glenoid reconstruction using a distal tibial allograft was later described by Gupta et al in 2013.

Indications: The primary indications for posterior distal tibial allograft include the failure of conservative management, recurrent instability after an arthroscopic stabilization, or glenoid bone loss $>$ 20% to 25%.

Technique Description: The patient is positioned in lateral decubitus, and examination under anesthesia is performed. Following arthroscopic evaluation, an incision is made medial to the posterolateral aspect of the acromion at the glenohumeral joint level. Electrocautery is carried to the deltoid, which is split in line with its fibers. A split between the infraspinatus and teres minor is performed. Vertical capsulotomy is performed, and deep retractors are placed. Attention is turned to the back table for graft preparation. The graft is measured, marked on the lateral aspect of the articular surface, and cut accordingly. Two 3.5-mm holes are drilled 1 cm apart, and the graft is thoroughly irrigated before being placed into the wound. A 2.5-mm drill is used in the 3.5-mm holes, and two 3.5-mm solid fully threaded screws are placed under power and tightened by hand. The wound is closed in the traditional fashion.

Results: Graft nonunion and/or resorption are the primary concerns following posterior distal tibial allograft. Amar et al found no cases of nonunion or partial unions on 6-month computerized tomography (CT) scan, most patients having no or $<$50% resorption. Millet et al also found bony union by CT scan and improved patient-reported outcome measures. A case series by Gilat et al found 90% of patients reported restoration of stability.

Discussion/Conclusion: Posterior distal tibial allograft is a successful surgical intervention for patients with recurrent posterior shoulder instability with glenoid bone loss.

Keywords: posterior shoulder instability; distal tibial allograft; glenoid bone loss; shoulder instability; allograft

VIDEO TRANSCRIPT

We will be presenting an open posterior glenoid reconstruction using a distal tibial allograft performed at Midwest Orthopaedics at Rush in Chicago, IL.

Here are the relevant disclosures for our authors.

Here is an outline of the presentation we will be going through.

Posterior instability occurs much less commonly than anterior instability, and particularly occurs in a select group of contact athletes including football and rugby players. It has also been known to occur with traumatic injuries. The posterior glenoid reconstruction using a posterior distal tibial allograft was first described by Dr Provencher and colleagues in 2009, and subsequently an arthroscopic technique was described in 2013. The primary indications for posterior distal tibial allograft include the failure of conservative management, recurrent instability after an arthroscopic stabilization, or glenoid bone loss. There are several open and arthroscopic techniques that have been described; however, there are limited investigations of the outcomes.

Beginning with our patient, he is a 20-year-old right-hand dominant male college student with right shoulder pain and instability. His index injury occurred 3 years prior while playing high school football, which he no longer plays. This was a posterior dislocation. Since then, he has had multiple subsequent instability events. Previously he had a magnetic resonance imaging (MRI) that identified a posterior Bankart tear, and he failed conservative management.

Approximately a year and a half prior to presentation to our office, he underwent an arthroscopic posterior Bankart repair by an outside surgeon. Initially, he had some improvement in regaining function; however, this was quickly followed by a decline in function and recurrent instability. His primary goals are to get back to weight

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lifting and to be able to perform the hands-on work required as part of aviation technology education.

On physical examination, he has general guarding and pain with manipulation of the shoulder; however, he has full active and passive range of motion bilaterally. He has great strength and can do a wall pushup with ease; however, he does have mild apprehension when he is brought into a position of forward flexion and adduction. He is also noted to have posterior laxity with provocative maneuvers such as a jerk test.

On plain radiographs, there is some inferior bone loss present based on the anteroposterior x-ray, where you see a loss of the cortical contour of the inferior glenoid. Looking at the axillary lateral, you can see posterior inferior bone loss that is present. Most of the information comes from the computerized tomography (CT) scan, and you can see on axial image there is posterior-inferior bone loss. There is not a very significant reverse Hill-Sacks lesion, although there might be a small one anteriorly.

The best way to assess posterior glenoid bone loss is on sagittal cuts of the CT scan, looking at an on-face view of the glenoid. You can see on the left that there is a significant loss of posterior glenoid bone, essentially flattening out the pear shape of the posterior glenoid. On the right, you can see the measurements that we have done using a perfect circle method, showing a loss of 9 mm of bone and based on calculations 32% loss of posterior glenoid. On 3-dimensional (3D) reconstruction, there is posterior-inferior bone loss estimated at 32%.

Now, we will proceed to go through our surgical technique.

Once in the operating room, the patient is placed in the lateral decubitus position, and an examination under anesthesia is performed. You can see with the posterior load shift test we are easily able to sublux the patient's shoulder posteriorly.

Next, we begin with an arthroscopic evaluation. You can see on arthroscopic video that there is blunting and flattening of the posterior glenoid and that most of the posterior glenoid has been filled with fibrous tissue.

Next, we will go through the incision and exposure. A 10-cm vertical incision is made approximately 2 cm medial to the posterolateral aspect of the acromion. You can place a spinal needle in the glenohumeral joint posteriorly, and in general, this incision is at the level of the glenohumeral joint. Once skin is incised, electrocautery is carried down to the level of the deltoid with generous skin flaps. The deltoid is then split in line with its fibers. Once the posterior rotator cuff is exposed, a split in the rotator cuff between the infraspinatus and teres minor is performed. In general, this is performed where there is a fat stripe raphe to ensure you are able to get low enough on the glenoid. Once the rotator cuff has been split, a vertical capsulotomy is performed, and deep retractors are placed. You can see our deep retractors with a Fakuda placed into the glenohumeral joint and a Richardson retractor medially. You can also place a pitchfork retractor medially on the glenoid neck. We have a Chandler retractor inferiorly, and a pointed Hohmann superiorly.

Next, we will begin our graft preparation. This procedure is performed with a distal tibial allograft, as seen here. We begin by measuring our graft. For this procedure, we planned to measure for a 12 $\times$ 12 $\times$ 20 mm graft. We then mark it on the lateral aspect of the articular surface of the distal tibia. This has previously been shown in cadaveric and radiographic studies to closely mimic the natural radius of curvature of the glenoid. Next, we cut our graft from the distal tibia, generally done with a short, ACL-type saw.

Harvesting from the lateral aspect does have its advantages, because it does yield a good tricortical graft.

We then do some final carpentry to clean up the edges, confirm the measurements of our graft, and you can see our final graft. Next, we predrill our holes. This is done with a 3.5-mm drill bit, each drilled at least 1 cm apart to prevent fracturing the graft during screw placement. The graft is thoroughly irrigated using pulse lavage.

Next, we move on to graft insertion.

Once the graft is prepared, it is then placed into the wound. It is placed in a provision location, the reduction is assessed with a freer and elevator, and the graft is provisionally pinned in place. We then drill through the previous 3.5-mm holes with a 2.5-mm drill to lag by technique. We place 3.5 mm solid, fully threaded screws.

The first screw is placed under power, followed by the second screw. The screws are hand-tightened for final tightening.

Last, here is the visualization of our final construct with the 2 solid 3.5 cortical screws present.

Here are our 2-week postoperative radiographs. You can see the graft is in an appropriate low position and screws are appropriately linked on the outlet view. On the anteroposterior view, you can see the screws are in subcortical bone. It is important that you get good purchase, but you do not want to violate the joint surface.

Our rehabilitation protocol is generally fairly slow. For the first 6 weeks, patients will be in a sling at all times

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except for gentle passive range of motion exercises in therapy. From 6 to 12 weeks, they will begin active assist and active range of motion exercises. From weeks 12 to 24, there is a strengthening phase. In general, patients return to sport at approximately 6 months.

The key to this surgery is all about the exposure. Pertinent pearls to this are to make sure to have a low rotator cuff split between the infraspinatus and teres minor. Generally, there is a fat stripe raphe that demarcates this interval. Preserve a layer of the capsule for repair at the end of the procedure, particularly the inferior capsule that has the posterior inferior glenohumeral ligament fibers present. For retractor placement, placing the Fakuda is generally aided by externally rotating the shoulder. When you want to get the final exposure, ideal retractor placement is to have a Fakuda within the joint, an anterior glenoid retractor such as pitchfork medially on the glenoid neck, a Derra or Chandler inferiorly under the glenoid rim, and consider a Steinmann pin superior medially to retract superiorly. Predrill holes in the graft to expedite placement of the graft once it is in the wound. Use a freer or elevator to assess articular reduction.

The biggest pitfalls are too superior a rotator cuff split—which would lead to poor visualization and inability to get to the inferior glenoid—an oversized graft that cannot fit through the split, or if the graft is over-medialized or over-lateralized creating a step off.

The literature regarding this procedure is relatively sparse; however, there are a few studies that have been published. In general, this procedure is very successful at decreasing further instability and improving patient reported outcome measures. There have been several studies that looked at union after this procedure, the largest of which was done by Amar et al in 2018 looking at 42 patients. They had no cases of nonunion or partial unions when they had CT scans at 6 months postoperatively, but there was some evidence of graft resorption. Forty-two percent had less than 50% graft resorption, and 16% of patients had greater than 50% of graft resorption. This is concurrent with what is seen with anterior distal tibial allograft as well. Thank you.

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