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Operative Techniques in

Sports Medicine

Open Distal Tibial Allograft Augmentation

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Isolated soft tissue stabilization procedures for treatment of recurrent shoulder instability are often not appropriate when the patient demonstrates bone loss of greater than 15% and in situations where there is recurrent instability after multiple attempts at arthroscopic stabilization. Current techniques for glenoid reconstruction include autografts with coracoid transfers, both Latarjet and Bristow techniques, autografts from the iliac crest, and allografts. Recent focus is on the use of distal tibial allografts for glenoid reconstruction. Distal tibial allografts provide a nearly identical radius of curvature to the glenoid with the addition of a thick cartilaginous surface that helps to restore the natural arc of the glenoid, ultimately leading to improved contact pressures by increasing the contact area. Additionally, these grafts are readily available and offer exceptional bone strength for fixation with a screw. This article discusses the surgical technique of distal tibial allograft augmentation for recurrent shoulder instability as well as the pre- and postoperative management of these patients.

KEYWORDS shoulder instability, distal tibial allograft, glenoid reconstruction

Introduction

Shoulder instability leading to recurrent dislocations is a debilitating injury for patients. In patients who are 15-35 years old who experience a first time dislocation, 50% will have another instability event within 2 years, and two-thirds will have an event within 5 years.[1] These injuries are most often found in younger male patients who participate in competitive, contact sports. Hovelius et al found that at 25-year follow-up, 72% of patients under the age of 22 at the time of the first dislocation experienced recurrence, while only 27% of those over the age of 30 experienced another dislocation.[2] Due to the high rate of recurrent dislocations, especially in the younger population, surgical intervention for shoulder stabilization is often the choice of treatment.

The choice of the appropriate surgical intervention, however, can be complicated by bone loss, especially in the setting of recurrent instability. Varying degrees of humeral head bone loss, glenoid bone loss, or both, has been found in up to 90%-100% of patients, making arthroscopic and soft tissue only procedures less appealing.[3-9] More specifically, glenoid bone loss has been seen in up to 76% of patients after recurrent episodes of instability.[10] Clinically this is relevant as it has been shown that recurrent instability occurs when bone loss is greater than 20%-30% of the glenoid width as measured by CT scan.[10] As the amount of bone loss increases beyond 15%, the biomechanical stability of the glenohumeral joint is compromised, and there is a loss of resistance to shear stress.[3,7] Most commonly, the bone loss is located from the 12 o'clock position to the 6 o'clock position on the glenoid clock face.[10] Additional risk factors for recurrent instability after a primary repair include males younger than 22 years old who have had an increased number of dislocations prior to surgery.[4]

Due to the high recurrence rates of instability events associated with glenoid bone loss over 20%, it is recommended to reconstruct, or augment, the glenoid in these cases rather than use a soft tissue only repair, which is better suited for patients with less than 15% bone loss.[11] Current options for glenoid reconstruction include autograft with coracoid transfer, Latarjet or Bristow, autograft with iliac crest bone graft or allografts from the glenoid or tibia. Recently, focus has been put on the use of distal tibial allografts (DTA) for glenoid reconstruction. Ideally, the goal is to recreate the natural anatomy of the glenohumeral joint to prevent future instability as well as prevent the development of arthritis.

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https://doi.org/10.1053/j.otsm.2019.03.003

Cadaveric studies have shown that the distal tibia exhibits almost the exact radius of curvature as the glenoid, meaning the distal tibia is able to fit well with the humeral head in any position of the arm. Additionally, the distal tibia contains a thick layer of cartilage which also helps to recreate the natural glenohumeral joint. The weight-bearing properties of the tibia provide strong bone for screw fixation, which has been noted as a complication with other techniques.[10,12] Biomechanical studies have shown that distal tibial allografts improve joint congruity and lower peak forces within the joint when compared to Latarjet.[13] Another more practical reason to use distal tibial allografts is that they are more readily available than other options.[7,12]

Preoperative Management

Preoperatively, it is essential to obtain a thorough history and physical exam in order to accurately define the instability, specifically the directionality, age at first event, duration of symptoms, total number of events, and triggering events. Both shoulders should be examined for range of motion, strength, and signs of ligamentous laxity or instability. Patients should also receive plain radiographs including true AP, axillary, scapular Y, and West Point views to evaluate humeral and glenoid bone loss. If bone loss is present on X-ray or a revision surgery is planned, a CT with 3D reconstruction is necessary to evaluate the extent of bone loss. Of note, when ordering the distal tibia allograft, there is no need for size or side matching as there is with graft orders in the knee. Prior to surgery, patients may continue their normal activities but are encouraged to avoid those activities which are known to lead to instability events.

Technique

Set-Up

Regional anesthesia with or without general anesthesia is preferred for this case, with general anesthetic often helpful in relaxation of surrounding soft tissues. The patient is positioned in the beach chair position, with the head inclined to approximately 40°. A bump is placed under the medial border of the scapula. Prior to draping, the arm is examined thoroughly to identify passive range of motion and to further define the instability pattern. The shoulder is then draped in the normal sterile fashion. The operative arm is placed into a commercially available arm holder.

Incision and Approach

If there is any question regarding joint degeneration, rotator cuff integrity, or other intra-articular pathology, a diagnostic arthroscopy can be performed prior to proceeding with the glenoid reconstruction.

An incision is marked starting at the coracoid process and extending towards the inferior axillary crease, approximately 7-8 cm in length. This incision heads slightly more medial than the standard deltopectoral incision which allows for a more cosmetic incision as well as gives greater access to the glenoid. The cephalic vein is carefully dissected and preserved, then retracted laterally with the deltoid. The fascia overlying the conjoined tendon is incised with metz just lateral to the muscle belly of the short head of the biceps, and a subfascial plane is developed for placement of a self-retaining retractor, retracting the conjoined tendon medially. At this stage, any adhesions in the subcoracoid recess are released. Once there is adequate exposure of the subscapularis tendon and muscle, the subscapularis is incised in line with its muscle fibers at the junction of the middle third and upper third and carried to the medial aspect of the glenoid. Beneath the subscapularis, the capsule is then incised with a medially based T-capsulotomy and sharply elevated down the medial neck of the glenoid in a subperiostial fashion. The capsule is tagged with #2 nonabsorbable suture for later closure. If there is retained anterior labrum, this can be released from the anterior glenoid for later repair, with careful attention to protecting the axillary nerve.

Glenoid Exposure

Once the glenoid is exposed, the humeral head is evaluated for evidence of an engaging Hill-Sachs lesion (if not already evaluated arthroscopically). If the patient has undergone a prior failed Laterjet procedure, the hardware must be removed at this point, along with scar tissue and excess bone. The self-retainer is removed and a facuda retractor is placed in the glenohumeral joint to aid in retracting the humeral head away from the glenoid. Next, a high-speed burr or rasp is used with pulsed irrigation to denude the anterior bone to allow a bleeding bony surface for acceptance of the graft. Once excess bone is removed, the amount of the glenoid bone loss is measured and documented. Careful attention is paid to contouring the glenoid to accommodate the graft.

Graft Preparation

On the back table, the anterior glenoid bone graft is harvested from the lateral one-third of the fresh osteochondral DTA (Fig. 1). The graft is sized to appropriately match the size of the glenoid defect. Constant saline irrigation is used to cool the graft while it is being cut using a 0.5 inch sagittal saw. The size of the graft is generally between 20 and 25 mm from superior to inferior and 6-10 mm from anterior to posterior (Fig. 2). As discussed earlier, a preoperative 3D CT scan is helpful for graft shaping. Pulse lavage is used to remove any marrow elements from the DTA prior to placement in the patient. Next, 2 1.6 mm smooth K-wires are placed into the graft at a 20° angle from the articular surface. It is important to place the K-wires away from the desired location of your planned screws. Optional at this stage is soaking the graft in platelet-rich plasma or bone marrow concentrate, which some authors believe improve the biologic healing capacity, though this is still experimental at this stage.

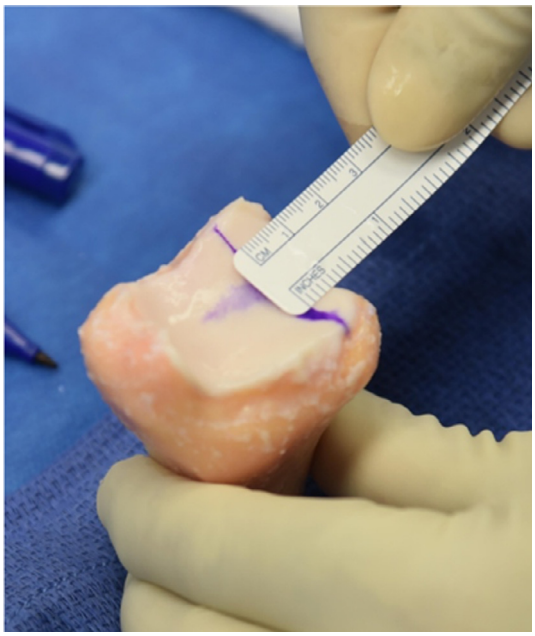

Figure 1 Measuring the fresh osteochondral DTA for graft harvest.

Graft Placement

The graft is then brought to the surgical field and provisionally fixed to the anterior glenoid rim by advancing the K-wires in a bicortical fashion into the posterior glenoid; a third K-wire can be used to aid in fixation to the native glenoid if necessary (Fig. 3). A 2.5 mm drill is used for placement of 3.5 mm fully threaded screws, which are used to secure the graft to the native glenoid (Fig. 4). The screws are typically 32-38 mm in length and washers are placed. The fit of the graft on the glenoid is assessed, as is the congruency of the humeral head on the glenoid. The cartilage of the graft should be flush with the cartilage of the glenoid. If the anterior-inferior labrum and capsule were preserved, they can then be repaired using the sutures from the suture washers. A capsular shift is performed for additional stability of the shoulder. The T-capsulotomy is closed, the subscapularis split is repaired, and the subcutaneous tissue and skin are closed in layers through a standard fashion.

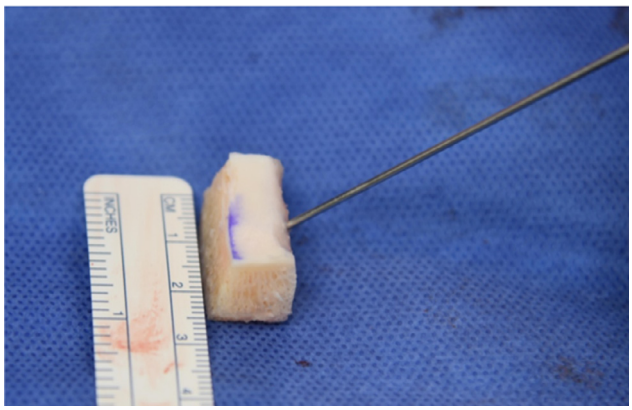

Figure 2 Final measurement and size of the fresh osteochondral DTA harvested graft.

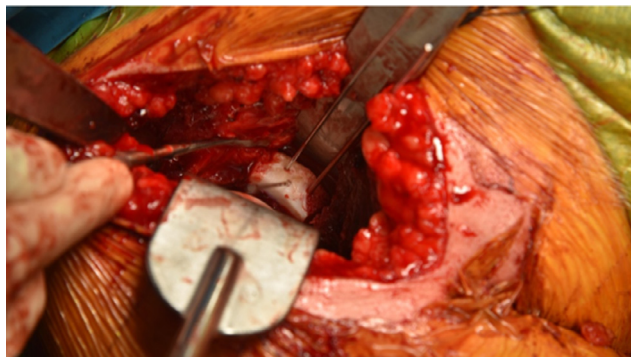

Figure 3 Properly sized graft fixed to glenoid utilizing K-wires.

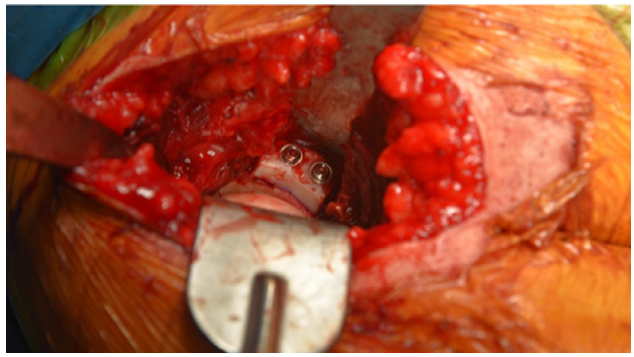

Figure 4 Graft secured to the native glenoid utilizing 2 3.5 mm fully threaded screws.

Postoperative Management

The patient is placed in an abduction sling to be worn at all times for the first 4-6 weeks postoperatively, removing it 2-3 times per day for gentle exercises, including hand, wrist, and elbow motion. For the first 2 weeks, shoulder motion is limited to pendulum activities and passive range of motion in the scapular plane. At 4 weeks the patient is then progressed to active-assisted exercises as well as isometric deltoid strengthening. At 6 weeks postoperatively, active motion can begin. Any strengthening is reserved until 8 weeks post operatively. During the entire postoperative period, cardiovascular endurance is maintained by use of a stationary bike or walking on a level surface but limiting exercise that causes repetitive cycling of the shoulder. Proper education on fall precaution is important to prevent reinjury to the shoulder. Return to full activity is expected at 4-6 months for the majority of patients. If the patient experiences an increase in pain, or there is any question of graft incorporation, a CT scan may be ordered.

Conclusion

In cases of recurrent instability with bone loss of greater than 15%, distal tibial allografts offer an excellent option for recreating the natural curvature and osteochondral make-up of the glenohumeral joint. As these grafts are more readily available than glenoid allografts and contain strong bone for screw fixation, it is reasonable and likely preferable to utilize this technique rather than others currently available.

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