Graft Transfer Technique in Arthroscopic Posterior Glenoid Reconstruction With Distal Tibia Allograft

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Abstract: Posterior glenoid reconstruction using distal tibia allograft is an available technique for the treatment of posterior shoulder instability with glenoid bone loss. A key aspect to this procedure relies on maintaining complete control of the graft during insertion and securement to the posterior glenoid. Although there are commercially available products to aid with graft control, we describe a novel graft transfer technique that is compatible with all cannulated systems for maintaining positive graft control. This technique allows the surgery to be performed in an arthroscopic manner using current instrumentation for open glenoid reconstruction.

Posterior glenoid reconstruction has been described for the treatment of posterior instability in the setting of posterior glenoid bone loss, as well as after failed posterior labral repair.1-6 Several techniques for reconstruction have been described, ranging from glenoid osteotomies7 to bone augmentation with the use of iliac crest1,8 and allograft distal tibia.2-4 Although technically demanding, allograft distal tibia augmentation has been shown to restore glenohumeral contact pressure, comparable to both an intact glenoid and an iliac crest graft, but providing the advantage of an anatomic and congruent joint surface.9 It has the additional benefit over iliac crest graft of providing a cartilaginous surface while also avoiding the morbidity associated with autograft harvest.

Techniques for allograft distal tibia include both open and arthroscopic approaches, with commercially available arthroscopic systems that allow the surgeon to secure the graft to the graft positioner. There is at least 1 system that includes the use of “top-hats” that screw into the bone graft and then allow the screws to thread inside of them. This specific instrumentation can be difficult to use and if not used properly, can limit the compression of the graft to the posterior glenoid. Other systems do not feature any form of securing the graft and therefore do not allow safe retrieval of the graft once it has been placed through the soft tissue, or positive control that allow the graft to be easily manipulated once placed through the arthroscopic portal.

We describe a technique that allows securement of the graft to the graft positioner for ease of insertion, manipulation, and potential removal during an arthroscopic posterior glenoid reconstruction through the use of commonly available instrumentation sets.

Fig 1. Clinical image showing the articular view of a distal tibia allograft prior to preparation. The portion of the lateral tibia outlined in purple (indicated by black asterisk) indicates the proposed graft width. The freer elevator is pointing at the lateral portion of the graft that is harvested.
**Surgical Technique**

**Distal Tibial Allograft Preparation**

The fresh (never-frozen) allograft distal tibia is neither size- nor laterality-matched (Fig 1). The preparation of this graft can be completed before the patient is even brought into the operating room, minimizing operative time (Video 1). The operative surgeon scrubs in and a graft preparation table is used separate from the operative back table. The graft is prepared according to preoperative planning; the average size in our series is approximately 9 mm in width by 23 mm in superior-inferior length. Guide holes are created in the graft and then pulsatile lavage is used to remove all marrow elements and potentially decrease any allogeneic response (Fig 2). Either whole blood or platelet-rich plasma can then be drawn from the patient by the anesthesia team and passed sterilely to the surgeon to soak the graft in until it is ready to be inserted.

**Patient Positioning**

The patient is positioned in the beach-chair position and traditional posterior as well as anterior portals are used for arthroscopy.

**Posterior Glenoid Preparation**

Removal of any loose sutures is performed arthroscopically and the remainder of the deficient posterior labral tissue is debrided with the use of a shaver as well as a radiofrequency ablator. A burr and then subsequent rasp is used to prepare the posterior glenoid bone,
creating a flat, bleeding surface that is perpendicular to
the face of the glenoid. The radiofrequency ablator
(Super Turbovac Coblation Wand, Arthrocare; Smith &
Nephew, Austin, TX) is then used through an anterior
portal to create a horizontal split in the interval between
the supraspinatus and infraspinatus posteriorly. The
posterior portal is then enlarged to 3 cm and blunt
palpation with a switching stick and then the surgeon’s
finger is performed to dilate the tissue. A clamp can be
introduced through the portal and then opened while
inside the joint to further dilate the soft tissues. The
opposite end of a neutral offset guide, or any instrument
with a flat end, is then placed through the posterior
portal to confirm that the posterior glenoid has been
adequately prepared to allow the guide to sit flush on the
posterior glenoid, in line with the cartilage. If any further
preparation is deemed necessary, then it is completed at
this point. The opposite end of the neutral offset guide is
our preferred instrument to confirm the appropriate
plane of the prepared posterior glenoid as it is a good
analog for the dimensions of the graft.

Preparations for Graft Delivery
At this point, the graft is ready to be arthroscopically
placed in position. The graft is placed on the dual can-
nulated graft positioner (glenoid parallel drill guide;
Arthrex, Naples, FL) and a no. 3-0 Prolene suture
(Prolene polypropylene suture; Ethicon US, Somerville,
NJ) with the needle removed is threaded through both
cannulas of the positioner, creating a loop securing the
graft to the graft positioner (Fig 3A). The free ends of
the suture are grasped as they exit the positioner and a
snap is used to secure them. The graft is now securely
fixed to the positioner allowing manipulation and de-

Fig 5. Arthroscopic image of the right shoulder in the beach
cap position viewing from the anterior portal, showing the
graft (indicated by red asterisk) in proper position after final
fixation with cannulated screws.

Fig 6. Computed tomography of left shoulder in a 32-year-old man with recurrent posterior shoulder instability after a failed
posterior labral repair. Preoperative 3D reconstruction showing prior suture anchor placement with posterior bone loss (A) and
axial image obtained 4 months after posterior glenoid augmentation with distal tibial allograft (B). Imaging reveals anatomic
restoration of glenoid curvature, congruent glenohumeral joint, with graft incorporation to the native glenoid.
An absorbable suture prevents the potential for a foreign body reaction in the event of retained suture. No. 3-0 suture is the largest size that we have found to facilitate ease of passage of guidewires. The sutures is best passed in a retrograde fashion from the graft-end of the graft positioner than antegrade. No. 3-0 suture is the largest size that we have found to facilitate ease of Kirschner-wire passage without compromising strength. An absorbable suture prevents the potential for a foreign body reaction in the event of retained suture.

### Table 1. Advantages and Disadvantages

| Advantages                                                                 | Disadvantages                                                                                           |
|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Allows for positive control of graft during insertion and guidewire placement | Potential for suture breakage                                                                          |
| Decreased cost compared with commercially available systems               |                                                                                                           |
| Easy to retrieve without added steps                                       |                                                                                                           |

#### Graft Delivery

With the graft now well secured, it is introduced into the joint through the posterior portal until it is visible arthroscopically (Fig 4). We commonly employ a blunt half-trocar to slide the graft on to ease its insertion into the joint. Prior to passing the guidewires, the graft is purposely placed slightly medial to the face of the glenoid and an assistant provides posterior translation of the humeral head to push the graft into a position that is flush with the plane of the glenoid. The anatomic position of the graft is then maintained by the surgeon for fixation.

As the guidewires are passed through the cannula and subsequently overdrilled with the cannulated drill, the sutures are broken and able to then be easily retrieved by simply pulling on each end that is exiting the graft positioner. This should be done prior to screw placement to decrease the amount of retained suture material. If small remnant pieces of the suture are not retrieved, however, it does not pose any issue to the surgery or the patient.

#### Graft Fixation

Cannulated screws are then appropriately sized and placed under compression, lagging the graft to the intact glenoid (Fig 5). Washers can be used, and specialized washers with embedded sutures can be used to repair the capsule at the completion of the procedure. Intraoperative fluoroscopy is not routinely used, and radiographs are taken in the recovery room after the conclusion of the case. Computed tomography can be used in the immediate postoperative period when the surgeon is early in their learning curve to assess location of the graft and screws or can be obtained 5 months postoperatively to gauge bony incorporation of the graft (Fig 6).

#### Discussion

Posterior glenoid augmentation is a technically demanding procedure that requires strict surgical indication, which includes posterior glenoid bone loss or dysplasia in the setting of posterior shoulder instability. In the absence of bone loss or dysplasia, bone augmentation should be avoided as capsulolabral repair has been found to more precisely restore posterior and inferior glenohumeral joint stability. Methods for assessment of glenoid bone loss have been extensively investigated, and the bone loss can be assessed with either MRI or computed tomographic imaging, although caution should be exhibited when using 2-dimensional imaging as the imaging gantry relative to the glenoid axis has been shown to significantly affect glenoid measurements. Because of this, we use computed tomographic imaging with 3D reconstructions to calculate glenoid bone loss.

Numerous techniques have been described for treatment including both iliac crest bone graft and allograft distal tibia. Although both iliac crest and distal tibia allograft have been shown to restore glenohumeral contact pressures, we prefer distal tibia allograft because of its congruity to the articular surface, lack of graft harvest morbidity, and retained cartilaginous surface for articulation with the native humeral head in a patient cohort that is at risk for progressive osteoarthritic development. Certainly, there remains the minimal risk of disease transmission with use of any allograft tissue, which is a concern and must be discussed with the patient. There can also be graft resorption even when an autograft is used; that is, the risk of graft resorption is present with either allograft or autograft. We feel that this risk is lessened by preparing the graft with a pulsatile lavage and allowing it to soak in autologous blood or platelet-rich plasma. Cost and availability are additional concerns in the use of distal tibial allograft; however, they can be offset by the decreased operative time, as there is no need for tissue harvesting of iliac crest and we have the graft completely prepared before the patient even has induction of anesthesia. Availability for us has not been

#### Table 2. Pearls and Pitfalls

| Pearls                                                                 | Pitfalls                                                                                           |
|-----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| After trialing several suture types and sizes, we feel that no. 3-0 Prolene suture allows for the greatest ease of use, security of the graft, and ease of passage of guidewires. | If the graft is inserted and subsequently removed several times, the sutures will likely weaken and should be replaced if there are any signs of wear. |
| The sutures is best passed in a “retrograde” fashion from the graft-end of the graft positioner than antegrade. | If the suture is not retrieved before placement of the cannulated screws, it will likely cause increased retained suture fragments. |
| No. 3-0 suture is the largest size that we have found to facilitate ease of Kirschner-wire passage without compromising strength. |                                                                                                      |
| An absorbable suture prevents the potential for a foreign body reaction in the event of retained suture. |                                                                                                      |
an issue as distal tibial allograft is not widely used in foot and ankle cases or other reconstructive procedures and is readily harvested, as opposed to glenoid allografts, which are rare and difficult to harvest.

Posterior glenoid bone block augmentation is a reliable technique for treatment, albeit a technically challenging procedure, regardless of the selected graft (Tables 1 and 2). One of the more challenging aspects of this procedure involves the intra-articular delivery of the graft with several described techniques in the literature, including use of cannulas and the use of suture anchors. Manipulating the graft after it has been placed in the joint can be a difficult portion of this case. In some cases in our series, especially early in our experience, it became necessary to remove the graft from the joint to further prepare the glenoid or further size our graft. This scenario provided the impetus to create a technique that would easily allow secure fixation of the graft to the graft positioner to even allow the surgeon to completely remove the graft back through the soft tissue tunnel for additional preparation of either the graft or the glenoid. We advise replacing the suture if the graft does need to be removed from the joint after 1 or 2 times as this may weaken the suture and lead to breakage.

We describe a graft fixation technique that is compatible with all commercially available cannulated graft positioner systems, allowing for the maintenance of positive control of the graft during intra-articular delivery while simultaneously facilitating ease of instrument removal once the graft is satisfactorily positioned. Using this technique, there is no impediment with guidewire placement and the suture can be easily removed prior to cannulated screw insertion. Our technique provides the surgeon with a low-cost technique to allow securement of the graft to a graft positioner for ease of insertion, manipulation, and potential removal during an arthroscopic posterior glenoid reconstruction.

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