Technical Note

Arthroscopic Anterior and Posterior Glenoid Bone Augmentation With Capsular Plication for Ehlers-Danlos Syndrome With Multidirectional Instability

Mitchel D. Armstrong, M.D., B.M.Sc., Benjamin Smith, M.D., F.R.C.S.(C.), Catherine Coady, M.D., F.R.C.S.(C.), and Ivan H. Wong, M.D., M.A.C.M., F.R.C.S.(C.)

Abstract: Recurrent multidirectional shoulder instability is a difficult clinical problem. This can be compounded in patients with connective tissue diseases such as Ehlers-Danlos syndrome. We present an all-arthroscopic technique involving extra-articular anterior and posterior glenoid bone grafting to augment a capsular repair in a patient with Ehlers-Danlos syndrome and recurrent multidirectional shoulder instability. Graft options include either distal tibial allograft or iliac crest autograft. Anterior graft placement uses a dilated far medial portal using an inside-out technique. The posterior graft is placed through a dilated posterior portal. A 1-mm edge of anterior and posterior glenoid rim is denuded of cartilage for later capsular repair, and grafts are secured flush to the osseous surface. A capsular plication is then completed and repaired to the prepared native glenoid surface, using the grafts as extra-articular osseous bumpers.

We present an all-arthroscopic technique involving anterior and posterior capsular plication with extra-articular glenoid bone grafting to treat a patient with Ehlers-Danlos syndrome and recurrent multidirectional instability of the shoulder. Nonoperative measures were exhausted prior to surgical intervention. We prefer this technique as it preserves the subscapularis muscle and coracoid-conjoint complex while combining soft-tissue and osseous support to treat a difficult patient population.

Surgical Technique

Positioning and Preparation

The patient was placed in the semilateral position by rolling 30° posteriorly to make the glenoid surface parallel with the floor (Table 1). This position allows for easier placement of glenoid graft screws later in the procedure. Both the arm and ipsilateral hip were prepped and draped in the usual fashion. The arm was abducted 60° in balanced traction using a pneumatic arm holder (Spider 2; Smith and Nephew, Memphis, TN).

Arthroscopic Evaluation and Debridement

Skin landmarks and diagnostic portals are placed in standard fashion for shoulder arthroscopy with the addition of an enlarged anterior medial portal (Fig 1). A thermal probe (Dyonics RF-S Whirlwind 90° probe, Smith and Nephew, Memphis, TN) is used to perform a complete release of the rotator interval. This step is important for allowing passage of the anterior graft and visualization of the coracoid process and conjoint tendon, necessary landmarks for development of the far medial (M) portal.
After preparing the glenoid similarly to a standard Bankart repair, a small curette is used to remove 1 mm of anterior glenoid rim cartilage for later capsular repair to bone. The posterior glenoid labrum and neck are released and prepared from the 10 to 6 o'clock positions in a similar fashion using the anteroinferior portal. Using a calibrated probe, the glenoid defect size is determined and compared with preoperative computed tomography measurements (Fig 3).

The far M portal is created using an inside-out technique. To release tension and medialize the conjoint tendon, the elbow is flexed to 90°, and the arm is adducted to neutral. A switching stick is then placed through the posterior portal, parallel to the glenoid surface and superior to the subscapular muscle. The switching stick is kept lateral to the conjoint tendon as it is advanced through the deltoid muscle to protect the neurovascular structures. The skin is opened over the top of the switching stick and followed by slotted cannula retractors (Smith and Nephew). A large channel dilator is then passed through the slotted cannula for anterior graft placement and screw fixation (Depuy Synthes, Latarjet set, Raynham, MA). The M portal must be parallel to the anterior glenoid neck for proper graft positioning. The posterior portal is dilated in a similar fashion using the slotted cannula and channel dilator prior to posterior graft placement.

Iliac Crest Harvest and Graft Preparation

Tricortical graft is required for an adequate anterior and posterior structural glenoid bumper. Iliac crest is harvested in standard fashion, with the size based on interoperative arthroscopic measurements. Grafts are skeletonized of any soft tissue. A microsagittal saw is used to cut grafts to appropriate dimensions. The anterior graft measured 10 × 20 × 15 mm, and the posterior graft measured 5 × 20 × 15 mm. The DePuy Mitek Bristow-Latarjet Instability Shoulder System (DePuy Synthes, Mitek) is used. Two k-wires are placed through the alpha-beta guide in the appropriate position for screw angulation (Fig 4). The k-wires are then overdrilled and tapped. The drill holes are filled with top-hat washers and then secured into place to help reduce hoop stress and prevent graft fracture. The prepared grafts are then secured in place with the double-barrel cannula (Fig 5; Video 1).

Graft Placement

Using the AS viewing portal, a small switching stick is placed through the posterior portal to retract the subscapular muscle inferiorly. The graft and double-barrel cannula are passed between the slotted cannulas through the M portal. The lateral surface of the graft should be flush or slightly medial to the glenoid bone surface (Fig 6). The superior k-wire is secured in place to allow for fine-tuning of graft alignment followed by the second k-wire. The graft should then be viewed from multiple portals to ensure optimal placement. A 2.8-mm calibrated cannulated drill is used to drill over the k-wires. Screw length is measured off the drill as it perforates the posterior glenoid cortex. Two titanium

| Table 1. Operative Pearls |
|----------------------------------|
| Lateral decubitus position, leaning back slightly to allow the glenoid to be placed horizontal with the floor. |
| Drape out patient to midline anteriorly and just until the medial edge of scapula posteriorly (to be able to fully create the anterior and posterior portals). |
| Save all capsule-labral tissue from both anterior and posterior glenoid rims as multidirectional instability (MDI) will need plication as well as boney augment to minimize chance for recurrence. |
| Bone graft measurements to compare with cadaveric values (best measure from intra-articular findings). For MDI, the goal is to make glenoid 120% of normal size to limit dislocations. |
| Medial portal creation from inside-out technique: quick, safe, reproducible. |
| Retractor to help viewing of posterior bone grafting position. |
| Use finger in the posterior portal to assess posterior graft position, which helps to ensure both are visually and tactilely flush with glenoid. |
| Capsule plication sutures to help soft-tissue tensioning at end of case on top of the increased bone volume of the glenoid (capsule to decrease subluxation, bone to decrease dislocation). |

Fig 1. Patient is placed in the lateral decubitus position and rolled 30° posteriorly with the ipsilateral hip prepped for iliac crest tricortical graft harvest. A standard posterior portal is created and kept slightly medial in order to stay parallel with the glenoid face.
3.5-mm cannulated screws are passed over the top of the guide wires (Fig 7). The subscapular muscle with attached capsular/labral complex is then reduced back into place.

The posterior graft is placed in a similar sequence of steps. The AS viewing portal is still used, but the graft is now placed through the slotted cannula in the dilated posterior portal. The graft is visually confirmed to be at or slightly medial to the glenoid bone surface. Visualization of graft placement can be challenging, and we have found that a switching stick placed through the anteroinferior portal can be used to lift the posterior capsule laterally to improve visibility. Due to the limited bone volume of the glenoid neck, screw convergence with anterior screws is a risk. Care should be taken with k-wire placement to avoid this problem. The 2.8-mm calibrated cannulated drill is used to drill over the k-wires, and screw lengths are measured off the drill. Two titanium 3.5-mm cannulated screws are passed

---

**Fig 2.** Standard arthroscopic portals are made. Portal 1, standard posterior portal; portal 2, posterolateral portal; portal 3, direct medial portal; portal 4, anterosuperior (AS) portal.

**Fig 3.** Left shoulder. Viewing from anterosuperior portal. Calibrated probe is placed through the posterior portal. The defect size is then measured to confirm graft size.

**Fig 4.** The harvested iliac crest bone graft has 2 k-wires placed using the alpha-beta guide to prepare screw tracks. This technique is used to prepare both the anterior and posterior glenoid augment grafts.

**Fig 5.** The double-barrel cannula is secured to the prepared graft in readiness for insertion into the shoulder. This cannula allows for ease of stable graft passage into the shoulder.
over top of guide wires and observed as they compress the graft to the bone.

**Capsular Repair**

The posterior capsular repair is completed first with the arm positioned in 60° of abduction. The capsular/labral complex is repaired to the site of the patient’s native glenoid, leaving the graft extra-articular. Percutaneous suture anchor placement is established, followed by impaction of the suture anchor (1.4 mm Linvatec All-Suture Y-knot anchor; Linvatec, Largo, FL). A suture passer (Smith and Nephew Accu-Pass suture passer) is then used to shuttle sutures through the redundant capsule and labrum. For the posterior capsular repair, 2 anchors are placed in the 7 and 9 o’clock positions.

Anterior capsular/labral complex repair and plication is done in a similar fashion at the edge of the patient’s native glenoid. One to 2 millimeters of articular surface was previously removed with a small curette to create a bony surface for capsular healing. As with the posterior repair, the anterior bone block is left extra-articular. Three to 4 suture anchors are then used to span the length of graft (Fig 8). Soft tissue is balanced to reduce the humerus over the center of the glenoid.

**Discussion**

Traditional stabilization procedures depend on tightening the anterior structures and recreating the labral bumper. In patients with connective tissue disease, tightening the anterior capsule and soft tissue may not provide enough stability and may stretch over time. By adding bony augmentation to the glenoid and increasing the available surface area for contact, the shoulder can be stabilized in a way that is more resistant to change.

Shoulder instability with associated bone loss has been shown to respond well to bony augmentation.²

**Table 2. Technique Advantages and Disadvantages**

| Advantages                                                                 | Disadvantages                                                                 |
|---------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Minimally invasive                                                        | No clinical outcomes studies currently available for this technique.         |
| Addresses soft-tissue laxity with capsular plication and reinforces glenohumeral stability with anterior and posterior glenoid bone graft. | Does not add further stability, as with the conjoint sling in the Latarjet procedure. |
| Preservation of key anatomical structures: pectoralis minor, coracoid, conjoint tendon, subscapularis. | Higher cost if iliotibial allograft is used.                                  |
|                                                                           | Donor site morbidity with iliac crest graft.                                 |
|                                                                           | Learning curve.                                                              |
|                                                                           | Possibility of graft resorption.                                             |

---

**Fig 6.** Left shoulder viewed from the anterosuperior portal; the graft (black arrow) is placed flush to the anterior glenoid surfaced. Note the 1-mm rim of denuded cartilage (blue arrow) that will serve for later capsular repair.

**Fig 7.** Left shoulder, anterosuperior viewing portal. Fixation of the anterior glenoid augment graft. Two 3.5-mm titanium screws are passed over the top of the guide wires within the double-barrel cannula (black arrow). Anterior graft (blue arrow).

**Fig 8.** Left shoulder, viewed from the anterosuperior portal. Anterior graft (blue arrow) is to the right of the picture. The capsule (black arrow) is secured along the edge of the patient’s native glenoid, keeping the graft extra-articular.
We have shown that anatomic recreation of glenoid anatomy is possible with arthroscopic techniques. Capsular repair is possible with new flexible drills to avoid damaging screws, and this acts to exteriorize the graft and prevent contact abrasion between the graft and humeral head.

We present this technique for surgical management of Ehlers-Danlos syndrome with both anterior and posterior shoulder instability. A multitude of surgical treatment options for shoulder multidirectional instability (MDI) have been reported with varying results (Table 2). Open inferior capsular shift, arthroscopic capsular plication, and thermal capsulorrhaphy are the most commonly used techniques for MDI treatment, with inferior clinical results noted post-treatment. Previously, open extra-articular anatomic glenoid structural transfer was described by Millet et al. for posterior instability in glenoid hypoplasia. The arthroscopic anterior Latarjet has been previously described, followed by arthroscopic posterior bony augmentation of the glenoid described in the beach chair position. Wong et al. described the technique for arthroscopic subscapularis preserving glenoid reconstruction using tibial allograft and iliac crest autograft.

As previously shown, the arthroscopic technique allows for anatomic placement of the graft with excellent visualization to ensure that the graft and articular surface are parallel. This technique also allows for graft placement without damage to the subscapularis tendon by mobilizing and retracting, as opposed to splitting the tendon. Inserting the graft through the rotator interval can be done with minimal soft-tissue dissection. By placing the M portal lateral to the conjoint tendon, the neurovascular structures are protected, allowing for safe passage of the graft and all hardware through the anterior soft tissues.

This minimally invasive technique allows for the combined advantage of extra-articular anterior and posterior osseous support with the volume-reducing effect of arthroscopic capsular plication. Although technically demanding, we feel this technique is a viable option for a difficult patient population and may offer improved clinical outcomes. This will be elucidated with larger clinical volumes.

References
1. Wong IH, Urquhart N. Arthroscopic anatomic glenoid reconstruction without subscapularis split. *Arthrosc Tech* 2015;4:e449-e456.
2. Provencher M, Frank RM, Golijanin P, et al. Distal tibia allograft glenoid reconstruction in recurrent anterior shoulder instability: Clinical and radiographic outcomes. *Arthroscopy* 2017;33:891-897.
3. Longo UG, Rizzello G, Loppini M, et al. Multidirectional instability of the shoulder: A systematic review. *Arthroscopy* 2015;31:2431-2443.
4. Millet PJ, Schoenahl J-Y, Register B, Gaskill TR, van Deurzen DFP, Martetschläger F. Reconstruction of posterior glenoid deficiency using distal tibial osteoarticular allograft. *Knee Surg Sports Traumatol Arthrosc* 2013;21:445-449.
5. Lafosse L, Boyle S, Gutierrez-Aramberri M. Arthroscopic latarjet procedure. *Orthop Clin North Am* 2010;41:393-405.
6. Lafosse L, Lejeune E, Bouchard A, Kakuda C, Gobezie R, Kochhar T. The arthroscopic Latarjet procedure for the treatment of anterior shoulder instability. *Arthroscopy* 2007;23:1242.e1-1242.e5.
7. Schwartz DG, Goebel S, Piper K, Kordasiewicz B, Boyle S, Lafosse L. Arthroscopic posterior bone block augmentation in posterior shoulder instability. *J Shoulder Elbow Surg* 2013;22:1092-1101.
8. Fortun CM, Wong I, Burns JP. Arthroscopic iliac crest bone grafting to the anterior glenoid. *Arthrosc Tech* 2016;5:e907-912.