

# Posterior Glenohumeral Capsular Reconstruction Using an Acellular Dermal Allograft



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**Abstract:** Posterior shoulder instability is an uncommon and challenging cause of shoulder pain and dysfunction. Surgical management has less reliable results and higher failure rates compared with techniques for anterior shoulder instability. The presence of generalized ligamentous laxity further complicates options for surgical management. If primary capsulolabral repair fails, controversy exists as to the optimal revision procedure. This technical description and video present an arthroscopic technique for reconstruction of the posterior glenohumeral capsule with an acellular dermal allograft to treat posterior instability in a patient with Ehlers-Danlos syndrome and a previously failed posterior capsular plication.

Posterior instability of the glenohumeral joint is a rare condition compared with anterior instability, accounting for approximately 2% to 10% of shoulder instability.<sup>1-3</sup> It is a historically underdiagnosed and misdiagnosed pathology due to its common association with an atraumatic etiology and varying clinical presentations; however, it is becoming an increasingly common cause of shoulder pain and dysfunction, especially among athletic populations.<sup>2,4</sup> Most often, instability occurs because of microtrauma from activities in the flexed, adducted, and internally rotated position with no history of a single inciting event. Physiotherapy is the mainstay of initial management, especially with an atraumatic etiology. However, if symptoms persist, surgical management may be indicated.<sup>5</sup>

Determining the cause of posterior instability is important for guiding surgical management. Soft tissue injuries often include tearing of the posterior labrum and stretching of the capsule and posterior inferior glenohumeral ligament.<sup>6-8</sup> In addition, hereditary collagen disorders can predispose to ligamentous laxity of the joint and complicate repair of the damaged soft tissues.<sup>9</sup> Typical surgical management involves repair of the capsulolabral complex.<sup>5,10</sup> Arthroscopic techniques allow better delineation of the cause of posterior instability and have been shown to have superior outcomes, lower recurrence rates, and higher return to sport compared with open approaches.<sup>10,11</sup> If primary repair of the soft tissues is not possible, a limited number of surgical options exist for the management of these patients.

The purpose of this Technical Note is to describe our surgical approach for reconstruction of the posterior glenohumeral capsule with an acellular dermal allograft for posterior instability in a patient with Ehlers-Danlos syndrome and a previously failed posterior capsular plication (Video 1, Tables 1 and 2).

## Surgical Technique

### Preoperative Assessment

The patient is assessed in clinic with a focused history and physical examination. Posterior glenohumeral instability can be detected with the following maneuvers: posterior stress test, load and shift test, Kim test, and jerk test. Beighton's criteria should be assessed for generalized ligamentous laxity. Initial imaging includes

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**Table 1.** Pearls and Pitfalls

| Pearls   | Pitfalls  |
|--|---|
| <ul style="list-style-type: none"> <li>• A 3-dimensional CT printed shoulder model is helpful to understand patient-specific anatomy and plan graft size</li> <li>• All-suture anchors are useful for poor quality bone and revisions</li> <li>• Systematic suture management with multiple suture colors and corresponding diagram prevents entanglement</li> </ul> | <ul style="list-style-type: none"> <li>• Failure to recognize bone loss may result in a recurrence of instability</li> <li>• Inaccurate measurement of distance from the glenoid to the humeral head bare area can result in a poorly tensioned graft</li> <li>• Patient compliance is important during postoperative rehabilitation</li> </ul> |

CT, computed tomography.

standard anteroposterior, axillary, and scapular “Y” radiograph views. A magnetic resonance imaging is completed to evaluate for capsulolabral injury and a computed tomography to look for bony pathology. A 3-dimensional shoulder model is then printed from the computed tomography scan to aid in pre- and intraoperative planning.

### Anesthesia and Patient Position

General anesthetic and antibiotic prophylaxis are administered. With the assistance of a bean bag positioner, the patient is placed in the lateral decubitus position, and then rolled posteriorly 30° to align the glenoid parallel to the floor. Examination under anesthetic is completed to confirm the findings of posterior instability. The operative shoulder and axilla are prepped and draped in a sterile fashion. The patient’s arm is secured in a SPIDER Limb Positioner (Smith & Nephew, London, England) and abducted to 60° with slight traction. Bony landmarks are drawn on the skin, and 3 arthroscopic portals are marked: anterosuperior, anteroinferior, and posterior (Fig 1).

### Diagnostic Arthroscopy and Debridement

The complete surgical technique can be seen by viewing [Video 1](#). A diagnostic arthroscopy is completed in a standard fashion from the posterior portal. The camera is then placed in the anterosuperior portal to assess the posterior capsule. A 10-mm passport cannula (Arthrex, Naples, FL) is placed in the posterior portal to allow eventual passage of the graft.

Through the anteroinferior portal, a Bankart knife is used to elevate and release the labrum from the posterior glenoid. Any previous hardware from a capsulolabral repair should be removed at this time. The posterior labral tissue is assessed and repaired if possible. The posterior glenoid is then rasped and decorticated using a shaver or burr to create a bleeding surface. The bare area of the humeral head is similarly decorticated using a curette (Fig 2). With the shoulder in neutral rotation and 60° abduction, the distance from the posterior glenoid to the humeral head bare area adjacent to the cuff is measured to estimate the graft size. This measurement is compared with that taken from the 3-dimensional model preoperatively (Fig 3).

### Anchor Placement

Three Q-Fix suture anchors (Smith & Nephew) are inserted into the posterior glenoid through percutaneous incisions. A spinal needle is first used to landmark the anchor placement onto the face of the glenoid. The most inferior anchor is placed first, at the 8 o’clock position, followed by anchors at the 9 o’clock and 10 o’clock positions (Fig 4A).

Attention is then directed toward anchor placement on the humeral head. Using the posterior portal, 3 Q-Fix anchors are inserted into the previously decorticated humeral head bare area. These anchors are placed directly lateral to the glenoid anchors, so that in 60° of shoulder abduction, a rectangular-shaped graft will be adequately tensioned (Fig 4B). All suture limbs from the humeral anchors are pulled out a percutaneous incision used for glenoid anchor insertion.

### Graft Preparation and Suture Management

The GraftJacket allograft acellular human dermal matrix (Wright Medical Technology, Arlington, TN) is prepared on the back table. The graft is cut to appropriate dimensions based on the intra- and preoperative measurements. Markings for 3 sutures are made on the planned medial and lateral sides of the graft at 3 mm from the edge (Fig 5A). The graft is then brought to the posterior edge of the shoulder. Beginning with the most inferior glenoid anchor, 1 suture limb from each anchor is sequentially passed out the posterior portal, through the edge of the graft, and tied with a short-tailed interference knotted suture. The other suture limbs from each of the glenoid anchors are passed out the anteroinferior cannula. These steps are then repeated

**Table 2.** Advantages and Disadvantages

| Advantages   | Disadvantages   |
|--|---|
| <ul style="list-style-type: none"> <li>• Arthroscopic technique</li> <li>• Use of allograft tissue in patients with connective tissue disorders</li> <li>• No donor site morbidity</li> <li>• Achieves reduction of the glenohumeral joint</li> <li>• Maintains native anatomy (vs osteotomy or arthroplasty)</li> </ul> | <ul style="list-style-type: none"> <li>• Cost of the acellular dermal allograft</li> <li>• Technically challenging</li> <li>• Potential for long operating time, especially if graft or suture entanglement occurs</li> <li>• Long-term outcomes unknown</li> </ul> |



**Fig 1.** View of the right shoulder in the semilateral position with a pneumatic arm holder. Markings for portal placement are indicated. Posterior portal (1) located 2 cm inferior to the posterolateral corner of the acromion. Anterosuperior portal (2) located in the rotator interval just anterior to the biceps tendon. Anteroinferior portal (3) is created with an outside-in technique, slightly inferior to the coracoid.

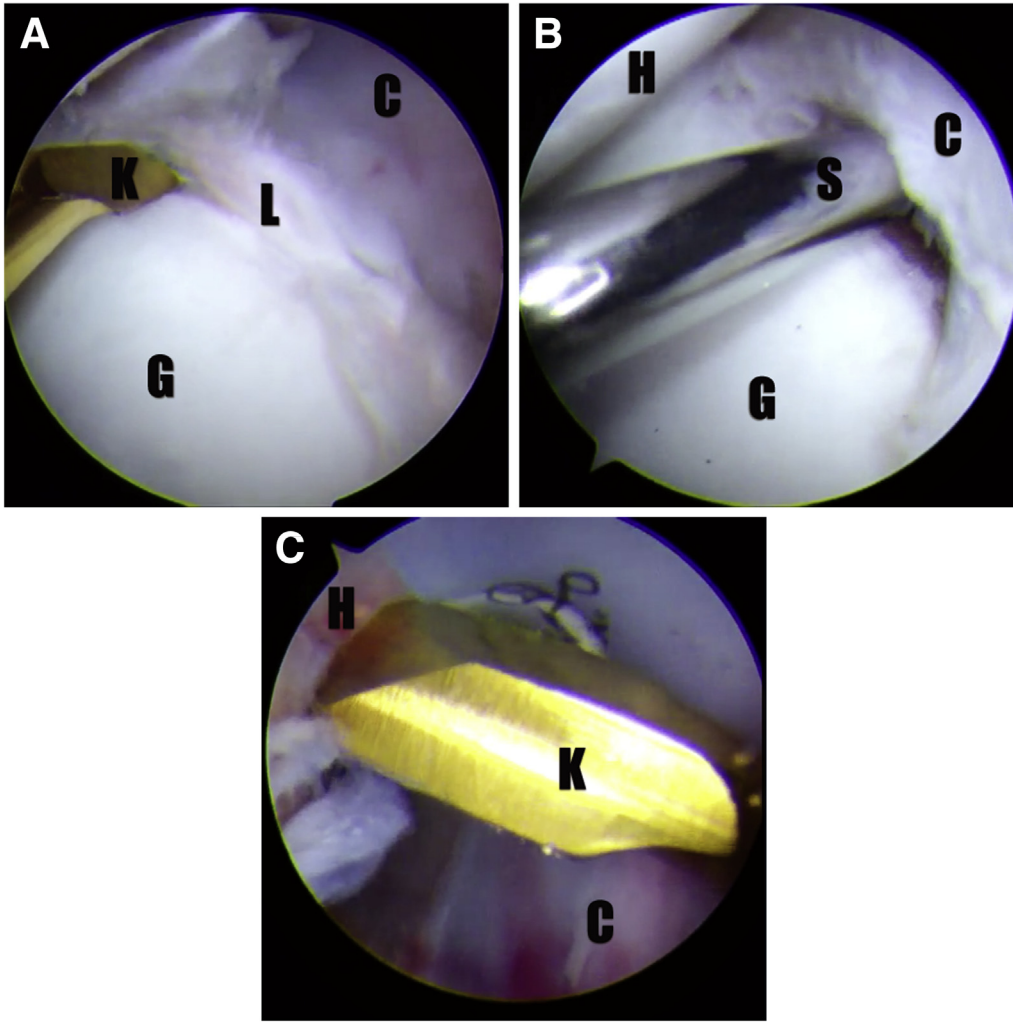
for the 3 humeral head anchors. The second limb of the humeral anchors is kept in the percutaneous incision for tensioning (Fig 5B).

Once all sutures have been passed through the graft, a grasper is used to manipulate the graft as the free suture limbs are tensioned to pull the graft into the shoulder. The graft is then assessed for correct dimensions and appropriate tension (Fig 5C).

### Securing of Graft

Beginning at the inferior glenoid anchor, both suture limbs from 1 anchor (1 short-tailed interference knotted and 1 free end) are passed out the posterior portal. An SMC knot, followed by 3 stacked half-hitches, is used to secure the graft. This process is then repeated for each anchor, moving sequentially around the graft.





**Fig 2.** Viewing from the anterosuperior portal in the right shoulder. (A) Bankart knife to elevate the labrum. (B) Decorticate the posterior rim of the glenoid with a burr. (C) Decorticate the bare area of the humeral head with a curette. (C, capsule; G, glenoid; H, humerus; K, knife; L, labrum; S, shaver.)

On completion of graft fixation, the shoulder is assessed under direct visualization, with both intra- and extra-articular views. A posterior directed force is applied to the humerus to test stability in internal, external, and neutral rotation. With an appropriately tensioned graft, the reconstructed posterior capsule should act as a restraint to posterior translation of the humeral head (Fig 6).

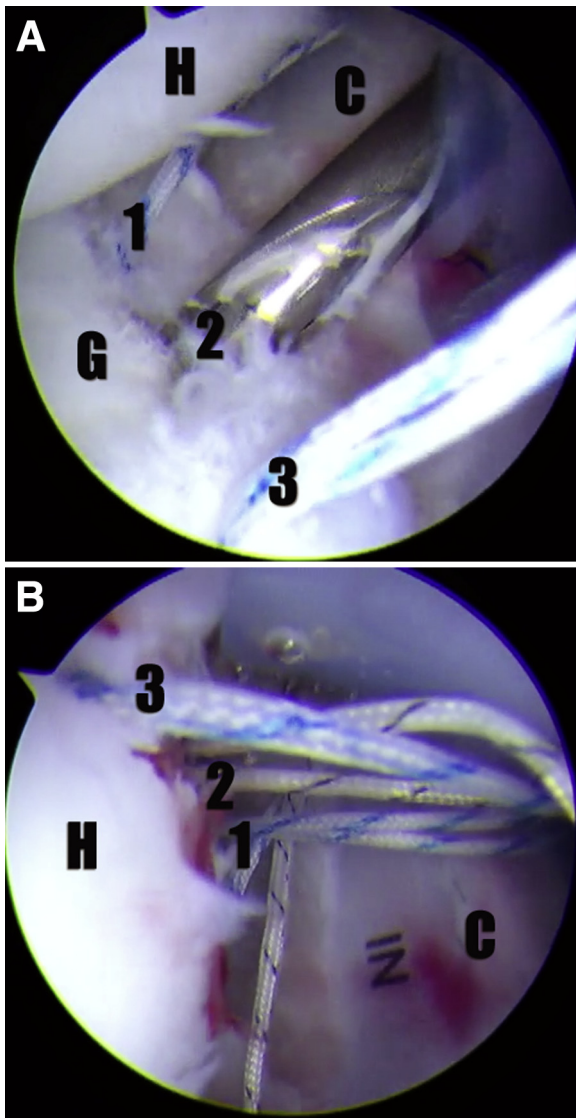
### Discussion

Because of the relatively low incidence of posterior instability, studies with large cohorts of patients are limited. Literature that is available indicates that arthroscopic treatment is an effective technique to restore normal function. Early clinical studies showed a range of failure rates from 3% to 25%<sup>10,12-17</sup> for arthroscopic reverse Bankart repair and/or capsular plication. A more recent prospective cohort of 200 shoulders found a failure rate of 6% to 7% at an average of 36 months after arthroscopic capsulolabral repair with suture anchors or anchorless fixation.<sup>18</sup>

Few options exist for patients who have failed primary repair, especially when soft tissue pathology is the predominant cause. Multiple techniques have been



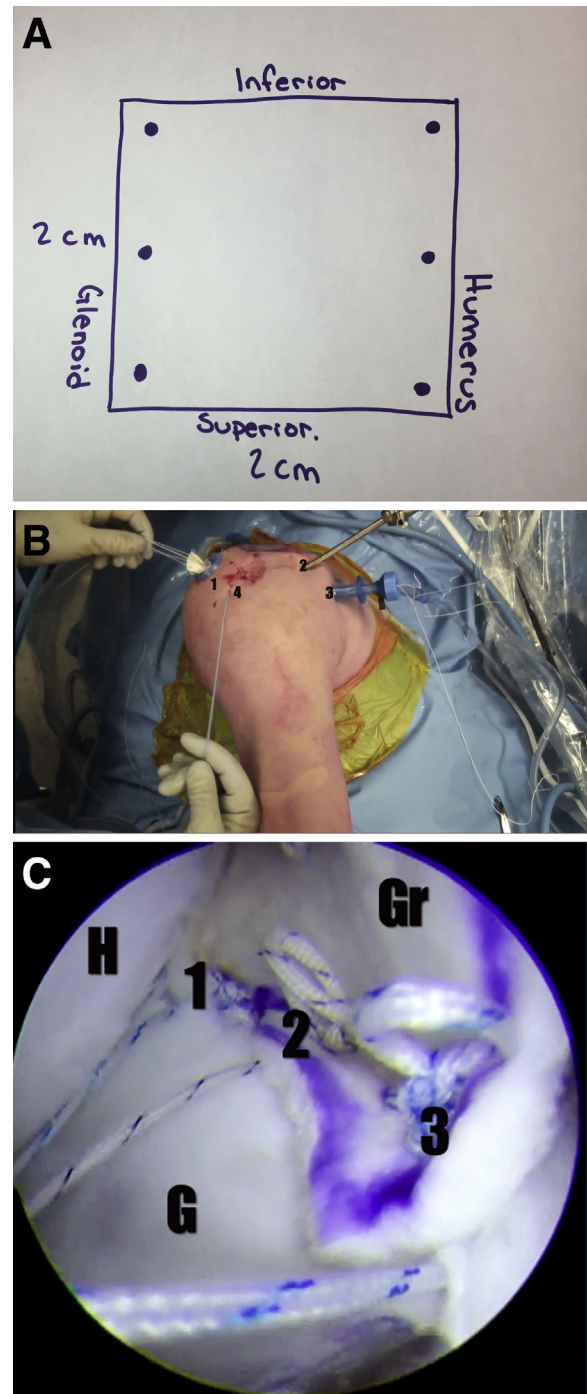
**Fig 3.** A 3-dimensional printed model of the shoulder is used to measure the dimensions of the graft in 60° of shoulder abduction.



**Fig 4.** Viewing from the anterosuperior portal of the right shoulder. (A) Insertion of 3 suture anchors on the posterior glenoid rim. (B) Insertion of humeral anchors. (1, first glenoid anchor; 2, second glenoid anchor; 3, third glenoid anchor; C, capsule; G, glenoid; H, humerus.)

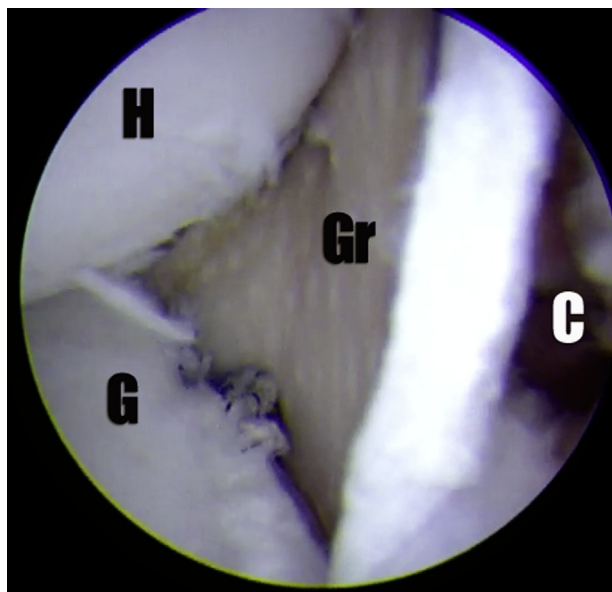
described for posterior bone block procedures and reverse remplissage techniques with varying choices of graft material.<sup>19-21</sup> In addition, multiple procedural reports have described alternate methods for capsular repair. However, a challenge is faced in cases where tissue quality is not amenable to repair and shoulder arthroplasty may need to be considered.

The use of acellular dermal allografts has been described in technical reports for superior capsular reconstruction and for reconstruction of massive rotator cuff tears with promising early clinical results.<sup>22,23</sup> Dermal allografts have also been used in open reconstruction of the anterior capsule for anterior shoulder instability.<sup>24</sup> These grafts allow for a large area of contact between the graft and its fixation points,



**Fig 5.** (A) GraftJacket cut to 2 cm × 2 cm based on pre- and intraoperative measurements. Markings for 3 sutures are made on the planned medial and lateral sides. (B) Sequential passing of the sutures through the graft. The GraftJacket is oriented so the short-tailed interference knotted sutures are on the smooth “basement membrane” surface of the graft so that this surface will heal to the native capsule. (1, posterior portal; 2, anterosuperior portal; 3, anteroinferior portal; 4, percutaneous humeral suture.) (C) Viewing from the anterior superior portal of the right shoulder. The graft is tensioned against the glenoid and humeral head and assessed for correct dimensions before securing the graft. (1, first glenoid anchor; 2, second glenoid anchor; 3, third glenoid anchor; G, glenoid; Gr, graft; H, humerus.)





**Fig 6.** Viewing from the anterior superior portal of the right shoulder. Final views of the secured graft. The humeral head is well balanced over the glenoid. (C, capsule; G, glenoid; Gr, graft; H, humerus.)

increasing the potential for healing, and eliminate concerns for donor site morbidity. For capsular reconstruction, we expect the graft to incorporate into the native capsule and effectively dissipate posterior directed forces on the shoulder.

The described technique offers patients the advantages of an arthroscopic procedure, including decreased post-operative pain, lower morbidity, and general acceptance by patients. This technique also reduces the humeral head back to its anatomic position, confirmed with direct visualization, and may be performed in a revision setting after failure of capsular plication and reverse Bankart repair. The limitations of this technique include the learning curve associated with shoulder arthroscopy and the careful suture management required during insertion of the graft (Table 3). Operative time can be a concern, especially if graft entanglement becomes an issue, and fluid extravasation must be monitored. In addition, long-term outcomes are unknown.

Posterior capsule reconstruction with GraftJacket allograft is an acceptable technique to manage posterior

glenohumeral instability in patients who have failed primary surgical management or with collagen disorders that cannot rely on repair of soft tissue. It may be used as an alternative to shoulder arthroplasty in the young population, where no other options exist; however, long-term follow-up is still unknown.

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**Table 3.** Limitations of the Technique

- Surgeon must be comfortable with shoulder arthroscopy and suture management
- Capsule reconstruction may not be sufficient if the patient has significant glenoid retroversion
- Scapular dyskinesia should be corrected preoperatively
- Patients with volitional dislocations will likely tear through the reconstruction
- Requires longer period of time for healing of allograft to native tissue

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