Technical Note

Coracohumeral Ligament Reconstruction for Patients With Multidirectional Shoulder Instability

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Abstract: Coracohumeral ligament pathology arises from acute trauma, capsular thickening, or congenital connective tissue disorders within the glenohumeral joint. Recent studies have highlighted the significance of this pathology in multidirectional shoulder instability because insufficiency of the rotator interval has become increasingly recognized and attributed to failed shoulder stabilization procedures. The diagnosis and subsequent treatment of coracohumeral ligament pathology can be challenging, however, because patients usually present with a history of failed surgical stabilization and persistent laxity. At the time of presentation, most patients have undergone failed nonoperative treatments and are indicated for surgical intervention. One of the options for the treatment of coracohumeral ligament pathology is reconstruction. The purpose of this Technical Note is to describe our preferred surgical technique for the reconstruction of the coracohumeral ligament. Research was performed at the Steadman Philippon Research Institute.

Multidirectional instability (MDI) affecting the glenohumeral joint was initially defined as instability in 2 or more directions[1,2] and has long been a challenge for the orthopaedic surgeon. Muscular imbalance, bony abnormalities that affect joint congruency, repetitive microtrauma, and congenital pathology are just some of the causes of MDI.[3-5] In particular, patient populations with Ehlers-Danlos syndrome (EDS), a connective tissue disorder of abnormal collagen function and composition, are likely to exhibit joint hypermobility.[6] This often complicates surgical intervention and historically has led to poor outcomes.[7-10]

For these patients, surgery consisting of capsular shift or plication, including additional measures such as closure of the rotator interval or augmentation of other dynamic stabilizers, is prone to poor outcomes because of the compromise of collagen structural integrity. Thus, when reconstruction procedures of glenohumeral stabilizers, in conjunction with capsular procedures, or as part of salvage procedures, have been attempted, postoperative results have been variable thus far.[11-13] As the importance of the coracohumeral ligament (CHL) in the stability of the shoulder and its role in the rotator interval has emerged in the recent literature, surgical treatment to repair the CHL has emerged as a possible treatment option for patients with MDI.

Originating at the lateral process of the coracoid and containing both ligamentous and smooth tissue components,[14] the CHL has been reported to be an important structure in the rotator interval with regard to posterior and inferior translation.[15-17] Although the CHL seemingly plays an extensive role in stability of the shoulder, underlying pathology such as collagen disorders makes reconstruction of the CHL, rather than repair, a possibly critical component in reducing MDI in the soft-tissue compromised patient population or those who have undergone numerous stabilization procedures.[15,16] The purpose of this Technical Note is therefore to describe our preferred surgical technique for the reconstruction of the CHL.

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Fig 1. Preoperative anteroposterior radiograph indicating inferior subluxation of the humeral head and large acromiohumeral distance in a left shoulder. (CP, coracoid process; HH, humeral head.)

Surgical Technique

CHL Reconstruction

In patients with persistent laxity, resultant instability, and a residual sulcus at initial presentation, and who remain refractory to surgical intervention after primary stabilization techniques have been attempted, it is likely that the rotator interval (RI) is incompetent. Because the RI is incompetent, 1 of the most important structures, the CHL, is likely injured and attenuated. This results in in a persistent sulcus in external rotation (Fig 1). If a residual sulcus is observed, a decision can be made to reconstruct the CHL using a semitendinosus allograft (or autograft) to improve the MDI picture (Video).

The semitendinosus graft is first prepped on the back table with a standard whipstitch at 1 end of the graft with No. 5 FiberWire and again with FiberTape. The insertion site of the CHL at the coracoid is then identified and prepped with a small cobb and needle tip Bovie device to elevate soft tissue. In cases of failed Latarjet procedures in which the coracoid process has been removed, the resultant coracoid stump should be available for anchor placement, because it is just lateral and inferior to the elbow of the coracoid. Carefully, the tunnel should be drilled under power while ensuring that the drill is intracortical in the coracoid. Using a depth gauge, the tunnel can be sounded to ensure the tunnel is contained and surrounded by 4 cortices. The tunnel is then tapped under power to a 4.75-mm diameter. The suture tails of the whipstitched end of the graft is loaded into a 4.75-mm SwiveLock anchor (Arthrex) and then fixated in anatomic position (Fig 2). To ensure solid fixation, the graft can be oversewn at the base with the remaining FiberWire and FiberTape (Arthrex) suture tails.

Next, the humerus is placed in approximately 40° of external rotation and fully superiorly translated. The superior aspect of the lesser tuberosity, where the normal CHL insertion site is located, is identified, and a tunnel is created with a drill under power. A preloaded 4.75-mm SwiveLock Anchor (Arthrex) with FiberWire is then placed at the insertion site of the CHL at the most superior aspect of the lesser tuberosity (Fig 3).

The arm is placed in 40° of external rotation and 30° of abduction and neutral flexion to place the graft in appropriate tension eliminating the sulcus and held in this position by an assistant during fixation. The semitendinosus graft is then brought out to the insertion of the CHL to approximate the total desired length of the graft (Fig 4A). A free needle is loaded with a single FiberWire tail and subsequently whipstitched proximally, starting at the desired length location and then back distally for a total of 25 mm through the taut semitendinosus graft several times. Using the free end

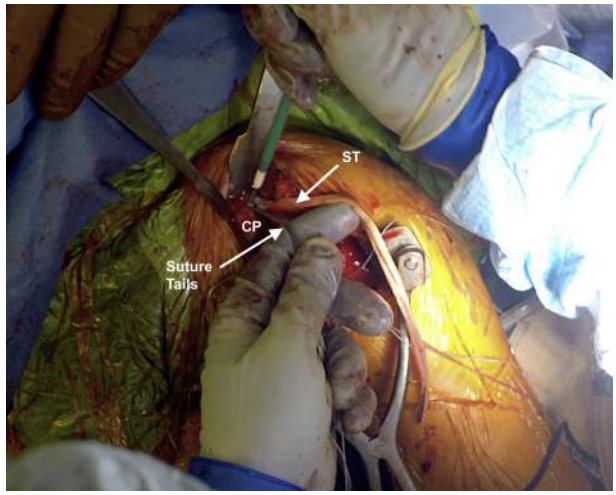

Fig 2. Proximal anchor placement to the coracoid process in a left shoulder. The FiberWire and FiberTape suture tails are preloaded into a 4.75-mm SwiveLock anchor and tightened to the end of graft. The anchor with the loaded graft is then position into the predrilled tunnel at the coracohumeral ligament insertion site of the coracoid process. The remaining suture tails can then be over sewn into the base of the graft to ensure solid fixation. (CP, coracoid process; ST, semitendinosus graft).

Fig 3. Humeral head anchor placement in a left shoulder. A preloaded 4.75-mm Swivelock anchor with FiberWire is placed in the predrilled tunnel at the insertion site of the coracohumeral ligament located at the superior aspect of the lesser tuberosity prior to graft fixation. (HH, humeral head; LT, lesser tuberosity; SSC, lateral portion of tenotomized subscapularis tendon.)

of the FiberWire suture tail that is passing through the SwiveLock anchor, this is pulled to approximate the graft to the insertion site and then tied with alternating half-hitches to the limb that had just been whipstitched. The graft should be secured to the superior aspect of the lesser tuberosity while ensuring that the sulcus is reduced (Fig 4 B and C). Additional sutures into the RI and rotator cuff (the subscapularis) may be used to strengthen the construct. Postoperative imaging can be further used to assess if the humeral head has been sufficiently reduced. The advantages and disadvantages and pearls and pitfalls of this technique are summarized in Tables 1 and 2, respectively.

Discussion

This Technical Note describes the reconstruction of the CHL to augment MDI of the shoulder stabilization procedures in patients with EDS. When previous stabilization procedures have failed, other secondary stabilization procedures should be acknowledged during preoperative decision making to restore native shoulder function. Several previous studies have suggested the use of RI plication or closure to address posterior and inferior subluxation of the shoulder[15,18]; however, biomechanical studies evaluating these techniques have reported that arthroscopic RI plication does not reduce posterior and inferior subluxation.[19] In contrast, the same study found that medial to lateral CHL plication improved both anterior and inferior stability.[19] Furthermore, rotator interval closure (capsular plication of medial glenohumeral ligament and superior glenohumeral ligament) has also been shown biomechanically to decrease external rotation and could possibly lead to postoperative stiffness.[18,20,21] Although reconstruction of the CHL with a semitendinosus graft has yet to be evaluated biomechanically, in clinical cases in which a residual sulcus is present, reconstruction of the CHL should provide additional superoinferior instability when other stabilization techniques are inadequate.

Clinical studies reporting successful outcomes in patients with EDS and MDI have been limited. Open inferior capsular plication for patients with EDS and MDI has been shown to improve both subjective and objective shoulder function and stability[22]; however, rates of recurrent instability remain a challenge in this patient population.[22] Furthermore, although plication of the RI has been reported to reduce the rate of recurrent instability for patients with anterior instability, to the authors' knowledge, the efficacy of RI

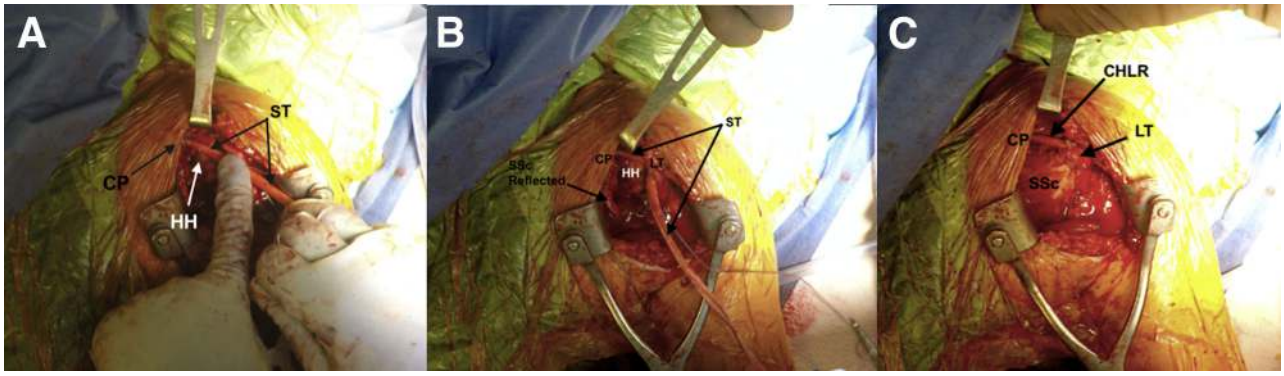

Fig 4. Coracohumeral ligament graft fixation to the humeral head in a left shoulder. (A) The semitendinosus graft is brought out to the site of the previously placed anchor at the superior aspect of the lesser tuberosity. The length of the graft is then approximated and subsequently whipstitched proximally with 2 of the 3 remaining anchor suture tails. (B) The graft is then fixated to the lesser tuberosity by pulling the free suture tail through anchor. (C) The excess semitendinosus graft is excised at base of fixation. The tenotomized subscapularis tendon is then repaired and the procedure is complete. (CP, coracoid process; HH, humeral head; SSc, subscapularis tendon; ST, semitendinosus autograft.)

Table 1. Advantages and Disadvantages

Advantages	Disadvantages
- Restores an incompetent rotator interval - Soft-tissue procedure that can aide in inferior instability - Reproducible and anatomic technique that restores the native acromiohumeral distance - Good visualization of anatomic attachment sites of the coracohumeral ligament	- Last resort soft-tissue operation for patients with recurrent inferior shoulder instability - Not commonly used as an isolated procedure - Outcomes dependent on the efficacy of concomitant primary stabilization procedures

plication concurrent with additional stabilization procedures have not been performed.[18,23] One study also reported that RI closure in addition to posterior capsular repair does not improve outcomes, and possibly only improving stability for patients with anterior instability.[20] It is possible that plication procedures may not be adequate to restore normal shoulder function because of capsular tissue laxity secondary to injury and connective tissue disorder. We therefore believe that reconstruction of the CHL may combat this challenge with the addition of new allograft tissue and the ability to properly reduce the glenohumeral joint at time 0.

We acknowledge that there are some risks and limitations innate to this technique. First, it is technically demanding and requires careful drilling, especially at the base of the coracoid, where there is a possibility of fracture. Furthermore, although reconstruction of the CHL may help reduce inferior subluxation of the glenohumeral joint, CHL reconstruction is not commonly performed as an isolated procedure, and patient-reported outcomes may be dependent on the efficacy of concomitant stabilization procedures used to address multidirectional stability.

This Technical Note describes our preferred surgical technique for reconstruction of the CHL with a semitendinosus allograft. In our experience, this procedure successfully treats patients with persistent shoulder laxity, recurrent MDI instability, and connective tissue disorders. We believe that this technique provides a viable and reproducible stabilization procedure that can be performed concurrently with major stabilization procedures to improve patient satisfaction and functionality when primary surgical interventions have failed or are insufficient when unable to fully address the patient's MDI of the shoulder.

Table 2. Pearls and Pitfalls

Pearls	Pitfalls
- Tension the graft in 40° of external rotation 30° abduction and neutral flexion - Center humeral head and ensure sulcus is not present - Partially drill anchor site at origin of coracohumeral ligament and followed by sounding to ensure the anchor will be intracortical	- Rare and technically challenging - Eccentric drilling at the base of the coracoid could lead to coracoid fracture

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