Arthroscopic Coracoclavicular Ligament Reconstruction Utilizing a Semitendinosis Graft and Titanium Flip Button Tension Band Construct

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Introduction

The surgical treatment of symptomatic complete or high grade acromioclavicular (AC) joint disruptions remains controversial with more than 60 published techniques.[1] Concerns regarding strength of initial fixation, cyclic failure, and inconsistent outcomes with techniques similar to the coracoacromial (CA) ligament transfer first described by Weaver and Dunn have been reported.[2-5] Failure due to synthetic material abrasion at the clavicle or coracoid as well as cyclic failure of the synthetic material is a concern with techniques utilizing a synthetic material construct alone.[6, 7] Excellent biomechanical strength and clinical outcomes have been recently reported with tendon graft coracoclavicular (CC) reconstruction.[8-10] This paper describes an arthroscopic technique that is equally suitable to acute or chronic high grade AC joint disruptions as well as previously failed CC reconstructions. A tension band construct is created utilizing a single titanium flip button device placed at the inferior cortex of the coracoid (#7 PE ZipLoop Extended ToggleLoc; Biomet. Warsaw, IN) combined with a Semitendinosis graft. Along with offering the benefits of an arthroscopic approach, the technique also offers the additional advantage of placing no hardware at the superior aspect of the clavicle.

Surgical Technique

After initially learning an arthroscopic AC reconstruction technique in August 2000, as described by Wolf,[11] we have gradually modified our technique both to address potential biomechanical and clinical limitations and to formulate the most reliable technique with inherent applicability for the broadest possible patient population.

We perform all shoulder arthroscopy procedures in the modified lateral decubitus position utilizing 6-10 pounds of counter-traction to suspend the arm. (Figure 1) For patients that prefer an autograft, we recommend harvesting the ipsilateral Semitendinosis graft with the patient initially in the supine position.[12] Glenohumeral and subacromial arthroscopy for diagnosis and treatment is initially performed as required for each unique patient circumstance. We prefer to address all other concurrent pathology prior to proceeding with the CC reconstruction. Visualization of the inferior aspect of the coracoid is then performed similar to the manner first described by Wolf.[11]

Figure 1a: *Patient with symptomatic Right Grade IV AC Separation.*

Figure 1b: *Same patient positioned in the semi-lateral decubitus position with portal sites and clavicle incision outlined.*

The inferior and lateral aspect of the coracoid process is clearly visualized followed by a 1.5cm incision in Langer's lines at the superior aspect of the clavicle (3cm incision if also performing a distal clavicle resection). Subcutaneous dissection is performed followed by subperiosteal elevation of soft tissues to the anterior and posterior margins of the clavicle. The periosteum anterior and inferior to the clavicle is elevated to allow instrument passage to the coracoid. The clavicular and coracoid tunnels are created utilizing an arthroscopic ACL guide and a 2.4mm drill point guide wire as previously described.[11] (Figure 2) A 4.5mm cannulated drill is utilized over the initial guide wire to create a 4.5mm tunnel in the clavicle and coracoids. (Figure 3) The clavicular tunnel is placed approximately 35mm proximal to the distal clavicle, placing it between the trapezoid and conoid ligament insertions.[13, 14]

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The guide wire is removed leaving the cannulated drill in place. After a pulling suture is passed through the cannulated drill, superior to sub-coracoid, and retrieved via the anterior cannula, the pulling suture is tied to the ToggleLoc passing suture. The ToggleLoc device has two adjustable ZipLoops, a passing suture loop, and a "zip suture" loop. (Figure 4) With counter traction applied to the ZipLoops to ensure the ToggleLoc does not flip prematurely, the ToggleLoc device is pulled down through the clavicle and coracoid tunnels until it is clearly visualized inferior to the coracoids. (Figure 5) The ToggleLoc device is now allowed to flip and engage the inferior coracoids. (Figure 6)

Figure 2: *Sawbones model demonstrating placement of 2.4mm drill point guide wire.*

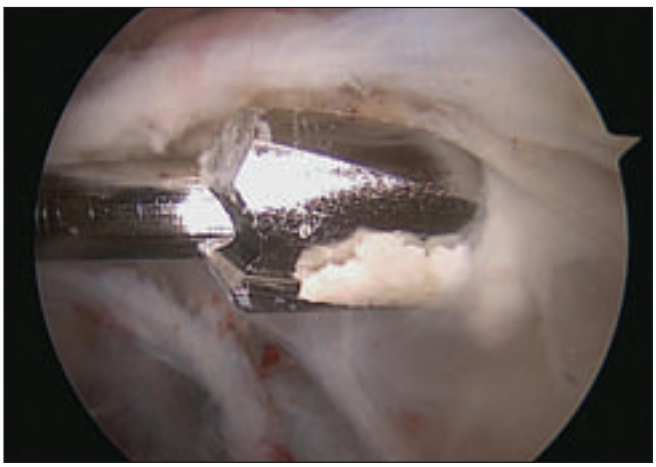

Figure 3: *Arthroscopic view of 4.5mm cannulated drill over the initial guide wire at inferior aspect of coracoid.*

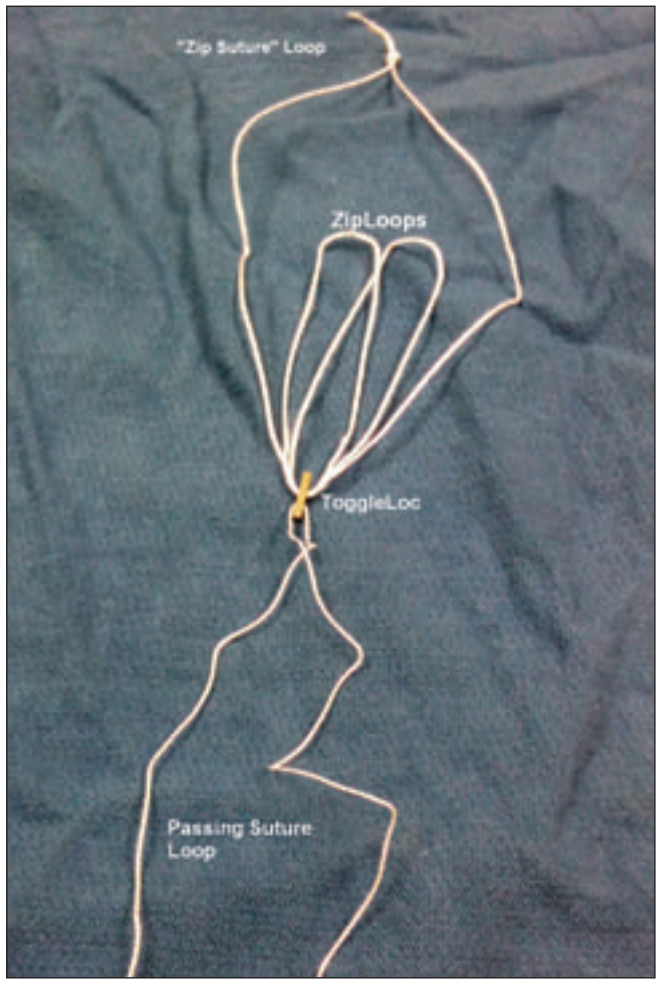

Figure 4: *#7 PE ZipLoop Extended ToggleLoc; Biomet. Warsaw, IN.*

The "zip suture" loop and one of the ZipLoops is retrieved anterior to the clavicle leaving one ZipLoop within the clavicular tunnel and one anterior to the clavicle. (Figure 7) The Semitendinosis graft is passed through the anterior ZipLoop to create two equal limbs. The appropriate limb of the "zip suture" loop is pulled to shorten this anterior ZipLoop, pulling the Semitendinosis graft to the coracoid tunnel. The ToggleLoc can be rotated or adjusted under direct visualization, utilizing a probe via the anterior cannula, prior to fully reducing the anterior ZipLoop. The anterior ZipLoop is reduced fully, firmly approximating the midpoint of the Semitendinosis graft to the superior aspect of the coracoid and fixing the position of the ToggleLoc at the inferior coracoids. (Figure 8)

One limb of the Semitendinosis graft is now passed posterior to the clavicle and medial to the clavicular tunnel to mimic the conoid ligament. With one limb of the Semitendinosis posterior to the clavicle and the other anterior, the limbs are passed through the remaining ZipLoop in the clavicle tunnel. A surgeon's knot is utilized to tie the

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Figure 5a: *ToggleLoc device is pulled down through the clavicle and coracoid tunnels.*

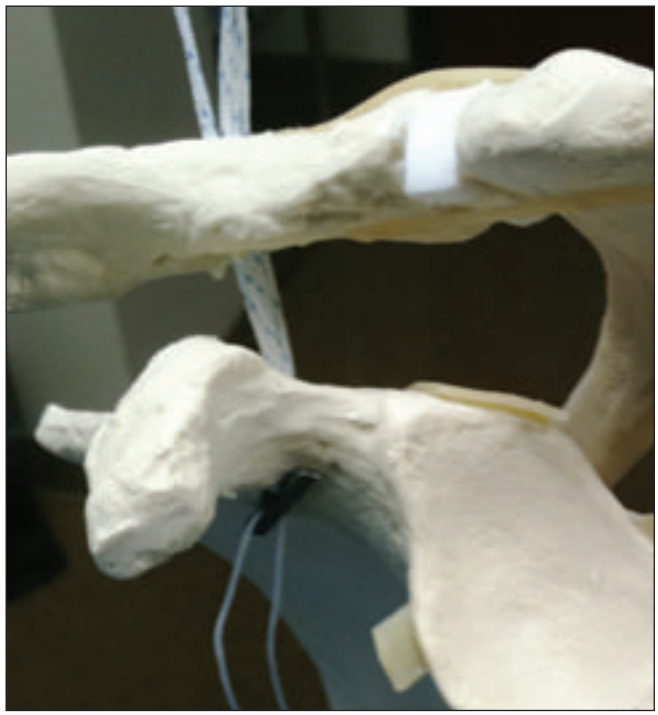

Figure 5b: *ToggleLoc device engaged at inferior aspect of coracoid.*

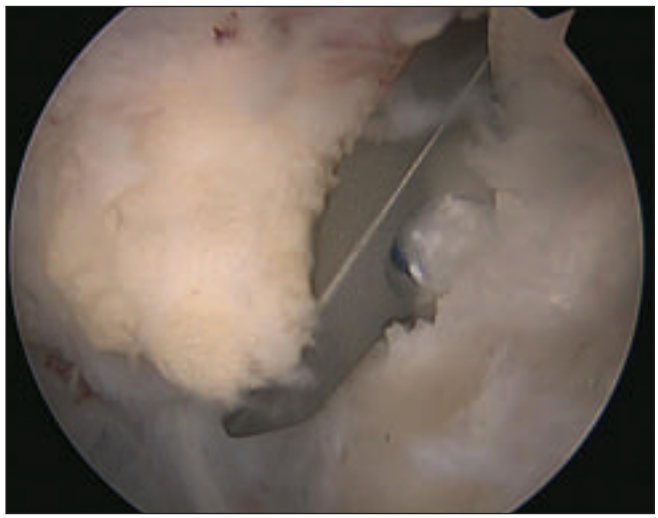

Figure 6: *Arthroscopic view of ToggleLoc device engaged at inferior aspect of coracoid.*

two limbs of the graft over the clavicle while the clavicle is held in a reduced position with the arm traction released. A running locking suture (MaxBraid, Biomet) is utilized to suture the two limbs together. The "zip suture" is now pulled to shorten the clavicular ZipLoop until it is shortened as much as possible. This ZipLoop compresses the graft to the superior aspect of the clavicle, while also creating a construct to maintain tension in the graft. (Figure 9)

The passing suture is removed from the ToggleLoc device. Next, the two limbs of "zip suture" are separated and tied, sliding the knot to the superior aspect of the coracoid utilizing standard arthroscopic techniques. The excess ends of the graft are trimmed and the incision is closed in layers (fascia, subcutaneous, skin). The portals are closed with simple sutures. The patient wears a simple sling for one month postoperatively, performing Codman and supine range of motion exercises daily. Active motion and activities are gradually increased with most patients returning to all regular activities at 12-16 weeks postoperatively. We encourage patients to wait at least 6 months to return to contact sports (football, rugby, hockey, etc.) and Olympic style lifts (Dead lift, Snatch, Clean and Jerk). [15]

Discussion

Of the multiple techniques previously described for high grade AC disruptions, arthroscopic CC reconstruction has only been described recently.[11, 16-21] Although many techniques focus on transfer of the CA ligament with or without augmentation, we prefer to avoid utilizing the CA ligament because the CA ligament may play an important role in shoulder function.[5] Strength of initial fixation, cyclic failure, and inconsistent outcomes with techniques similar to the coracoacromial CA ligament transfer first described by Weaver and Dunn are also of potential concern.[3-6, 9, 22] Techniques utilizing only a synthetic material or rigid fixation to maintain the relationship between the clavicle and coracoid are inherently reliant on the biologic healing

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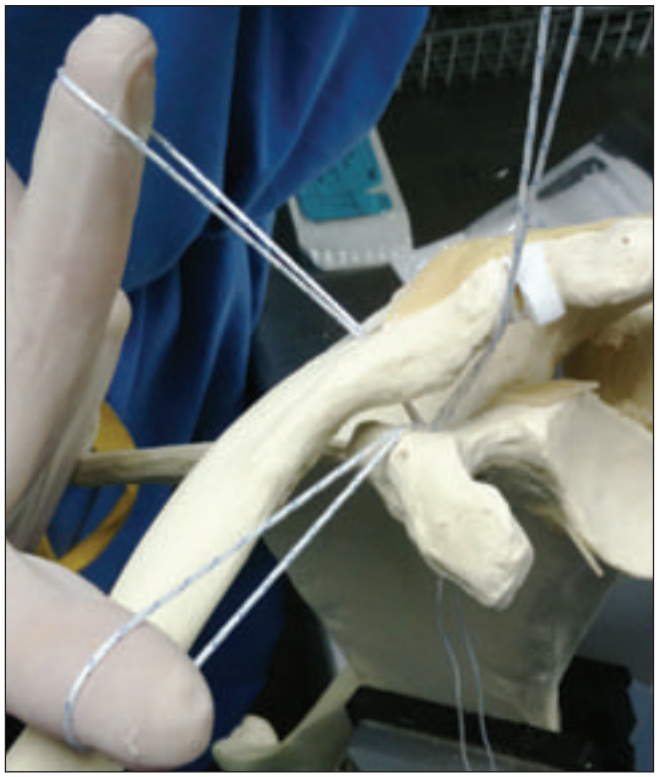

Figure 7: *The "zip suture" loop and one of the ZipLoops is retrieved anterior to the clavicle leaving one ZipLoop within the clavicular tunnel and one anterior to the clavicle.*

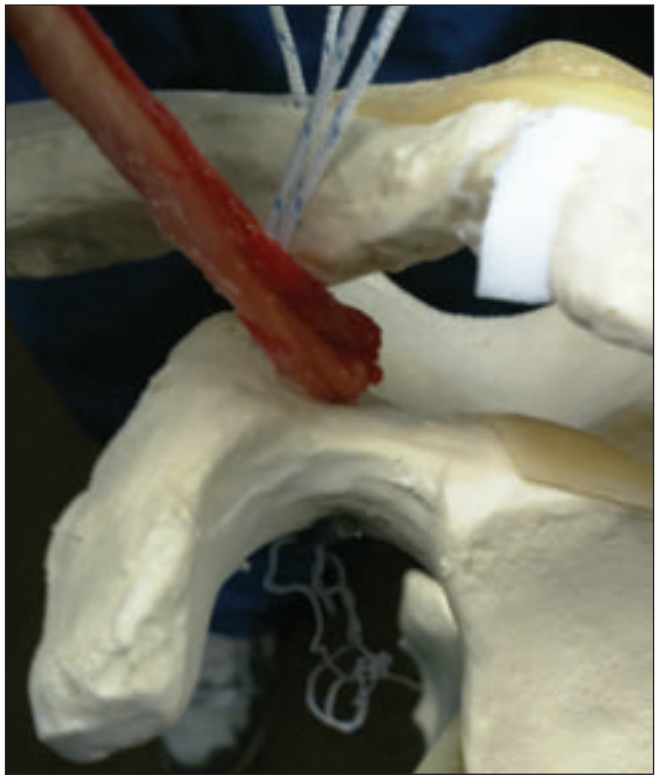

Figure 8: *The anterior ZipLoop is reduced fully, firmly approximating the midpoint of the Semitendinosis graft to the superior aspect of the coracoid and fixing the position of the ToggleLoc at the inferior coracoid.*

potential of the patient's disrupted CC ligaments and may not be appropriate for chronic AC disruptions or previously failed reconstructions. The biomechanical and functional limitations of these techniques have also been studied.[4, 6, 7, 23] Recent work focusing on reconstruction of the CC ligaments with biologic tissue (allograft or autograft) has shown promising biomechanical and clinical results.[8, 10, 13, 20, 22, 24, 25] Our technique builds on and differs from previously reported open and arthroscopic biologic CC reconstruction techniques:

- An arthroscopic technique potentially offers reduced morbidity, improved cosmesis, and the ability to address concurrent shoulder pathology.[11, 16]
- The lack of superior hardware placement avoids the potential for hardware loosening, irritation, or prominence.
- A single 4.5mm tunnel in the clavicle and coracoid instead of larger or multiple tunnels help reduce the risk of subsequent fracture.[26, 27]
- The continuous suture loops placed through the coracoid and clavicle provide uniform compression of the graft at the coracoid and clavicle. Rather than relieve load from the graft, they create a tension band construct to maintain graft tension and position.
- Placing the graft at the superior cortex of the coracoid more accurately reproduces the anatomic location of the native CC ligaments and avoids the possibility of anterior clavicle translation with passage of the graft around the clavicle.[14, 28, 29]
- The risk of neurovascular injury to structures medial to the coracoid is reduced as no dissection medial to the coracoid is required.
- The placement of a single drill hole in the clavicle at 35mm medially allows the two limbs of the graft to reproduce the anatomic course and function of the Trapezoid and Conoid ligaments.[14]
- The #7 Adjustable Loop ToggleLoc Device has an average peak load of 1664.1N, 374.1lbs with 0mm cyclic loading slippage under testing resulting in the highly desirable likelihood of failure of the Semitendinosis graft rather than at the points of fixation similar to the open technique described by Lee et al (Biomet Sports Medicine, data on file).[9]
- Minimal preparation of the graft is required reducing operative time.
- The technique utilizes readily available implants and instruments, familiar to many arthroscopic surgeons, making it relatively simple to learn.

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Figure 9a: *Graft passed and tied through clavicular ZipLoop.*

Figure 9b: *Ziploops fully reduced fixing tension and position of graft.*

Figure 9c: *Postoperative radiograph of arthroscopic CC reconstruction technique.*

As of January 2010, we have performed the technique in six patients. All patients had high grade AC disruptions with disabling symptoms secondary to high energy injuries (motor vehicle accident, recreational vehicle accident, bicycle accident, contact sports, or industrial accident). All six patients also had concurrent shoulder pathology treated arthroscopically at the same operation (rotator cuff tear-2, anterior instability-1, posterior instability-1, SLAP Lesion-4) highlighting the benefits and advantages of an arthroscopic approach. With an admittedly short follow-up, we have had no complications or failures to date and find the technique highly satisfactory for our patients. We continue to follow our patients prospectively for longer term outcomes. In summary, we present a strong and reliable arthroscopic technique for anatomic CC reconstruction as an option for significantly symptomatic high grade acute and chronic AC disruptions as well as failed CC reconstructions.

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