

# Arthroscopically Assisted Acute Acromioclavicular Joint Reconstruction Using the Infinity-Lock Button System



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**Abstract:** Acromioclavicular (AC) joint injuries are the most common shoulder injuries in the athletic population. The literature is rife with various surgical techniques and implants as well as opinion on proper timing of surgical options. Patient outcomes are generally similar across fixation method. Complications are common following reconstruction, and the specific type of complication may depend on the technique used. Fracture and graft elongation are associated with use of allograft, whereas button cutout and skin irritation can occur with cortical suture-fixation methods. This technical paper describes an arthroscopically assisted acute AC joint reconstruction technique using the Infinity-Lock Button System. This technique provides a minimally invasive, low-profile reconstruction that may minimize risk of clavicle and coracoid fracture as well as overlying skin irritation. Acute reconstruction may permit healing of the native coracoclavicular and AC ligaments and mitigate risk of future AC joint arthritis.

Acromioclavicular (AC) joint injuries are some of the most commonly sustained athletic shoulder injuries, with about 90% of all injuries to the AC joint occurring during athletic participation.<sup>1,2</sup> Generally, Rockwood type 1 and type 2 injuries are managed conservatively whereas greater-grade AC joint injuries such as types 4, 5, and 6 frequently require surgical stabilization of the AC joint.<sup>2,3</sup> There is less unanimity on the management of Rockwood type 3 injuries. A recent randomized control trial showed similar outcome scores at 1 year in patients managed conservatively versus

operatively with a suture button construct for type 3 and type 4 injuries.<sup>4</sup> Although nonoperative management resulted in significantly lower overall cost and generally provided a faster recovery, 16% were dissatisfied with nonoperative treatment and went on to surgical stabilization. Therefore, many recommend that type 3 injuries initially undergo a trial of conservative management, with those not responding proceeding on to surgery.<sup>2,3</sup>

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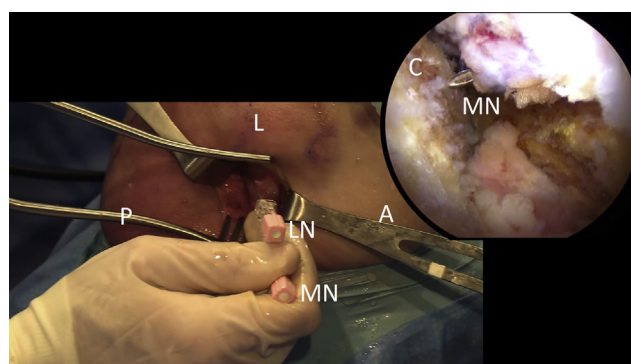
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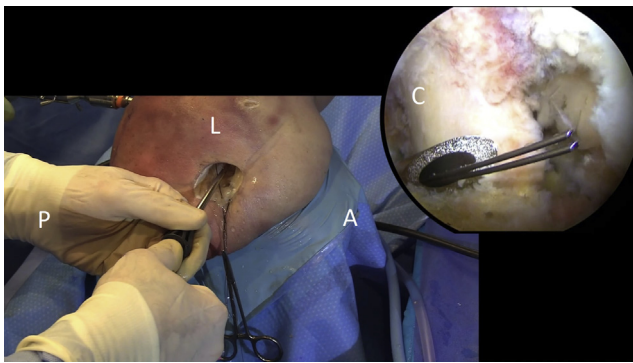
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**Fig 1.** This is a left shoulder with the patient positioned in the lateral decubitus position. Anterior (A) is to the right, posterior (P) to left, lateral (L) is up. The lateral needle (LN) is in the acromioclavicular joint. The medial needle (MN) is through the fascia just anterior to the clavicle directed towards the coracoclavicular ligament origin on the coracoid (C). This provides the trajectory for drilling the guide pin through the clavicle. The arthroscopic image is shown from the posterior portal through a 70° arthroscope confirming appropriate trajectory of the needle.



**Fig 2.** This is a left shoulder with the patient positioned in the lateral decubitus position. Anterior (A) is to the right, posterior (P) to left, lateral (L) is up. The coracoid passer is placed anterior to the clavicle through the fascial incision. It is slid down the medial aspect of the coracoid underneath the coracoid (C). The arthroscopic image is shown from the posterior portal through a 70° arthroscope and demonstrates the coracoid passer underneath the coracoid aiming laterally. The tail ends of the nitinol wire have been passed through the passer and will be retrieved back through the fascial incision with a grasper.

Potential benefits of acute reconstruction that have not been definitively shown in the literature include healing of native ligamentous tissue and easier reduction of the AC joint, as scar tissue has not had sufficient time to develop.<sup>5</sup> In addition, Muench et al.<sup>6</sup> showed that heterotopic ossification and AC joint arthritis occurred exclusively in reconstructions with chronic AC joint injuries (defined by the authors as >6 months postinjury). Importantly, the definition of an acute AC joint injury in the literature is not without contention, ranging from less than 2 weeks up to 6 months following injury.<sup>4-7</sup> In this technical paper, we describe an arthroscopically assisted acute AC joint reconstruction using the Infinity-Lock Button System (Xiros, Leeds, UK).

### Surgical Technique (With Video Illustration)

The patient is placed in the lateral decubitus position (Video 1). General endotracheal anesthesia and a supraclavicular region block are used. An examination under anesthesia is performed, noting the degree of AC joint instability and reducibility.

After routine skin preparation and draping, landmarks are marked out. With a ruler, the planned Infinity-Lock drill hole through the clavicle is marked approximately 3 to 4 cm medial to the AC joint.

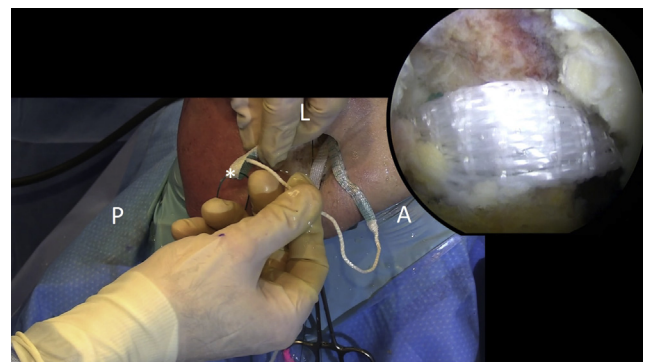
A standard mid-posterior glenoid viewing portal is established followed by an anterior rotator interval portal. Visualization is accomplished with a 30° arthroscope. With a shaver, the rotator interval tissue is cleared away to identify the coracoid. We then switch to a 70° arthroscope for the remainder of the case. Both the shaver and radiofrequency ablation are used to

remove tissue circumferentially around the coracoid to provide visualization. One should be able to see the undersurface of the clavicle and the coracoid tubercle.

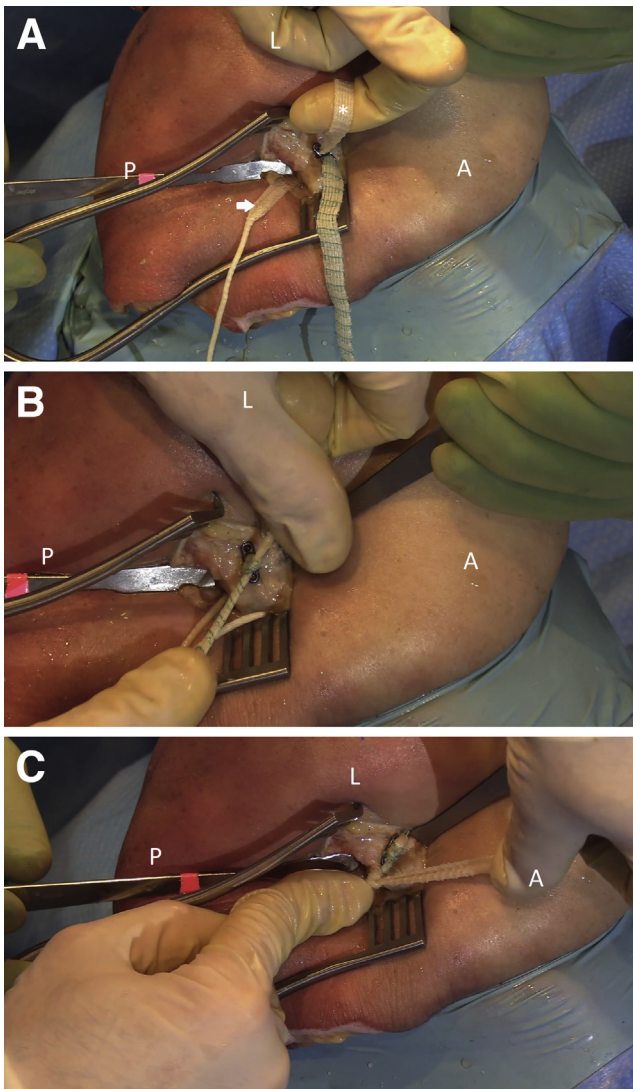
A saber incision is made half the distance between the AC joint and the planned clavicular drill hole. The deltotracheal fascia is taken down in a single layer longitudinally along the clavicle. Care is taken not to strip anteriorly or posteriorly to maintain the arthroscopic space underneath.

A needle is placed in the AC joint for reference. A second needle is placed 3 to 4 cm medial to the AC joint just anterior to the clavicle to verify the drilling trajectory over the anatomic insertion point of the coracoclavicular ligaments (Fig 1). A 2.4-mm drill pin is placed centrally through the clavicle 3 to 4 cm medial to the AC joint and directed toward to the coracoclavicular ligament origin of the coracoid. A 4.0-mm cannulated drill is passed over the pin drilling through the clavicle. The central drill pin is removed while keeping the drill in the clavicle. A nitinol wire is passed through the drill and shuttled out the rotator interval portal with a retriever. The drill is removed, leaving the nitinol wire in place. A 1-cm fascial incision is made anterior to the clavicle adjacent to the drill hole. The nitinol wire loop exiting out the anterior portal is retrieved through the fascial split.

The coracoid passer is placed through the fascial incision into the space between the clavicle and coracoid. The tip of the passer slides along the medial edge of the coracoid inferiorly coming around the base laterally (Fig 2). The tails of a second nitinol wire are placed through the passer and retrieved through the anterior clavicular fascial incision with a grasper. The coracoid passer is removed, leaving the nitinol wire around the base of the coracoid with the looped end on the medial side.



**Fig 3.** This is a left shoulder with the patient positioned in the lateral decubitus position. Anterior (A) is to the right, posterior (P) to left, lateral (L) is up. The Infinity-Lock has been shuttled around the coracoid. Now, the tails of the Infinity-Lock are loaded through the concave portion of the loop (asterisk) of the device. The arthroscopic image is shown from the posterior portal through a 70° arthroscope and demonstrates that the Infinity-Lock is around the base of the coracoid.



**Fig 4.** This is a left shoulder with the patient positioned in the lateral decubitus position. Anterior (A) is to the right, posterior (P) to left, lateral (L) is up. The 2 limbs of the Infinity-Lock have been passed up through clavicle and threaded through the Infinity-Lock Button. (A) One limb (arrow) is then partially shuttled underneath the clavicle from anterior to posterior, leaving a loop (asterisk) anteriorly. (B) After the acromioclavicular joint is reduced, the 2 limbs are tensioned to remove any slack from the system and a half-hitch is thrown. (C) The posterior limb is then completely passed posteriorly and knot-tying is finished minimizing any bulk superiorly that may cause irritation.

The green-lead ETHIBOND suture (Ethicon, Somerville, NJ) of the Infinity-Lock is loaded into the loop of the nitinol wire around the coracoid. The Infinity-Lock is then shuttled from medial to lateral around the coracoid. It should move freely around the coracoid without soft-tissue entrapment. The tails of the Infinity-Lock are loaded through the concave portion of the loop of the device and the green lead suture is removed (Fig 3). The tails are tensioned to synch the device

around the coracoid. Toggling the tails helps remove any laxity. Direct palpation through the fascia as well as arthroscopic viewing allows confirmation the Infinity-Lock is secured around the coracoid.

The tails of the device are loaded through the remaining nitinol wire loop. The tails are then shuttled through the clavicle from inferior to superior. The tails are loaded through the center 2 holes of the Infinity-Lock button, which is approximated to the clavicle. Next, the coracoid passer with nitinol wire is placed from posterior to anterior underneath the clavicle. This allows shuttling of a single tail of the Infinity-Lock device. Incompletely shuttle the Infinity-Lock limb to leave a loop anteriorly (Fig 4). The 2 tails are tensioned to reduce the AC joint. A half hitch is tied. While maintaining tension, the posteriorly passed limb is completely shuttled and the knot stack is completed on the posterior surface of the clavicle. The deltotracheal fascia is closed followed by a standard skin closure. The postoperative protocol is provided in Table 1.

## Discussion

Various techniques and implants for AC joint reconstruction have been reported in the literature, with few showing definitive superiority over another.<sup>2,3</sup> Although the nonanatomic Weaver–Dunn reconstruction has been shown to have inferior outcomes compared with anatomic reconstructions, the proliferation of techniques makes other direct head-to-head comparisons difficult.<sup>3,6</sup> Thus, no current gold-standard reconstructive technique exists for the AC joint.

Postoperative failures and complications are common after AC joint reconstruction, occurring in about one quarter of all cases.<sup>6,8</sup> Common reasons for failure include clavicle and/or coracoid fracture, graft elongation, suture button cutout, skin irritation from bulky subcutaneous devices, heterotopic ossification, AC joint arthritis, and adhesive capsulitis.<sup>2,5,6,8</sup> The incidence of

**Table 1.** Postoperative Protocol After Arthroscopically Assisted Acute Acromioclavicular Joint Reconstruction Using the Infinity-Lock Button System

Postoperative Period	Rehabilitation Process
Immediate	Patient is immobilized in a sling with an abduction and derotation pillow.
0-6 weeks	Use of the sling and pillow continues; elbow, wrist, and hand range-of-motion exercises are permitted.
6-8 weeks	Use of the sling is discontinued; active-assisted range of motion is begun.
8-16 weeks	Isometric rotator cuff strengthening is started and progressed as tolerated.
16-24 weeks	Sports-specific training is performed.
>24 weeks	Return to full activity.



**Table 2.** Advantages and Risks of Surgery

Advantages	Risks
Minimally invasive, arthroscopically assisted	Risk of neurovascular injury
Low profile	Risk of clavicle fracture
No risks or cost of allograft use	Cost of implant
Minimizes risk of fracture/cutout	
<ul style="list-style-type: none"> <li>• Single, small drill hole through clavicle</li> <li>• Looped fixation around clavicle</li> <li>• Luggage tag fixation around coracoid</li> </ul>	

these complications varies by reconstructive technique as well as by study.

While some anatomic allograft reconstructions avoid drilling a hole through the coracoid by looping the graft, the 2 drill holes through the clavicle to mirror the native conoid and trapezoid ligaments place this bone at elevated fracture risk.<sup>2</sup> Minimizing the size of these drill holes helps increase the load to clavicle fracture.<sup>9</sup> Although suture button constructs may not experience the same complication profile as allograft reconstructions, they are susceptible to cut-through, particularly on the coracoid side unless proper button deployment is confirmed arthroscopically.<sup>9</sup> These constructs also may be particularly susceptible to overlying skin irritation.

While the Infinity-Lock Button System (Xiros) has not been evaluated against other techniques, the authors believe it presents several theoretical advantages (Table 2). When done acutely, it may allow native ligament healing and does not necessitate the use of allograft, which increases surgical cost and exposes the patient to the infectious risks of allografts. This system minimizes fracture risk, since it is looped around the coracoid in luggage tag fashion and requires only a single, small 4.0-mm drill hole through the clavicle. With no button on the coracoid, risk of cutout is removed. In addition, looping the implant around the clavicle mitigates risk of clavicular button cutout. By

tying the knot stack posteriorly on the clavicle, potential skin irritation also is minimized. As with other suture constructs, there is still a small risk of osteolysis and implant failure.

Overall, this technique describes an arthroscopically assisted acute reconstruction of the AC joint through a minimally invasive incision with minimal implant bulk decreasing the risk of irritation of the construct.

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