A novel method of acromioclavicular joint separation fixation using a knotless dog bone technique

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ABSTRACT

Acromioclavicular (AC) joint separations are common in both sports and trauma injuries. Many surgical options exist for fixation of these injuries. Although the suture button has become popular, it has a moderately high complication rate. The most common complication is the loss of reduction, but another common complication is knot-related pain. This article outlines a method of suture button fixation that addresses both of these complications with a novel knotless construct using TightRopes.

KEYWORDS Acromioclavicular separation; dog bone; TightRope

Acromioclavicular (AC) joint separations are common injuries that typically result from a medially directed force to the lateral shoulder. They were initially classified into Types I to III by Tossy et al^{1,2} in 1963 and were further classified into Types I to VI when Rockwood³ expanded the classification in 1989. Most authors agree that Type I and II injuries should be treated conservatively and Types IV to VI are best treated with surgery. However, the optimal treatment modality for Type III injuries is controversial. Surgery is typically reserved for patients involved in high-demand sporting or working activities.⁴ In addition, multiple surgical techniques have been employed for AC separation fixation. Recently there has been an increase in the use of suture buttons, two titanium endobuttons that reduce the distal clavicle to the coracoid with nonabsorbable suture for nonrigid fixation.^{5,6} Biomechanical studies have shown these to have comparable and possibly higher biomechanical strength than native ligaments.^{7,8} The procedure has a relatively high overall complication rate, with a commonly described complication being pain related to knot prominence.⁹ In an effort to mitigate this complication, the senior author developed a knotless technique with the use of the Arthrex Adjustable Button System (ABS) TightRope®.

CASE REPORT

A 66-year-old man presented at a level 1 trauma center after fall from a 12-foot ladder, which led to a left

Rockwood Grade V AC separation. Additional injuries included an ipsilateral olecranon fracture treated in a splint, a left pneumothorax, and multiple rib fractures. The patient was admitted to our surgical intensive care unit for management of his rib fractures and ultimately underwent extensive rib plating. He did well postoperatively from his rib fixation and we then proceeded with surgery to correct the AC joint separation 5 days after injury.

An anterior approach to the AC joint was obtained with a scalpel through the skin and then blunt dissection was carried down to the fascia. The distal clavicle was isolated and retracted posteriorly to gain access to the coracoid. The coracoid process was exposed, isolating the center of its base, and a 3.0-mm cannulated drill bit was used to make a drill hole through the base of the coracoid. A McGlamry elevator was placed underneath the coracoid to protect nearby structures and then the drill was removed from the cannulated drill bit, allowing the drill bit to rest on the McGlamry elevator. A Hewson suture passer was then placed through the drill bit and was guided out with the McGlamry elevator. Two ABS TightRopes were selected and the interlocking loops of the ABS TightRope were placed in the suture slots of the Arthrex Dog Bone Button® with the concave side facing cranially on the inferior aspect of the coracoid. Next, a #2 Fiberwire passing suture was looped through two TightRopes and then the tails of the #2 Fiberwire passing suture were looped through the suture passer and pulled

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Figure 1. (a) The two TightRopes have been pulled through a coracoid tunnel made with the 3.0-mm drill bit and are retracted laterally so that the clavicular tunnel can be drilled. (b) The TightRopes have been pulled through the clavicular tunnel, and the second Dog Bone is applied concave down. The Dog Bone is being tensioned to the clavicle using a hemostat while the TightRopes are being tensioned. A indicates acromion; C, clavicle.

Figure 2. (a) Intraoperative fluoroscopy films taken in the operating room. (b) X-rays taken 2 weeks postoperatively showing a well reduced AC joint and stable knotless Dog Bone construct. (c) X-rays taken 20 weeks postoperatively demonstrating that the reduction has been maintained and the hardware has not migrated.

through the coracoid (*Figure 1a*). The TightRope suture tails were then tagged with hemostats.

Attention was then turned to the clavicle. A 3.0-mm solid drill bit was used to make a drill hole through the clavicle at the appropriate position (verified with C-arm fluoroscopy). A suture passer was placed through the drill hole and the #2 Fiberwire passing suture was pulled through the clavicle. The two TightRopes were then pulled through the drill hole and a second Dog Bone Button was attached to the clavicular side of the two TightRopes. This was accomplished by positioning the TightRope “swedges” on either side of the suture slots of the button with the concave side of the button facing caudally. The Dog Bone was placed onto the superior aspect of the clavicle and centered over the drill hole and the TightRopes were tensioned until the Dog Bone laid flush on the clavicle (*Figure 1b*). The arm was taken through a complete range of motion (ROM) and the TightRopes were retensioned; the AC joint was visually seen to be stable with ROM. The TightRope suture ends were cut, leaving 3-mm suture tails on top of the button. Final radiographs were taken, verifying correct placement of all implants as well as excellent reduction of the AC joint (*Figure 2*).

Postoperatively the patient was instructed to avoid pushing, pulling, or lifting but was allowed passive ROM as well as active assisted forward flexion of the shoulder for the first 2 weeks. At the 2-week appointment, the sutures were

removed, upright radiographs were obtained, and the patient was permitted to begin more active ROM of his shoulder. At 6 weeks postoperatively, the patient had a pain score of 1/10, weaned from pain medications, and had nearly full active ROM of the shoulder. He was allowed to start light pushing, pulling, and lifting with the upper extremity. At 20 weeks postoperatively, he continued to do well without pain or evidence of hardware complications, both clinically and radiographically.

DISCUSSION

The complication rate of surgical repair of AC separation with a suture button system is between 27.1% and 44%, if clinical complications and unsatisfactory radiological results are taken into account.⁹ The most common complication is the loss of reduction. Many authors have proposed solutions to this problem, such as using a double button fixation system.^{7,10} Additionally, hardware-related pain, typically at the site of the upper button and knot, is a frequent complication of this type of fixation. Our technique addressed each of these complications by using ABS TightRopes rather than traditional suture.

Two ABS TightRopes were used to enhance the strength of the construct and to eliminate the need for knots. However, TightRopes require tension within the construct at

all times or the TightRope may loosen. Our surgical plan addressed this potential complication by applying a small 1- to 2-mm overreduction of the distal clavicle to maintain tension at all times. Additionally, we recommend retensioning the TightRope after taking the shoulder through a complete ROM intraoperatively. Finally, the TightRopes are cut without knots, which should eliminate knot-related pain.

We have had short-term success with this technique in our practice. Future studies may better describe the success of this technique in minimizing the loss of reduction and knot-related pain. In addition, new and innovative implant designs are likely to assist in minimizing these complications. However, our early success suggests that further investigation and utilization are warranted. Currently, we suggest the use of this technique, particularly if knot-related pain has been encountered with the treatment of these injuries.

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