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Arthroscopic low-profile reconstruction for acute acromioclavicular joint instability

Video online

The online version of this article (<https://doi.org/10.1007/s11678-019-0506-4>) contains the video: “Arthroscopic low-profile reconstruction for acute acromioclavicular joint instability.” You will find the video at the end of the article as “Supplementary material.” Video by courtesy of Dr. M. Minkus, Dr. N. Maziak, PD Dr. P. Moroder, and Prof. Dr. M. Scheibel, Charité—Universitätsmedizin Berlin 2018, all rights reserved.

Background

Acromioclavicular (AC) joint dislocation represents one of the most common injuries of the shoulder girdle and mainly affects young patients who are active in sports [1–3]. Numerous open and minimally invasive techniques have been described for the management of acute high-grade dislocations requiring surgical intervention. Arthroscopic techniques in particular have been improved and were subject to further development during the past decade [4–6]. Pulley-like implants such as TightRope (Arthrex Inc., Naples, FL, USA) or ZipTight (Zimmer Biomet, Warsaw, IN, USA) devices are widely used for minimally invasive reconstruction of the AC joint [7–9]. However, loss of reduction especially in the horizontal plane with dynamic posterior translation (DPT) was observed in up to 43% of patients and seemed to be associated with inferior clinical results [6]. Biomechanical studies suggested that an additional AC cerclage can reconstruct and stabilize the AC joint in the horizontal plane [10, 11]. Current

Fig. 1 ▲ Preoperative radiograph using a panoramic stress view (a) and modified Alexanderviews (b, c) showing a Rockwood type V injury with dynamic posterior translation

Fig. 2a,b ▲ Set-up and arthroscopic portals (see text for details)

Fig. 3a–f ▲ Coracoclavicular drilling (see text for details)

Fig. 4a–d ▲ Clavicular drilling for acromioclavicular cerclage (see text for details)

clinical data suggest that the combined coracoclavicular and AC stabilization technique can reduce DPT and can lead to satisfactory clinical results [7]. However, several patients complain about implant irritation due to knot stack and require implant removal. A new low-profile TightRope device aims to diminish this complication and simplify the anatomical reduction process. We present the arthroscopic low-profile reconstruction for acute acromioclavicular joint instability in a case of a 25 year old male patient (Fig 1).

Surgical technique

Set-up and arthroscopic portals

The patient is placed in the beach-chair position with the arm prepped and draped in a sterile fashion (■ Fig. 2a). The patient's head should be slightly tilted to the contralateral side allowing enough space for drilling of the coracoclavicular tunnel. For this minimally invasive surgical technique, a posterior and lateral viewing portal and an

Fig. 5a–d ▲ Acromial drilling for acromioclavicular cerclage (see text for details)

anteroinferior working portal are necessary. Additionally, a 2–3-cm incision on top of the clavicle is required (■ Fig. 2b). Diagnostic arthroscopy is performed via a standard posterior portal, and possible concomitant intra-articular lesions can be detected and treated if necessary. The anteroinferior working portal is established just above the subscapularis tendon using the outside-in technique. The transtendinous lateral viewing portal is placed approximately 1 cm posterior to the anterior border of the supraspinatus tendon. The incision of the lateral portal is made parallel to the tendon fibers of the supraspinatus tendon to minimize the trauma of access. Using a switching stick, the arthroscope is then introduced through the lateral portal. The subcoracoid bursa and the base of the coracoid are exposed and dissected with the aid of a radiofrequency ablation device or a shaver introduced through the anteroinferior portal. The aim is to achieve clear visualization of the undersurface of the coracoid arch through which the drill hole is to be made. A 2–3-cm sagittal incision is made over the clavicle approximately 3 cm medial to the AC

joint and the superior surface of the clavicle is cleared of soft tissue.

Coracoclavicular drilling

An image intensifier is used for the correct placement of the drill holes and the anatomical reduction of the AC joint. For coracoclavicular drilling, an adjustable drill guide is used and the marking hook is introduced through the anteroinferior portal under direct visualization and placed under the central part of the coracoid base. The other end with the drill sleeve is placed about 3 cm medial from the lateral end of the clavicle. The drill hole is established in between the previous coracoclavicular ligaments in a transclavicular–transcoracoid fashion. With the drill guide held in this position and under arthroscopic guidance, a 3-mm drilling through the clavicle and the base of the coracoid is performed using a drill bit with an implemented K-wire (■ Fig. 3a). Alternatively, a 2-mm K-wire can be used that is overdrilled with a 3.5-mm drill. The correct placement of the coracoclavicular drilling is controlled using the image intensifier (■ Fig. 3b, c).

Subsequently, the superior part of the clavicle is unicortically overdrilled using a 5.1-mm drill bit (■ Fig. 3d, e). The K-wire is then removed and a nitinol suture passing wire is inserted via the cannulated drill bit into the subcoracoid space and retrieved via the anteroinferior portal (■ Fig. 3f). The cannulated drill bit can then be removed.

Clavicular and acromial drilling

For horizontal stabilization, a percutaneous AC cerclage is used with a classic anterior cruciate ligament (ACL) drill guide. Therefore, the marking hook is placed via the superior incision behind the clavicle while the drill sleeve is introduced through the anteroinferior portal. The first drilling is performed in a transclavicular approach from anterior to posterior (■ Fig. 4a, b).

A 1.25-mm K-wire is placed through the clavicle using an image intensifier and overdrilled with a 2.7-mm cannulated drill bit (■ Fig. 4c, d). The K-wire can then be removed, and a nitinol suture passer is inserted via the cannulated drill bit and retrieved at the clavicular incision. For transacromial drilling, another 1.25-mm K-wire is used and drilled from lateral-caudal to medial-cranial and anterior of the AC joint (■ Fig. 5a, b). Transarticular drilling can be avoided by caudalization of the clavicle. After overdrilling with a 2.7-mm cannulated drill bit and removal of the K-wire, a nitinol suture passer is inserted and retrieved via the clavicular incision (■ Figs. 4 and 5c, d).

Reduction of the AC joint and coracoclavicular stabilization

The inferior sutures of the low-profile Tightrope device are attached to the proximal eyelet of the first nitinol wire and pulled from the other end through the clavicle and coracoid (■ Fig. 6a). Under arthroscopic guidance, the sutures are retrieved via the anteroinferior portal (■ Fig. 6b, c). A DogBone button (Arthrex Inc., Naples, FL, USA) is attached to the inferior sutures (■ Fig. 6d). By using a clamp and by pulling from the superior end, the inferior button is placed under the coracoid arch. Under

Fig. 6a-h ▲ Reduction of the acromioclavicular joint and coracoclavicular stabilization (see text for details)

Fig. 7a-f ▲ Acromioclavicular cerclage for horizontal stabilization (see text for details)

arthroscopic guidance, the button is placed in the correct position (■ Fig. 6e). By pulling the sutures of the low-profile device in an alternating manner, the double-button system tightens itself. The two suture pairs are pulled in an alternating manner until the superior button is on the level of the clavicle

enabling an anatomical reduction of the AC joint (■ Fig. 6f, g). A suture tensioner is mandatory for proper tensioning of the Tightrope device. In total, 80–100 N is applied for each suture, which can lead to a slight overreduction of the AC joint, which is acceptable (■ Fig. 6h). The anatomical reduction of the AC joint

should be controlled using the image intensifier. Once reduction is achieved, the sutures are knotted securely (seven knots) to provide sufficient stability. To date, there are no biomechanical data on how many knots are necessary. The sutures are cut and no knot stack occurs

Fig. 8 ▲ Follow-up radiographs with a panoramic stress view (a) and bilateral modified Alexander views (b, c) 3 months postoperatively

owing to the low-profile and recessed TightRope hole.

Acromioclavicular cerclage

For horizontal stabilization, a triangular AC cerclage with a non-absorbable tape is used. First the tape is attached to the clavicular nitinol suture passer and pulled from the other end (Fig. 7a, b). The tape is then attached to the eyelet of the acromial nitinol passing wire and pulled through the lateral portal (Fig. 7c). The back part of the tape at the antero-inferior portal is attached to a knot pusher device and retrieved via the clavicular incision (Fig. 7d). The tape from the lateral portal is also attached to the knot pusher and retrieved subcutaneously to the clavicular incision (Fig. 7e). This step avoids soft tissue interposition. The ends of the non-absorbable tape can now be tightened and knotted (Fig. 7f).

The superior incision is closed in two layers including the repair of the deltatrapezial fascia over the sutures and the superior button. The arthroscopic portals are closed in a standard fashion.

Rehabilitation

For 6 weeks postoperatively, the shoulder is protected in a brace. During that time, the patient is only allowed to perform

passive range-of-motion exercises up to a flexion and abduction of 45° in the first 3 weeks and up to 90° in the following 3 weeks. Free passive and early active range-of-motion exercises are allowed from week 7 on. Muscle strengthening exercises are delayed up to 10–12 weeks. The radiographs 3 months postoperatively show an anatomical reduction of the AC-joint (Fig. 8)

Discussion

Arthroscopic techniques for AC joint reconstruction have become more popular in recent years thanks to their multiple benefits, i.e., a minimally invasive approach, hence a satisfying cosmetic outcome and a possible reduction of the risk of infection; the possibility to treat concomitant glenohumeral lesions; and a one-step procedure using implants without the necessity of later implant removal. The combined arthroscopically assisted and image intensifier-controlled double-button technique with additional AC cerclage represents a safe procedure that enables an anatomical reduction of the AC joint. The combined coracoclavicular and AC reconstruction allows for stabilization in the vertical and horizontal plane. The low-profile device facilitates self-tensioning thereby facilitating a simplified anatomical reduction

process. The recessed TightRope hole design reduces the risk of a knot stack profile, aiming to reduce the knot stack profile leading to impaired wound healing or persistent pain and hence revision surgery (Fig. 8).

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Compliance with ethical guidelines

Conflict of interest P. Moroder and M. Scheibel are consultants for Arthrex. M. Minkus, N. Maziak declare that they have no competing interests.

This article does not contain any studies with human participants or animals performed by any of the authors.

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