

INNOVATIONS IN AC-JOINT RECONSTRUCTION USING LOW-PROFILE IMPLANTS

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SUMMARY

Background: Acromioclavicular (AC) joint dislocations are common orthopedic injuries. While various arthroscopic techniques using pulley-like implants have been developed, high rates of persistent horizontal instability and dynamic posterior translation (DPT) remain a clinical challenge. Furthermore, conventional double-button devices often lead to symptomatic hardware prominence and knot stack irritation, frequently necessitating secondary implant removal.

Objective: This article describes a minimally invasive, arthroscopically assisted surgical technique for acute high-grade AC joint separations using a low-profile double-button device combined with an acromioclavicular cerclage to address both vertical and horizontal instability.

Key Points: The procedure utilizes a beach-chair position and three arthroscopic portals to visualize the subcoracoid space. Under fluoroscopic guidance, a transclavicular-transcoracoidal tunnel is established for the insertion of a low-profile TightRope system. Vertical stabilization is achieved through a self-tensioning mechanism, applying 80-100 N of force per suture. To address horizontal stability, a percutaneous AC cerclage is performed by drilling 2.7 mm tunnels through the clavicle and acromion, followed by the placement of a non-absorbable tape in a triangular configuration. This combined approach aims to restore anatomical alignment while the low-profile design minimizes soft tissue irritation and the risk of wound healing complications. Postoperative management involves six weeks of protected range of motion before progressing to strengthening.

Conclusion: The integration of a low-profile double-button system with an additional AC cerclage provides multiplanar stability for acute AC joint dislocations. This technique simplifies anatomical reduction and potentially reduces the need for hardware removal by mitigating knot-related complications.

KEYWORDS

Acromioclavicular Joint; Joint Dislocations; Orthopedic Procedures; Arthroscopy; Suture Anchors

INTRODUCTION

Acromioclavicular (AC) joint dislocations are frequent (1-3). When surgery is indicated, several techniques have been proposed to treat AC dislocation. Especially arthroscopic techniques have been improved and were subject to further development during the last decade (4-6). Pulley-like implants such as TightRope (Arthrex Inc., Naples, Florida) devices are widely used for minimal 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 the patients and seemed to be associated with inferior clinical results (6). Biomechanical studies suggested that an additional acromioclavicular cerclage can reconstruct and stabilize the AC-joint in the horizontal plane (10,11). Current clinical data suggest, that the combined coracoclavicular and acromioclavicular stabilization technique can reduce DPT and leads to satisfying clinical results (7). However, several patients complain about implant irritation due to knot stack and require implant removal. A new low-profile TightRope (Arthrex, Naples, Florida) device aims to diminish this complication and simplify the anatomical reduction process.

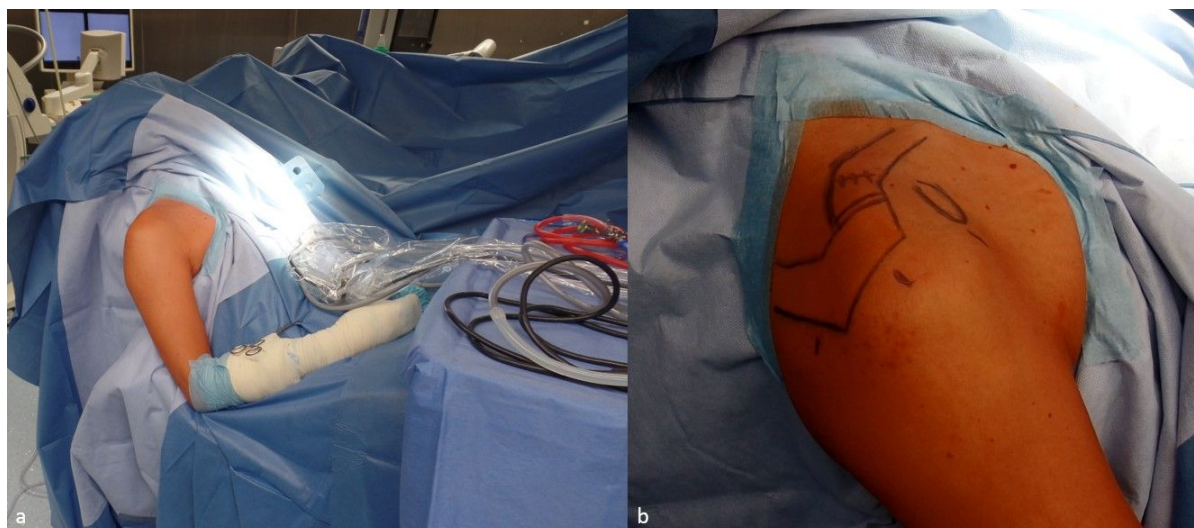


Figure 1: Preoperative X-ray using a panorama stress view (a) and modified Alexander-views (b, c) showing a Rockwood type V injury with dynamic posterior translation

SURGICAL TECHNIQUE

Setup 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 slightly be tilted to the contralateral side allowing enough space for drilling of the coracoclavicular tunnel. For this minimal invasive surgical technique, a posterior and lateral viewing portal and an anteroinferior working portal are necessary. Additionally, a 2-3 cm incision on top of the clavicle is required (Fig. 2b).

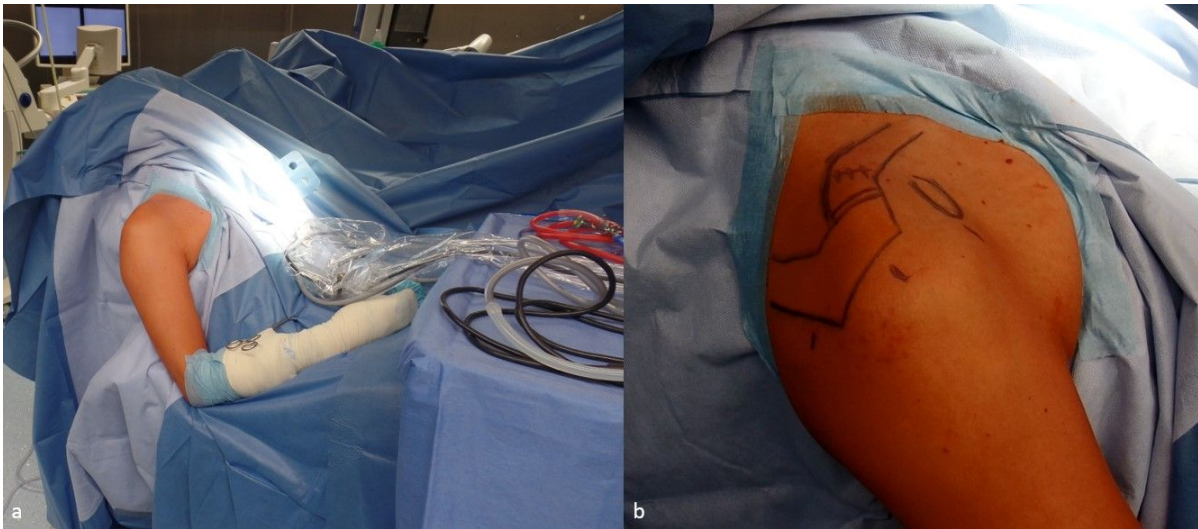


Figure 2: Setup and arthroscopic portals

A diagnostic arthroscopy is performed via a standard posterior portal and eventual concomitant intraarticular 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 obtain a 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 3cm medial from the lateral end of the clavicle. The drill hole is established in between the previous coracoclavicular ligaments in a transclavicular-transcoracoidal fashion. With the drill guide held in this position and under arthroscopic control, a 3mm 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 using a 3.5 mm drill. The correct placement of the coracoclavicular drilling is controlled using the image-intensifier (Fig 3b & c).

Subsequently the drill is unicortical 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.

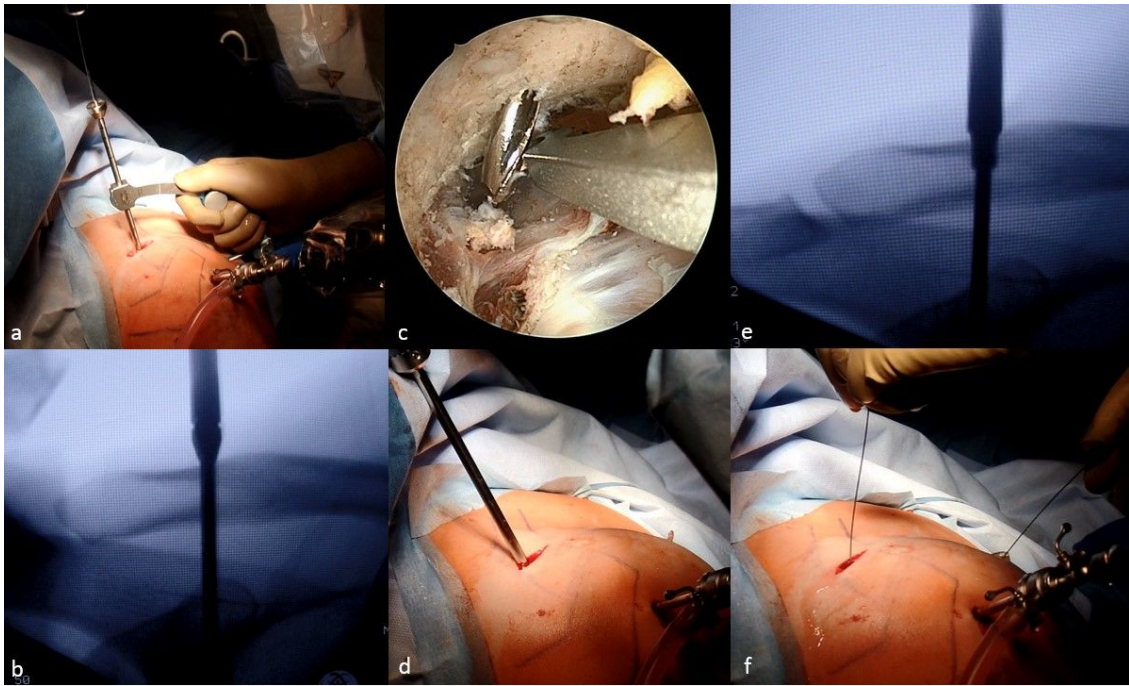


Figure 3: Coracoclavicular drilling

Clavicular and acromial drilling

For horizontal stabilization, a percutaneous acromioclavicular cerclage is used using 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 transclavicular from anterior to posterior.

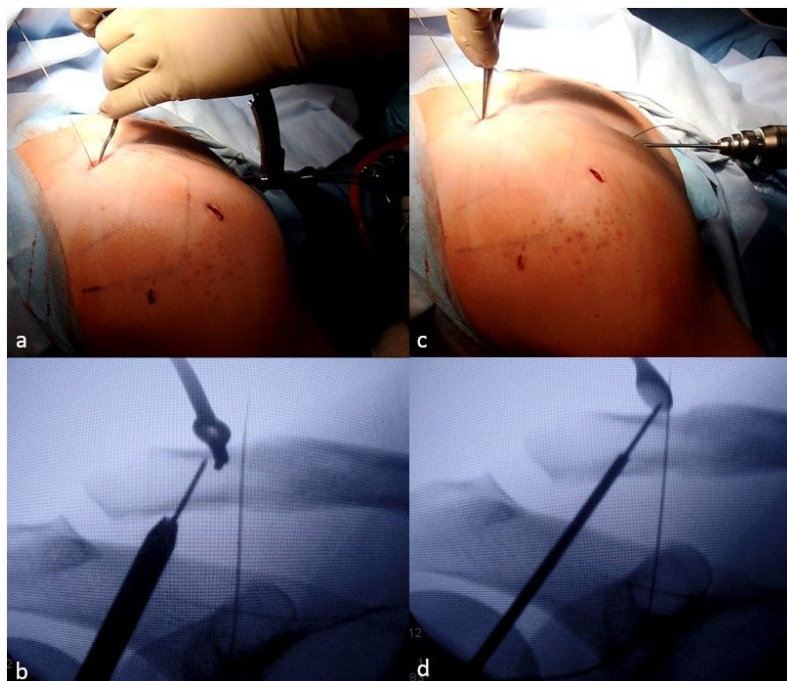


Figure 4: Clavicular drilling for AC-Cerclage

A 1.25 mm K-wire is placed through the clavicle under image intensifier control and overdrilled with a 2.7 mm cannulated drill bit. 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. A 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.

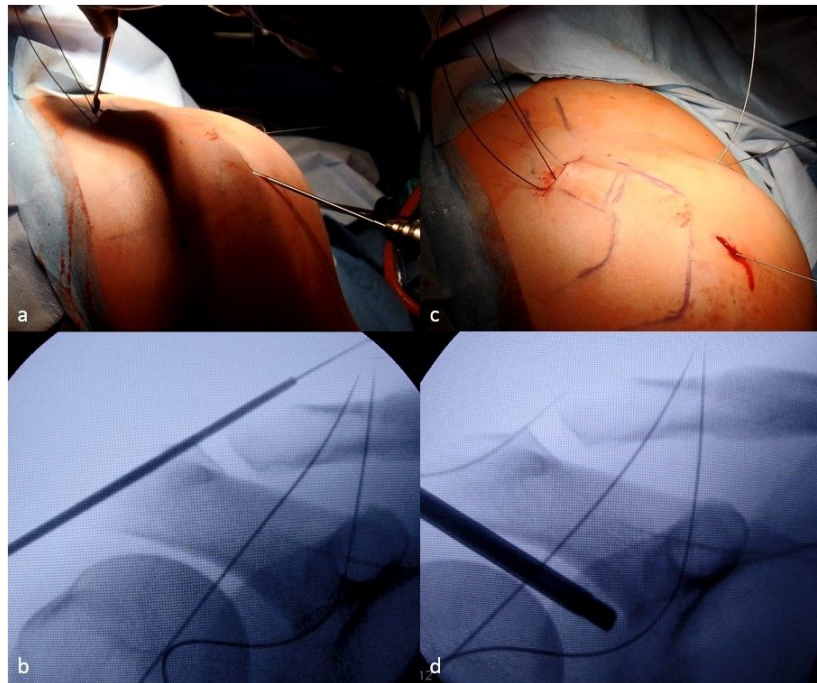


Figure 5: Acromial drilling for AC-Cerclage

Reduction of the AC-joint and coracoclavicular stabilization

The inferior sutures of the low-profile Tightrope device (Arthrex, Naples, Florida) 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 control, the sutures are retrieved via the anteroinferior portal (Fig 6b & c). A DogBone button (Arthrex, Naples, Florida) is attached to the inferior sutures (Fig 6d). By using a clamp and by pulling from superior, the inferior button is placed under the coracoid arch. Under arthroscopic control, the button is placed in the correct position (Fig. 6e). By pulling the sutures of the low-profile device alternating the double button system tightens itself. The two suture pairs are pulled alternating 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 a proper tensioning of the Tightrope device. 80-100 N are applied for each suture which can lead to some overreduction of the AC-joint that is accepted (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. Before cutting the sutures on a low profile, to reduce knot stack, we recommend knotting the sutures of the device to provide sufficient stability and avoid early redislocations.

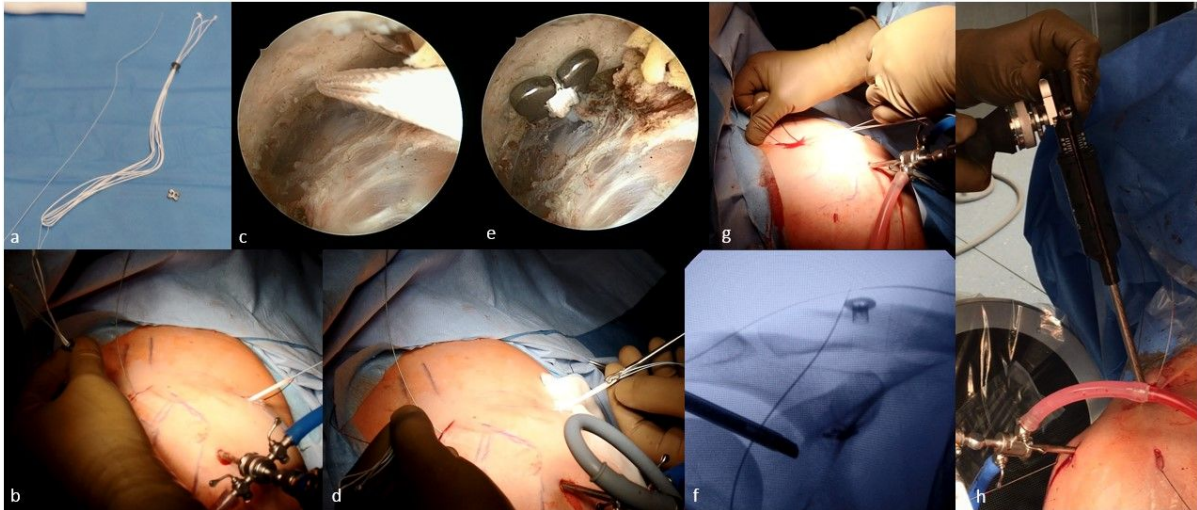


Figure 6: Reduction of the AC-joint and coracoclavicular stabilization

Acromioclavicular cerclage

For horizontal stabilization, a triangular acromioclavicular 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). Then the tape is 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 anteroinferior 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).

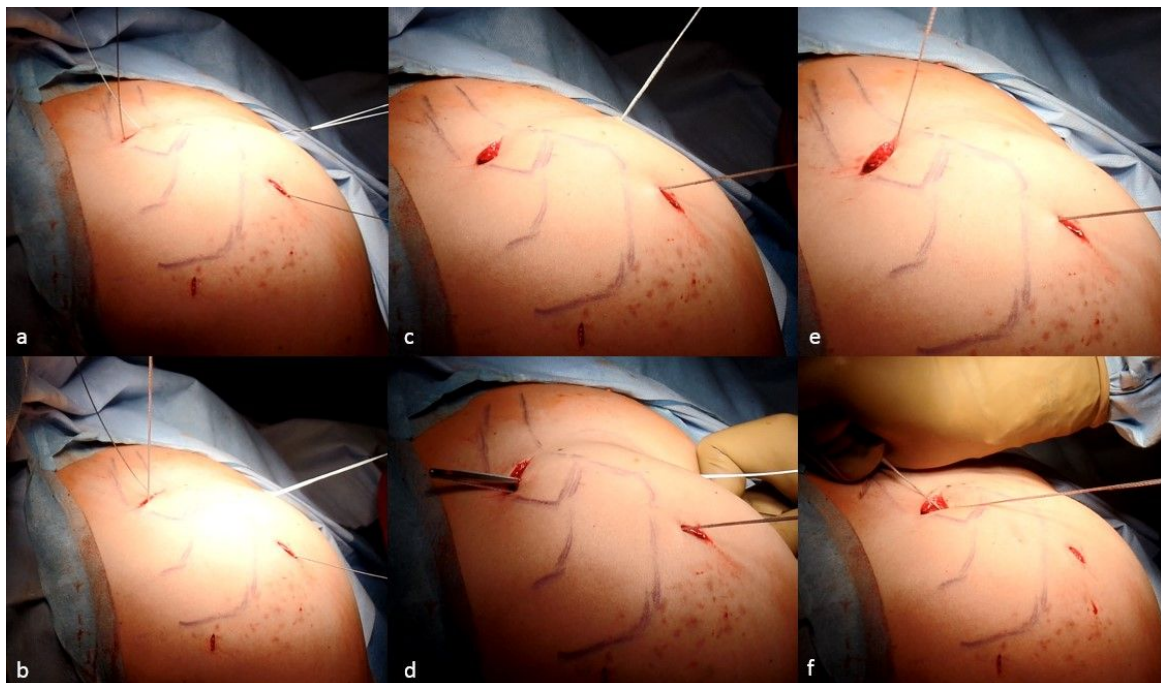


Figure 7: Acromioclavicular cerclage for horizontal stabilization

The superior incision is closed in 2 layers including the repair of the deltotrapezial 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 seven on. Muscle strengthening exercises are delayed up to 10–12 weeks.

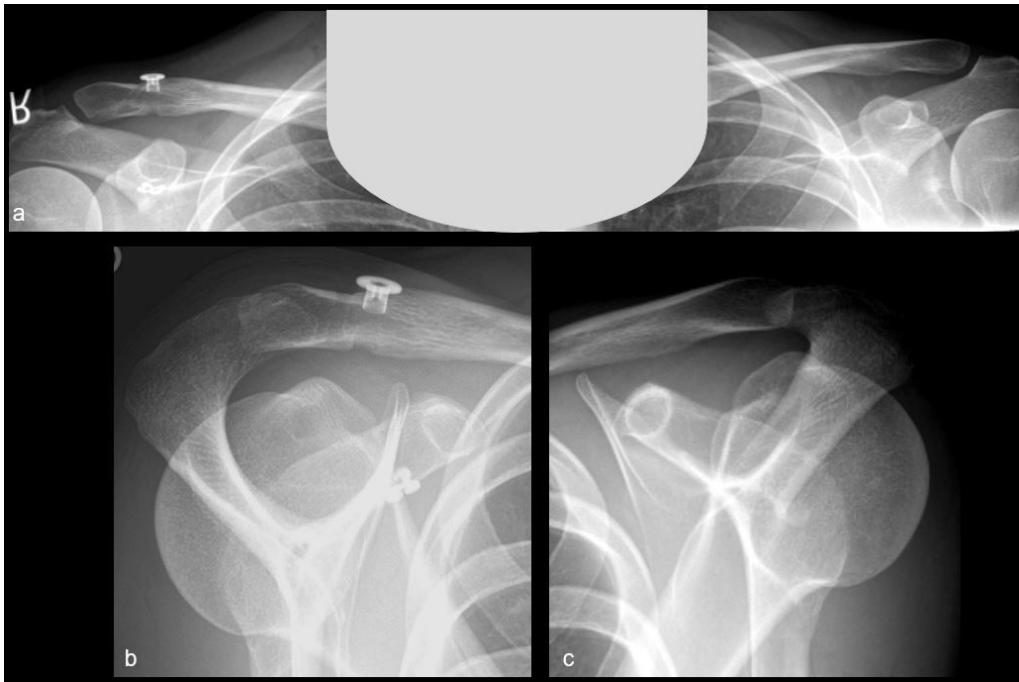


Figure 8: X-ray control with a panorama stress view (a) and bilateral modified Alexander-views (b, c) 3 months postoperative

DISCUSSION

Arthroscopic techniques for AC-joint reconstruction became more popular in recent years due to 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 one-step procedure character using implants without the necessity of later implant removal. The combined arthroscopically-assisted and image intensifier-controlled Double-Button technique with an additional AC cerclage represents a safe procedure which enables an anatomical reduction of the AC joint. The combined coracoclavicular and acromioclavicular reconstruction allows a stabilization in the vertical and horizontal plane. The low-profile device facilitates self-tensioning allowing a simplified anatomical reduction process. The recessed TightRope hole design reduces the risk of a knot stack profile, aiming to reduce knot stack profile leading to impaired wound healing or persistent pain and hence revision surgery.

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