Technical Note

Arthroscopic Treatment of Horizontal Acromioclavicular Joint Instability With Reverse Weaver-Dunn Procedure

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Abstract: Acromioclavicular (AC) joint instability is a common issue. The stability of this joint depends on the combined support of the coracoclavicular ligaments and the AC ligament and capsular structures. Several surgical methods for treating horizontal instability have been reported. The arthroscopic Weaver-Dunn procedure, involving the transfer of the acromial end of the acromial-coracoid ligament to the clavicle, is a well-known option for coracoacromial reconstruction, particularly for addressing vertical instability. This technique has demonstrated positive functional and clinical outcomes. We modified the Weaver-Dunn procedure to treat horizontal instability of the AC joint. Using this technique, we transferred the coracoid end of the coracoacromial ligament to the clavicle.

Acromioclavicular (AC) joint instability is a common issue.[1,2] The stability of this joint depends on the combined support of the coracoclavicular (CC) ligaments and the AC ligament and capsular structures. The CC ligaments, comprising the conoid and trapezoid ligaments, play a crucial role in stabilizing the shoulder joint. Of these 2 ligaments, the conoid ligament is stronger. The CC ligaments connect the clavicle to the coracoid process of the scapula, thereby providing vertical (superioinferior) stability. However, most surgical techniques address vertical instability, often overlooking the horizontal component, which results in misdiagnosis and leads to chronic pain and functional disability (Fig 1).

Several surgical methods for treating horizontal instability have been reported. Aliberti et al. described the technique of open AC ligament reconstruction and repair with semitendinosus allograft.[3,4] The arthroscopic Weaver-Dunn procedure, involving the transfer of the acromial end of the acromial-coracoid ligament to the clavicle, is a well-known option for coracoacromial reconstruction, specifically addressing vertical instability. This technique has demonstrated positive functional and clinical outcomes.[5,6] We modified the procedure to treat horizontal instability of the AC joint. Using this technique, we transferred the coracoid end of the coracoacromial ligament to the clavicle.

Surgical Technique

Surgery is performed with the patient in the beach-chair position, with the injured arm (in this case, the right arm) placed under a traction force of 1.5 kg. We use 4 portals and an additional approach (Fig 2). Following diagnostic arthroscopy through the standard posterior portal (portal A), we create the anterior-superior portal near the anterior angle of the acromion (portal B). The camera is then placed to portal B within the subdeltoid space. After visualizing the pectoralis minor muscle, coracoacromial ligament, and the tip of the coracoid using needle guidance, we create a third portal in front of the tip of the coracoid process (portal C). An additional portal, portal D, is created 2 cm medial to portal C. The arthroscope is then guided to portal C.

Using the arthroscope in portal C from portals D and B, the coracoacromial ligament (CA ligament) is prepared and dissected from the surrounding soft tissue (Fig 3). Footprints of the CA ligament on the acromion

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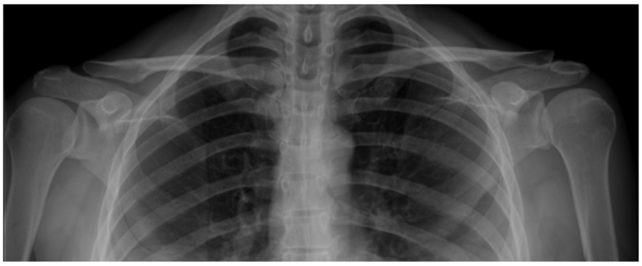

Fig 1. Preoperative radiographs (anterior-posterior view) showing side-to-side differences in the acromioclavicular distance between the right and left shoulders of patients with horizontal acromioclavicular joint instability.

and coracoid are identified. ORTHOCORD (DePuy Synthes, Raynham, MA) No. 2-0 or any other strong nonabsorbable suture is placed in portal B with a standard suture manipulator. The Cleverhook (DePuy Synthes) is passed through portal D. The suture is passed through the Cleverhook and the coracoid insertion of the AC ligament, and a lasso-loop is created (Fig 4). These steps are repeated until the lateral edge of the AC ligament is stitched at least 3 to 4 times (Figs 5 and 6). In the next step, several lasso-loop stitches are created in the same manner, and the medial edge of the CA ligament is moved in the reverse direction to the base of the coracoid. Both sutures are passed through portal B. The coracoid end of the AC ligament is dissected from the coracoid process with the tapes placed under tension (Fig 7).

The AC joint is then dissected from portal D. The horizontal and vertical stability of the AC joint are manually checked, and the CC ligaments are defined. Resection of the AC joint is performed from portal D, if necessary. The undersurface of the distal clavicle is prepared using a burr. A small surgical approach, designated as E (Fig 2), is created 2 cm medial to the distal border of the clavicle for the placement of the button. Using this small approach, the clavicle and the base of the coracoid are drilled with a 2.4-mm K-wire in a freehand technique or with the standard guide (Fig 8). If the position of the wire is optimal, we drill 4-mm bone tunnels using a cannulated drill. The suture shuttle is passed through the clavicle. Both ends of the threads and shuttle are passed through the portal D together. The threads are connected to a suture shuttle and passed through the clavicle (Fig 9).

Another suture shuttle is passed through both the clavicle and coracoid drill holes. A button with an adjustable loop device is connected to the shuttle and passed through the coracoid and clavicle. A button is then placed on the undersurface of the coracoid (Fig 10). Both strands of the sutures and loops from the adjustable button are passed through the DogBone (Arthrex, Naples, FL, USA). After manual clavicle repositioning, the adjustable loops are securely tightened. Both strands of the suture from the AC ligament are also tightly secured with several knots and then cut (Fig 11). Pearls and pitfalls of this technique are summarized in Table 1. The final postoperative radiograph is shown in Figure 12. All the surgical steps are depicted in Video 1.

Discussion

The Weaver-Dunn procedure, along with its modifications,[7] is a recognized method for addressing vertical instability of the coracoacromial joint and can be performed arthroscopically.[6] However, the classic Weaver-Dunn procedure alone does not reduce horizontal instability. Mowbray et al. described the possibility of transferring the coracoacromial ligament to the clavicle in a cadaveric study.[8] Here we described a full-arthroscopic surgical technique of the reverse Weaver-Dunn procedure that involves the transfer of the coracoid end of the coracoacromial ligament to the anterior-inferior surface of the clavicle and could be performed both in acute and chronic cases. Dissection of the AC ligament from the coracoid process significantly improved the arthroscopic view and simplified other surgical steps. Our technique combined vertical stabilization through adjustable buttons, using the same tunnels and buttons for fixation of the transferred CA ligament.

This technique offers several advantages over the suture-anchor technique.[9] First, it is more cost-effective. Second, it is less invasive, eliminating the necessity for a direct mini-open approach to the AC joint, thereby minimizing the risk of infection. Compared with the technique described by Hachem et al., in which double-cerclage suture fixation was performed,[10-12] we used less synthetic material. Moreover, the creation of additional bone tunnels could potentially result in acromial or distal clavicular fractures. Autograft use leads to donor-side morbidity and complications associated with graft harvesting. Additionally, autografts and allografts require additional hardware for fixation. Allografts for AC joint stabilization[3] are expensive and not always available. Furthermore, this technique can be performed arthroscopically and mini-openly.

However, our procedure had some disadvantages. This technique cannot restore the normal anatomy of ligaments. Advanced arthroscopic skills are required for an arthroscopic graft suture. The thickness and length

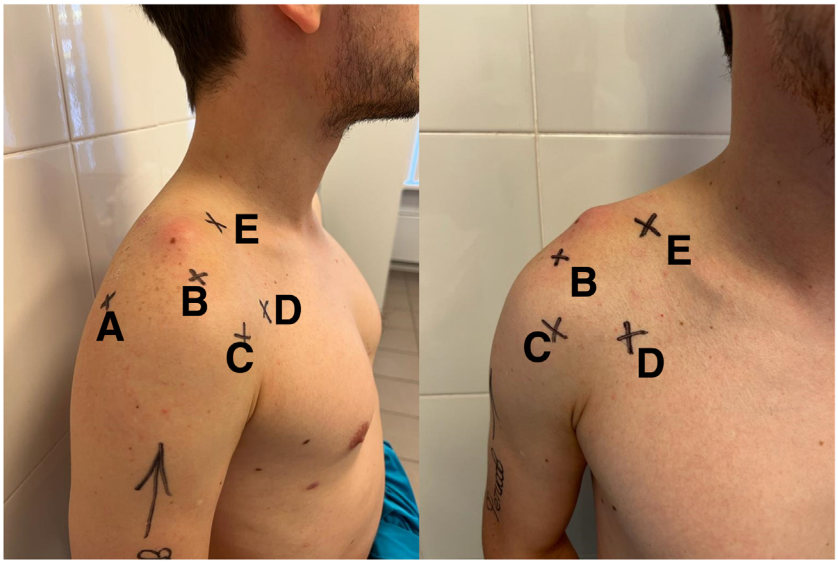

Fig 2. Arthroscopic portals used in this procedure: standard posterior portal (A), anterior-superior portal (B), portal in front of the tip of the coracoid process (C), additional portal 2 cm medial to portal C (D), and surgical approach for superior button (E).

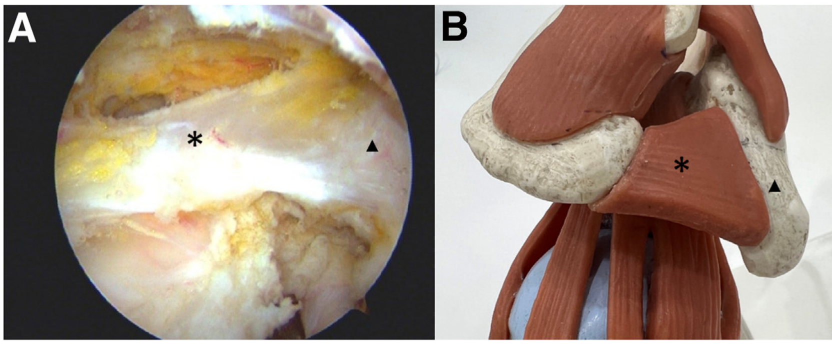

Fig 3. The patient is in the beach-chair position, with the right arm placed under a traction force of 1.5 kg. (A) Arthroscopic view of the right shoulder subdeltoid space through portal C. The acromioclavicular ligament is identified, dissected, and prepared for suture. (B) Model of a procedure. *, Acromioclavicular ligament; ▲, coracoid process.

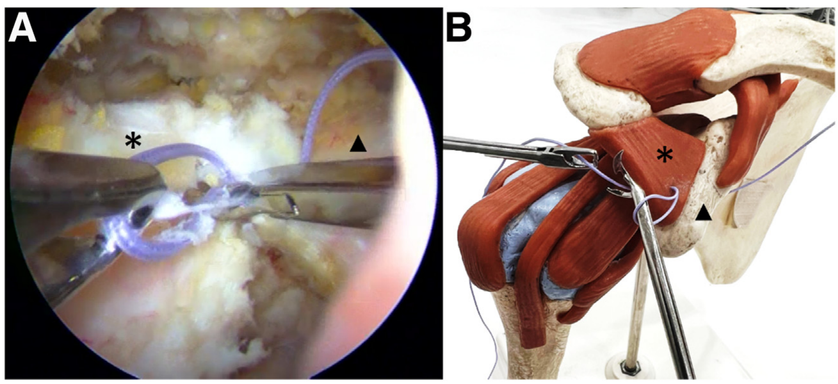

Fig 4. The patient is in the beach-chair position, with the right arm placed under a traction force of 1.5 kg. (A) Arthroscopic view of the right shoulder subdeltoid space through portal C. The first lasso-loop is created on the acromioclavicular ligament with the Cleverhook in portal D with the suture manipulator in portal B. (B) Model of a procedure. *, Acromioclavicular ligament; ▲, coracoid process.

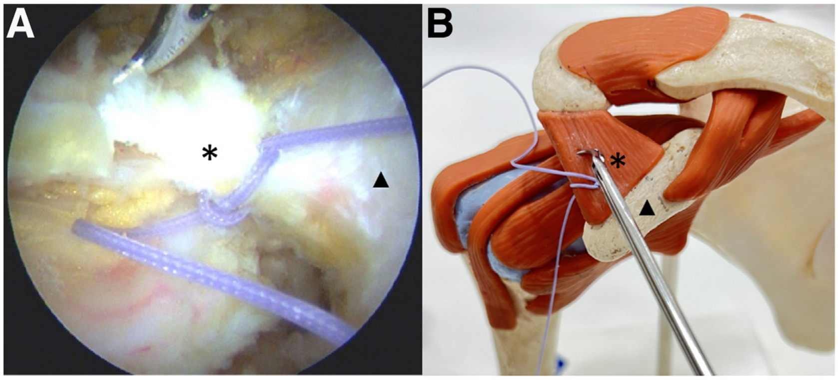

Fig 5. The patient is in the beach-chair position, with the right arm placed under a traction force of 1.5 kg. (A) Arthroscopic view of the right shoulder subdeltoid space through portal C. The lasso-loop is initially tied through portals D and B. The Cleverhook in portal D is ready to perform the second lasso-loop. (B) Model of a procedure. *, Acromioclavicular ligament; ▲, coracoid process.

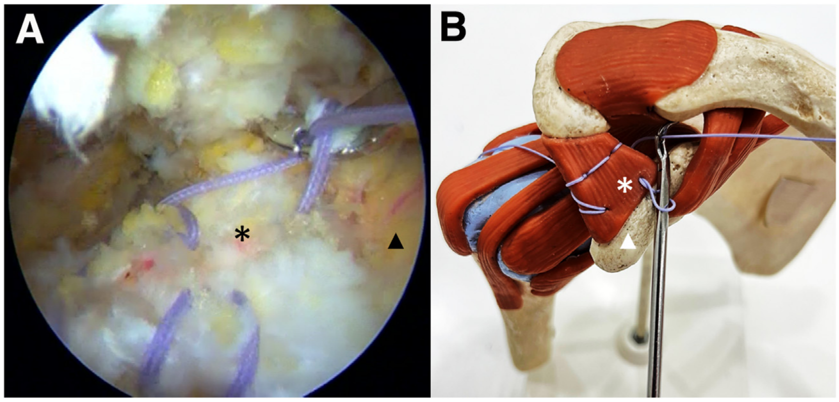

Fig 6. The patient in the beach-chair position, with the right arm placed under a traction force of 1.5 kg. (A) Arthroscopic view of the right shoulder subdeltoid space through portal C. The last lasso-loop is formed on the medial edge of the acromioclavicular ligament through the D portal. (B) Model of a procedure. *, Acromioclavicular ligament; ▲, coracoid process.

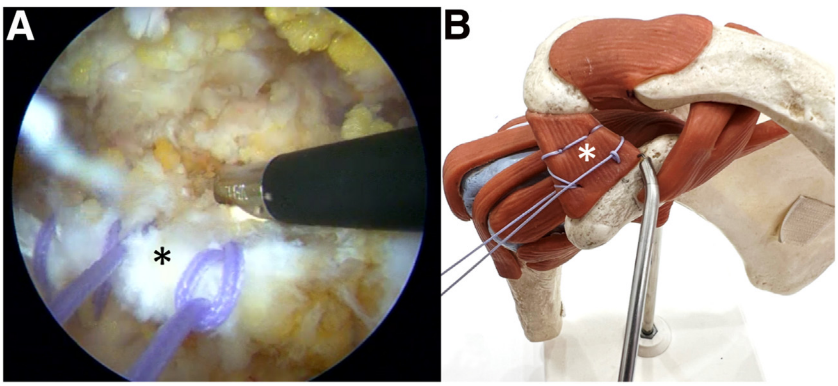

Fig 7. The patient is in the beach-chair position, with the right arm placed under a traction force of 1.5 kg. (A) Arthroscopic view of the right shoulder subdeltoid space through portal C. Both threads are passed through portal B. The coracoid end of the acromioclavicular ligament is dissected with an ablator passed through portal D from the coracoid process, with tapes put under the tension through portal B. (B) Model of a procedure. *, Acromioclavicular ligament.

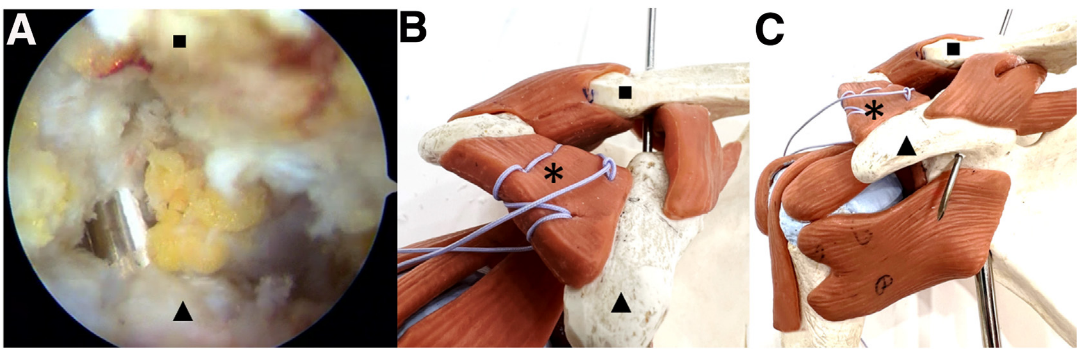

Fig 8. The patient is in the beach-chair position, with the right arm placed under a traction force of 1.5 kg. (A) Arthroscopic view of the right shoulder subdeltoid space through portal C. The K-wire with the suture shuttle is passed through the drill-hole via the small incision in the distal clavicle and coracoid process. (B) Model of a procedure. The K-wire with the suture shuttle is passed through the drill-hole in the distal clavicle. (C) Model of a procedure. The K-wire with the suture shuttle is passed through the drill-hole in the coracoid process. *, Acromioclavicular ligament; ▲, coracoid process, n clavicle.

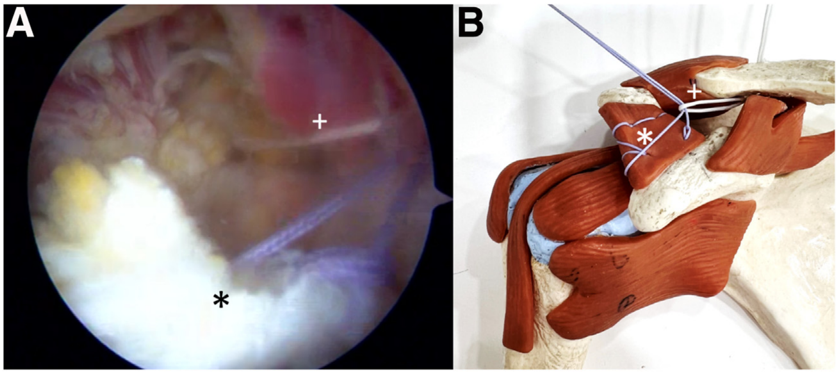

Fig 9. The patient is in the beach-chair position, with the right arm placed under a traction force of 1.5 kg. (A) Arthroscopic view of the right shoulder subdeltoid space through portal C. Both ends of the sutures with the shuttle are passed through the drill-hole of the clavicle. (B) Model of a procedure. *, Acromioclavicular ligament, ± shuttle.

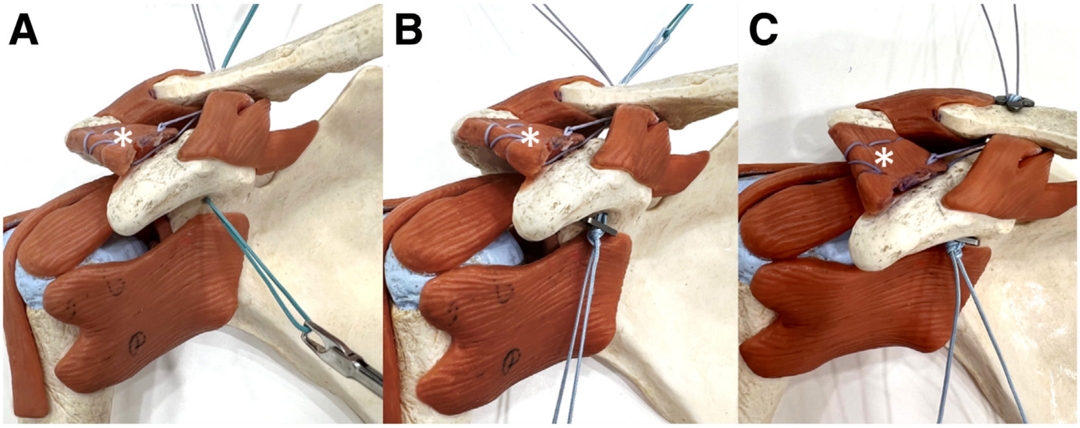

Fig 10. Model view of a procedure. (A) Shuttling device 2 (green suture) is passed through the coracoid process, grabbed through portal D with a standard suture manipulator, and connected to an adjustable button. (B) Button is placed in the undersurface of the coracoid. (C) Both strands of the tape and loops from the adjustable button are passed through the DogBone (Arthrex, Naples, FL) and tightened on both sides. The knots are made on the superior clavicular surfaces.

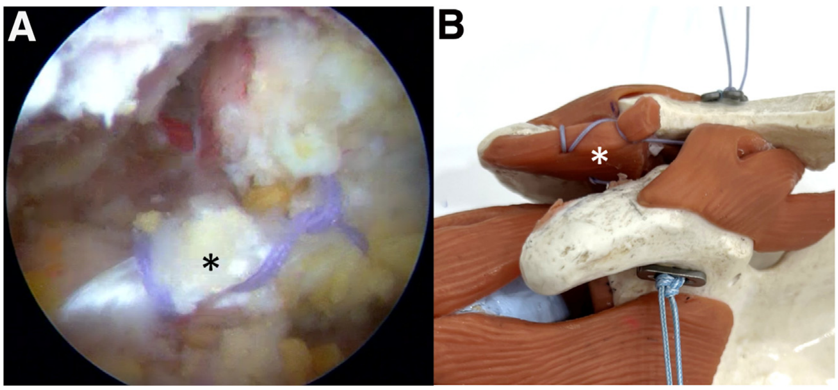

Fig 11. The patient is in the beach-chair position, with the right arm placed under a traction force of 1.5 kg. (A) Arthroscopic view of the right shoulder subdeltoid space through portal C. The acromioclavicular ligament is fixed to the inferior surface of the distal clavicle. (B) Model of a procedure. *, Acromioclavicular ligament.

Table 1. Pearls and Pitfalls

Pearls	Pitfalls
Good manual technique is essential.	In the case of chronic horizontal acromioclavicular joint instability with significant osteoarthritis or traumatic deformation, acromioclavicular joint resection should be performed to avoid postoperative pain and progression of acromioclavicular joint osteoarthritis.
The camera is held by the assistant while the surgeon uses both hands to sew the acromioclavicular ligament using the Cleverhook and manipulator.	An adjustable loop could be placed in antegrade or retrograde direction, as per the preference of the surgeon.
Overcorrection of the clavicle is critical.	

Table 2. Advantages and Disadvantages

Advantages	Disdvantages
Procedure can be performed arthroscopically or via a mini-open approach	Technically demanding procedure
Reduces both horizontal and partial vertical instabilities (Rockwood stages 1-2)	Nonanatomic procedure
Can be used in combination with other techniques in complex and revision cases	Not recommended as a single procedure in cases with severe vertical instability (Rockwood stage 3)
Cost-effective	
Can be performed in the "beach-chair" or the lateral decubitus position	
Large knots are not formed at the upper part of the clavicle under the skin	

of the ligament are variable, and, in some cases, they are not sufficient. Therefore, additional techniques can be used in these cases. The advantages and disadvantages of this method are summarized in Table 2.

The primary stabilizing effect of our reverse Weaver-Dunn procedure lies in the partial reconstruction of the AC ligaments, and this technique could be used as a single or combined procedure for complex horizontal and vertical instability of the AC joint in both acute and chronic cases.

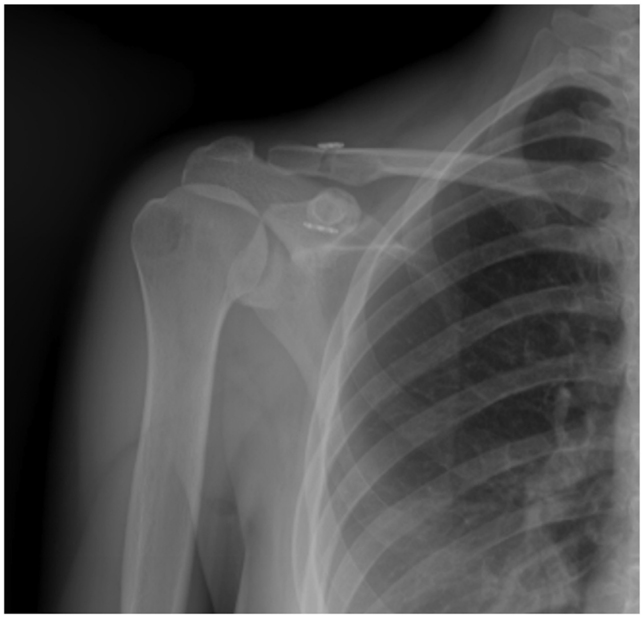

Fig 12. Postoperative radiograph (anterior-posterior view) of the right shoulder showing the button position and diminution of acromioclavicular distance.

Disclosures

The authors (O.M., A.R., K.E.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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