A Modified Technique of Arthroscopically Assisted AC Joint Reconstruction and Preliminary Results

Daniel P. Tomlinson MD, David W. Altchek MD,
Jeffrey Davila MD, Frank A. Cordasco MD

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Abstract Surgical treatment of high-grade acromioclavicular (AC) joint separations has become analogous to ligament reconstructions elsewhere in the body with the goal being restoration of the native anatomy. Circumferential access to the base of the coracoid is essential to reconstruct the coracoclavicular ligament complex. Using some of the traditional open approaches, this access requires detaching the deltoid insertion and performing extensive soft tissue dissection. Also, poor visualization risks injury to nearby neurovascular structures. An arthroscopically assisted reconstruction offers the advantage of less soft tissue dissection and superior visualization to the base of the coracoid. We have developed a unique arthroscopically assisted technique that uses a subacromial approach to pass suture material and a tendon graft around the coracoid to reconstruct the coracoclavicular ligament complex. We describe our technique and preliminary results in 10 patients who have undergone coracoclavicular ligament reconstruction for high-grade AC separation. All patients improved subjectively with regard to pain and function at a minimum followup of 3 months (mean, 5 months; range, 3–18 months). This arthroscopically assisted technique has the potential to allow for safe and at

least in the short term reliable restoration of the coracoclavicular ligament complex and provides an alternative technique to treat AC joint separations.

Level of Evidence: Level IV, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

Introduction

The primary goal in ligament reconstruction is to restore function, which we believe is best achieved by recreating the native anatomy. Many techniques used to treat acromioclavicular (AC) joint dislocations, including coracoacromial ligament transfer, plate fixation, wire fixation, and screw fixation, do not achieve this goal. Nonanatomic reconstructions such as coracoacromial ligament transfer have failure rates reported as high as 30% [16, 17]. Given this high failure rate, alternative methods to restore the coracoclavicular ligaments have been developed and include the use of a screw or suture material [3, 11, 15]. The problem with these two methods is they rely on the native ligaments healing for success. Healing is less likely in chronic cases or in cases with extensive soft tissue dissection, and therefore the risk of failure increases secondary to screw or suture breakage. Two recent biomechanical studies have demonstrated reconstruction of the coracoclavicular ligaments with a free tendon graft provides initial stability and a load to failure rate equivalent to the intact coracoclavicular ligaments [8, 9]. For these reasons, we favor reconstruction of the disrupted native ligaments with a tendon graft.

To successfully reconstruct the coracoclavicular ligament complex with a free tendon graft, adequate exposure to the base of the coracoid is helpful and should be

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D. P. Tomlinson (✉), D. W. Altchek, J. Davila, F. A. Cordasco
Hospital for Special Surgery, 535 E 70th Street, New York,
NY 10021, USA
e-mail: dtomlinson@CrystalRunHealthCare.com

obtained. Most standard procedures require an open approach and are fraught with complications. Visualization of the coracoid in an open fashion involves a large incision, disruption of part of the deltoid insertion, and extensive soft tissue dissection. Even after extensive dissection, visualization medial to the coracoid is limited and risks damage to vital neurovascular structures when attempting to pass suture or graft material.

Arthroscopically assisted coracoclavicular ligament reconstruction offers the advantage of superior visualization of the base of the coracoid, less soft tissue dissection, and a smaller incision, yet still allows for safe graft passage. Various arthroscopic AC joint and coracoclavicular ligament reconstruction techniques have been described in the literature. Some of these techniques involve releasing the middle and superior glenohumeral ligaments or the rotator interval through an intraarticular approach to visualize the coracoid [14, 18]. Others describe an arthroscopic approach to assist with insertion of screws or plates to reduce the AC joint [4, 13]. An arthroscopic technique using a subacromial approach to isolate the coracoid and pass a tendon graft was first described by Baumgarten et al. [1]. The advantage of this technique over other described arthroscopic techniques is it does not require disruption of the glenohumeral ligaments, and there is no need for hardware removal.

Over the past year, we have modified this technique to simplify the reconstruction. Some of these modifications include the suture and graft passage technique, using a different suture material, and not routinely isolating and transferring the coracoacromial ligament. We describe our arthroscopically assisted technique to reconstruct the coracoclavicular ligament and present our preliminary results.

Materials and Methods

We retrospectively reviewed 12 patients who underwent arthroscopically assisted coracoclavicular ligament reconstruction by one of two surgeons (FAC, DWA). Each dislocation was described using the classification system expressed by Rockwood et al. [12]. Our operative indications for AC joint dislocations include all Type IV and V dislocations, acute Type III dislocations in overhead athletes or heavy manual laborers, and chronic Type III dislocations with residual pain about the AC joint or limitations in function. All patients in this report had traumatic Type III, IV, or V AC joint dislocation. Five were acute (less than 3 weeks) and seven were chronic with a mean time to surgery of 22 weeks. Two of the acute dislocations were Type IV and three were Type V. Five of the chronic dislocations were Type III and two were Type IV. The chief complaint in all patients was pain and loss of function

of the involved extremity. All patients had preoperative plain radiographs that documented the dislocation. Two of the 12 patients were lost to followup before the 3-month followup point leaving 10 patients with a mean age of 38.5 years (range, 16–58 years). The minimum followup for inclusion was 3 months. We received prior approval from our Institutional Review Board.

The procedure was performed under a regional interscalene block in the beach chair position with a bean bag and a McConnell arm holder (McConnell Orthopedics, Greenville, TX). All patients received intravenous antibiotics before incision. After sterile preparation and draping, we marked the portal sites and inserted a 30° arthroscope into the glenohumeral joint through a standard posterior portal (Fig. 1). We inspected the joint to diagnose and treat any concomitant abnormalities. Concomitant procedures at the time of the AC joint reconstruction included subacromial decompression in one patient, SLAP repair in one patient, labral débridement in two patients, and rotator cuff débridement in one patient.

Once the concomitant procedures were completed, the arthroscope was placed into the subacromial space through the same posterior portal. We used a spinal needle to localize the anterolateral portal approximately 1 cm lateral and 1 cm posterior to the anterolateral corner of the acromion. This anterolateral portal became the viewing portal and the arthroscope was moved there. A second anterior portal was created under spinal needle localization. This portal was located approximately 1 cm anterior to and in line (medial/lateral) with the anterolateral corner of the acromion. This working portal was slightly more lateral than the standard anterior portal normally used to allow an appropriate angle to work around the coracoid (Fig. 2). We then dissected the anterior soft tissue with electrocautery through the anterior portal down to the level of the

Fig. 1 Preoperative markings show the portal locations. P = posterior portal; A = anterior portal; AL = anterolateral portal.

Fig. 2 Arthroscopic view shows the anterior subacromial space with the arthroscope in the anterolateral portal. A spinal needle (arrow) is used to localize the anterior working portal ensuring a proper angle to work around the coracoid.

coracoid. The soft tissue around the base of the coracoid was débrided with electrocautery (Fig. 3A, B). Damage to nearby neurovascular structures can be avoided by keeping the tip of the cautery probe close to bone around the coracoid. A right-angle clamp placed through the anterior portal was used to complete the dissection medial to the coracoid. The tip should be visible medially with the clamp inferior to the coracoid for later suture passage.

We removed the arthroscope and all instruments from the joint and a 3-cm to 4-cm incision was made perpendicular to the long axis of the clavicle approximately 1 cm medial to the AC joint. Dissection with a needle-tip electrocautery was completed to the level of the deltatrapezial fascia. We then created full-thickness skin flaps with Metzenbaum scissors. The fascia and AC joint capsule are incised in one layer parallel to the long axis of the clavicle with electrocautery. Care must be taken to incise this layer in the center of the clavicle to avoid taking down the deltoid insertion and to allow for a strong layer of tissue for later closure. Flaps were developed so the anterior and posterior edges of the clavicle could be visualized 2 cm medial to the AC joint. The distal clavicle was inspected at this time by placing small Homan retractors anterior and posterior to the clavicle. We did not routinely excise the distal clavicle unless there was evidence of substantial arthrosis given that resection of even 1 cm can compromise stability [2]. In these cases (four of the 12 patients), a minimal (less than 5 mm) distal clavicle excision was performed using a microsagittal saw to maintain stability. Next, a 5-mm hole was drilled through the center of the clavicle from superior to inferior 1 cm medial to the AC joint. If the clavicle was greater than 2 cm in anteroposterior thickness, two 5-mm holes could be drilled with one

Fig. 3A–B (A) Arthroscopic view shows the electrocautery seen through the anterior portal after débridement of the coracoid base (C). (B) Arthroscope is shown in the anterolateral portal and the electrocautery in the anterior portal.

slightly posterior and one slightly anterior to midline keeping a minimum 10-mm bony bridge between the holes. Two holes were made for three of our patients. A Number 5 Ethibond suture (Ethicon Inc, Somerville, NJ) on a large curved needle was placed through the hole to act as a shuttle suture for later graft passage.

We then placed the arthroscope back into the subacromial space through the anterolateral portal. Using a spinal needle for localization, a portal was made in the inferior AC joint capsule through the superior incision directly above the coracoid. A free Number 5 Ethibond suture was placed through the anterior portal with a right-angle clamp and around the inferior base of the coracoid exiting medially. We used an arthroscopic grasper through the superior portal to grab this end of the suture and pull it out of the superior wound. A suture retriever through the superior portal was used to retrieve the other end of the suture that was exiting the anterior portal. We then looped

this Number 5 Ethibond suture under the coracoid with both free ends exiting the superior portal to be used to shuttle the graft (Fig. 4A, B).

We fashioned a tendon graft on the back table to pass through a 5-mm tunnel. A Number 2 Orthocord suture (DePuy Mitek, Norwood, MA) was run over a 3-cm span in each end of the tendon in a locking fashion. We used allograft tibialis anterior tendon, allograft semitendinosus tendon, or autograft semitendinosus tendon. We prefer one of these allografts because there is no donor site morbidity involved, they are of adequate length to be looped around the coracoid and over the clavicle, and they are readily available at our institution. Autograft semitendinosus is used only if a patient feels strongly against using an allograft and is willing to accept the morbidity associated with the donor site. Mineral oil was placed on the tendon to facilitate its passage around the coracoid and through the bone tunnel. The two sutures exiting one end of the tendon along with one free Number 2 Orthocord suture were tied

to the medial limb of the passing suture previously placed around the coracoid. These were then shuttled around the coracoid (Fig. 5). We tied the free suture and tendon suture exiting medial to the coracoid to the inferior end of the shuttle suture previously passed through the drill hole in the clavicle and shuttled through inferior to superior. If we had placed two holes in the clavicle, the lateral free suture and graft end could be shuttled through the anterior lateral drill hole in the clavicle in a similar way (Fig. 6). The AC joint was reduced by having the assistant push down on the distal clavicle with one hand and push up on the flexed elbow with the other hand. Once reduced, we tied down the

Fig. 4A–B (A) Arthroscopic view shows passing the suture around the base of the coracoid (C). (B) Green passing suture is shown going through the clavicle hole. Blue passing suture is shown around the base of the coracoid with both limbs exiting the superior incision.

Fig. 5 The tendon graft (G) was passed around the base of the coracoid (C).

Fig. 6 An illustration represents the free tendon graft and suture after passage around the base of the coracoid and, in this case, through two 5-mm holes in the clavicle.

Fig. 7 The tendon graft is seen in the superior wound after passage around the coracoid and through the clavicle. Both limbs of the graft are held taut to be sewn together after the free Orthocord suture (DePuy Mitek, Norwood, MA) is tied down.

free Number 2 Orthocord suture to hold the reduction. Pressure was released and the reduction checked. If the reduction was satisfactory, the graft was secured. The assistant then pulled both ends of the graft taut and the ends were sutured together with multiple Number 2 Orthocord sutures in a figure-eight fashion (Fig. 7). With this construct, we did not believe it necessary to transfer the coracoacromial ligament to the clavicle.

After irrigation with sterile saline, the deltatrapezial fascia was closed over the graft with Number 0 Vicryl suture (Ethicon Inc, Somerville, NJ). The subcutaneous tissue was closed with Number 2.0 Vicryl suture and the skin with a running subcuticular Prolene suture (Ethicon Inc, Somerville, NJ) and SteriStrips (3M, St Paul, MN). The portals were closed with simple Number 4.0 nylon sutures. A sterile dressing was applied and a standard sling was used.

Postoperatively, patients were maintained in a standard sling full-time for 5 weeks except when doing physician-directed exercises. Patients were started on a home exercise program postoperatively. Activities centered on protected, limited range of motion of the extremity to minimize stress on the AC joint reconstruction. We recommended exercises twice daily including active wrist, elbow, and hand range of motion along with external rotation of the shoulder from 0° to 20° with the arm at the side. After the first 2 weeks, full external rotation was allowed along with beginning progressive, active assisted abduction of the extremity up to 60° in the plane of the scapula. Isometric scapular retraction exercises were also started 2 weeks postoperatively.

Formal physical therapy began at postoperative week 5 with supervised visits three times a week. The goals were

to restore normal glenohumeral and scapulothoracic motion and function. Therapists directed progressive, active assisted range of motion of the glenohumeral joint to include overhead activity. Controlled periscapular motion was restored with manual scapular exercises (protraction, retraction, elevation, and depression) and progressed to gentle resistance with rows using tubing. Typically, three sets of eight to 10 repetitions were performed. Resistance and intensity gradually increased with time. From weeks 8 to 12, scapular-, biceps-, and triceps-strengthening exercises were added. Typical exercises included use of the row machine, free weight biceps curls, and theraband triceps exercises. The upper body ergometer may also be used to assist in recovery of full motion. Finally, two of the patients in this report involved in competitive athletics started a sports-specific training program using proprioceptive neuromuscular facilitation at week 12, which had to be successfully completed before we recommended return to sport.

The operating surgeons (FAC, DWA) evaluated all patients radiographically with a nonweighted anteroposterior radiograph of the involved AC joint at 2 weeks and clinically at 2 weeks, 6 weeks, 12 weeks, and 6 months postoperatively. Each clinical followup involved the patient's subjective description of pain, strength, range of motion, and overall function of the involved extremity. The operating surgeon (FAC, DWA) documented the appearance of both the AC joint and the incision on inspection, and performed range of motion and manual strength testing of the involved extremity.

Results

At most recent followup (mean, 5 months; range, 3–18 months), eight of the 10 patients were pain-free, and two patients reported mild discomfort with activities of daily living, both at 6 months. When asked by the operating surgeon (FAC, DWA) at the time of latest followup, all patients stated they believed their strength and range of motion improved compared with preoperative function.

Two patients developed superficial wound cellulites that resolved with a short course of oral antibiotics. Based on inspection by one of the operating surgeons (FAC, DWA), eight of the 10 patients with minimum 3 months followup had maintained reduction of their AC joints. Two patients had falls at 3 and 5 months postoperatively, which resulted in a slight loss of the anatomic reduction that was confirmed on an anteroposterior radiograph of the involved AC joint. Both of these patients had one hole drilled in the clavicle for graft passage. Both losses in reduction were less severe when compared with preoperative radiographs, and at latest followup, each of these two patients were

pain-free with no functional deficits and neither required further surgery. One patient, a high-level baseball pitcher, sustained a coracoid fracture 7 months after surgery while pitching. The AC joint remained reduced and the coracoid fracture was surgically fixed with a single cannulated screw. Two months after coracoid fixation, this patient was pain-free with equal range of motion compared with the same extremity before the original injury and in a strengthening program. When examined both preoperatively and at the latest postoperative visit by one of the operating surgeons (FAC, DWA), all patients demonstrated improved shoulder motion attaining equal to near-equal range of motion as compared with their unaffected extremity.

Discussion

The arthroscopically assisted technique to treat AC joint dislocations described in this report allows for excellent and safe visualization of the coracoid to reconstruct the coracoclavicular ligaments with a free tendon graft while at the same time limiting the potential complications associated with traditional open procedures. Numerous ligament reconstructions throughout the body, including the knee, ankle, and elbow, use tendon grafts of sufficient strength with the ability to revascularize to restore the anatomy and function of the joint. We believe the same principles should apply to the AC joint.

Limitations to our study include a small number of patients. Our followup was short-term and included no validated outcomes measure. Our primary purpose, however, was to describe a novel technique to a problem that does not have a clear solution.

Other surgical options described in the literature to treat AC joint separations include dynamic muscle transfers, primary AC joint fixation, coracoclavicular screw fixation, coracoclavicular suture fixation, and the Weaver and Dunn [16] procedure with coracoacromial ligament transfer. Dynamic muscle transfer involves transferring the tip of the coracoid process with the conjoint tendon attached to the bottom of the clavicle to act as a dynamic depressor of the clavicle. In a report describing this technique, close to 50% of the patients had residual pain, especially if over the age of 40 [5]. The potential problem with this technique is it does not restore static stability, which will allow for continued motion at the AC joint and likely lead to pain. Primary AC joint fixation involves fixing the joint with Kirschner wires, pins, or screws with or without repair of the coracoclavicular ligaments. This procedure is fraught with potential complications such as risk of loss of fixation, hardware breakage, pin migration, and the need for further surgery to remove hardware [10]. Coracoclavicular screw

fixation was first described by Bosworth [3] in which a screw was placed from the clavicle to the base of the coracoid to reduce the AC joint without repairing the coracoclavicular ligaments. This procedure relies on primary healing of the coracoclavicular ligaments and also requires repeat surgery to remove the screw. A report by Tsou [15] using this technique with a percutaneous cannulated screw found failures in 17 of 53 patients (32%). These included failed percutaneous insertion in two, early screw pullout in three, late screw pullout in four, subluxation after screw removal in six, serous drainage in two, and malreduction of Type IV dislocations in two. There was no screw breakage or evidence of migration. Recently, Osti et al. [11] described minimally invasive endoscopic reconstruction for acute Type III AC joint separations using the Neviaser portal to place an anchor in the coracoid loaded with Number 5 FiberWire suture (Arthrex Inc, Naples, FL). The suture was then placed through a drill hole in the clavicle and tied down to reduce the AC joint. They also passed a Number 2 FiberWire suture from the clavicle to the acromion through the AC joint to supplement the reduction. Although Number 5 FiberWire provides excellent initial stability of the AC joint in biomechanical testing, this technique relies on the native ligaments to heal [9]. If this does not occur, there is potential for suture failure and subsequent loss of reduction.

One of the most commonly used procedures in treating high-grade acute and chronic AC joint dislocations is one described by Weaver and Dunn [16] with or without modifications. This procedure involves recreating the coracoclavicular ligaments by transferring the acromial attachment of the coracoacromial ligament to the distal clavicle. A common modification of this procedure involves placement of an augmentation band, which is typically an absorbable suture braid or ribbon, between the coracoid and the clavicle to protect the reconstruction in the early stages of healing. Biomechanical studies suggest the coracoacromial ligament transfer has approximately 25% of the initial fixation strength of the native coracoclavicular ligaments and less than 50% of the appropriate stiffness [7, 8]. Lee et al. [8] reported free gracilis, toe extensor, or semitendinosus grafts have ultimate failure loads equivalent to the native coracoclavicular ligaments. Jari et al. [7] found anterior, posterior, and superior translation of the distal clavicle was appreciably increased by 110%, 360%, and 100%, respectively, for coracoacromial ligament transfer combined with a suture sling using two loops of suture passed through the clavicle and around the coracoid. Most recently, a cadaveric study compared a modified Weaver-Dunn technique [16] (with a coracoacromial ligament transfer and Number 2 FiberWire looped around the coracoid), an anatomic coracoclavicular ligament reconstruction with a semitendinosus tendon graft,

and an arthroscopic coracoclavicular ligament reconstruction with a double loop of Number 5 FiberWire through drill holes in the clavicle and coracoid to reduce the AC joint. There was no considerable difference in superior displacement with cyclic loading among the groups. However, they found the anatomic reconstruction with tendon graft had less anterior and posterior translation and more closely approximated the intact coracoclavicular ligaments compared with the modified Weaver-Dunn procedure [9, 16]. These biomechanical studies suggest reconstruction of the coracoclavicular ligaments with a free tendon graft offers initial stability most closely related to the intact AC joint when compared with other procedures.

The best method to pass the graft during reconstruction also remains controversial. Traditional open procedures require larger incisions, deltoid takedown, and extensive soft tissue dissection to isolate the coracoid and pass the graft, which increases the risk for complications. We believe our arthroscopically assisted technique eliminates these potential complications while still allowing for superior visualization of the coracoid. It is also our hope that once the graft matures and revascularizes, it will maintain the initial stability of the AC joint demonstrated in biomechanical studies [8, 9]. Without histologic sampling, we cannot be certain as to the length of time necessary for the graft to fully mature. However, one study evaluating hamstring tendons for anterior cruciate ligament reconstructions in a sheep model suggested that by 12 weeks, the collagen fibers of the graft went from a random organization to a completely longitudinal one and that graft maturation continued for up to 1 year after surgery [6]. After a simple home exercise program immediately after surgery, we do recommend keeping patients in supervised physical therapy until at least the 12-week point to help protect the graft in this critical stage.

Using this technique, 10 patients with an average followup of 5 months have all been satisfied with the result and have reported substantial pain relief and functional improvement when questioned and examined by the operating surgeon (FAC, DWA). The patients who lost reduction did not require repeat surgery because they remained pain-free with no loss of function. The coracoid fracture sustained in the high-level baseball pitcher may have been related to the high torque placed on the coracoid during the repetitive act of pitching with the suture acting as a stress riser. Despite the fracture, this patient maintained reduction of the AC joint and is currently pain-free 2 months after fixation of the fracture.

To determine if this arthroscopically assisted coracoclavicular ligament reconstruction can produce cosmetic and functional results equal or superior to traditional open procedures with fewer complications, we will need to continue to follow our patients and report long-term results.

At this point, we believe this technique offers the arthroscopic surgeon an additional treatment option for a common problem.

References

1. Baumgarten KM, Altchek DW, Cordasco FA. Arthroscopically assisted acromioclavicular joint reconstruction. *Arthroscopy*. 2006;22:228.e1–228.e6.
2. Boehm TD, Kirschner S, Fisher A, Gohlke F. The relation of the coracoclavicular ligament insertion to the acromioclavicular joint. A cadaver study of relevance to lateral clavicle resection. *Acta Orthop Scand*. 2003;74:718–721.
3. Bosworth BM. Acromioclavicular separation: new method for repair. *Surg Gynecol Obstet*. 1941;73:866–871.
4. Chernchujit B, Tischer T, Imhoff AB. Arthroscopic reconstruction of the acromioclavicular joint disruption: surgical technique and preliminary results. *Arch Orthop Trauma Surg*. 2006;126:575–581.
5. Ferris BD, Bhamra M, Paton DF. Coracoid process transfer for acromioclavicular dislocations: a report of 20 cases. *Clin Orthop Relat Res*. 1989;242:184–194.
6. Goradia VK, Rochat MC, Kida M, Grana WA. Natural history of a hamstring tendon autograft used for anterior cruciate ligament reconstruction in a sheep model. *Am J Sports Med*. 2000;28:40–46.
7. Jari R, Costic RS, Rodosky MW, Debski RE. Biomechanical function of surgical procedures for acromioclavicular joint dislocations. *Arthroscopy*. 2004;20:237–245.
8. Lee SJ, Nicholas SJ, Akizuki KH, McHugh MP, Kremenec II, Ben-Avi S. Reconstruction of the coracoclavicular ligament with tendon grafts: a comparative biomechanical study. *Am J Sports Med*. 2003;31:648–654.
9. Mazzocca AD, Santangelo SA, Johnson ST, Rios CG, Dumonski ML, Arciero RA. A biomechanical evaluation of an anatomical coracoclavicular ligament reconstruction. *Am J Sports Med*. 2006;34:236–246.
10. Nuber GW, Bowen MK. Acromioclavicular joint injuries and distal clavicle fractures. *J Am Acad Orthop Surg*. 1997;5:11–18.
11. Osti M, Seil R, Bachelier F, Kohn D. Minimally invasive endoscopic reconstruction technique of acute AC-joint dislocations: a cadaver study. *Knee Surg Sports Traumatol Arthrosc*. 2006;14:686–691.
12. Rockwood CA Jr, Williams GR, Young DC. Disorders of the acromioclavicular joint. In: Rockwood CA, Malsen FA, eds. *The Shoulder*. 2nd ed. Philadelphia: WB Saunders Co; 1998:483–553.
13. Rolla PR, Surface MF, Murena L. Arthroscopic treatment of acute acromioclavicular joint dislocation. *Arthroscopy*. 2004;20:662–668.
14. Trikha SP, Acton D, Wilson AJ, Curtis MJ. A new method of arthroscopic reconstruction of the dislocated acromio-clavicular joint. *Ann R Coll Surg Engl*. 2004;86:161–164.
15. Tsou PM. Percutaneous cannulated screw coracoclavicular fixation for acute acromioclavicular dislocations. *Clin Orthop Relat Res*. 1989;243:112–121.
16. Weaver JK, Dunn HK. Treatment of acromioclavicular injuries, especially complete acromioclavicular separation. *J Bone Joint Surg Am*. 1972;54:1187–1194.
17. Weinstein DM, McCann PD, McIlveen SJ, Flatow EL, Bigliani LU. Surgical treatment of complete acromioclavicular dislocations. *Am J Sports Med*. 1995;23:324–331.
18. Wolf EM, Pennington WT. Arthroscopic reconstruction for acromioclavicular joint dislocation. *Arthroscopy*. 2001;17:558–563.