Midterm results of modified coracoclavicular ligament repair using suture anchors for acute acromioclavicular joint dislocation

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Purpose
The aim was to prospectively gauge the clinical and functional patient outcomes of modified coracoclavicular ligament repair and stabilization using suture anchors and disc reduction in management of acute acromioclavicular joint (ACJ) dislocation at a minimum 2 years of follow-up.
Study design
This was a case series, and the level of evidence was IV.
Patients and methods
This study was carried out on 30 consecutive patients who had acute ACJ dislocation Rockwood types III–V in the period between June 2009 and March 2014. Average follow-up was 34.7 (25–75) months. This study was conducted in two tertiary centers: Suez Canal University Hospitals and El-Galaa Military Hospital. All patients were operated within 1 month of injury using an anchor with loaded sutures that was inserted into the dorsal part of coracoid base. The ends of the sutures were then passed through clavicular holes placed at coracoclavicular ligament attachment, and each suture strand was separately tied.
Outcome measures
Patients were evaluated postoperatively for persistence of good reduction, complications, range of motion, and return to preinjury activity level. Visual analog scale was used to assess postoperative pain. The functional outcomes of the shoulder were evaluated by Disabilities of the Arm, Shoulder, and Hand and Constant shoulder scores.
Results
A total of 28 patients (93.33%) returned to work and resumed sports activities. The mean Constant score was 88.2 points. The mean Disabilities of the Arm, Shoulder, and Hand score was 12.2 points.
Conclusion
Treatment of acute ACJ dislocation with coracoacromial ligament repair and stabilization using suture anchors and disc reduction is technically simple and showed encouraging midterm clinical results with a low complication rate.

Keywords:
acromioclavicular disc repair, acromioclavicular dislocation, coracoclavicular ligament repair, suture anchor

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Introduction

Acromioclavicular joint (ACJ) dislocation accounts for approximately 9% of all shoulder injuries [1–3]. ACJ dislocation has been subclassified by Rockwood in 1984 into six types according to the extent of clavicle displacement and the severity of ligament injuries [4]. According to this classification, types I and II are incomplete dislocations and types III–VI are complete dislocations [5].

Treatment of incomplete ACJ dislocation is favored using conservative methods; however, treatment of complete ACJ dislocation is still controversial [4], and no consensus exists in literature on the optimal therapy. The goal of therapy was to stabilize the clavicle by substitution of the ruptured CC ligaments [6].

The current criterion standard is to reconstruct the torn CC ligaments with either local tissue or an allograft. However, many procedures have been described for the repair of acute and chronic type III–VI injuries, such as pins placed through the acromion, across the ACJ, and into the clavicle; threaded wires; hook-plate fixation; CC slings and loops; coracoacromial (CA) ligament graft with or without excision of the distal end of the clavicle; a screw placed from the clavicle into the coracoid base; and bioabsorbable or nonbioabsorbable devices passed through a drill hole in the clavicle and

around the coracoid base. The AC ligaments and CC ligament are repaired, if possible. Weaver and Dunn [7] described a procedure designed to reconstruct the CC ligament by excising the distal end of the clavicle and transferring the acromial attachment of the CA ligament to the resection site and more recently arthroscopic reconstruction of the ACJ [8].

The use of metal implants may be associated with fixation failure, implant breakage, and need for removal of hardware. To prevent these complications, many authors have advocated the use of sutures or synthetic loops of absorbable or nonabsorbable material to stabilize the clavicle to the coracoid process [9–11].

Therefore, this study aimed to prospectively gauge the clinical and functional patient outcomes of modified coracoclavicular ligament repair and stabilization using suture anchors and disc reduction in management of acute ACJ dislocation at a minimum 2 years of follow-up.

Patients and methods

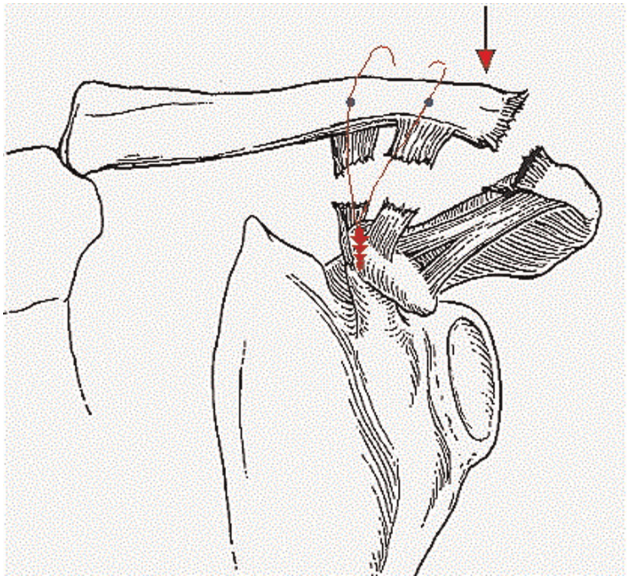
Between June 2009 and March 2014, we prospectively performed coracoclavicular ligament repair and stabilization using suture anchors in 32 consecutive patients who had acute Rockwood type III through V ACJ injuries. The study was approved by the institutional ethics committee in the Orthopedic Department of Orthopaedic Surgery, Suez Canal University Hospitals, Ismailia. This study was conducted in two tertiary centers: Suez Canal University Hospitals and El-Galaa Military Hospital, Egypt. All patients were operated on within 1 month of the injury. Mean follow-up was 34.7 months (range: 25–57 months). Patients presented with type I and II, pathological dislocation, associated clavicle fracture, previous shoulder operations, open ACJ injuries, and paralytic problems were excluded from the study. Two patients were lost to follow-up during the first year after surgery and were excluded from the study. This left 30 patients available for analysis.

Preoperative anteroposterior, cephalic angled oblique (10–15°), and axillary radiographs were taken. Stress views using 5 lbs with the healthy side used as a control were also obtained. According to the Rockwood classification, 20 (66.66%) patients had type III lesion, six (20%) had type IV lesion, and four (13.33%) had type V lesion. A total of 27 (90%) were men and three (10%) women. Average patient's age was 26 (20–35) years. Overall, 22 (73.33%) injuries were on the dominant side and eight (26.66%) on the nondominant side. Possible etiologies included traffic accidents in 20 (66.66%) patients, sports accidents in three (10%) patients, and falling in seven (23.33%) patients. A total of 18 patients (60%) were manual workers, seven patients (23, 33%) were housewife, and five patients (16.66%) were employees. Moreover, (36.66%) patients participated in sports activities.

Surgical technique

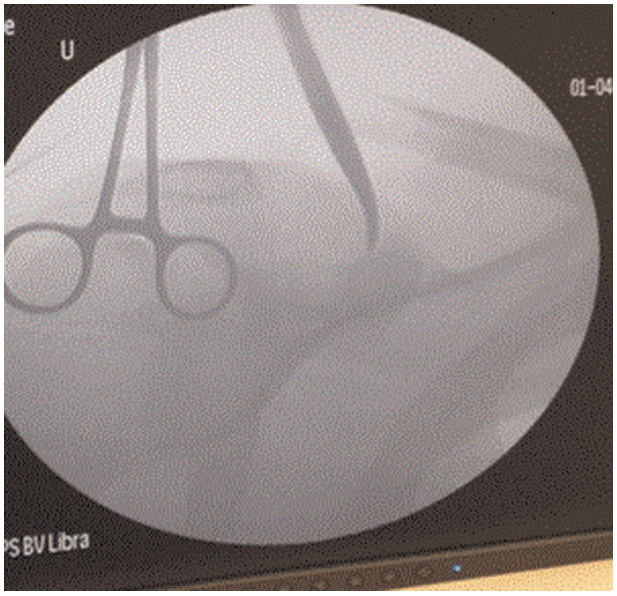
Under general anesthesia and in beach-chair position, the arm and shoulder of the patient was draped and displaced outside the table to facilitate C-arm positioning for evaluation of fixation. After injection of the skin with a local anesthetic epinephrine mixture, a strap incision to expose the ACJ, the lateral end of the clavicle, and the coracoid process was performed. It began 1 inch posterior to the clavicle, crossed the clavicle 1 inch medial to the ACJ, and then extended down to a point medial to the tip of the coracoid process. The incision was then undermined so that the ACJ, the distal 2 inches of the clavicle, and the anterior deltoid could be visualized. The interval between the trapezius and the deltoid in the distal 2 inches of the clavicle was divided so that the clavicle could be grasped by a clamp and lifted upward. Subcutaneous mediolateral dissection was performed to expose the delto-pectoral fascia and identify the conoid and trapezoid ligament attachment to the clavicle. Blunt dissection was done to identify the base of the coracoid process. One self-drilling suture anchor (Smith-Nephew, 7135 Goodlett Farms Pkwy, Cordova, United States) was inserted into the dorsal part of coracoid base just anterior to the stump of the CC ligament. The sutures are tugged forcefully to test the anchor insertion. The sutures ends are clamped. A 2-mm drill bit was used to make two holes through the distal clavicle, one cm apart, just above the CC ligament attachment in posterosuperior to anterior-inferior direction. Any excess bone was removed, and the hole ends were smoothed to decrease risk of laceration of the sutures. The ends of the sutures were then passed through the clavicular holes, and each suture strand was separately tied. The anchor suture was tightened until the ACJ was reduced. Difficult reduction needed open ACJ reduction and disc reduction. The coracoclavicular ligaments were repaired if needed. Reduction was tested by C-arm. ACJ reduction and stabilization was done with one or two temporary 1.8-mm K-wires for 4 weeks (Figs. 1–3).

Figure 1



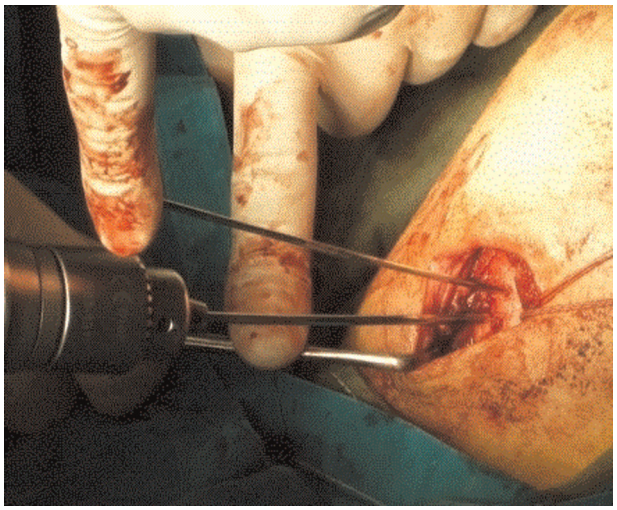
Schematic diagram showing a self-drilling sutur anchor inserted into coracoid base. The ends of the sutures were passed through the clavicular holes and sture strand was tied.

Figure 2



Intraoperative fluoroscopy, anchor positioning.

Figure 3



Drilling clavicular holes.

Postoperative care and follow-up

Postoperatively, each patient was used a pouch arm sling for 4 weeks. Then, passive pendulum exercises were started. Patients were permitted to perform their daily activities gradually. Abducting the upper extremity above the shoulder was prohibited for 6 weeks. After 3 months, patients were permitted to perform normal activities.

Clinical follow-up visits were carried out at 3, 6, and 12 weeks, and then at 3 months interval till 2 years postoperatively and whenever necessary. In each visit, patients underwent plain radiographs to ensure the accuracy and persistence of good reduction and were assessed for presence of complications, range of motion (ROM), and return to preinjury activity level. Visual analog scale was used to assess postoperative pain [12,13]. The functional outcomes of the shoulder were evaluated by Disabilities of the Arm, Shoulder, and Hand functional score [14] and Constant shoulder score [15]. The difference of Constant score between normal and abnormal shoulder was grade as follows: greater than 30 poor, 21–30 fair, 11–20 good, and less than 11 excellent [16].

Statistical analysis

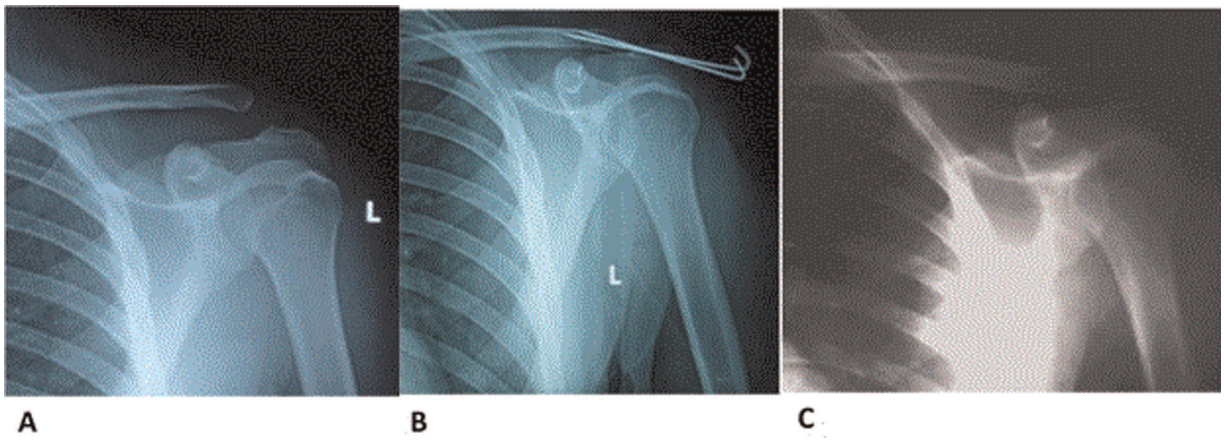
Descriptive statistics were summarized with frequencies or means±SD. To compare between preoperative and postoperative findings, Student's *t*-test was used for continuous data. χ^2-Test was used for categorical data, but if any cell in the contingency table has a value of 5 or less, Fischer's exact test. A *P* value less than 0.05 was considered to be statistically significant.

Results

Mean operation time was 56 min (range: 45–78 min) and incision length was 82 mm (range: 70–95 mm). On the second day after operation, mean visual analog scale was 2.3 (0–3).

The immediate postoperative radiography finding showed 30 patients (100%) had complete ACJ reduction. At the final follow-up, two patients (96.66%) still had complete ACJ reduction (Fig. 4), and one patient (3.33%) had subluxation.

Figure 4



Plain radiographs of type III acromioclavicular joint dislocation that was treated surgically using suture anchor. (a) Preoperative radiograph. (b) Immediate postoperative radiograph with temporary K-wires fixation. (c) Follow-up radiograph at 2 years with maintenance of reduction.

After early ROM exercises, 93.3% of the patients (28/30) could abduct and elevate their shoulder more than 90° at 3 months postoperatively. At the final follow-up, 28 patients (93.33%) returned to work and resumed sports activity. The mean Constant score was 92.2 (81–100) points, with eight patients having full score. The mean difference in Constant score between normal and abnormal shoulders was 7.6 (0–19) ($P<0.05$). The mean Disabilities of the Arm, Shoulder, and Hand score was 12.2 (10–14) points.

One patient developed superficial infection; it was resolved successfully by intravenous antibiotics. Another patient had subluxation, but it did not affect clinical outcome.

Discussion

Our study shows favorable outcomes with return to preinjury activity level when using suture anchors for stabilization of acute ACJ dislocations. In our technique, by placing the suture anchor at the base of the coracoid, the line of pull of the sutures is as anatomical as with the native CC ligaments. This also allows the remnant fibers of the torn CC ligament to be more closely aligned and thus heal together in a more anatomical position.

Reconstruction of the CC ligament using sutures requires dissection around the coracoid process, risking injury to the neurovascular structures. To avoid the potential risk with the passage of sutures around the coracoid, suture anchors were favored to reconstruct CC ligament alone with encouraging results [6,11]. In a human cadaveric model, it was reported that suture anchors can provide strength similar to that of intact CC ligament. Furthermore, CA ligament transfer alone was found to be the weakest, and it was recommended that this type of repair should be augmented with another form of CC fixation [17]. Jerosch *et al.* [18] studied the more 'anatomical' between eight different ACJ stabilization methods and found that a simple coracoid sling led to significant anterior displacement of the clavicle. They recommended a bone anchor system for distal fixation and a 'medialized' hole in the clavicle in order to restore the anatomy best. Our technique allows anatomical reconstruction of CC and provides a downward force to the clavicle, which usually rises superiorly under the force of the trapezius muscle. Reconstructions involving high tensile sutures such as fiber wire have been shown to behave similarly to native ligaments biomechanically [19].

Complications following surgical treatment of ACJ injuries are common [20]. Stam and Dawson [21] reported a series of 20 patients undergoing surgical management using Dacron tape, and nine had erosion of the clavicle by the tape. Neault *et al.* [22] reported three cases of deep infection following the surgical reconstruction of using Dacron tape. Larsen *et al.* [23] treated 41 cases of AC dislocations; half of the patients had problems with the metallic device and six had superficial infections. Compared with these techniques, our complication rate is relatively low.

Our results are agreed by others. Choi and colleagues described a surgical technique involving securing the clavicle to the coracoid process using suture anchors for the treatment of acute ACJ injury. A total of 20 patients were evaluated retrospectively, for a mean of 41.2 months. At the last follow-up, the mean Constant

score for the 20 patients was 89.5. Moreover, 18 patients (90%) maintained complete ACJ reduction. Slight loss of reduction was noted in two patients (10%), but their functional outcomes were good. No fixation failure or pulling out of suture anchors was encountered [24]. Similarly, Friedman *et al.* [25] retrospectively reviewed 24 consecutive cases of patients who underwent CC stabilization with a suture anchor moored in the base of the coracoid process for a type III and type V separation or type II and type V distal clavicle fracture. Of the 22 patients, 18 had full strength and painless ROM in the affected extremity at the final follow-up (mean: 39 months). Basyoni *et al.* [26] used anchor sutures tied over a small button plate to reconstruct ACJ type IV–V injuries in 15 patients with a mean age of 31 years (range: 19–48 years). All patients returned to work within a mean time of 11.2 weeks (range: 8–18) postoperatively. The mean Constant–Murley Shoulder Score at the last follow-up was 92.8. Residual subluxation occurred in one patient and dislocation occurred in another.

There is a widely accepted trend in many series toward nonoperative treatment of ACJ injuries [27–29]. Some studies prospectively comparing nonoperative and operative management of these injuries have reported similar outcomes with no superiority of either treatment [23,30]. However, some patients, especially those involved in overhead throwing sports or heavy manual workers, may develop pain and mechanical symptoms interfering with their ability to perform their usual activity. The disruption of the synchronous scapuloclavicular rotation [31,32] is the main cause of this disability and has led some authors to recommend surgical repair or reconstruction [33–35].

The study has some limitations. The sample size was small, but the rarity of injury and the small percentage of high demand patients who need surgical intervention should be taken into consideration. The follow-up period was relatively short (minimum 2 years), but as the clavicle remained reduced for a minimum of 2 years following surgery, we do not expect a deterioration of clavicular posture in the long term. Similarly, longer follow-up will be necessary to determine the incidence of post-traumatic osteoarthritis, but the restoration of nearly anatomical congruity of the ACJ should minimize the progression of arthritis. The biomechanical characteristics of our technique need further investigation in cadaveric studies, especially regarding loads of failure. Finally, the usage of the mentioned technique without the temporary AC K-wire must be tested.

In conclusion, we recommend the use of suture anchors for stabilization of acute ACJ dislocation associated with CA ligament repair and disc reduction with favorable midterm clinical outcomes. This method provides another option for the surgical treatment of acromioclavicular injuries with the advantages of ease of operation and no need for fixation removal. Other advantages include smaller incision, dissection limited to the region above the coracoid, and better cosmetic appearance. As no instruments or fixation materials are passed underneath the coracoid, the risk for neurovascular injury was minimized with minimal blood loss, operative time was short with low morbidity, and there were minimal complications from breakage or migration of metal implants.

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Conflicts of interest
There are no conflicts of interest.

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