Surgical Treatment of High Degree AC-Joint Dislocations Using Double-Button Fixation Device

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Abstract

Objective

To evaluate clinical and radiological outcomes of Rockwood V acromio-clavicular-joint (AC-joint) dislocations, operated on with a double button device, within 5 days after trauma.

Design

Case series, level of evidence: IV.

Setting

In-hospital, tertiary level of clinical care.

Patients

123 patients entered the study with an average age of 37.3 years old. Of these, 95 patients met inclusion criteria, of which, only 86 patients attended follow-up (FU) evaluation and finished the study.

Interventions

123 patients with AC-joint dislocations were operated on under radiological guidance with the Zip-Tight \textsuperscript{*} fixation system. Preoperative evaluation was performed with panorama AP view. AP stress views with 10 kg and Alexander view of both shoulders were performed at each FU.

Main Outcome Measures

Acromioclavicular Joint Instability score (ACJI), simple shoulder test (SST), and mean clavicle-coracoid (CC) distance.

Results

Mean ACJI score: 84.7. Mean SST score: 11.5. Mean CC distance was 8.5 mm after surgery, and by the last FU it was 8.9 mm (not significant). Thirty-six patients presented some degree of horizontal displacement of the clavicle (mean ACJI score: 73.5) and fifty patients no presented displacement (mean ACJI score: 92.2). This difference was statistically significant (p<0.001). There were no significant differences in either subjective (pain, tenderness, daily live activities and cosmesis) or in strength parameters between groups.

Conclusion

The surgical treatment of high degree AC-joint dislocation using double-button device provides a stable fixation and satisfactory clinical results at intermediate-term FU.

Key Words: Shoulder; Acromioclavicular Joint; Dislocation; Double-Button Fixation; Outcomes

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Sub Date: April 26\textsuperscript{th}, 2019, Acc Date: May 7\textsuperscript{th}, 2019, Pub Date: May 8\textsuperscript{th}, 2019


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Introduction

Traumatically acromio-clavicular (AC) joint dislocations are frequent among the young athletic population [1,2]. Nine percent of the shoulder girdle lesions affect the AC joint, and the reported incidence in the U.S.A. is 3-4% per 100,000 [3]. The most frequent injury mechanism leading to a dislocation of the AC joint is a direct trauma applied over the shoulder region (fall or a direct blow), with the arm in an adducted position. Less frequently AC joint dislocations result from an indirect trauma: by falling over an adducted outstretched hand or elbow, causing the humerus to translocate superiorly and driving the humeral head into the acromion [2].

Biomechanically, AC joint separation involves a sequential injury of different shoulder structures: it starts with the acromio-clavicular ligaments disruption, progressing into the clavicle-coracoid (CC) ligament complex rupture and finally involving the deltoid and trapezius muscles and fascia [4]. Rockwood and Green classified the AC-joint dislocations into 6 types, according to its degree of severity [5]. For Rockwood type I and Rockwood type II, a conservative management is the rule, whereas for Rockwood type IV to VI surgical stabilization is indicated [2,6]. However, management of Rockwood type III remains controversial, with some authors recommending a conservative treatment and others suggesting surgical stabilization, particularly for athletes or manual workers who perform overhead activities [7-10]. Furthermore, there is still controversy about which kind of technique to use in patients with surgical indication.

More than 70 different surgical procedures have been reported, including coracoacromial ligament transfer, plate fixation, wire fixation and screw fixation, with no gold standard established until now. Many of these techniques often associate with complications, such as fracture of the coracoid, loosening, breakage and/or migration of the hardware, loss of reduction and postoperative osteoarthritis [9,11,12]. Recent evidence suggests that an anatomical reconstruction of the AC joint would improve the results [13-24].

For that purpose, novel anatomical-like techniques of acute AC joint dislocation have been introduced [22,23]. One of them is the use of 2 flip-button devices with or without biological reinforcement to independently augment the conoid and trapezoid ligaments with nonabsorbable sutures in order to get an anatomical healing of the CC ligaments, which would act as a scaffold to permit this process while maintaining a stable reduction of the AC joint [22]. Nonetheless, even after anatomical reconstruction of the AC joint, radiological and clinical improvements are still debatable, due mostly to residual pain associated to postoperative posterior displacement of the clavicle.

In search of a more significant outcome for the dislocated patient, we introduced an early intervention scheme for these types of lesions in our center by performing surgery within 5 days after the trauma occurs. We found that, by introducing this scheme, joint stabilization was significantly improved in terms of clinical and radiological outcomes.

Patients and Methods

All surgical procedures, clinical follow-up (FU), and data analyses were in accordance with the Institutional Review Board of the hospital. Between September 2014 and June 2017, 123 consecutive patients (108 males, 15 females), average age 37.3 years (range 17-59), with an acute AC joint dislocation were operated on using an open and radiological guided technique. All surgeries were performed by the same medical team.

Surgical therapy was indicated in patients with AC joint dislocation Rockwood type IV to VI and Rockwood types III to IV. For this study 95 patients were included under the following criteria: Rockwood V AC joint dislocations, and surgery performed within 5 days after trauma. Preoperative evaluation was performed with panorama (bilateral) AP view (Figure 1). Postoperatively bilateral AP view and Alexander view were performed at 1 month, 6 months and at last FU. Clinical evaluation was performed with Simple Shoulder Test (SST) and the Acromio-Clavicular Joint Instability scoring system (ACJI) [23,25].

Figure 1: Preoperative panorama radiograph of a type V right acromioclavicular dislocation.
Surgical Technique

General anesthesia and inter-scalenic brachial plexus blockade were used for all the patients along with perioperative antibiotics. The patient was placed in the decubitus supinum position, with 20° of thoracic elevation. The shoulder and ipsilateral arm were prepared and draped in a sterile fashion. A vertical 5 cm incision was done, taking care to preserve the clavipectoral fascia adequately. To perform the AC-joint stabilization, the X-ray image intensifier was positioned anteriorly showing an AP view of the AC-joint.

Then a 2.5 mm tunnel was drilled 4 cm lateral to the AC-joint. Keeping the drill in this position, this tunnel was overdrilled with a cannulated 4.5 mm drill, and the AC-joint was considered reduced. Under X-ray inspection, a 2.5 mm tunnel was drilled through the center of the coracoid, followed by a 4.5 mm cannulated drill. While keeping the joint reduced, a Zip-Tight ® fixation system (Biomet, Warsaw, USA), consisting on a self-retained round clavicular (6.5 mm diameter) and an oblong coracoid titanium button (10 mm x 3.5 mm), connected by high resistance nonabsorbable N° 5 super-suture, was inserted under radiological view. The position of the devices and the reduction of the AC-joint were then observed under an image intensifier. Acromioclavicular capsule was sutured with absorbable sutures. The deltotrapezoidal fascia was then closed. The sub-dermic tissue and skin were stitched separately.

A sling was used postoperatively to protect the shoulder for 6 weeks. During that time, passive range of motion exercises were allowed up to 45° of abduction and flexion during the first 3 weeks and up to 90° in the following 3 weeks. After 6 weeks, active range of motion exercises were allowed. Weight-bearing exercises were allowed when patient achieved full range of motion (not before 7 weeks). Return to contact sports was allowed 6 months after the procedure (Figure 2).

Postoperative Evaluation

Postoperative clinical and radiological evaluations were performed by 2 examiners, different from the surgeons. Complete physical examination of both shoulders was done. Two tests or scores were used to evaluate the outcomes: SST (maximum 12 points) and ACJI (maximum 100 points).

ACJI score was described and published in detail by Scheibel et al. [23]. Abduction strength was measured with an isometric dynamometer (Isobex TM dynamometer, Medical Devices Solutions AG, Burgdorf, Switzerland) in 90° degrees of abduction in the scapular plane of both shoulders. Postoperative AP radiographic view with 10-kg load, and Alexander view of both shoulders were performed to evaluate the presence of AC-joint osteoarthritis, and to evaluate vertical and horizontal displacement of the clavicle.

Displacement of the clavicle was measured in the bilateral AP stress view with 10-kg load. The Coraco-Clavicular (CC) distance of both sides was measured, as the distance between the inferior cortex of the clavicle and superior cortex of the coracoid process. Percent differences between the affected and the contralateral side were calculated. Ten points were given when sides differed less than 10%; 8 points when sides differed between 10% and 25%; 4 points when sides differed between 25% and 100%; and 0 points when sides differed more than 100%. Horizontal position of the joint was evaluated in the Alexander view. The position of the clavicle regarding the acromion was evaluated. A stable joint was defined as the clavicle in line with the acromion. A subluxated joint was described when the joint was incongruent, with a displacement of the clavicle less than one clavicle shaft width. A dislocated joint was defined when the displacement of the clavicle was more than one width.
Migration of the implants between the clavicle and the coracoid process were classified as: none, up to the superior cortex of the clavicle, up to the clavicle or the coracoid process, and full migration, as described by Scheibel et al. [23]. Ossifications between the clavicle and the coracoid were evaluated and differentiated into none, mild, moderate and severe. Mild ossifications were small ossicles in the CC ligament. Moderate ossification was almost complete bridging between the coracoid and the clavicle, severe ossification were complete bridgings between the bones.

Statistics

Descriptive and univariate statistics analysis were performed using SSPS 13.0. Groups were compared using the Mann-Whitney U test. Comparison of metric data within one group was performed with Wilcoxon Signed Ranks Test. Descriptive results are demonstrated as the mean (range). Statistical differences were defined with a P value <0.05.

Results

Ninety-five patients were included in this study, under the following criteria: Rockwood V AC-joint dislocations and surgery performed within 5 days after trauma. After a mean of 24.2 months (range, 12 -32 months) 86 of 95 patients were available for clinical and radiological evaluation. Of the 9 patients lost to FU, one case had presented a skin infection that recovered after antibiotic treatment. Six patients were women, and 80 were men. Mean age in this group was 37.9 years (range, 18-60 years). There was a mean of 2.31 days (range, 0-5 days) delay between the trauma and the surgery for this group of patients.

Mean CC distance was 8.5 mm (4-13.3) after surgery, at last FU was 8.9 mm (4.3-13.4). This difference was not significant. The mean CC distance in the non-affected side was 8.1 mm (5-12.6). Compared to the mean CC distance of the affected side at last FU, this difference was not significant. Three patients (9.3%) showed moderate ossification between the clavicle and the coracoid in the area of the CC ligaments.

The mean SST score was 11.5 points for the 86 patient’s evaluated (range, 9-12 points).

The mean ACJI score was 84.7 points (range, 62-98 points), for the entire group. For pain items patients reached 17.1 points (range, 0-20 points), for activities of daily living (ADL) 9.6 points (range, 5-10 points), for cosmesis 7.6 points (range, 0-10 points), for function 23.1 points (range, 10-25 points) and for radiological assessment, 24.5 points (range, 4-25 points). There was no migration or dislocation of the implants at last FU(Figure 3).

Figure 3: A. B. Patients with AC-Joint dislocation. A’. B’. Radiological results 12 months after reduction and fixation with Zip-Tight® in situ.
Fifty patients did not show postoperative horizontal displacement in the Alexander view and had a mean ACJI score of 92.2 points (range, 68-98 points). Thirty-six patients (41.8%) patients presented some degree of horizontal postoperative displacement (subluxation or dislocation) of the AC-joint in the Alexander view. They had a mean ACJI score of 73.5 points (range, 61-85 points). This difference was statistically significant (P<0.001). The subcategories of the ACJI scoring system for these two groups are compared in (Figure 4).

**Discussion**

Surgical treatment of acute AC-joint dislocation has a large number of techniques and normally all can achieve a satisfactory rate, but until now there is no reported gold standard. Many techniques result in difficulties, e.g. fracture of the coracoid, loosening of the implants, breakage and/or migration of the hardware, loss of reduction and postoperative osteoarthritis [11,12,26,27].

Recent biomechanical studies have described that an anatomical reconstruction of the CC ligaments could lead to better clinical outcomes [28,10]. Beitzel et al. (2012) found a significantly higher load to failure for superior translation, less translation in all 3 directions and higher superior stability when compared reconstruction of the AC-joint with single or double clavicular tunnels using suture pulley and 2 or 3 buttons versus modified Weaver Dunn reconstruction [28]. Therefore, new surgical techniques have been described using biological [3,20,29,30] and non-biological [19,22-24,10] materials to anatomically reconstruct the CC ligaments. However, it is not yet clear if these techniques will have any clinical advantage [30].

Two studies, with over 2 years of FU, have presented the clinical results of the reconstruction of acute AC-joint dislocation using the double Tight Rope technique. Salzmann et al. (2010), after a mean FU of 30.6 months, reported the results of 23 patients (3 Rockwood type III, 3 Rockwood type IV and 17 Rockwood type V). The mean Constant score (CS) was 94.3 points (range, 88-89 points). They had 8 patients with unsatisfactory radiological outcomes. There were 3 complications that were further examined surgically: one coracoid fracture, one slip of the medial coracoid button associated to vertical instability and one superficial infection at 6 months FU [22].

Scheibel et al. (2011) presented the outcomes for 28 out of 37 patients with a Rockwood type V AC-joint dislocation, operated on with double Tight Rope arthroscopically and radiologically assisted AC-joint reconstruction. Mean age was 38.8 years (18-66 years), average FU 26.5 months (20.1-32.8 months), mean CS was 91.5 points (84-100), mean subjective shoulder value was 95.1% (85-100%) and the mean Taft score was 10.5 points (7-12). They also introduced a new evaluation tool, the ACJI score, to attenuate the overestimation the rate of success after surgical reconstruction of the AC-joint. In fact, this score seems to be a more specific tool to evaluate AC-joint dislocation outcomes than the previously reported Taft score, because it considers different categories like subjective degree of satisfaction, clinical objective parameters and radiological measurements [23].

Currently this score is being validated but could be a more comprehensive tool than the Taft score and more specific than other shoulder scores used in the literature. The mean ACJI score for this study was 79.9 points (84-100 points), in their study. The
In our data, the mean ACJI score was 84.7 points (range 62-98 points), for the entire group at a mean of 24.2 months (range, 12-32 months) of FU. The mean SST was 11.5 points. These clinical outcomes are comparable with the results from both of the studies previously described [22,23]. Our patients presented a higher degree of satisfaction, as demonstrated by the SST. No patient presented dislocation or migration of the implants. Only one patient presented an elongation of the sutures, with a stable but dislocated joint, likely because we used only one implant (one single hole drilled trough the coracoid). This could possibly be explained by the timing of the surgery. Operation within 5 days after the trauma shows better scarring and healing of the CC ligaments(Figure 5).

This study suggests that the ACJI score may overestimate horizontal displacement of the clavicle under stress, in the postoperative Alexander view, misleading the interpretation of the specialist. This study also suggests that attention should be emphasized on the function and strength of patients, as well as on subjective outcomes rather than on radiological FU. Among the strengths of this study we highlight the evaluation of a homogeneous cohort of patients with high degree (Rockwood V) AC-joint dislocations, operated on within 5 days after trauma, as part of a prospective study, with an adequate number of patients and follow up. We have a conscience about this study not having a control group.
Conclusions

The surgical treatment of patients with acute high degree AC-joint dislocation using double-button device provides a stable fixation. This technique shows satisfactory subjective results, such as cosmesis and activities of daily living, as for objective parameters like the strength and range of motion at the intermediate-term FU. However, 41.8% of our patients presented horizontal displacement of the clavicle in the radiological evaluation. In order to avoid this displacement currently we are performing an open trans-osseous cerclage of the AC-joint, with highly resistant non-absorbable sutures.

References


