Original article

Complication rates and types of failure after arthroscopic acute acromioclavicular dislocation fixation. Prospective multicenter study of 116 cases

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A B S T R A C T

Aims: To report and analyze both the surgical and radiographic complications associated with anatomic coracoclavicular (CC) ligament procedures and to evaluate the effect of these complications on patient outcomes.

Patients and methods: From July 2012 to July 2013, 116 primary anatomic CC ligament procedures (all arthroscopic endobutton fixations) were performed in 14 different centers. Demographic, surgical, subjective, and radiographic data were prospectively analyzed in 14 centers with a minimum follow-up of 12 months.

Results: This series included 96 men and 20 women, mean age 37 years old, with a mean delay to surgery of 10 days. No intraoperative complications were reported. There were 11 complications due to hardware failure resulting in a loss of reduction, 1 coracoid fracture, 7 cases of adhesive capsulitis, 2 local infections, 5 cases of hardware pain. There were significant differences in outcomes between patients who did and did not develop complications: mean CS = 71 vs. 93, (P < 0.0001). All the parameters of the CS were statistically affected (P < 0.0001). Forty-eight patients had persistent dislocation > 150° on an AP X-ray which affected the pain and activity CS (P = 0.023 and P = 0.044). No preoperative predictive factors were identified. These patients could not return to the same level of sports activities due to persistent pain.

Discussion: Anatomic procedures to treat AC joint dislocation using CC ligament reconstruction resulted in an overall complication rate of 22.4% and influenced the return to sports. Good to excellent outcomes were reported in patients without complications.

Clinical series: Level of evidence 4.

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1. Introduction

There are sixty surgical techniques to treat acromioclavicular (AC) dislocations [1], and none of them has been recognized as a gold standard. At present arthroscopic techniques focus on anatomic reconstruction of the AC joint and the coracoclavicular (CC) ligaments. The rate of surgical complications in the literature following arthroscopic reconstruction of the CC ligaments to stabilize acromioclavicular dislocations (ACD) varies from 12.5 to 27.1% [2], and can reach 40% if postoperative loss of reduction is taken into account [3]. Complications are usually intraoperative and due to difficulties associated with the surgical techniques and the hardware. Moreover, although the short and/or long term functional consequences of these complications can be significant, their radiographic and clinical consequences have not been systematically evaluated.

The hypothesis of this systematic analysis of complications is that poor clinical and radiographic results of surgery for ACD are correlated with unsuccessful AC joint reconstruction due to the development of complications related to hardware or the surgical
Table 1

<table>
<thead>
<tr>
<th>Epidemiological series of acute ACD.</th>
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<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>Mean BMI</td>
</tr>
<tr>
<td>Limb injured on dominant side</td>
</tr>
<tr>
<td>Sports activities</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Professional activity</td>
</tr>
<tr>
<td>Accident</td>
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<tr>
<td>Rockwood stage</td>
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2. Patients and methods

This prospective study was performed in 14 centers between July 2012 and July 2013 and included 116 patients with severe ACD (Rockwood type III, IV and V [4]). Injuries were considered to be acute if surgery was performed within 21 days after injury. Exclusion criteria were the presence of a fracture, associated tears (torn rotator cuff, labral tears) or glenohumeral arthritis. The choice of surgical technique for CC stabilization was left up to the surgeon and AC stabilization was optional.

All patients underwent clinical (Visual Analog Scale [VAS]) for pain, Constant score (CS) [5] and a surgical evaluation and quick DASH score and radiological follow-up (AP X-ray, lateral axillary view and comparison with the contralateral side) with a minimum follow-up of 1 year.

The main judgment criteria were the clinical results (EVA and CS) in patients who presented with a clinical and/or radiological complication compared to the rest of the population.

Statistics: descriptive analysis was performed for all the variables. Because of the small number of patients in each group, the results were compared using the non-parametric Mann and Whitney test and the Kruskal-Wallis test. The Spearman correlation coefficient was used for quantitative variables. Significance was determined in relation to the main judgment criteria (variations in the Constant score) and $P<0.05$ was considered to be significant. All statistical analyses were performed using XlStat software (Addinsoft, Paris, France).

3. Results

This cohort of 116 patients included 96 men (83%) mean age 37 years old (range 20–67), who were operated on a mean 10 days after the initial injury (1–21 days). The other epidemiological data are presented in Table 1. The overall rate of complications was 20.7%.

3.1. Intraoperative complications

No general complications (vascular or nerve injuries), or specific complications related to the hardware or the surgical technique were reported.

3.2. Complications related to the surgical technique

We identified three cases of hardware failure, with only one revision and good final clinical and radiological results (CS = 91 points at 1 year); the CS at the final follow-up in the two patients who did not undergo revision surgery was good (88 and 88.5 points). No specific predictive factors were identified in the three patients who presented with type 3 ACD.

The following hardware-related complications were identified at the final follow-up:

- cases of cutaneous hardware-related pain (superior endobutton fixation and knot);
- 1 displaced fracture of the coracoid process identified during the 6-month follow-up consultation, which was not present on the immediate postoperative radiograph (Fig. 1);
- 8 cases of loss of reduction of the dislocation. No specific event or accident was reported by the patients in these cases.

Once again, no predictive factors were identified.

3.3. General complications

The general complications were:

- 2 immediate postoperative infections were diagnosed and treated by debridement/lavage and appropriate antibiotics with a normal clinical outcome and healing of the infection;
- 7 cases of algodystrophy and type I complex regional pain syndrome;
- 1 case of erosion of the distal quarter of the clavicle. We also observed the development of ossifications of the coracoclavicular ligaments in one patient with no clinical consequences (Fig. 2).

3.4. Analysis of clinical failures

With defined clinical failures as a final Constant score of less than 85 points. This included 32 patients in our series whose mean Constant score was 71.5 points compared to 93 points for the rest of the series. All of the items on the Constant score were affected (Table 2). The mean Quick DASH score was also statistically higher in patients compared to that of the overall series (20.4 vs. 2.3 [P < 0.0002]).

None of the factors such as age, gender, BMI, professional activity, delay to surgery, the type of injury or the type or length of immobilization was found to be a predictive factor for the development of these complications.

An unsatisfactory outcome did not significantly affect the return to work ($P=0.076$), but did affect the return to sports ($P=0.003$).
accident/surgery, the grade of the injury and the length/type of immobilization were not found to be prognostic factors. This loss of reduction had a significant negative influence on the objective Constant score (88.4 points vs. 82.8 points, \(P=0.024\)) and the functional DASH score (4.9 vs. 12.9, \(P=0.005\)). This loss of reduction mainly affected items on the Constant score related to pain and activities (pain \(P=0.023\), activity \(P=0.044\)).

4. Discussion

Acromioclavicular dislocations (ACD) are frequent sports injuries. Although there seems to be a consensus on the management of Rockwood type IV and V injuries, the surgical indications for type III injuries are still a subject of debate. There are numerous surgical techniques and theoretically the development of arthroscopic techniques should reduce the morbidity of this type of surgery, limit incisions and allow early rehabilitation [6]. Recent studies in the literature mainly report clinical results and new surgical techniques but most do not specifically focus on complications, especially since the study populations in these series are relatively small. Nevertheless, the rate of specific and nonspecific complications is quite high in these series, up to 27.1% [2] and can reach up to 44% if clinical complications and unsatisfactory radiological results are taken into account [3].

Loss of reduction or recurrence is the most frequent complication [2,3,7]. This may be due to the slipping of suspension sutures, passing the buttons through the coracoid process or the clavicle (generally because the position of the upper button is too distal) or a fracture of the distal clavicle [2,6,8–10]. The mechanical cause of this loss of reduction is also associated with the use of a single point of fixation, which makes it impossible to reconstruct the two components of the CC ligament and to reconstruct the AC joint [2,3,6,8,11]. Certain authors thus recommend using a double button fixation system [12–14]. Persistent anteroposterior instability of the AC joint increases the strains on the upper button and thus the risk of suture failure, clavicular fracture, passing the button through the clavicle or clavicular bone erosion. This is why, like other groups, and based on the results of this series, we recommend repairing the AC joint to obtain healing of the CC with a double button system [15,16].

We identified a coracoid process fracture on the follow-up radiograph in one patient (also reported by Tomlinson et al. [17] and Jeon et al. [18]). A coracoid process fracture is a rare complication, which has long been known with open surgery techniques [19], but was reported by Gerhardt et al. in 2011 [20] with arthroscopic techniques with small diameter bone tunnels. It has also been observed if the clavicle is threaded with grafts that are placed under the coracoid process [18] due to a “cheese wire effect”, and in case of infection resulting in erosion of the clavicle and the coracoid process [19]. The risk factors of this complication are bone density, diameter of the drilling, the number of tunnels and their position, and the type of fixation. Besides the loss of reduction in these patients, the revision surgical technique must be decided. Indeed anchoring is not longer possible in the coracoid process to secure the biological graft for AC joint and CC ligament reconstruction.

Erosion of the distal clavicle is also a complication that has been described in the literature. In our series this complication was probably not due to the surgical technique itself, (CC reconstruction with proper positioning of grafts and AC reconstruction) but to the AC injury since no loss of reduction was observed. [3]. This complication could also be the result of a silent infection in particular Propionibacterium acnes, even if there is no specific article on this topic in the literature.

A relatively high rate of patients with hardware-related pain (at the site of the upper button and knots) was also observed in

### Table 2

<table>
<thead>
<tr>
<th>Analysis of clinical failures.</th>
<th>&lt;85</th>
<th>&gt;85</th>
<th>(P)</th>
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</thead>
<tbody>
<tr>
<td>Pain</td>
<td>9.7</td>
<td>13.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Activity</td>
<td>14.9</td>
<td>18.9</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Mobility</td>
<td>34.2</td>
<td>38.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Strength</td>
<td>12.8</td>
<td>21.4</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

3.5. Analysis of radiological failures

A radiological failure was observed if there was a 50% loss of reduction at the final follow-up on AP radiographs of the clavicle corresponding to a 50% increase in the CC distance (Fig. 3) compared to the contralateral side [3].

Forty-eight patients were found to have a radiological failure (41.3%). These patients underwent surgery later (1.2 weeks vs. 1.6, \(P=0.028\)) and presented with a higher BMI than the population in the symposium (23.95 vs. 32.8, \(P=0.008\)); the delay

**Fig. 2.** Ossifications of the coracoclavicular ligaments with no loss of reduction.

**Fig. 3.** Example of recurrent acromioclavicular recurrence with measurement of the coracoclavicular distance.
this series (5 patients or 4.3%). Patients usually reported pain when wearing a backpack or carrying a handbag.

Finally, although we did not observe certain complications in this series that have been reported in the literature such as vascular or nerve injuries, [6,21,22], the surgeon should be aware of this risk when a medial and inferior approach must be used for the coracoid process.

5. Conclusions

Our series confirms that surgery for AC dislocations is difficult with radiological results that must still be improved by our surgical techniques (radiological failures in 41% with an increase of 50% in the CC distance compared to the healthy contralateral side). Radiological failures are associated with poorer functional results especially for the pain and activity CS (P = 0.023) and (P = 0.044) respectively. The delay between the accident and surgery and the BMI influence radiological results was 1.2 weeks vs. 1.6 (P = 0.028) and 23.95 vs. 32.8, (P = 0.008) respectively. A fairly high rate of complications (21% in our series) should also be noted, which suggests that care should be taken when indicating this surgical option. However it should also be noted that many of these complications will not directly affect the patients’ daily and professional activities, but significantly affect the return to sports.

Disclosure of interest

The first author is consultant for Mitek and for Tornier, Inc. and J. Barth is consultant for ARTHREX.

References