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ORIGINAL STUDY

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Does the choice of the optic portal influence the radiographic and early functional results in acute acromioclavicular disjunctions?

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Exposure of the coracoid process during arthroscopic stabilization of acute acromioclavicular disjunctions (ACDs) can be achieved either by passing an extra-articular optical portal through the subacromial space or by an intra-articular optical route through the glenohumeral joint with opening of the rotator interval. The objective of our study was to compare the impact on the functional results of these two optical routes. This was a retrospective, multicentre study that included patients operated on for an acute acromioclavicular disjunction arthroscopically. The treatment consisted of surgical stabilization under arthroscopy. The surgical indication was retained for an acromioclavicular disjunction of grade 3, 4 or 5, according to the Rockwood classification. Group 1, which consisted of 10 patients, was operated on with an extra-articular subacromial optical route, and group 2, which consisted of 12 patients, was operated on with an intra-articular optical route with opening of the rotator interval according to the habits of the surgeon. A follow-up of 3 months was performed. The functional results were evaluated for each patient using the Constant score, Quick DASH, and SSV. The delays in returning to professional and sports activities were also noted. A precise postoperative radiological analysis made it possible to analyse the quality of the radiological reduction. No significant difference between the two groups was found between the Constant score (88 vs. 90; p = 0.56), Quick DASH (7 vs. 7; p = 0.58), or SSV (88 vs. 93; p = 0.36). The times to return to work (6.8 weeks vs. 7.0 weeks; p = 0.54) and sports activities (15.6 weeks vs. 19.5 weeks; p = 0.53) were also comparable. The quality of the radiological reduction was satisfactory in the two groups and did not depend on the approach. No clinically or radiologically significant differences between the extra-articular and intra-articular optical portals in the surgical treatment of acute ACDs were found. The optical route can be chosen according to the habits of the surgeon.

Keywords: shoulder; arthroscopy; acromioclavicular disjonction; surgery; surgical technique; ligament repair.

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INTRODUCTION

Acromioclavicular disjunction (ACD) accounts for 12% of dislocations of the shoulder joint *(1,2)* and up to 40% of shoulder injuries in athletes. ACD is classified in six stages according to Rockwood *(3)*, according to the state of the muscles and ligaments, as well as the position of the clavicle in relation to the acromion. If the interest of orthopaedic treatment for stages I and II is beyond doubt, there is debate for certain ACD in stage III, especially in young and athletic patients *(4,5)*. The surgical indication is consensual for stages IV-VI.

The arthroscopic surgical technique makes it possible to maintain a reduction in ACD during the ligament healing phase. The exposure of the coracoid process during this arthroscopic stabilization procedure can be carried out either by passing an extra-articular optical portal through the subacromial space or by an intra-articular glenohumeral optical portal with opening of the rotator interval *(6-8)*. If in the literature several articles describe and compare the different arthroscopic or open techniques *(9-15)*, none compare the impact of the arthroscopic optical route (intra- or extra-articular) and its potential clinical and radiological consequences.

The objective of our study was to compare the impact on the functional and radiological outcomes of these two optical routes. The secondary objectives were to compare the clinical and radiological failure rates as a function of the time between surgery and trauma.

Our hypothesis was that the exposure of the coracoid process by the extra-articular portal gave better results than the intra-articular portal because it was less iatrogenic. In fact, by remaining extra-articular, the capsule is preserved, which limits the theoretical risk of postoperative glenohumeral joint instability. Moreover, it avoids cartilaginous or labral lesions, which can be created during the installation of the optic *(16)*. However, the intra-articular approach is simpler to carry out because it suffices to follow the acromiocoracoid ligament to arrive at the coracoid process. Moreover, it allows for an assessment of the associated lesions.

MATERIALS AND METHODS

We conducted a retrospective, non-randomized, multicentre study comparing two groups of patients operated on for an acute ACD.Between January 2018 and January 2019, all patients under the age of 65 who had stage III, IV or V ACD (there was no stage VI patients), identified on a Zanca view, with a delay between trauma and surgery less than 3 weeks and having benefited from arthroscopic treatment by double endobutton were included. These patients were selected from two Army Instruction Hospitals (AIH) not using the same arthroscopic approaches to the coracoid process.

The exclusion criteria were surgery converted to open surgery because of arthroscopic failure (one patient in the extra-articular group) or a surgery delay greater than 3 weeks.

A total of 22 patients were included in our study. The vast majority of patients were male (n = 20). The average age of the patients was 40 years (24-61 years) old. In most cases, it was a sports accident, with a direct impact on the shoulder; 13 patients presented with stage III, eight patients with stage IV and one patient with stage V of the Rockwood classification. Stage III patients were operated on because they were young and athletic patients with a strong functional or aesthetic demand after validation of the indication by orthopaedic surgery staff.

Group 1, which underwent the extra-articular optical route, was made up of 10 patients, and group 2, which underwent the intra-articular optical approach, was made up of 12 patients.

The two groups were comparable in terms of sex, age, severity of disjunction, level of professional or leisure activity and time to surgery (Tables I and II).

Patients were operated on under general anaesthesia. The installation was made in the beach-chair position, allowing surgical stabilization under arthroscopy (with a 30° scope) by the placement of a double endobutton (DOG-BONE®, ARTHREX® laboratory).

The first group included patients operated on by a senior surgeon with an extra-articular optical route (subacromial) to the coracoid process. In group 1, there was no intra-articular approach associated with

Table I. — Demography of the Sainte-Anne group (extra-articular approach)

Patient	Sex	Age (years)	Surgery time (days)	Initial Rockwood classification
1	M	52	2	4
2	M	21	3	4
3	M	61	8	4
4	M	42	14	3
5	M	27	3	5
6	M	37	20	3
7	M	22	5	3
8	M	31	5	3
9	F	25	6	3
10	F	50	5	3

Table II. — Bégin group demography (intra-articular approach)

Patient	Sex	Age (years)	Surgery time (days)	Initial Rockwood
1	M	60	8	4
2	M	48	Unknown	3
3	M	34	8	4
4	M	36	14	3
5	M	40	8	3
6	M	31	7	3
7	M	42	9	4
8	M	32	1	4
9	M	56	1	3
10	M	44	8	4
11	M	33	10	3
12	M	43	9	3

respect to the rotator interval. The optical route was lateral, and the instrumental route was anterolateral.

Group 2 consisted of patients operated on by a senior surgeon and who benefited from an intra-articular optical approach to the coracoid process. The optical route was posterior, and the instrumental route was anterior, allowing for the opening of the rotator interval.

In both groups, the method was the same: anterior subcoracoid bursectomy allowing for the placement of a guide (ARTHREX® ancillary) with placement of a wire crossing the clavicle and the coracoid process. Then, stabilization of the acromiocoracoid joint by double endobutton, with control of the reduction with the image intensifier.

Postoperatively, the patients were immobilized for 4 to 6 weeks by an elbow-to-body splint for analgesia, with training in self-rehabilitation by pendulum and immediate passive mobilization. Active mobilization was authorized at 6 weeks, depending on the progress, and resumption of sports activities at 3 months.

Patients were systematically followed in consultation at 6 weeks, 3 months, 6 months and 1 year postoperatively. The following data were collected: age, mechanism of trauma, time to surgery, and postoperative complication(s). The evolution of articular amplitudes was collected to guide the rehabilitation exercises. The presence of instability related to the opening of the rotator interval was also looked at for each stage.

Functional results were evaluated with a minimum follow-up of 12 months for each patient using the Constant score *(17)*, the Quick Disabilities of the Arm, Shoulder and the Hand (DASH) *(18)*, and the Subjective Shoulder Value (SSV) *(19)* during the final follow-up consultation. The delays in resuming professional and sporting activities were also noted.

A postoperative radiological analysis was performed on the immediate postoperative radiographs and on those at the last follow-up. This analysis made it possible to judge the quality of radiological reduction as precisely as possible and to search for a failure of reduction by comparison of the two radiographs.

Radiographic analysis was performed according to the method described by Gatsaud et al. *(20)*. The X-ray was requested with the incidence of Zanca *(4)*. The D/A ratio was calculated, with the distance "A" corresponding to the size of the acromion between its upper and lower cortex and the distance "D" corresponding to the distance between the inferior line of the acromion and the parallel line passing through the inferolateral angle of the clavicle (Fig. 1).

The primary outcome was the composite including the radiological and functional results objectified by the Constant score, the quick DASH, the SSV and the quality of radiological reduction (D/A ratio and coracoclavicular distance).

Table III. — Clinical and radiological results

	Group 1 (extra-articular)	Group 2 (intra-articular)	p
Constant's score at 3 months	88	90	0,56
Quick DASH at 3 months	7	7	0,58
SSV at 3 months	88	93	0,36
Time back to professionals activities (weeks)	6,9	7	0,54
Time back to sports activities (weeks)	15,6	19,4	0,53
Instability at 3 monts	0/10	1/12	1
Satisfaction of surgery at 1 year 1	10/10	11/12	1
Coraco-clavicular distance (cm)	1,3	1,5	0,34
D/A ratio (%)	35	55	0,67

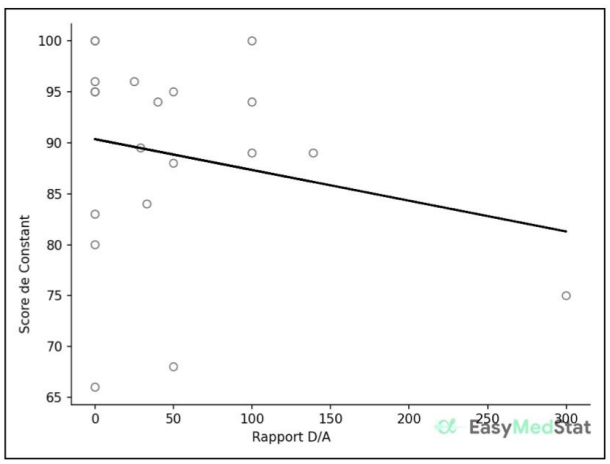

Figure 1.

Secondary outcomes were the clinical and radiological evolutions of the patients as a function of the time before surgery.

For the statistical analysis, we compared the data from the two groups using EASYMEDSTAT® software (Neuilly-sur-Seine, France). The differences found in the different analyses were considered significant at $p < 0.05$. The correlation was sought by the Pearson test. It was judged to be very strong for a coefficient between 1 and 0.8, strong between 0.8 and 0.5, weak between 0.5 and 0.2 and very weak between 0.2 and 0.

In accordance with the legislation in France, this retrospective study has been declared to the CNIL (Commission Nationale de l'Informatique et des Libertés) under number 2222008.

RESULTS

Clinically, there was no significant difference in postoperative glenohumeral instability at 3 months (no patients in group 1 and one patient in group 2; $p = 1$). There was also no significant difference in satisfaction with the surgery (10 patients in group 1 and 11 patients in group 2; $p = 1$). In terms of functional results at 3 months, there was no significant difference in the Constant score (88 vs. 90; $p = 0.56$), Quick DASH (7 vs. 7; $p = 0.58$), or SSV (88 vs. 93; $p = 0.36$). The times to return to work (6.9 weeks vs. 7.0 weeks; $p = 0.54$) and sports activities (15.6 weeks vs. 19.5 weeks; $p = 0.53$) were also comparable (table III).

Regarding the quality of the radiological reduction, there was no significant difference in the measurement of the coracoclavicular distance or in the D/A ratio (table III).

Regardless of the approach, there was a weak and significant correlation between the D/A ratio and the Constant score ($p = 0.0074$; Pearson = -0.217) (Fig. 1), which was not found on the Quick DASH, on the SSV, on the time to resume activities of daily living, or on the resumption of sports activities.

We did not find a significant correlation between the time to surgery and the Constant score, on the SSV, on the resumption of sports activities, on the quick DASH, on the time to resume activities of daily living. We found a weak and significant correlation between the time to surgery and the evolution of the D/A ratio (Pearson = 0.426; $p = 0.049$) (quality of the radiological reduction) (Fig. 2).

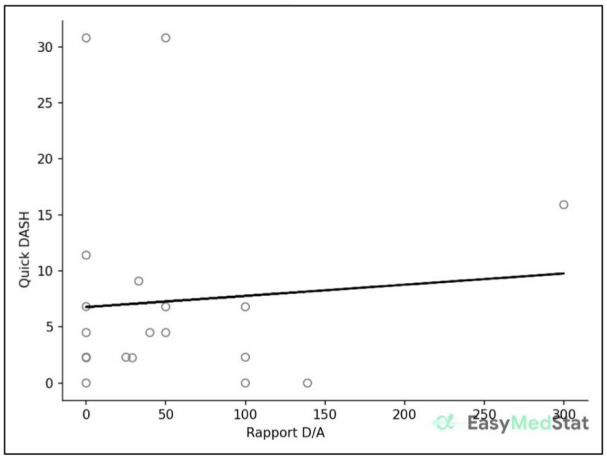

Figure 2.

We did not observe any perioperative or post-operative complications (infection, fracture, material defect, or neurovascular injury) during the follow-up period.

DISCUSSION

After analysing our results, our hypothesis was not verified, and it does not seem that exposure of the coracoid process by an extra-articular approach gives better clinical and radiological results than an intra-articular approach. To our knowledge, this is the first study to evaluate the impact of the optical approach for the exposure of the coracoid process.

The demography of our included patients corresponds to the general epidemiology of ACDs *(21)*.

All of our clinical results seem to agree with the data in the literature - the Constant score was on average 92 (min 66-max 100) and the Quick DASH was on average 7 (min 3-max 11). Issa et al. *(22)* found, in a series of 25 surgery cases, a mean Constant score of 96 and a mean Quick DASH of 9 at a mean follow-up of 76.9 months. Likewise, the SSV was comparable 9], with an average of 90%, showing the effectiveness of the surgical intervention in a young and athletic patient population.

We found a single episode of anterior gleno-humeral dislocation, which concerned a patient operated on by the intra-articular route; the intra-operative exploration did not find any cartilaginous or labral lesions explaining this instability.

Time to return to a sporting activity was on average 17.68 weeks (min 4.00-max 78), all activities combined. We researched neither the impact on the return to the same sporting level nor dichotomize the different types of sporting activity since this was not the aim of our study. However, the meta-analysis by Kay et al. *(23)*, including 315 patients in 12 studies, showed the resumption of sporting activity between 9 and 24 weeks, with a return to the same level for 94% to 100% of the patients. For high-level athletes, the study by Triantafyllopollous et al. *(24)* showed for patients operated on in the first 10 days a mean Constant score of 94.81 at 2 years.

From a radiological point of view, there was no difference between the two arthroscopic approaches.

We have not demonstrated a relationship between the surgical delay and the results; however, Barth et al. *(25)*, in 2015, on a series of 116 patients, concluded that treatment before the 10th day gives better results at 1 year.

The classic arthroscopic portal for ACDs surgery is intra-articular because it makes it possible to assess the lesion of the joint (30% of lesions are associated with ACDs, which may require an additional procedure in 8% of cases) *(26)*. However, the systematic intra-articular approach can lead to complications, such as adhesive capsulitis, as shown by Ecalle et al. *(27)* in the context of calcifications of the rotator cuff. It would appear, however, that this mode of exposure is simpler and more reproducible for approaching the inferior surface of the coracoid process, as described in the arthroscopic Latarjet procedure of Boileau et al. *(28)*. Although we have not found any typical complication linked to the resection of the rotator interval, the extra-articular approach allowed the surgeon to respect the joint and could accelerate postoperative recovery, as shown by Sirveaux et al. *(29)* in 2005 in the context of calcifications of the rotator cuff.

Our study has limitations, including the small numbers of patients in the two groups and recruitment from only two centres in France, with a risk of selection bias and possible centre effect. There was also no randomization of the surgical technique used since each centre did as it usually did. We were

also unable to assess the anteroposterior instability of the acromioclavicular joint because it was not recorded in the medical file of all patients and it is difficult to assess it over the telephone according to the ESSKA recommendations *(4)*. In our study, we did not highlight any difference between the two techniques, perhaps due to the small size of our series. A larger study should be carried out with more patients included in order to increase the power.

We can conclude that, given the results of our study, the optical approach for a reduction of ACDs by arthroscopy has no influence on the clinical or radiological evolutions of patients in the very short term.

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