

ACUTE ACROMIOCLAVICULAR DISLOCATIONS TREATED BY FIXATION OF THE JOINT AND LIGAMENT REPAIR OR RECONSTRUCTION

by P. JALOVAARA*, M. PÄIVÄNSALO**, V. MYLLYLÄ** and T. NIINIMÄKI*

We reviewed 55 patients, median age 34 years, who had had acute complete acromioclavicular dislocation treated by transient acromioclavicular fixation with a Knowles pin and ligament repair by suturing or reconstruction of the superior acromioclavicular ligament with transfer of the coracoid end of the coracoacromial ligament onto the clavicle. At followup examination 50 patients showed at least a satisfactory result. Five cases, two of which had had subsequent resection of the distal end of the clavicle, were classified as poor, mainly because of pain, even though the functional result was good in three. Reconstruction of the superior acromioclavicular ligament, although it improved the anatomic result, was shown to be of no advantage and may even have caused discomfort. The numerous radiological findings of residual subluxation or dislocation, deformity of the distal end of the clavicle, soft tissue calcification and osteoarthritis or pathological physical findings did not correlate significantly with the clinical outcomes. In general this operation gave results comparable with those achieved by other operative methods. It is useful if surgery is preferred to conservative treatment.

Keywords : acromioclavicular joint ; dislocation ; subluxation ; surgical treatment.

Mots-clés : articulation acromio-claviculaire ; luxation ; subluxation ; traitement chirurgical.

RÉSUMÉ

P. JALOVAARA, M. PÄIVÄNSALO, V. MYLLYLÄ et T. NIINIMÄKI. Traitement des luxations acromio-claviculaires aiguës par transfixion de l'articulation et réfection ou reconstruction ligamentaire.

Les auteurs ont revu 55 patients, d'un âge moyen de 34 ans, qui ont présenté une luxation acromio-claviculaire aiguë complète, traitée par fixation trans-

articulaire temporaire, à l'aide de broches de Knowles et réfection ligamentaire par suture ou reconstruction des ligaments supérieurs ; cette reconstruction fut pratiquée à l'aide de l'extrémité supérieure de la coracoïde ou du ligament coraco-acromial, transposé à la face supérieure de la clavicle.

À la revue des cas, 50 malades présentaient un résultat satisfaisant ou, au moins une amélioration. Cinq cas eurent un résultat médiocre ; deux de ceux-ci furent traités par une résection de l'extrémité externe de la clavicle, notamment à cause de douleurs résiduelles, malgré une récupération fonctionnelle satisfaisante chez 3 malades. La réfection du ligament acromio-claviculaire supérieur donne un résultat anatomique meilleur mais peut être la cause de douleurs résiduelles.

On n'a pas observé de corrélation entre les résultats cliniques et les constatations radiologiques, notamment d'une subluxation ou d'une luxation, d'une déformation de l'extrémité externe de la clavicle, de calcifications des parties molles ou d'une arthrose ainsi que d'anomalies à l'examen clinique.

Les résultats de ces techniques chirurgicales furent comparables à ceux d'autres méthodes sanglantes. Cette technique s'avère valable si l'on décide d'un traitement chirurgical.

SAMENVATTING

P. JALOVAARA, M. PÄIVÄNSALO, V. MYLLYLÄ en T. NIINIMÄKI. Acute acromioclaviculaire luxaties, behandeld met transarticulaire fixatie en ligamentair herstel of reconstructie

Vijfenvijftig patiënten, gemiddeld 34 jaar oud, die een acute volledige acromio-claviculaire luxatie op-

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gelopen hadden, werden behandeld met een tijdelijke acromio-claviculaire fixatie met Knowles pins en ligamenteair herstel door hechting of door reconstructie van het craniaal acromio-claviculair ligament, d.m.v. een transpositie van het uiteinde van de processus coracoïdeus of van het coraco-acromiaal ligament naar de dorsale zijde van de clavicula. Bij 50 patiënten was het resultaat op zijn minst goed. In 5 gevallen werd het resultaat als ongunstig beschouwd; bij 2 van deze patiënten werd een resectie van het distaal uiteinde van de clavicula verricht omwille van pijn, ofschoon het functioneel resultaat goed was bij 3 gekwetsten. De reconstructie van het craniaal acromio-claviculair ligament bezorgde wel het beste anatomisch resultaat maar leverde klinisch geen gunstiger resultaat op en mocht zelfs de oorzaak zijn van residuele hinder. Er was geen correlatie tussen het klinisch resultaat en de talrijke radiologische residuele afwijkingen zoals een subluxatie of een luxatie, een misvorming van het distale uiteinde van de clavicula, calcificaties van de weke delen, secundair aan arthrosis, of afwijkingen bij klinisch onderzoek.

Het resultaat van deze chirurgische techniek was even gunstig als deze van andere operatieve behandelingen. De techniek blijkt betrouwbaar wanneer men tot een chirurgische indicatie besluit.

INTRODUCTION

With an acute third-degree acromioclavicular separation injury (fig. 1) there is a major difference of opinion as to whether to operate initially or even whether any treatment other than vigorous rehabilitation is indicated at all. Many authors are generally satisfied with the results of initial surgery (2, 3, 7, 9) whereas others (8, 11, 16, 17, 22, 28) advocate conservative treatment as the initial method. There are numerous surgical procedures available, most of them relying on open reduction, some form of temporary acromioclavicular fixation and ligament reconstruction or repair. The aim of this paper is to analyze the results of a series of 83 successive operations using a uniform fixation method to evaluate surgery as the initial method of treatment.

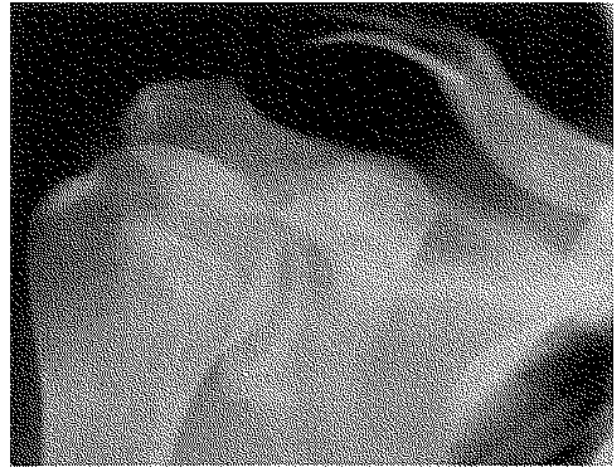


Fig. 1. — Complete (III degree) acromioclavicular dislocation.

MATERIAL AND METHODS

A centralized followup survey was made of patients operated for acute acromioclavicular dislocation from 1973 to 1984 using Knowles-pin fixation and either simple ligament repair or reconstruction of the superior acromioclavicular ligament. Of the 83 patients, 2 had died, 3 were excluded because of delayed initial surgery and 4 because of only a partial dislocation. Nineteen were lost to following. The remaining 55 patients (Table I) had had a type III dislocation according to the classifications of Tossy *et al.* (27) and Allman (1), i.e. no contact between the articular surfaces of the clavicle and acromion and rupture of the acromioclavicular and coracoclavicular ligaments. The diagnosis was easily made by physical examination and routine X-rays complemented with stress radiography. All

Table I. — Clinical data

Number of patients	55
Male/Female	50/5
Age at surgery (mean, range)	34 (16-64) years
Right/left	28/27
Mechanism of injury	
— Traffic accident	23
— Falling	16
— Sports injury	8
— Various	8
Interval between injury and surgery (mean, range)	3 (0-14) days
Follow-up (mean, range)	6.5 (2-13) years

patients had swelling and tenderness over the acromioclavicular joint and a lump formed by the lateral end of the dislocated clavicle, which could be pressed into its normal position with slight force.

The operations were performed by trained residents (29 cases) or specialists in general or orthopedic surgery (26 cases) on emergency duty. A curved incision was made along the anterior border of the clavicle and acromion. The deltoid muscle was detached from the anterior border of the distal clavicle and the acromion to expose the joint. The damaged intra-articular disc was removed. The coracoclavicular ligaments were exposed in every case and found to be completely ruptured. The clavicle was reduced into an exact position and the acromioclavicular joint stabilized with Knowles-pin fixation (fig. 2). The capsule and acromioclavicular ligaments were repaired as well as possible (fig. 3a). In 31 cases in which ligament reconstruction was not performed, the coracoclavicular ligaments were repaired by suturing (fig. 3a). No coracoclavicular ligament repair but reconstruction of the superior acromioclavicular ligament using the coracoacromial ligament according to Neviaser (19) was performed in 24 cases. The coracoid end of the ligament was detached from the coracoid process with a piece



Fig. 2. — Fixation after reduction of the acromioclavicular joint using a Knowles pin.

of bone and sutured to the soft tissues over the joint and onto the clavicle through drill holes (fig. 3b). Finally the deltoid muscle was sutured back to the clavicle and routine closure performed. The arm was kept in a collar and cuff sling for 1 to 2 weeks postoperatively. Pendulum exercises were started on the first postoperative day. Active rehabilitation was begun 2 weeks after the operation, but abduction and flexion of the shoulder to more than 90° were not permitted until the screw had been removed under local anesthesia an average of 7 weeks (range 4-10 weeks) after the operation.

The appearance of the wound, deformity and tenderness of the acromioclavicular joint, mobility of the lateral end of the clavicle and the range of motion were recorded at the followup examination. Strength was evaluated manually with the arm abducted 90° and in 90° flexion.

Radiographs were taken of both acromioclavicular joints with the patient standing with and without an 8-kg weight in each hand. The involved and uninvolved sides were compared for evaluation of the reduction, deformity of the lateral end of the clavicle, signs of osteoarthritis and soft tissue calcification.

The grade of the reduction of the acromioclavicular joint was evaluated according to Rosenorm and Pedersen (26) :

Exact reduction — no displacement compared with the uninvolved side.

Persisting subluxation — slight upward displacement of the clavicle.

Persisting dislocation — an upward dislocation of the clavicle greater than the height of the acromioclavicular joint.

Deformity of the lateral end of the clavicle was evaluated in terms of irregularity of the contour, hypertrophy and osteolysis :

None — clavicular end normal compared with the uninvolved side.

Slight — irregularity of the contour, slight hypertrophy or atrophy and demineralization of the end of the clavicle.

Marked — the thickness of the end of the clavicle was more than 4 mm greater than the control, or clearly visible, marked osteolysis.

Osteoarthritis was assessed in terms of conventional signs, degenerative bone cysts, osteophytes, narrowing of the joint space and subchondral sclerosis :

None — no signes of osteoarthritis.

Slight — subchondral sclerosis, small osteophytes and minimal narrowing of the joint space.

Marked — the joint badly deformed.

The extent of soft tissue calcification between the clavicle and coracoid process and around the joint was assessed in three categories :

None — no signs of calcification.

Slight — thin calcification around the torn ligaments.

Marked — large amounts of radio-opaque material around the ligaments.

The results were evaluated on a scale designed by Imatani *et al.* (11), assigning 40 points for pain, 30 for function and 30 for motion :

Excellent — 90 to 100 points.

Good — 80 to 89 points.

Fair — 70 to 79 points.

Poor — less than 70 points.

The chi-square test was used for the statistical analysis of the results.

RESULTS

Limitation of range on motion was observed in 6 shoulders, but this was slight in 5 of those cases. In one elderly patient only the deficit was more than 30° in abduction. Subjective sense of wea-

kness in the upper limb was reported by 6 patients, of whom 5 had a poor and 1 a fair result. This could not be verified by physical examination, however. Instability of the acromioclavicular joint seemed to be related to an unfavorable result to some extent, but otherwise the pathological clinical findings were distributed evenly among the different categories of results (tabl. II).

The results were graded as excellent or good in 45 cases, fair in 5 and poor in 5. The outcome was less favorable in the older patients, as two of those with a poor result were over 40 years old and two over 50 years old. Two of the patients with a poor result had subsequent resection of the distal 2 cm of the clavicle, with a good result in 1 case and a satisfactory result in 1. These are not included in the radiological analysis of reduction, deformity of the lateral clavicular end and osteoarthritis.

The results seemed to be somewhat better in the 31 shoulders having only repair of coracoclavicular and acromioclavicular ligaments (fig. 3a) than in the group of 24 shoulders with transfer of the coracoid end of the coracoacromial ligament to reconstruct the superior acromioclavicular ligament (fig. 3b) (tabl. III), but the difference was not significant. On the other hand the reconstruction of the superior acromioclavicular ligament maintained the reduction more effectively, leaving only 4 subluxations and 1 dislocation, compared with 10 and 2, respectively, in the group with ligament repair only.

Unsatisfactory reduction showed no significant correlation with the results (tabl. IV), but all 3 poor result cases included in this analysis had

Table II. — Pathological findings at physical examination in the different result categories

Clinical findings	Results				
	Excellent	Good	Fair	Poor	Total
Wide scar (over 10 mm)	5	5	5	2	17
Deformity	10	11	5	3	29
Pain on palpation	1	2	5	1	9
Abnormal mobility of lateral end of clavicle	3	4	5	4	16

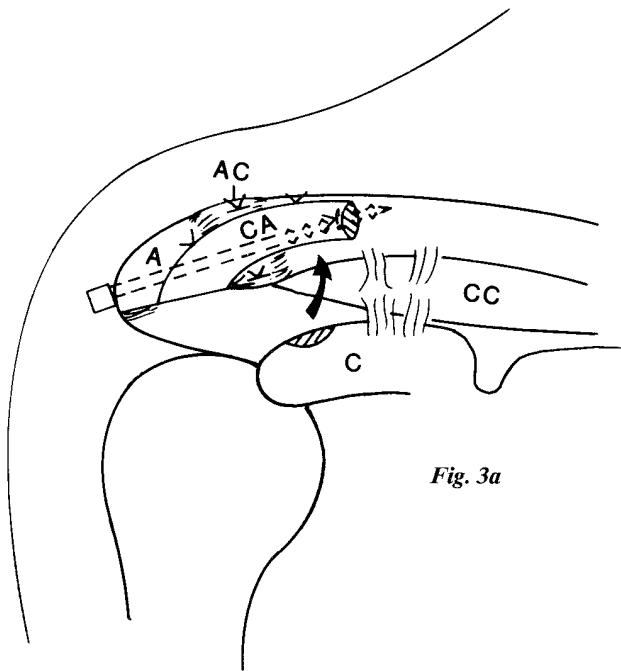


Fig. 3a

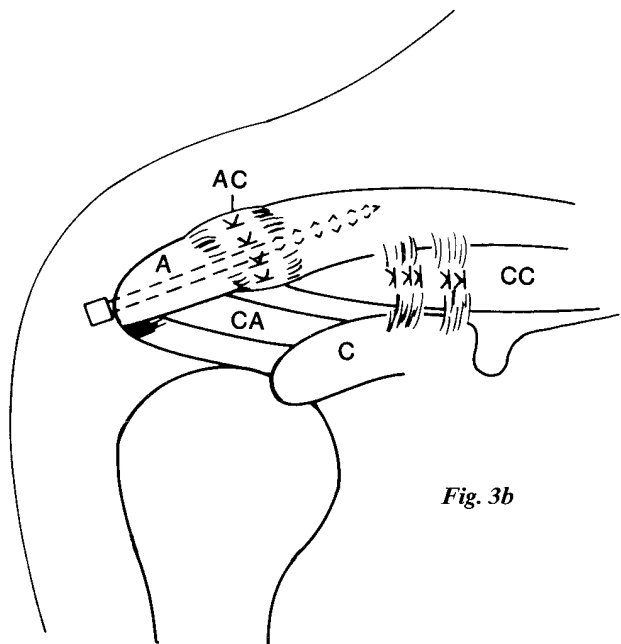


Fig. 3b

Fig. 3. — The two operative methods used here depicted schematically. Fixation of the acromioclavicular joint using a Knowles pin combined either with simple ligament repair (a) or reconstruction of the superior acromioclavicular ligament by transfer of the coracoid end of the coracoacromial ligament onto the clavicle (b).

A = acromion, AC = acromioclavicular ligaments, C = coracoid process, CA = coracoacromial ligament, CC = coracoclavicular ligaments.

subluxation. Some degree of deformity was seen on the radiographs of 35 shoulders (tabl. V). The deformity was of the osteolytic type in 8 cases and of the hypertrophic type in 27. This parameter again did not display any significant correlation with the operative result.

Slight osteoarthritis was observed in 9 acromioclavicular joints and marked osteoarthritis in 5 (tabl. VI). Osteoarthritis was not a sign of a poor result, as 4 of the marked osteoarthritis cases were graded good or excellent. Soft tissue calcification was a frequent finding, but was of no clinical relevance (tabl. VII).

There were few complications, and no major ones. A superficial wound infection developed in 2 shoulders, and the screw was prematurely removed after 4 to 5 weeks rather than the intended 6 weeks fixation time in 3 shoulders because it was working its way out. An open reduction of a redisplacement of the joint by correcting the position of the Knowles pin was performed within the first 2 postoperative weeks on 3 patients. One patient was operated again by the same method after a fall 10 months after the primary operation.

DISCUSSION

Once the decision to treat an acromioclavicular dislocation surgically has been made, there are a variety of methods to choose from, differing mainly in the mode of ligament repair and fixation. There are basically five choices of approach to ligament repair or reconstruction: no ligament repair, simple repair of the acromioclavicular and coracoclavicular ligaments, transfer of the acromial end of the coracoacromial ligament onto the clavicle to reconstruct the acromioclavicular ligaments (19), transfer of the coracoid end of the acromioclavicular ligament to the clavicle to reinforce or replace the coracoclavicular ligaments (30) and transfer of the coracoid process with its conjoint tendon to the end of the clavicle to replace the coracoclavicular ligaments (5). This last approach is also called dynamic repair as it involves a dynamic downward pull on the clavicle by the muscles of the conjoint tendon. The ligament procedures, especially simple ligament

Table III. — Results in patients with reconstruction of the superior acromioclavicular ligament by transfer of the coracoid end of the acromioclavicular ligament onto the clavicle, and patients with ligament repair by simple suturing only. The fixation was with a Knowles pin in both groups

	Results				
	Excellent	Good	Fair	Poor	Total
Reconstruction of the superior coraco-acromial ligament	7	12	1	4	24
Ligament repair only	15	11	4	1	31
Total	22	23	5	5	55

Table IV. — The degree of reduction in the different result categories

Reduction	Results				
	Excellent	Good	Fair	Poor	Total
Exact reduction	14	18	3	0	35
Persisting subluxation	7	4	1	3	15
Persisting dislocation	1	1	1	0	3
Total	22	23	5	3	53

Table V. — Extent of the deformity of the distal end of the clavicle in the different result categories

Deformity of the distal clavicular end	Results				
	Excellent	Good	Fair	Poor	Total
None	7	8	1	2	18
Slight	9	7	4	1	21
Marked	6	8	0	0	14
Total	22	23	5	3	53

Table VI. — The extent of soft tissue calcification in different result categories

Soft tissue calcification	Results				
	Excellent	Good	Fair	Poor	Total
None	7	8	1	3	19
Slight	9	7	4	2	22
Marked	6	8	0	0	14
Total	22	23	5	5	55

Table VII. — Acromioclavicular osteoarthritis in the different result categories

Degree of osteoarthritis	Results				
	Excellent	Good	Fair	Poor	Total
None	16	16	4	3	39
Slight	4	5	0	0	9
Marked	2	2	1	0	5
Total	22	23	5	3	53

repair and acromioclavicular reconstruction, are not sufficient to maintain reduction of the clavicle, and therefore some primary fixation must be used. There are two fixation possibilities.

Acromioclavicular joint fixation may be performed using Kirschner wires (21) or various screws. Coracoclavicular fixation can be achieved by means of screws (4), steel wire or a nylon loop (6, 10), or a dacron loop (2, 12). In addition resection of the lateral end of the clavicle has been used in association with the former procedures in fresh acromioclavicular dislocations (29, 30), although it is mainly used in chronic cases.

The methods used here followed the guidelines described above, and consequently the 9% frequency of poor results is very close to the overall frequency of poor results, 6.5%, in a set of clinical series involving the surgical treatment of acute acromioclavicular dislocation using all possible combinations of ligament repair and fixation as presented in table VIII. The small difference is easily explained by the longer followup period and higher median age of the patients than these series on the average, although the differences between individual classifications must also be considered. As indicated earlier (11), it was difficult to apply the earlier classifications of results because the degree of pain, weakness and limitation of motion of the shoulder were not usually in proportion. Most of the patients with unsatisfactory results were limited by pain and subjective weakness of the upper extremity, whereas the range of motion was rarely limited despite marked pain and subjective disability. We therefore used the classification system of Imatani *et al.* (11), which is based

on the scoring of pain, function and motion, pain being assigned the greatest weight. Most of our patients were graded poor using this system precisely because of the pain factor.

As restoration of the anatomy of the acromioclavicular joint to as nearly normal as possible and maintaining reduction of the dislocation are the main purposes of the surgical treatment (23), the results must also be considered from these points of view. The numerous radiological findings of lost reduction, soft tissue calcifications and osteoarthritis of the acromioclavicular joint indicate that the surgical treatment does not completely fulfill these requirements. Fortunately the numerous pathological physical and radiological findings had minor bearing on the results, however, as observed in many earlier reports (20, 22, 29). Thus it must be stated that surgery is of questionable value for the treatment of acute acromioclavicular dislocation with respect to restoration of the anatomy alone.

A careful radiological analysis performed to evaluate the effect of the penetrating screw on the joint showed either atrophic or hypertrophic deformity of the lateral end of the clavicle in 64% of the cases. As the size of the Knowles pin is considerable in relation to the area of the joint, some of these deformities can be ascribed to the penetration of the joint, which has been shown to cause posttraumatic arthritis (18).

Also important is the observation that reconstruction of the superior acromioclavicular ligament by transfer of the coracoacromial ligament, which did improve the grade of reduction, was nonetheless associated with a slightly worse outcome than the

Table VIII. — Rate of poor results in a set of series
on the surgical treatment of acute acromioclavicular dislocation

Authors	Method	Follow-up	No of cases (Poor/Total)	% Poor cases
Weaver and Dunn (1972)	Resection of the clavicle. Transfer of the acromial end of the coracoacromial ligament to the clavicle.	Mean 35 months	0/12	0%
Ejeskär (1974)	C-C wire loop. No ligament repair.	Mean 9.6 years	6/54	11%
Rosenorm and Pedersen (1974)	C-C AO-screw. No ligament repair.	Mean 12 months	2/11	18%
Katznelson <i>et al.</i> (1975)	Dynamic repair. A-C ligaments repaired if possible.	Mean 3 years	2/20	10%
Imatani <i>et al.</i> (1975)	A-C transfixation with Steinmann pins. C-C screw. No routine ligament repair.	Minimum 1 year	5/11	45%
Gronmark (1976)	C-C nylon loop. Ligament repair.	Mean 52 months	2/17	12%
Bargren <i>et al.</i> (1978)	A-C Kirschner transfixation. C-C loop (Dacron, wire). No ligament repair.	Mean 24 months Minimum 6 months	9/44 1/17	20% 6%
Berson <i>et al.</i> (1978)	Dynamic repair. A-C ligament repair.	Median 47 months	0/23	0%
Fleming <i>et al.</i> (1978)	C-C Dacron loop. No ligament repair.	Mean 25 months	0/11	0%
Kappakas and McMaster (1978)	C-C Dacron loop. No ligament repair.	Mean 13 months	2/20	10%
Rauschnig <i>et al.</i> (1980)	Resection of the distal clavicle. Transfer of the acromial end of the coracoacromial ligament to the resected end of the clavicle. No ligament repair.	Mean 3 years	0/12	0%
Roper and Leveck (1982)	A-C fixation with Kessel pins (13 cases). C-C cancellous screw (2 cases). Ligament repair.	Median 2.5 years	0/15	0%
Paavolainen <i>et al.</i> (1983)	A-C fixation with A-O screw. Ligament repair.	Mean 4 years	1/36	3%
Karlsson <i>et al.</i> (1986)	A-C Kirschner fixation. Transfer of the acromial end of the coracoacromial ligament to the clavicle. Ligament repair.	Mean 6 years	1/47	2%
Larsen <i>et al.</i> (1986)	A-C Kirschner fixation. Ligament repair.	13 months for all pts	1/39	3%
Eskola <i>et al.</i> (1987)	A-C Kirschner fixation. A-C fixation with cortical screw. A-C ligaments repaired. No C-C ligament repair.	1 year for all pts «	1/61 0/25	2% 0%
Lancaster <i>et al.</i> (1987)	A-C Kirschner fixation. C-C ligaments repaired or not repaired. A-C fixation with Kirschner wires/tension wiring. C-C ligaments repaired or not repaired. A-C Kirschner fixation. Transfer of the acromial end of the coracoacromial ligament to the clavicle. C-C screw.	Mean 16 months	0/9 0/23 0/12	0% 0% 0%
Warren-Smith and Ward (1987)	Occasional repair of C-C ligaments. A-C Kirschner fixation. Resection of the distal clavicle. Transfer of the acromial end of the coracoacromial ligament to the resected end of the clavicle. No ligament repair.	Median 45 months	3/33 0/10	9% 0%
Ferris <i>et al.</i> (1989)	Dynamic repair. No ligament repair.	Mean 56 months	0/7	0%

A-C = acromioclavicular.
C-C = coracoclavicular.
Dynamic repair = transposition of coracoid process onto the clavicle.

cases without reconstruction. Excessively tight approximation of the joint surfaces and fixation after removal of the disc probably causes the acromion and the end of the clavicle to rub against each other. After simple ligament repair, on the other hand, the joint remains loose, and rubbing is avoided. An alternative explanation is that the coracoacromial ligament as such is an important structure and its elimination may have harmful biomechanical effects on the rotator cuff.

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