Acta orthop. scand. 45, 652–661, 1974

Department of Orthopaedic Surgery 1, Sahlgren Hospital, S-413 45 Göteborg, Sweden.

CORACOCLAVICULAR WIRING FOR ACROMIOCLAVICULAR JOINT DISLOCATION

A Ten Year Follow-up Study

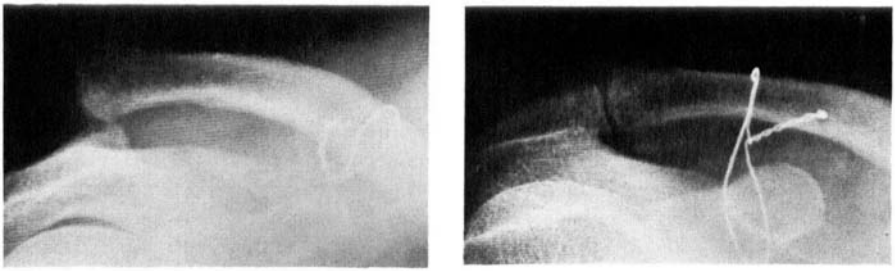
ARVID EJESKÄR

Accepted 7.ii.74

At the Department of Orthopedic Surgery I (formerly Department of Extremity Surgery), Sahlgren Hospital, Göteborg, the standard method of treatment for acute acromioclavicular dislocations has been fixation of the clavicle to the coracoid with a single loop of wire of stainless steel. Among the long-term results (mean time of follow-up greater than 1 year) which have been published (Arnér et al. 1957, Bergh 1945, Hackstock and Jacobs & Wade 1966, Lazcano et al. 1961, Millbourn 1949/50, Scholze & Ludwig 1970, and Wilson & Prothero 1967), Bergh reported the results of a series of 6 patients followed from 3 months to 2½ years. Arnér et al. reported 14 cases operated with a slightly modified technique using a double loop of wire. This study was undertaken in order to report the results of a larger series of patients consistently treated with the above-mentioned method and with a longer period of observation.

METHOD

With the patient under general anaesthesia an incision is made from the acromioclavicular joint along the anterior margin of the clavicle and down into the deltopectoral sulcus to the tip of the coracoid. The clavicular portion of the deltoid is divided near its origin. In the majority of cases (39 out of 65) the acromioclavicular joint was also exposed and interposing tissue was excised. A wire of stainless steel 0.9–1.0 mm in diameter is brought around the coracoid process and the clavicle at a point directly above the coracoid. This is important in order to achieve an anatomical position in the acromioclavicular joint (Figure 1). After reduction of the dislocation, the wire is tightened sufficiently to keep the lateral end of the clavicle level with the acromion. The position is checked with a peroperative roentgenogram. In one instance transfixation of the acromioclavicular joint was also included.



A B

Figure 1. A disclocation in the acromioclavicular joint which has been operatively treated. The wire is placed too far medially permitting the joint to dislocate (A). The same patient after correction of the position of the wire (B).

MATERIAL

During the period 1959 to 1965, a series of 65 patients were treated by the method described above; 60 were men and 5 women. The mean age of the patients was 39 years with a range from 15 to 64 years. The right shoulder was injured in 30 instances and the left in 35.

The mechanism of injury in 33 patients was a variety of traffic accidents and in 30 instances a fall upon the shoulder. One patient was struck on the shoulder by a falling object and one was pressed between heavy metal sheets. The time between injury and operation was less than one week in 52 instances and less than one month in all patients. Although all patients were considered to have a complete dislocation at the time of treatment, the follow-up revealed that the diagnostic criteria had not always been strict. A re-assessment based on the initial roentgenograms and the operative report was performed. The criteria for a complete dislocation were either an upward displacement of the lateral end of the clavicle in relation to the acromion equal to or greater than the thickness of the clavicle and/or a total rupture of the coracoclavicular ligaments as observed at operation. With this definition 51 cases were assessed as having a complete dislocation and 14 patients as having subluxation of the acromioclavicular joint.

Postoperatively the shoulder was immobilized by fixation of the arm to the body for an average time of 26 days. The time of immobilization varied, however, from 0 to 51 days. The wire was extracted (6 weeks to 5 years postoperatively) in 28 instances; in some cases because of pain but in other patients as a routine procedure to prevent the wire from creating problems. In two cases resection of the lateral end of the clavicle was done because of persistent pain.

Follow-up

At the time of follow-up (1971) 8 patients had died (12 per cent) and 3 were not available for examination (5 per cent). The remaining 54 patients (83 per cent) were all personally examined 6–12 years after injury (average 9.6 years). The patients were questioned with regard to residual pain and weakness and the degree of

deformity and tenderness on palpation was noted. Shoulder motion was measured bilaterally in abduction, elevation and rotation and muscle strength was tested in the same directions by means of a Zadig Dynamometer (Zadig 1963). Roentgenograms of both acromioclavicular joints were taken on all patients.

When evaluating the muscle strength, the difference between the right and left shoulder in percentage of the force in the left arm was calculated. The number of injured right and left shoulders were almost equal and as only four persons were left-handed statistical assessment between the two groups of right-handed persons could be done. A reduction in strength of more than M ± 2 SD was called "reduced muscle strength".

The results of the follow-up were divided into four groups based mainly on the frequency and intensity of pain but also to a certain extent on the degree of limitation in shoulder motion and deformity. The groups were defined as follows:

Excellent: Patients free of symptoms with a normal range of movement and no deformity. *Good:* Patients who were without symptoms or complained only of tenderness on palpation and/or had a restriction of motion up to 5° in one or two directions and/or a deformity of less than 10 mm, and/or a painless "reduced muscle strength". *Acceptable:* Patients occasionally or up to once a week having slight to moderate pain not interfering with activities or sleep and/or having a restriction of movement less than 10° in one or several directions. *Poor:* Patients complaining of pain more often and above all of an intensity which disturbed night rest or caused reduced working capacity.

Table 1. Complications.

Suture granulomas	2
Superficial infections	2
Deep infections	1
Haematoma	2
Early redislocation	3
Rigidity of the shoulder requiring mobilization under anaesthesia	1
Penetration of piece of the wire loop into the glenohumeral joint	1
Total number	12

RESULTS

Complications

There were 12 complications (18 per cent) (see Table 1). Two cases with suture granulomas and two with superficial infections healed without problems. One deep infection including osteitis of the clavicle healed in 3 months following extraction of the wire. One haematoma which appeared some hours after an extensive exploration for a broken

wire required evacuation. One small haematoma was aspirated. One patient required mobilization of the shoulder joint under anaesthesia. Faulty operative technique resulted in early redislocations in two cases and a new trauma was the possible cause in another one. All these three patients were reoperated with uneventful recoveries.

Migration of the wire occurred in one case. A portion of the wire was extracted from the glenohumeral joint 2½ years after removal of the main part.

Results of the Clinical Examination at Follow-up

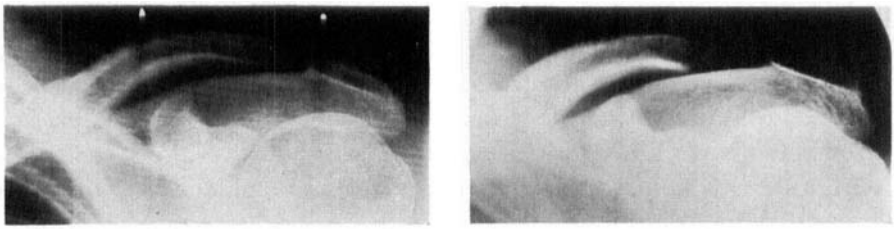
The results of the follow-up were 16 excellent (1 subluxation, 15 dislocations), 19 good (5 and 14 respectively), 15 acceptable (4 and 11 respectively) and 4 poor (1 and 3 respectively).

Of those patients with a good result, 5 complained of tenderness on palpation; 7 showed a deformity of 5 mm and one of 10 mm; 7 had a limitation of shoulder motion of 5°. Among those with an acceptable result 3 were tender on palpation; 3 had a deformity of 5 mm; 5 patients had restriction of shoulder motion of 5° and 4 up to 10°. In the poor group 2 patients had a deformity of 5 mm; 2 had limitation of shoulder motion one up to 5° and one up to 10°.

The assessment of the muscle force measurements revealed a slight tendency towards diminished power on elevation and abduction but the values were not statistically significant. However, "reduced muscle strength" in these two directions was found in a total of 6 patients; 4 of these, classified as poor, had pain in their shoulder on testing but the other 2, who were considered as good, had painless shoulders and a reduction of force in only one direction.

Difficulties arose with evaluation of the findings in 3 cases. One patient had an operation performed for recurrent dislocations of the ipsilateral glenohumeral joint some years after the injury to the acromioclavicular joint. At the follow-up he had slight discomfort from the shoulder but showed a reduction in elevation and outward rotation of 25° and 15° respectively. He was therefore classified as acceptable. Another patient had symptoms and signs of a rotator cuff lesion without any complaints attributable to the acromioclavicular joint. He was also considered to have an acceptable result. A third patient classified as having a poor result had a history of cervical spondylosis.

The results at follow-up could not be correlated significantly with arthrotomy at operation but the frequency of arthrotomy was some-



A B

Figure 2. Patient with osteolysis in the "normal" shoulder. Roentgenogram taken at the time of the accident (A). Roentgenogram taken at follow-up 12 years later (B).

what higher in the patients with excellent and good results than in the other two groups. The duration of fixation was somewhat shorter in the patients with a poor end result but the variation within each group was too great and the groups themselves too small to allow any definite conclusions. Those who still had the wire loop *in situ* had slightly better end results than the others.

Results of the Roentgenological Examination at Follow-up

In 34 patients an anatomical position was found, whereas in 17 some upward displacement of the clavicle was found including two cases with unreduced dislocations in spite of operation. Three patients showed some downward displacement.

When comparing these roentgenograms with those taken immediately postoperatively a clear tendency for a slight upward shift of the clavicle during the healing period was revealed. No correlation between the late roentgenological position of the clavicle and the functional result could, however, be found.

Resorption of bone at the distal end of the clavicle of the type called "posttraumatic osteolysis" (Allen 1967, Jacobs 1964, Madsen 1963 and Ståhl 1952/54) was present in one patient. However, the same process was found in the uninjured shoulder of three other patients (Figure 2).

Six patients, all over 53 years of age, had degenerative changes in the acromioclavicular joint and all but one had bilateral changes of equal degree. Half of them were free of symptoms including the one with unilateral osteoarthritis of slight degree on the injured side.

In 8 cases a transformation of the joint from a so-called "vertical type" to a more or less "horizontal" one could be seen (Figure 3). This phenomenon, earlier described by Arnér et al. (1957), has none of the

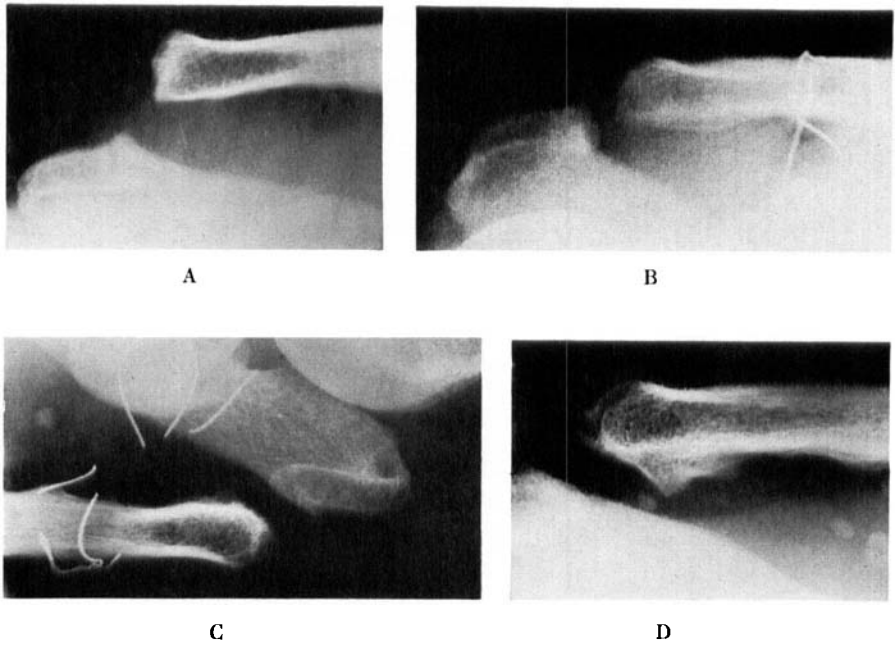


Figure 3. A dislocation of the acromioclavicular joint where the evolution of remodelling of the joint can be seen. A: Dislocated joint. B: Peroperative picture. C: 14 months after surgery. D: At follow-up 7 years postoperatively.

characteristics of osteoarthritis. A prerequisite for this remodelling is probably some degree of upward displacement.

DISCUSSION

As stated above, 50 out of 54 patients were considered to have an acceptable result or better. If the two cases in whom resection of the lateral end of the clavicle are included in the poor results 48 out of 54 cases (90 per cent) are acceptable or better. This is in accordance with the results found in the literature. For instance Arnér et al. (1957) found poor results in 3 out of 39 conservatively treated patients and in 3 out of 16 treated operatively. Jacobs & Wade (1966) stated that 7/35 patients treated operatively were dissatisfied versus 5/43 with conservative treatment. In these two series the proportion of subluxations was much higher (23/56 and 35/78 respectively) than in this series (11/54). Hackstock (1966) wrote that 2/56 had pain and 3/56 demonstrated restricted abduction, without classifying the results using

a total evaluation of each patient. Lazcano et al. (1961) reported a series of 73 patients treated with a large number of different methods. Each uniformly treated group of patients was as small as the total number of patients reported by Bergh (1945), Millbourn (1949/50) and Scholze & Ludwig (1970). The same holds also for the number of cases reported by Wilson & Prothero (1967). These series are too small to allow a comparison.

The lack of a generally accepted criterion for a complete dislocation versus subluxation also makes comparison between different reports more difficult. However, Fischetti (1962) stated that it is possible to differentiate between the two degrees of injury using arthrography of the acromioclavicular joint. No confirmation of this finding is found in the literature.

Searching for important points in the treatment it was not possible to prove a definite correlation between arthrotomy and the end result. However, it was quite clear that arthrotomy ensured a better reduction of the clavicle as in 4 out of 5 cases with great postoperative residual displacement (3 cases reoperated, 2 not corrected) arthrotomy was not done. In the last case another technical error caused early redislocation. The importance of arthrotomy has previously been stressed above all by Horn (1954) and Kennedy (1954).

The wire can be left without causing much discomfort. The only complaint that could be attributed to the wire was slight local tenderness in six patients. The one exception is the patient in whom a piece of wire migrated into the gleno-humeral joint.

The findings of a slight tendency towards diminished power in elevation and abduction has not previously been reported, but only Hackstock (1966) and Lazcano et al. (1961) have tested the strength and then only manually.

In the literature, posttraumatic osteolysis is reported to occur after varying degrees of injury to the acromioclavicular joint, but some patients have denied previous trauma. The interval between the accident and the symptoms has varied from some weeks up to more than 10 years. The injuries have initially either been neglected by the patients or treated conservatively. In this material 3 out of 4 cases with posttraumatic osteolysis have the process localized to their undislocated clavicle. Only one of them had had a trauma to that shoulder. The roentgenograms taken immediately after the accident were normal. Therefore I believe that posttraumatic osteolysis, if posttraumatic at all, is more correlated with minor traumas such as distorsions of the

acromioclavicular joint, or with the instability following a non-treated or insufficiently treated dislocation.

When trying to explain the poor results most authors mention post-traumatic osteoarthritis. The frequency of degenerative changes following injuries to the acromioclavicular joint as reported in the literature varies from 19–100 per cent in the operatively-treated patients and 11–60 per cent after conservative treatment (Table 2).

Table 2. Frequency of roentgenological osteoarthritis after injury to the acromioclavicular joint.

Author	Operative treatment	Conservative treatment
Arnér et al. (1957)	60% (10/17)	50% (20/39)
Hackstock (1966)	54% (30/56)	—
Jacobs & Wade (1966)	35% (12/35)	11% (5/43)
Lazcano et al. (1961)	35% (7/20)	—
Millbourn (1949/50)	100% (4/ 4)	60% (6/10)
Wilson & Prothero (1967)	19% (6/32)	—
(Own series	11% (6/54)	—)

However, only Millbourn (1949/50) makes the comparison between the uninjured and the injured shoulders and he found 6 out of 10 patients to have bilateral arthrosis of equal degree. Arnér et al. (1957) and Wilson & Prothero (1967) reported that only half of the degenerative changes on the roentgenograms were symptomatic and Jacobs & Wade (1966) found the corresponding figure to be 60 per cent.

In this study an incidence of 11 per cent was found. The changes were found in middle-aged persons of whom all but one had bilateral arthrosis of equal degree. Half of these patients had symptoms. Therefore it is believed that the roentgenological findings in this series of patients cannot be ascribed to the injury to the joint but instead represent an idiopathic osteoarthritis, which according to Lindholm (1936) is a common finding in old age.

The cause of the bad results in the four patients is, in spite of this evaluation of treatment, still obscure. One explanation could be the different degree of injury to the nerve supply of the acromioclavicular joint. This joint is innervated by the supraclavicular and suprascapular nerves. The latter one passes through the notch on the superior border of the scapula. At the moment of injury the nerve can be stretched or torn when the scapula and the clavicle separate.

CONCLUSIONS

This study shows that our results with coracoclavicular wiring are equal to or better than those previously published. The risk of posttraumatic osteoarthritis with this treatment is minimal. Arthrotomy should be done in every case as it ensures a good reduction, and it may also be of value for the final result. Furthermore the need for better criteria for the definition of subluxation versus dislocation is apparent.

SUMMARY

An analysis was performed of 65 acromioclavicular joint injuries consistently treated with fixation of the clavicle to the coraoid with a wire loop. 8 patients were dead whereas 3 could not be reached. The remaining 54, 43 dislocations and 11 subluxations, have been clinically and roentgenologically evaluated 9.6 years (average) after the injury.

a. The result is acceptable or better in 48/54 patients (90 per cent), which is equal to or better than previously published figures.
b. Arthrotomy is important to secure a good reduction and is probably also of value for the end result.
c. No definite case of roentgenological posttraumatic arthrosis has been found.

ACKNOWLEDGEMENTS

I am very grateful to Svend-Erik Sörensen, M.D., Department of Roentgenology I, Sahlgren Hospital, for help in evaluating the roentgenograms.

This study was financially supported by Göteborgs Läkaresällskap.

REFERENCES

Allen, W. C. (1967) Posttraumatic osteolysis of the distal clavicle. *Postgrad. Med.* **41**-A, 73–77.

Arnér, O., Sandahl, U. & Öhrling, H. (1957) Dislocations of the acromioclavicular joint. Review of the literature and a report of 56 cases. *Acta chir. scand.* **113**, 140–152.

Bergh, N. P. (1945) Operativ behandling av acromioclavicular luxationer. *Nord. Med.* **25**, 554–557.

Fischetti, P. (1962) Classificazione anatomo-patologica delle lesioni traumatiche della articolazione acromion-clavicolare. *Atti della Società emiliana-romagnola-triveneta di ortopedia e traumatologia* **7**, 87–96.

Hackstock, H. (1966) Nachuntersuchungsergebnisse perkutaner Bohrdrahtfixation bei frischer Luxation des Akromio-klavikular-Gelenkes. *Zbl. Chir.* **91**, 2 1583–1586.

Horn, J. S. (1954) The traumatic anatomy and treatment of acute acromioclavicular dislocation. *J. Bone Jt Surg.* **36**-B, 194–201.

Jacobs, B. & Wade, P. A. (1966) Acromio-clavicular-joint injury. An end-result study. *J. Bone Jt Surg.* **48**-A, 1 475–486.

Jacobs, P. (1964) Post-traumatic osteolysis of the outer end of the clavicle. *J. Bone Jt Surg.* **46**-B, 705–707.

Kennedy, J. C. & Cameron, H. (1954) Complete dislocation of the acromioclavicular joint. *J. Bone Jt Surg.* **36**-B, 202–208.

Lazcano, M. A., Anzel, S. H. & Kelly, P. J. (1961) Complete dislocation and subluxation of the acromioclavicular joint. End result in 73 cases. *J. Bone Jt Surg.* **43**-A, 379–390.

Lindblom, K. (1936) Eine röntgenologische Studie über Arthritis acromialis. *Acta chir. scand.* **77**, 174–182.

Madsen, B. (1963) Osteolysis of the acromial end of the clavicle following trauma. *Brit. J. Radiol.* **36**, 822–828.

Millbourn, E. (1949/50) On injuries to the acromioclavicular joint. *Acta orthop. scand.* **19**, 349–382.

Scholze, H. & Ludwig, B. (1970) Die Behandlung der Luxation im Akromio-klavikular-Gelenk. *Bruns' Beitr. klin. Chir.* **218**, 65–67.

Ståhl, F. (1952/54) Considerations on post-traumatic absorption of the outer end of the clavicle. *Acta orthop. scand.* **22-23**, 9–13.

Wilson, F. C. Jr. & Prothero, S. R. (1967) Results of operative treatment of acute dislocations of the acromioclavicular joint. *J. Trauma* **7**, 202–209.

Zadig, A. (1963) Objektiv mätning av muskelkraft med en ny dynamometer. *Svenska Läk.-Tidn.* **60**, 2937.

Correspondence to:

Arvid Ejeskär, M.D.
Department of Orthopaedic Surgery I
Sahlgren Hospital
S-413 45 Göteborg, Sweden