

ON INJURIES TO
THE ACROMIO-CLAVICULAR JOINT

Treatment and Results.

BY

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There are several important works on injuries to the acromio-clavicular joint. Outstanding are those by *Usadel* (1941), describing 105 cases from the Heidelberg Clinic, and *Urist* (1946), giving accounts of 41 cases, from an American military hospital stationed partly in Germany and partly in England, which were personally treated by him. *Usadel* points out that these injuries increased in frequency after the 1914-18 war, in relation to the higher speed of traffic. *Urist* finds that they were common during the world war 1939-45, for various reasons. *Lord* and *Coutts* describe them as a typical injury at the American parachutist school.

During the years 1937-46, 57 cases sufficiently severe to need radiography have been treated either as out-patients or in-patients at Lund Surgical Clinic. There was a fairly even distribution of 7-10 cases a year, with the exception of the years 1941-42 and 1944-45, when there were only 2-3 cases a year. The reason for this was probably the conservative use of radiography as a result of lack of film due to the crisis conditions. The injuries occur far more frequently in men than in women. Of our 58 cases¹ 53 were men and 5 women. The average age of the men was 37 years, and of the women 36 years. The youngest patient, a woman, was aged 17 years, and the eldest, a man, 72 years, at the time of injury (Table I).

¹ 57 cases from Lund and one case operated on at Varberg Hospital 1945.

TABLE I

58 cases of acute injury to the acromio-clavicular joint, verified radiographically at the time of injury (53♂, 5♀).

	No. of Cases	Various Conservative Treatments	Various Surgical Treatments	No. of Cases Followed-up	No. of Cases Re-examined by the Author and Radiographed
Subluxation .	45	44	1	40	10
Luxation	13	6	7	12	7
Total	58	50	8	52	17

Injuries to the acromio-clavicular joint may be divided into 1) *mild injuries*: distraction and subluxation, and 2) *severe injuries*—luxation— where dislocation is complete. The diagnosis is usually easy. The traumatic nature of the milder cases can be verified a few days after injury by the typical discoloration of the skin, due to gravitation haemorrhage into the delto-pectoral triangle area (frequent personal observations). Radiographic examination will give exact information on the degree of dislocation, providing that the exposure is by direct radiation, which can be most easily achieved fluoroscopically (with the arm hanging, to obtain the maximal degree of dislocation). A routine antero-posterior exposure will only show the condition in some cases.

The literature shows that the methods of treatment of acromio-clavicular joint injuries are many and varied. Thus, *Urist* states that there are 35 conservative, and at least 28 operative methods recommended, and notes that very few final results are available. Here in Sweden the usual view would seem to be—with good reason—that *mild injuries* should be treated conservatively, by the simplest method possible, and usually without any attempt at reduction (adhesive strapping and a firm pressure pad over the *lateral* end of the clavicle gives relief in the author's experience). The essential point is that immobilisation of the shoulder joint should be avoided, and from the beginning the patient



Fig. 1.

Abduction cushion used for injuries to the shoulder. (Picture from *Moberg*.)

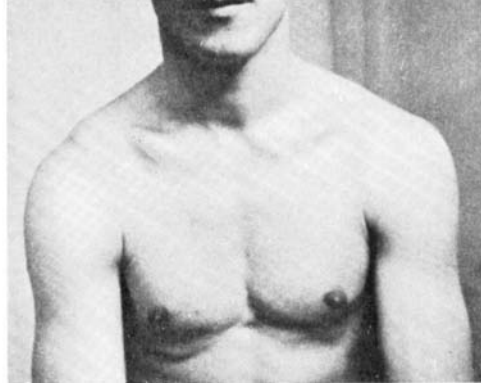


Fig. 2.

Conservatively treated subluxation. At follow-up examination 4 years after the injury, there is visible subluxation of the acromio-clavicular joint.

should receive passive movements of the shoulder joint, and preferably active exercises, if the pain is not too great: that is, *maximal* passive movements in all planes should be obtained once or twice daily. If in these cases the shoulder joint is immobilised for any length of time by strapping, there may be unnecessarily severe after-effects, especially if the patient is elderly, or if the shoulder joint has also suffered a slight *undiagnosed* injury. A *sling* acts as an unspoken reminder to the patient to keep his shoulder joint absolutely still, and should be avoided if possible. An abduction cushion—which for a long time has been called a *Frising* abduction cushion at Lund (fig. 1)—worn day and night is useful, especially when the shoulder joint is also slightly injured. If the patient is instructed to put the cushion and arm up on a table or on the back of a chair when he sits down, a usefully greater degree of abduction is achieved at intervals. Unnecessary surgical interference in these mild cases, such as nailing or wiring, may sometimes increase the length of time for which the patient is disabled, and may lead to permanent disability.

45 of the 58 cases in this material may be described as mild. In all cases the subluxation was seen on the radiographs. In 35 cases, upward dislocation of the lateral end of the clavicle was found, and 10 of these 35 showed in addition an abnormal degree of separation between the joint surfaces. In the remaining 10 cases there was only an abnormal degree of separation between the joint surfaces.

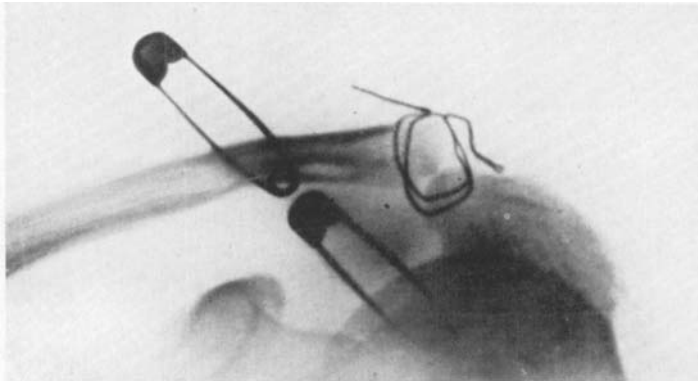


Fig. 3.

Man, 29 years, subluxated position immediately after operation.

Treatment was conservative in 44 cases, and surgical in 1 case.

Conservative treatment varied greatly, probably only partly according to the gravity of the case. A *sling* was used in 10 cases, *adhesive strapping and a pressure pad* in 8, an *abduction cushion* in 8, *firm bandaging* in 5, a *Böhler brace* in 3, and *bandaging with cotton wool* in 3. In no case was the arm fixed against the wall of the thorax. In 7 cases no information about the treatment is available. Exact information on the date when exercises were begun, or when passive and active movements of the shoulder joint were allowed, is often missing. Exercises were usually begun as early as possible, often after a week, in several cases at the first visit (e.g. the cases treated by the author during the time he spent at the poly-

clinic) and as a rule without the assistance of a physiotherapist.

The duration of disability was recorded for 29 of the 44 patients, and varied between 6 and 80 days, with an average of 23 days.

39 of the 44 patients with subluxation treated conservatively have been followed-up.

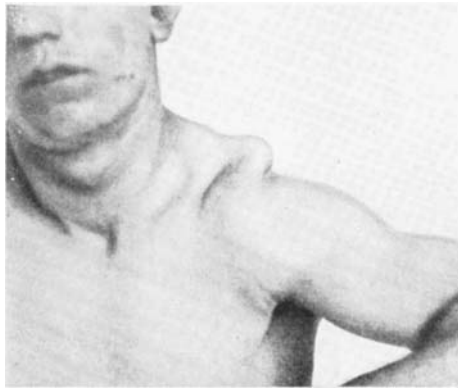


Fig. 4.

Recent total acromio-clavicular dislocation. (Picture from *Usadel*.)

29 were followed-up by questionnaire. All 29 reported complete, or almost complete, recovery from their injury. The only reservations were that they occasionally felt slight pain or inconvenience from the shoulder, and that the arm was not quite as strong as before the accident.

10 patients chosen at random from the 44 treated conservatively have been re-examined by me personally, and the joint area has been radiographed.

In 7 of these 10 the subluxation could be detected when the arms were hanging down and the injured was compared with the sound side (fig. 2). In 2 of these 7 it was easy to palpate part of the joint surface of the lateral end of the clavicle, and in 4 other cases the clavicle was felt to be widened. In no case were the changes enough to be of any

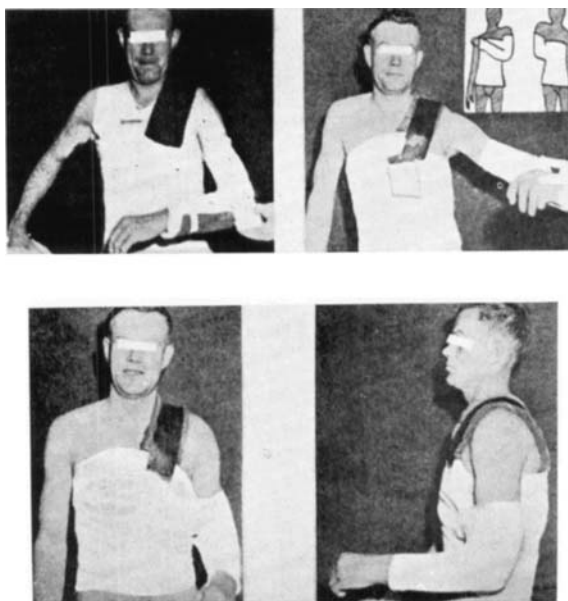


Fig. 5.
Conservative treatment by *Urist's* method.

cosmetic importance. If the arm was lifted passively above the horizontal plane, the clavicle could often be returned to its normal position, as judged by palpation and radiography; this was best achieved if pressure was exerted at the same time both forwards and downwards on the lateral end of the clavicle. Mobility of the shoulder joint was in 3 of the 10 cases quite normal, and in 4 cases there was a hardly measurable restriction of rotation which was of no practical importance; it was detected by placing the dorsum of the hand on the back; the thumb of the affected side only reached the angle of the opposite scapula, whereas the thumb of the hand of the sound side reached the base of the spine of the opposite scapula. 2 men, aged 62 and 61 years respectively at the time of injury, both showed a more pronounced limitation of movement at examination 4 years later. Admittedly there was only the slight restriction of rotation as described above,

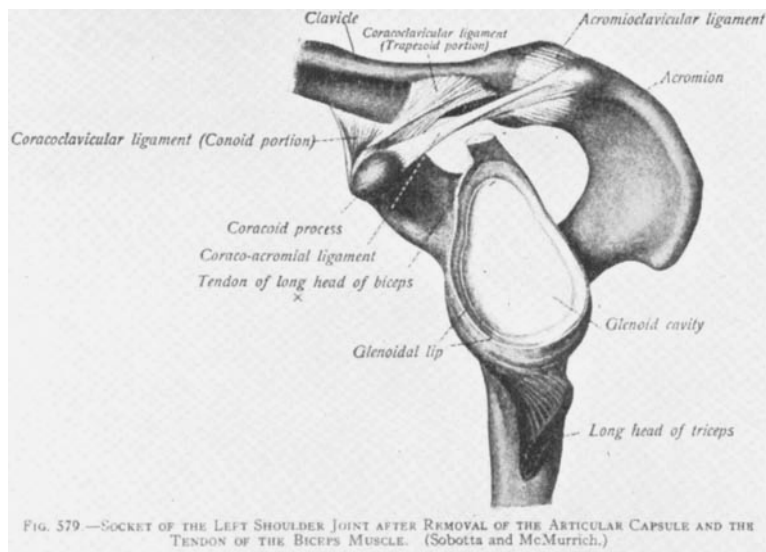


Fig. 7 a.

Acromio-clavicular region showing ligament. (Picture from Callander.)

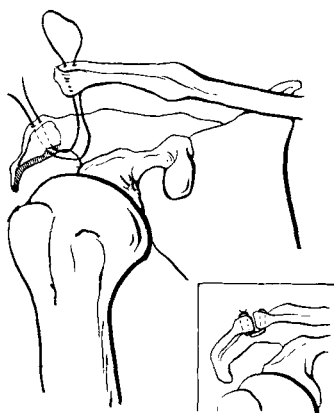


Fig. 6.

Wiring by Felsenreich's and Mitchell's method.
(Picture from Usadel.)

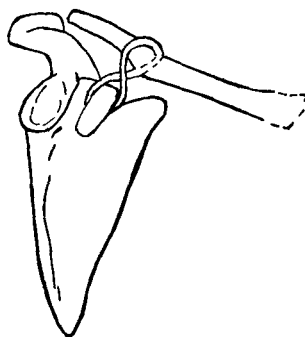


Fig. 7 b.

Suture of clavicle to coracoid process.

but they could not raise the arm to more than 60° and 70° respectively above the horizontal plane. The reason for this limitation in these 2 patients is not clear. Both were declared sound by an insurance company, 46 and 50 days respectively after the accident. The 10th patient, a man aged 65 years, showed considerable limitation of movement of both shoulder joints, secondary to a previously diagnosed chronic poly-arthritis (S.R. 101 in 1 hour), and presumably unconnected with the acromio-clavicular injury.

The case of subluxation which was treated surgically had an intra-articular operation, and 2 wires were placed mainly extra-articularly. Some degree of subluxation remained after the operation (fig. 3). The patient was discharged as fit for work 37 days after the accident. Soon afterwards a sinus formed over the site of the operation, and healed only after removal of the wires 5 months after operation. Reply to a questionnaire about 10 years after the injury showed him to be fully recovered.

As was to be expected, the prognosis is good in cases of subluxation of the acromio-clavicular joint, independent of the method of treatment, provided prolonged immobilisation of the shoulder joint is avoided. Surgical treatment is unnecessary. The time needed for treatment depends presumably mainly on the degree of injury, and on possible simultaneous injury to the shoulder joint. It cannot be determined from this material which conservative method of treatment is the most effective for these injuries. The author is inclined to recommend as a standard treatment an abduction cushion, with adhesive strapping and a felt pad on the lateral end of the clavicle, combined with exercises applied from the beginning of treatment; if necessary, because of the pain, at first only passive, and as soon as possible active movement of the shoulder joint. With this treatment, limitation of movement secondary to simultaneous mild diagnosed or often undiagnosed injury to the shoulder joint, is avoided, especially in elderly people.

With regard to severe injuries to the acromio-clavicular joint involving complete dislocation, opinions on conservative

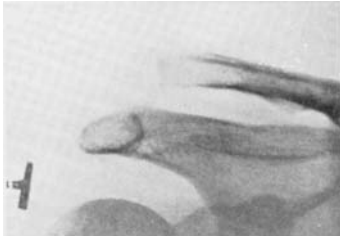


Fig. 8.
Case 1. Total acromio-clavicular
dislocation.

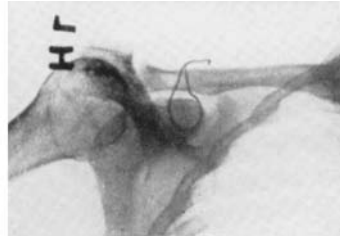


Fig. 10.
Case 2. Subacromial
subluxation immediately after
wiring plus free fascia
transplantation. Wire intact.

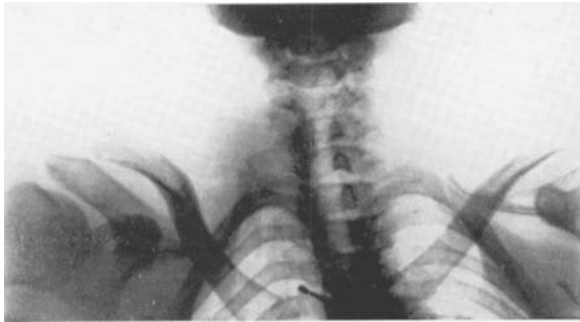


Fig. 9.
Case 1. Upward subluxation immediately after catgut suture of ligament
plus free fascia transplantation.

or surgical treatment differ. Some authorities hold extreme views, and think that nothing should be done to reduce the dislocation. The functional results are good, and the cosmetic impairment is of no importance to men. This extreme view will hardly be accepted in cases with severe degrees of dislocation, and where the connecting ligaments between the clavicle and the coracoid process have definitely been *completely* torn (figs. 4, 8 and 24).

Conservative treatment involves various types of splinting. The difficulty is to immobilise so that the dislocation is reduced. The simplest, but least efficient, method is by pressure

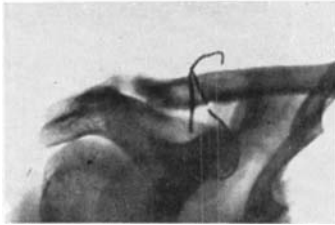


Fig. 11.

Case 2. Exact contact of joint surfaces after wire has broken.

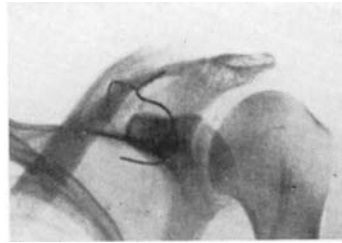


Fig. 12.

Case 3. Exact contact of joint surfaces after wire has broken.

with a felt pad and adhesive strapping. The safest, but most complicated, method is certainly *Urist's* (fig. 5). According to *Urist*, the plaster shown in fig. 5 should be worn by the patient for 6 weeks. The patients treated by *Urist* in this way were young soldiers on active service. This method of treatment must be considered unsuitable for elderly patients.

Operative treatment falls roughly into 2 groups, 1) *intra-* and 2) *extra-articular correction*.

For intra-articular correction the joint is opened. Arthrodesis (*Cooper* 1856), with resection of the joint surfaces, can be performed. Usually, however, the joint surfaces are preserved, and fixation is obtained in a variety of ways, for example, by a nail hammered in from the acromion across the joint to the clavicle, or by some kind of thread placed in various positions (wire, silk, fascia). *Felsenreich's* and *Mitchell's* wiring (strictly speaking applied extra-articularly), appears to the author to be one of the most reliable methods, and perhaps the one that gives the best chance of future function of the acromio-clavicular joint (fig. 6). *Odelberg* has used a similar method.

In the extra-articular operation, the joint is left intact during the rougher handling, but it is opened during the operation; the capsule ligaments are sutured with catgut. If an articular disc is found it is removed, if necessary. The basic purpose of the operation is reconstruction of the torn ligaments between the clavicle and the coracoid process (the



Fig. 13.

Case 1. Calcification of soft tissue in the injured area 4 weeks after catgut suture of ligaments plus free fascia transplantation.

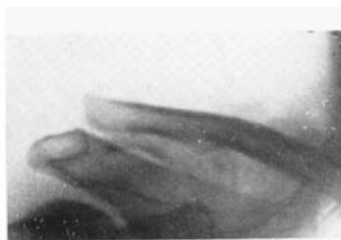


Fig. 14.

Case 1. Widespread calcification of soft tissue in injured area 2½ months after operation.

trapezoid and conoid ligaments, fig. 7 a). This can be done in different ways. The ruptured ligaments may be sutured. The stumps of the ligaments are, however, very short, the sutures are difficult to place and will not hold, especially under the strong mechanical strain to which they are exposed immediately after operation. As a substitute for the torn ligaments the acromio-coracoid ligament can be used, the whole of the acromial insertion being transferred to the clavicle. Fixation of the clavicle to the coracoid process can finally be achieved in various ways, by wiring (see *Bergh*, for example) or by free fascia transplantation (fig. 7 b).

In 1942 the author treated a case of severe dislocation of the acromio-clavicular joint, where all the connecting ligaments between the clavicle and the coracoid process had been ruptured (fig. 8). The dislocation was easily reduced, so conservative treatment was tried first. However, the dislocation soon recurred under the bandages (a pressure pad and adhesive strapping, and later firm bandaging of the upper arm to the wall of the thorax) and it was felt that operation was indicated. When it came to a choice of operative method, the author recalled a number of cases in which an intra-articular operation had had relatively unfavourable results, both anatomically and functionally.

A study of the literature, in which *Usadel's* comprehensive

work was most useful, showed that from all points of view the most rational operation in cases where direct suture of the ligaments was impossible was to transplant free fascia as a substitute for the torn ligaments between the coracoid process and the clavicle. At operation the dislocation could be completely reduced, and the torn ends of the ligaments were sutured with catgut, and secured by free fascia lata transplants: a 1.5 cm wide strip of fascia was looped round the clavicle, and both ends were sewn to the coracoid process. Radiography directly after the operation showed upward subluxation for half the width of the bone (fig. 9). In view of this subluxation immediately after the operation, the author modified his technique in the 2 subsequent operations, thus, in addition to suture of the ligaments and fascia transplantation, the clavicle was fixed to the coracoid process by a metal wire from the clavicle round the coracoid process. In all 3 cases the report on the operation states that the reduction of the dislocation was complete. In the 1st case a supra-acromial subluxation was found immediately after operation (fig. 9). In the 2nd case, which was wired, radiography after the operation showed over-correction, with a sub-acromial subluxation (fig. 10). Then the metal wire broke, and radiography showed a correct position (fig. 11). In the 3rd case a correct position was found after the wire had broken (fig. 12). The simplest way to interpret these findings is that the author's idea of the correct position during operation, was all right in all 3 cases, but when the arm was adducted towards the thorax after the operation, the strain on the plastic ligament was considerably increased. Normally, according to *Sommer*, the coraco-clavicular ligament will stand a stress of 80 kgms (appr. 176 lbs.). A supra-acromial subluxation appeared in case 1. In cases 2 and 3, the wires held at first and an over-corrected subacromial subluxation position was obtained (radiographic confirmation in case 2, fig. 10). Thus, when the wire breaks under the great strain, the subacromial subluxation is reduced to the correct position (fig. 11). The wire should therefore not be pulled too tight, and the surgeon

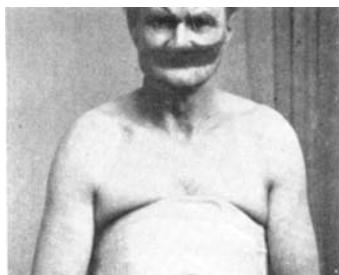


Fig. 15.

Case 1. Barely visible subluxation of right acromio-clavicular joint, 5 years after free fascia transplantation.



Fig. 16.

Case 1. Follow-up examination 5 years after operation. The slight limitation of movement is in the sound shoulder joint.

should, during the operation, check what the position will be when the arm is adducted against the lateral wall of the thorax. *Bergh* described 6 cases operated on by wiring between the clavicle and the coracoid process. The wire broke after the operation in 4 cases.

The post-operative course was smooth in all 3 cases. The first patient was put in a thoraco-brachial plaster, with the arm free in an abducted position. The arms of the other 2 patients were held in abduction by an abduction cushion. In all 3 cases passive and active exercises were begun very early (as soon as the wound showed normal healing). They were discharged as fit for work 2, 3 and 1 months respectively after the operation. All 3 were insurance cases. In this connection one may mention *Krieger Lassen's* striking statement that in 52 cases (18 hospitalised, 9 operated) of luxation of the acromio-clavicular joint there was 5-29 months interval between the injury and assessment of the disablement (average 10 %) by the Danish Workers Insurance Board.

Case 1. Man aged 51, building labourer (case history no. 3883-42) 18/10 fell from bicycle. Unconscious for several minutes. Felt unwell. Admitted to hospital 19/10: Superficial flesh wounds on right shoulder. Pronounced upward dislocation of lateral end of right clavicle. Radiography: Dislocation of acromio-clavicular joint, with lateral end of clavicle displaced upwards by twice the breadth of the bone (fig. 8).

TABLE II
Arthrosis deformans in the Acromio-Clavicular Joint at the Time of Injury and at Follow-Up Examination.

At the Time of Injury				At Follow-Up Examination							
Age in years	No bilateral arthrosis deformans	Slight bilateral a. d.	Marked bilateral a. d.	Years under observation	No bilateral a. d.	Slight bilateral a. d., equal on the two sides	A. d. increased equally on the two sides	No a. d. on sound side, slight on injured side	Slight a. d. on sound side, increased on injured side	Slight bilateral a. d. more severe on sound side	
21	1		8 Cases of Subluxation Treated Conservatively	4	1						
23	1			4	1						
21	1			4	1						
62		1		4			1				
65		1 ¹		5			1				
52		1		4						1	
47	1			10							
25	1			8		1					
										1	
2 Cases of Dislocation Treated Conservatively											
34	1		2 Cases of Dislocation Treated by Intra-articular Operation	9	1						
27	1			9				1			
58		1		10						1	
23	1			8				1			
2 Cases of Dislocation Treated by Fascia Transplantation											
51		1		5			1				
65				3			1				

¹ At the time of injury showed more severe arthrosis deformans on the sound side.

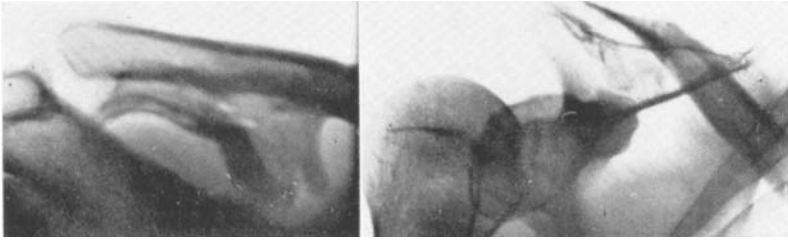


Fig. 17 a & b.

Case 1. Calcifications and ossification of injured area 5 years after free fascia transplantation.

Fixation with adhesive strapping and pressure pad. Radiography: Perfect alignment. 21/10: Radiography: Redislocation by breadth of bone; fixation completed by firm bandaging of the upper arm against the thorax. 24/10: Radiography: Redislocation unchanged. 28/10: *Open reduction plus fixation of clavicle to coracoid with free fascia transplantation by the author.* N₂O + Ether Anaesthesia given. The ends of the coraco-clavicular ligament caught with catgut sutures. Complete reduction occurs easily. Sutures: Fascia lata strip about 15 cm × 1.5 cm placed round clavicle and both free ends sewn to coracoid. Apparent effective and exact fixation. Suture of capsular ligaments on superior and anterior aspects of acromio-clavicular joint. No articular disc. 28/10: *Radiography after operation:* upwards subluxation by the width of half a bone (fig. 9). 13/11: Scar healed by first intention. Thoraco-brachial plaster cut away superiorly. Exercises given. Discharged. *Out-patient* re-examinations: 30/11: *Radiography:* calcification of soft tissue between coracoid process and lateral end of clavicle (fig. 13). 28/12: satisfied, to begin light work. 11/1 1943: Almost full mobility in shoulder-joint: *Radiography:* unchanged position. Widespread calcification of soft tissue (fig. 14). 15/2: No visible deformity. Normal mobility. *Follow-up examination* 16/9 1947: Feels no pain. Does very heavy work. Barely visible and palpable subluxation (fig. 15), increased width of lateral end of clavicle. Completely normal mobility (fig. 16). No crepitus. Radiography: lateral end of clavicle forming acromio-clavicular joint subluxated by half the width of the joint. Under this is found an irregular bony process 6 cm long and 2 cm wide, connected with the clavicle. It extends to the coracoid process, but is not in bony connection with it (fig. 17a & b).

Case 2. Man aged 65. Warehouse worker (case history 4840/44). 13/11 fell from height of 2 metres (7 ft.). Admitted 14/11: Pronounced upward dislocation of right acromio-clavicular joint. Restricted mobility of shoulder joint. Radiography: dislocation of acromio-clavicular joint with displacement of lateral end of clavicle by twice the width of the bone.



Fig. 18.

Case 2. Limitation of extension
3 years after wiring plus free
fascia transplantation.

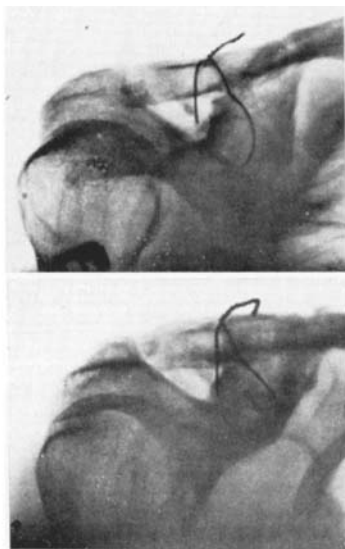


Fig. 19 a & b.

Case 2. Calcifications and
bone bridge between clavicle
and coracoid process, 3 years
after wiring and free fascia
transplantation.

15/11: *Open reduction and clavicle-coracoid fixation by metal wire and free fascia transplantation by the author.* The stumps of the coraco-clavicular ligament secured with one linen and one catgut suture. A metal wire, looped round the coracoid process and through hole drilled in lateral end of clavicle, was tightened and tied, using *Sven Johansson's* apparatus, to produce exact alignment of the acromio-clavicular joint. Ligament sutures tied. Fascia lata strip about 15 cm $\times$ 1.5 cm placed round clavicle and coracoid process, and sutured in this position. Otherwise operation as above. 21/11: Radiography: Sub-acromial subluxation in the acromio-clavicular joint (fig. 10). 23/11: Exercises begun. 2/12: Wound healed. *Aspiration* of 30 c.c. serous fluid from area of operation. Fairly good mobility: abducts arm to 45° above horizontal plane. Rotation 45°. Discharged. *Out-patient examinations* 6/12: Reaspiration. 12/12: Physical treatment continued twice weekly. 18/12: Radiography: Wire broken in two places. Practically exact alignment of the joint. Calcification of soft tissue (fig. 11). 12/1 1945: Physical treatment once a week. 23/2: Good mobility. Discharged as fit. 13/6 1945: Occasional pain round right shoulder. Movements normal. No pain on movement. *Final examination* 18/9 1947: Oc-



Fig. 20 a, b and c.

Case 3. Range of movement 2 years after wiring and free fascia transplantation.

casional slight discomfort in shoulder. On full work as warehouse worker, lifting and carrying sacks, etc. No visible or palpable subluxation. Lateral end of clavicle increased in width. *Mobility*: With arms stretched overhead, about 10° limitation of movement (fig. 18). Rotation normal, except for internal rotation: if the dorsum of the hand is placed on the back, tip of right thumb reaches only 10 cms below the angle of the scapula. Slight crepitus round right shoulder joint. Radiography: *Right shoulder*: Exact alignment of acromio-clavicular joint. Since previous examination 18/12 1944, calcification of area between clavicle and coracoid process further increased. Both bones now connected by bony bridge. A fairly long area of calcification found along the acromial insertion of the conoid ligament. The broken wire remains in the same position (fig. 19 a & b). *Left shoulder*: Some arthrosis deformans in acromio-clavicular joint.

Case 3. 36 year-old man. Dairy-farm foreman. Admitted Varberg Hospital 7/12 1945. Fell from bicycle same day. Lateral end of left clavicle dislocated upward, with 2 cms. palpable separation from the acromion. Radiography: Dislocation of acromio-clavicular joint, with lateral end of clavicle displaced upward by more than the width of the bone. 11/12: Operation (no. 1335) by author. Open reduction with fixation of clavicle to coracoid by wire and free fascia transplantation. Operation performed exactly as in case 2, except that fascia transplantation was looped round clavicle and coracoid process as figure-of-8. 22/12: Scar healed by first intention. Exercises begun early. Continuing abduction



Fig. 21.

Case 3. Calcifications and bone bridge between the clavicle and the coracoid process, 2 years after wiring and free fascia transplantation.



Fig. 22.

Man, now 37 years of age, after conservative treatment. 10 years after injury visible subluxation of acromio-clavicular joint.



Fig. 24.

Man, now 43 years old, showing dislocation 9 years after injury treated conservatively with pressure pad and adhesive strapping.

cushion. Discharged. *Out-patient re-examination:* 14/1 1946: Normal mobility. *Radiography:* Wire broken in one place. Joint surfaces in exact alignment (fig. 12). Discharged as fit. *Follow-up examination* 25/10 1947: Feels perfectly well. Can do all sorts of work, carry heavy sacks, etc. on left shoulder. No visible or palpable subluxation. Lateral end of clavicle increased in width. Mobility normal (see fig. 20 a, b & c). No crepitation. *Radiography:* Loop visible between clavicle and coracoid process; is broken. Lateral end of clavicle now connected with lateral aspect of coracoid process by rather irregular ribbon-like bony formation. Small areas of calcification found between the tip of the coracoid process and the lateral aspect of the clavicle. Position of bones of the acromio-clavicular joint correct (see fig. 21).



Fig. 23.

Man, now 37 years of age. Califications 10 years after injury treated conservatively with pressure pad and adhesive strapping.

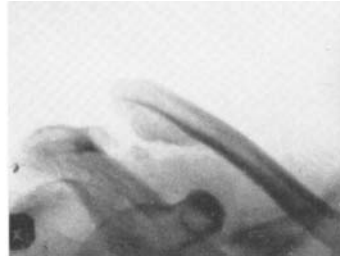


Fig. 25.

Man, now 43 years old. Califications 9 years after injury treated conservatively with pressure pad and adhesive strapping.

Thus at follow-up examination during September-October 1947 the 3 cases showed good anatomical and functional results roughly 5, 3 and 2 years respectively after operation. There was no visible or palpable subluxation, except to an insignificant degree in case 1 (fig. 15). In all 3 cases the lateral end of the clavicle could be felt to be definitely widened. All 3 patients were engaged in heavy manual labour. 2 showed an absolutely normal range of movement on both sides (the deficient mobility shown in fig. 16 is confined to the side not operated on). Case 2, a 65 year-old man, had a mild limitation of abduction (see fig. 18), and slight limitation of rotation could be detected when he placed the dorsum of the hand on his back; the tip of the thumb on the operated side only reached 10 cms (4") below the angle of the scapula, while that of the sound side could reach up to the angle of the scapula. Judging from these 3 cases operated for total dislocation of the acromio-clavicular joint, the extra-articular method, using fixation with wire and free fascia transplants, as applied in the author's cases 2 & 3, can be recommended. It is, however, essential that the patient should be given passive and active exercise of the shoulder joint, preferably beginning during the first week after operation. Good anatomical as well as functional results can then be expected.



Fig. 26.

Man, 58 years of age. Redislocation immediately after suture of joint capsule.



Fig. 27.

Man, now 68 years old. Suture of joint capsule. 10 years later: calcifications.

Of the 10 cases of complete dislocation which, apart from the 3 previously mentioned, are included in the material, 6 were treated conservatively, all with pressure pad and adhesive strapping. Incapacity for work varied between 21 and 75 days. The average was 45 days.

5 of these 6 patients have been followed-up later by questionnaire. 8-9 years after the injury 3 *patients* claimed to have recovered fully, and do not mention any dislocation. The 4th *patient*, a teacher, states in his letter that 9 years after the accident his injured arm is less strong, and will not stand prolonged strain. The dislocation remains unchanged, and during "some" movements the clavicular dislocation reduces itself spontaneously. Normal range of movement. The 5th *patient*, an officer, states that 10 years after the accident he has no complaints about his ability to work and move his arm, but that the outer end of the collar bone is displaced upward from the joint (fig. 22). Radiography 3/5 1948 (fig. 23). The 6th *patient* has been examined by the author 9 years after the accident. Dislocation is clearly visible. The patient can increase the dislocation (fig. 24) and it can be partly reduced by manipulation if the arm is raised above the horizontal plane. Palpation shows increased width of the lateral end of the clavicle. His arm does not feel quite as strong, but he has no pain. The range of movement is nearly normal; rotation is still somewhat limited. When he puts his right hand on the

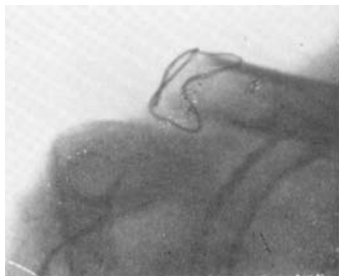


Fig. 28.

Man, 23 years old. Redislocation 1 month after wiring clavicle to acromion.

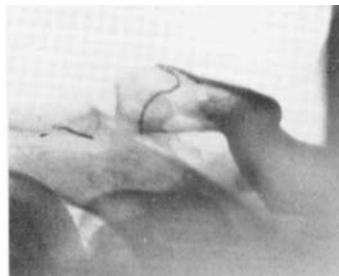


Fig. 29.

Man, now 31 years old. 8 years after operation: calcifications. Wire has broken.

back of his neck, the tips of his fingers reach just in front of the left outer ear (the left reaches the right corner of his mouth), and with the dorsum of the hand placed on the back, the tip of the right thumb reaches to the angle of the scapula (the left reaches as high as the base of the spine of the scapula). Radiography: 28/1 1948 (fig. 25).

The 4 patients with complete dislocation, treated surgically, all had intra-articular operations.

In 2 cases, the operation consisted only of suture of the joint capsule with catgut, giving in the first case normal alignment, in the second a redislocation, seen on the radiographs taken immediately after the operation (fig. 26). The post-operative course was uneventful. The 1st patient, a medical student, was considered unfit for 3 weeks after the operation. 3 months later he fractured the lateral end of the clavicle on the same side. At follow-up examination by letter, 9 years after the accident, there was said to be an abnormal palpable separation of the joint surfaces. The lateral end of the clavicle was increased in width, and the acromion was lying 1/2 cm below the clavicle, compared with the sound side. He had slight pain, and his arm tired more easily after, for example, carrying loads with the arm hanging. The 2nd patient, a bricklayer, who had a redislocation, was disabled for about 4 months, after which he was discharged with a certifi-

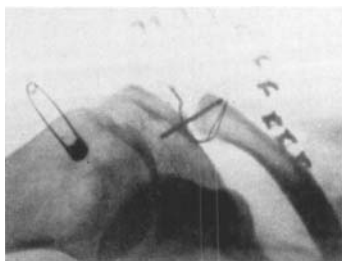


Fig. 30.

Man, 53 years old. Intra-articular operation by *Felsenreich's* method and fixation with *Rissler* pin.



Fig. 31.

Man, now 69 years old. Conservative treatment. 5 years after injury: bridge type of calcification of conoid ligament.

cate of disablement. The insurance company granted him a disablement pension for 1 year on the basis of a 10 % reduction of capacity for work. *At the follow-up examination* by the author 10 years after the accident, the dislocation could be clearly seen and palpated. The lateral end of the clavicle had increased to double its width. Occasional pain in the shoulder was felt in connection with heavy work. The lifting capacity was equal on the two sides. Normal range of movement. Radiography: 18/5 1948 (fig. 27).

In 2 cases the end of the clavicle was wired to the acromion. In the first, radiography, well over one month after the operation, showed that the wire was no longer attached to the acromion, and the dislocation had recurred (fig. 28). Incapacity for work after the operation lasted well over 2 months in this case. *At follow-up examination* 8 years after the accident, a subluxation was clearly seen and palpated. The lateral end of the clavicle had increased to double its width. Occasionally he felt tired and had slight pain in the arm. Lifting capacity and range of movement were normal. Radiography: 18/5 1948 (fig. 29).

The 4th and last case was treated by wire fixation by *Felsenreich's* method, combined with fixation with a *Rissler's* metal pin (fig. 30). Radiography 2½ months later showed no



Fig. 32.

Man, now 27 years old. Conservative treatment. 4 years after injury: calcification of trapezoid ligaments and conoid ligament joined to the coracoid process by bone: also hook-shaped process on the lateral end of the clavicle inferiorly.

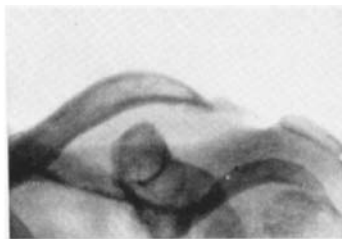


Fig. 33.

Man, now 27 years old. Conservative treatment. 4 years after injury: lateral end of clavicle pointed like a beak.

change of position and he was allowed to start light work. No further information about this patient is available.

From these 10 cases of complete dislocation of the acromio-clavicular joint, it would appear that, whether treatment has been conservative, using adhesive strapping and a firm pressure pad, or surgical, using various types of intra-articular operation, the anatomical result is usually poor. The important fact, however, is that the functional result is good.

RESULTS OF RADIOGRAPHIC FOLLOW-UP EXAMINATION

17 of the 58 cases forming the material have been radiographed later (16 of the cases at Lund diagnostic X-ray department, and one case at Visby Hospital X-ray department).

Areas of calcification in the injured area have been seen with great frequency, i.e. in 14 out of the 17 cases examined.

Krieger Lassen, Schnek, Svab, Usadel, Urist, Wahren, and others have described similar post-traumatic calcified areas. According to Svab, Grune and Meyer have each published descriptions of 2 cases, in 1911 and 1912 respectively, and Hart-

mann and *Poirier*, the anatomists, showed as long ago as 1887 similar formations in their anatomical specimens.

Calcifications may occur in different ways.

- 1) By periosteal new bone formation on the clavicle or coracoid process, or from fragments of periosteum detached from these bones.
- 2) By a calcification process in the coraco-clavicular ligament.
- 3) By calcareous deposits in devitalised tissue (remains of ligaments, transplanted strips of fascia, haematomata and bursae).

Svab found calcified areas of varying sizes in the coraco-clavicular ligament, in 15 out of 22 cases of long-standing acromio-clavicular dislocation. *Svab* believes that the calcification arises through a process of ossification deriving from the cartilaginous or true cartilage tissue on the outer surface of the ligament, which *Luschka*, *Poirier* and *Fick* demonstrated. *Svab* also thinks that there may be a connection between the extent of the ossification and the degree of damage to the vessels caused by the injury to the ligament.

Urist found calcification in 18 of 41 cases examined—this was restricted to the coraco-clavicular ligament. Macroscopic and radiographic examination of extensive areas of calcification excised in chronic cases treated by resection of the lateral end of the clavicle, showed that it sometimes appeared as a bony spur from the periosteum on the clavicle or coracoid process. In other cases it was found as an independent formation.

3 of the 17 cases forming the material showed no calcifications on the follow-up radiographs. These 3 cases are from the group of *cases of subluxation treated conservatively*. The areas of calcification in the remaining 7 *cases of subluxation treated conservatively* appear in various forms, namely calcification of the trapezoid ligament in 4 (in 2 of these it is restricted to the area of insertion on the lateral end of the

clavicle and in 2 to the insertion on the coracoid process). Similarly the conoid ligament shows calcification in 4 cases; restricted in 2 cases to the insertion on the lateral end of the clavicle, and in 1 case to the insertion on the coracoid process. *In the 4th case there is a calcified bridge between the clavicle and coracoid process* (fig. 31). In 2 cases areas of calcification have been seen in and round the acromio-clavicular joint. *In 1 of these the calcification on the coracoid process shows a bony structure* (fig. 32).

All 7 cases of dislocation, whether treated conservatively or surgically, show abnormal calcification of the injured area at the follow-up examination.

The 2 treated conservatively show calcification, localised in both cases to the insertion of the trapezoid ligament on the clavicle and to its central area, as an isolated, independent calcified area (figs. 23 and 25). In one case the insertion of the conoid ligament onto the coracoid process is also calcified (fig. 23).

The 2 treated by intra-articular operation show areas of calcification, localised in one case to the clavicular end of the trapezoid ligament and an independent insular area in the centre of the conoid ligament (fig. 29), in the other to the insertion of the trapezoid ligament onto the coracoid process as well as to the neighbouring area of the acromio-clavicular joint (fig. 27).

The 3 treated by free fascia transplantation all show calcification localised to the fascial transplant (figs. 17, 19 and 21). *All these areas show bony structure* and also there is calcification of the clavicular end of the trapezoid ligament, and in one there is also calcification of its insertion onto the coracoid process (fig. 21). In all 3 the fascial transplant was so placed that, to a great extent, it coincides with the line of the conoid ligament, for which reason it is not possible to determine whether there is also calcification in this ligament. In one of the 3 cases (case 2), the bony connection between the coracoid process and the clavicle is wide enough to justify a presumption that material from the conoid ligament is included in the

bony bridge (fig. 19). In case 3 it is uncertain whether the ligament is included in the bony bridge (fig. 21). In case 1, where a bony connection is not found between the coracoid process and the clavicle, it is clear from the width of the calcified area that the clavicular end of the conoid ligament is calcified (fig. 17).

A study of the radiographs of these 3 cases illustrates the author's method of placing the transplantation. In all 3 the loop of fascia was placed round the clavicle, and the bony bridge can be seen on the radiograph to be attached to the clavicle in all cases (figs. 17, 19 and 21). In case 1 the two free ends of the transplant were attached to the coracoid process, anteriorly and posteriorly, respectively. In this region no bony connection has appeared (fig. 17). In the 2 other cases, the loop of fascia was placed round the clavicle as well as the coracoid process, and a complete bony connection has developed: that is, a bridge of bone between the coracoid process and the clavicle (figs. 19 and 21). In case 3 the middle of the bridge is narrow, probably because the loop of fascia was placed as a figure-of-8 round the clavicle and coracoid process (fig. 21).

Bony connection between the clavicle and the coracoid process is thus found in 3 of the author's cases; in 2 of which fascia transplantation was used (figs. 19 and 21), and in 1 subluxation treated conservatively (fig. 31). *Urist* has also found bony connections in cases treated conservatively.

Urist found that calcification could be seen as early as 3-4 weeks after injury. It increased in area and intensity as the months went by. The final extent varied from a small patch of calcification to the bony union between the clavicle and coracoid process just described. In the author's surgically treated material, minimal calcification could be found as early as 1 month after operation (fig. 13), and 2½ months after operation it had assumed its final form and extent, even though the calcium content was still low (fig. 14). Like the author, *Liberson* and *Birkett* have found calcification after fascia transplantation—each in one case.

It is impossible to say why calcification does not occur in every case of acute injury to the acromio-clavicular joint. Calcification may appear whether the injury is mild or severe, and whether the treatment is conservative or surgical. Nutritional conditions would seem to play an important part in calcification of the transplanted fascial strip. The patient's age at the time of injury is not of decisive importance. 3 patients from the author's material, in which calcification did not occur, were 25, 47 and 61 years respectively at the time of injury. Among the conservatively treated patients showing calcification were 3 aged 21-23 years, and 4 aged 45-65 years at the time of injury. Among the patients showing calcification who had intra-articular operations, 3 were aged 23-34 years, and 1 58 years. The 3 patients treated by fascia transplantation, were aged 36, 51 and 65 years respectively at the time of injury.

The functional result is not influenced by calcification. Of the 3 cases in the author's material where the functional result proved poor (conservatively treated cases of subluxation, see pp. 355-56) calcification is absent in one (man aged 61 years), but appears in the 2 others (men aged 62 and 65 years).

14 of the cases which were examined radiographically can be used to throw light on the question of whether any connection can be found between acromio-clavicular joint injuries and arthrosis deformans in this joint. The result will be found summarized in Table II. In 6 cases an arthrosis either occurred after the injury, or increased in intensity on the injured side. In 2 of these, however, the facts are not so simple. In one case the arthrosis changes were from the beginning more marked on the sound side; later, at the follow-up examination 5 years after the accident, it was about equal on the two sides. In the 2nd case there was no arthrosis on either side at the time of injury. 10 years later, the patient showed slight bilateral arthrosis, but with rather more marked changes on the sound side. The result of the investigation is thus ambiguous. In some cases (in 4 of the 14 cases forming

the material), there is a possibility that the arthrosis changes occurred or increased as a result of the accident.

Radiographic changes have been shown in 3 more cases. In 2 cases, aged 23 and 45 years respectively, the lateral end of the clavicle has become pointed and beak-shaped since the accident (fig. 33), and in 1 case a hook-shaped process has formed below the lateral end of the clavicle (fig. 32).

S U M M A R Y

The results of treatment of 58 cases of acromio-clavicular joint injuries from Lund Surgical Clinic are reported.

44 mild injuries—subluxation of the acromio-clavicular joint—have been treated conservatively, and 1 surgically. Incapacity for work lasted on an average 23 days. The prognosis is usually good, independent of the method of treatment, provided that immobilisation of the shoulder joint is avoided. The author is inclined to recommend as a standard method an abduction cushion with a pressure pad and adhesive strapping on the lateral end of the clavicle, combined with physical treatment begun at the beginning of treatment; if necessary because of the pain only passive movements need be given at first, and active movements of the shoulder joint are begun as soon as possible. With this method of treatment, restriction of movement secondary to a mild injury to the shoulder joint, diagnosed or undiagnosed, is avoided, especially in elderly people. Surgical treatment is unnecessary.

Of 13 more severe injuries—dislocation of the acromio-clavicular joint—6 have been treated conservatively, using pressure pad and adhesive strapping, and 7 surgically. The period of incapacity for work averaged 45 days for the cases treated conservatively, and 65 days for the cases treated surgically.

3 patients have been operated on extra-articularly, using a free fascia transplant as a substitute for the torn coracoclavicular ligament (plus wire fixation in 2 of the 3 cases). 4 have been operated on intra-articularly by different methods. The follow-up examination showed that the functional result

was good in all cases of dislocation, whether they were treated conservatively or surgically. The anatomical result was usually poor in all the cases treated conservatively, and in the cases who had intra-articular operations. A good result, both functional and anatomical, was recorded 5, 3 and 2 years respectively after free fascia transplantation. In the 2 last cases to be operated on, the author used a free fascia transplant and wiring, and this method is recommended for severe cases of dislocation where the ligamentous connection between the clavicle and the coracoid process proves to be completely divided. An abduction cushion and early exercises are recommended.

Abnormal calcification of the injured area has been observed in 14 out of the 17 cases re-examined radiographically.

Calcification appears whether the injury is mild or severe, and whether the treatment is conservative or surgical. It can be observed as early as 3-4 weeks after the accident, according to the observations of the author and others, and it may have assumed its final form and extent $2\frac{1}{2}$ months after the accident. The calcification may have a bony structure and may form a bridge between clavicle and coracoid process, whether the treatment is conservative or surgical. The patient's age at the time of injury has no proven influence on the appearance of calcification. The calcification does not affect the later functional result.

The calcification may be localised to various parts of the coraco-clavicular ligament, to various positions in various cases, and to the area of the acromio-clavicular joint. The extent varies widely from a small patch of calcification to a number of extensive areas in the region of the injured area. In the cases treated by free fascia transplantation, the calcification has in all cases a bony structure, and is mainly localised to the transplanted strip.

With regard to the question of a relation between arthrosis deformans and acute injuries to the acromio-clavicular joint, the author's material shows that it is possible that arthrosis changes have occurred or increased as a result of the injury.

R E S U M É

Les résultats du traitement de 58 cas de lésions de l'articulation acromio-claviculaire de la Clinique Chirurgicale de Lund sont rapportés.

44 lésions peu graves — subluxation de l'articulation acromio-claviculaire — ont été soumises à un traitement conservateur, et 1 chirurgical. Il y a eu incapacité moyenne de travail pendant 23 jours. Le pronostic est généralement bon, indépendamment de la méthode de traitement, à condition d'éviter l'immobilisation de l'articulation de l'épaule. L'auteur est enclin à recommander comme méthode standard un coussin d'abduction avec coussin de pression et rattachement adhésif à l'extrémité latérale de la clavicule, combinée, à un traitement physique institué dès le début: si nécessaire par suite de douleurs, on peut se borner pour commencer à des mouvements passifs, mais il convient de commencer dès que possible les mouvements actifs de l'articulation de l'épaule. Avec cette méthode de traitement on évite, notamment chez les personnes âgées, une restriction des mouvements, secondaire à une lésion bénigne de l'articulation de l'épaule diagnostiquée ou non diagnostiquée. Le traitement chirurgical n'est pas nécessaire.

Sur 13 lésions sévères — dislocation de l'articulation acromio-claviculaire — 6 ont été soumises à un traitement conservateur en utilisant un coussin de pression et le rattachement adhésif, 7 à un traitement chirurgical. La période d'incapacité de travail s'est étendue en moyenne sur 45 jours pour les cas soumis au traitement conservateur, à 65 jours pour ceux traités chirurgicalement.

3 malades ont été opérés extra-articulairement, en utilisant la transplantation d'une fibre l'aponevrose femorale pour remplacer le ligament coraco-claviculaire déchiré (et fixation par fil métallique dans 2 de 3 cas). 4 cas ont été opérés intra-articulairement par diverses méthodes. Les examens subséquents ont fait ressortir un bon résultat fonctionnel dans tous les cas de dislocation, qu'ils aient été soumis à un traitement conser-

vateur ou chirurgical. Le résultat anatomique était généralement médiocre aussi bien dans les cas soumis au traitement conservateur que dans ceux opérés intra-articulairement. Un bon résultat, tant au point de vue fonctionnel qu'anatomique, a été enregistré 5, 3 et 2 ans respectivement après la transplantation de l'aponevrose. Dans les 2 derniers cas opérés, l'auteur a utilisé fixation par transplantation de l'aponevrose femorale et fil métallique et cette méthode est recommandée pour les cas graves de dislocation ou l'on constate que l'attache ligamenteuse entre la clavicule et l'apophyse coracoïde est complètement rompue. On recommande un coussin d'abduction et des exercices pratiqués à un stade précoce.

Une calcification anormale de la partie de la lésion a été observée dans 14 des 17 cas réexaminés à la radiographie.

La calcification apparaît que les cas soient bénins ou graves et que l'on ait institué un traitement conservateur ou chirurgical. On peut l'observer déjà 3 à 4 semaines après l'accident, suivant les observations de l'auteur et d'autres et on suppose qu'elle a atteint sa forme et son extension définitives 2½ mois après l'accident. La calcification peut avoir une structure osseuse et former un pont entre la clavicule et l'apophyse coracoïde, que le traitement ait été conservateur ou chirurgical. Il n'a pas été prouvé que l'âge du malade au moment de la lésion influe sur le développement de la calcification. Celle-ci n'affecte pas le résultat fonctionnel tardif.

La calcification peut être localisée dans les diverses parties du ligament coraco-claviculaire, dans des positions variées dans les différents cas et dans la région de l'articulation acromio-claviculaire. Son extension diffère beaucoup, elle peut passer d'une petite tache de calcification à de nombreuses plaques qui s'étendent sur toute la région de la lésion. Dans les cas traités par transplantation, la calcification a toujours eu une structure osseuse et était principalement localisée au lambeau transplanté.

En ce qui concerne la question d'un rapport entre l'arthrosis deformans et les lésions aiguës de l'articulation acromio-claviculaire, les observations de l'auteur montrent qu'il est

bien possible que des modifications d'arthrosis se soient développées ou accentuées à la suite de la lésion.

ZUSAMMENFASSUNG

Das Behandlungsergebnis in 58 Fällen von acromioclaviculär Schäden, behandelt an der chirurgischen Klinik in Lund wird mitgeteilt.

44 leichtere Schäden — *subluxatio acromioclavicularis* — wurden konservativ, und einer operativ behandelt. Die Arbeitsunfähigkeit betrug im Durchschnitt 23 Tage. Das Endresultat ist in der Regel ein gutes vorausgesetzt dass man die Fixierung im Schultergelenke vermeidet. Der Verfasser empfiehlt als Normalmethode Abduktionsschiene und Pelotte-Heftpflasterverband über dem lateralen Clavicularende mit Bewegungstherapie. Mit der letzteren beginnt man direkt vom ersten Tage der Behandlung, wenn die Schmerzen es vorschreiben zuerst mit passiven Bewegungen, doch so bald als möglich mit aktiven Bewegungen im Schultergelenk. Durch ein solches Regime verhindert man vor allem bei älteren Menschen eine Einschränkung der Beweglichkeit im Schultergelenk, die sekundär infolge einer gleichzeitig entstandenen diagnostizierten oder nicht diagnostizierten Schultergelenksschädigung auftreten kann. Eine operative Behandlung ist unnötig.

Von 13 schwereren Schäden — *luxatio acromioclavicularis* — wurden 6 konservativ behandelt mit Pelotte-Heftpflasterverband und 7 operativ. Die Arbeitsunfähigkeit betrug im Durchschnitt 45 Tage für die konservativ und 65 Tage für die operativ behandelten Fälle.

3 Patienten wurden operiert mit einem extraartikulären Eingriff mittels freier Fascientransplantation als Ersatz für das geborstene lig. coracoclaviculare (plus Metalldrahtfixation in zweien von diesen Fällen). 4 Patienten wurden operiert mittels verschiedener Eingriffe direkt am Gelenk.

Funktionell war das Resultat ein gutes in allen nachuntersuchten konservativ oder operativ behandelten Luxationen. Anatomisch war das Resultat in der Regel schlecht in al-

len konservativ behandelten Fällen und in jener Fällen wo der Eingriff direkt am Gelenk vorgenommen wurde. Ein sowohl funktionell als auch anatomisch gutes Resultat wurde registriert 5, resp. 3 und 2 Jahre nach der Operation mit freier Fascientransplantation. Die vom Verfasser in den beiden letzten operierten Fällen angewendete Methode der freien Fascientransplantation und Metalldrahtfixierung wird für die schwereren Fälle von Luxation anbefohlen, in welchen die Ligamentverbindung zwischen proc. coracoid. und clavicula vollständig zerstört ist.

Abnorme Verkalkungen im Gebiete des Schadens wurde in 14 von 17 röntgenuntersuchten Fällen festgestellt.

Die Verkalkungen treten auf gleichgültig ob der Schade leicht oder schwer war, und unabhängig von konservativer oder operativer Therapie. Man kann sie schon 3-4 Wochen nach dem Unfalle beobachten und sie können ihre definitive Form und Ausbreitung 2½ Monate nach dem Unfalle erreicht haben. Die Verkalkungen können Knochenstruktur besitzen, sie können den Raum zwischen clavicula und proc. coracoid. überbrücken, gleichgültig ob man operative oder konservative Behandlung anwendet. Das Alter der Beschädigten ist ohne nachweisbaren Einfluss auf das Auftreten der Verkalkung und diese selbst hat keinen Einfluss auf das funktionelle Endresultat.

Die Verkalkungen können sich in verschiedenen Teilen des lig. coraco-claviculare lokalisieren, bei verschiedenen Fällen in verschiedener Weise, und auch im Gebiete der articul. acromioclavicularis. Ihre Ausbreitung wechselte sehr von einem kleinen kalkdichten Fleck zu ausgebreiteten Verkalkungen an mehreren Stellen im Gebiete des Schadens.

In den mit freier Fascientransplantation behandelten Fällen zeigen die Verkalkungen immer eine knochenartige Struktur und sind in der Hauptsache im oder um das Transplantat lokalisiert.

Bezüglich der Frage eines Zusammenhanges zwischen arthrosis deformans und akuten Schäden im Acromioclaviculargelenk kann man, nach dem Material des Verfassers zu

urteilen, nicht ausschliessen, dass eine arthrosis deformans sich entwickelte oder verschlechterte auf Grund des Unfalles.

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