COMPLETE DISLOCATION OF THE ACROMIO-CLAVICULAR JOINT

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Complete dislocation of the acromio-clavicular joint is not a common injury. A review of the literature fails to disclose a carefully followed series numbering more than twenty-five identically treated cases. Treatment is indeed varied, and end-results uncertain.

In the past four years we have been fortunate in encountering twenty-seven cases of complete acromio-clavicular dislocation (Fig. 1); all have been treated identically by the use of coraco-clavicular fixation. These patients have recently been recalled for clinical and radiological examination. From this study we have arrived at preliminary but definite conclusions about selection of patients, operative technique and early end-results. In the course of our investigations we have also considered afresh the exact function of the acromio-clavicular joint.

Anatomy of acromio-clavicular injuries—In the anatomy of the acromio-clavicular joint it is noted that the conoid and trapezoid ligaments form the key mechanism which, helped only by the serratus anterior muscle, prevents the scapula from being driven medially. So long as these ligaments remain intact, the joint cannot suffer gross displacement.

The mechanism of injury in all cases was either a direct fall on the point of the acromion or a direct blow on the acromion as in a football tackle, driving it, with the scapula, downwards and medially. Of twenty-seven complete dislocations twenty-three were right-sided. We have been unable to discover any anatomical variations that make the right shoulder more vulnerable. We can only conclude that inherent protective mechanisms exhibited by the patient just before injury render the right shoulder a more susceptible target.

METHODS OF TREATMENT

There are many methods of treating acromio-clavicular dislocation; these range from "studied neglect," through various forms of conservative management, to some form of open operation.
It must be admitted that patients with untreated dislocations are discovered occasionally with surprisingly good functional results. On our University staff are two doctors—one an ear, nose and throat specialist, the other a psychiatrist—both of whom have untreated acromio-clavicular joint dislocations without symptoms. Three weeks after complete dislocation of the acromio-clavicular joint, when effusion and swelling have disappeared, there is not likely to be much pain locally. However, in a good proportion residual subluxation is associated with pain, crepitus and restriction of movement.

An analysis of the literature reveals also that 20 per cent of patients treated conservatively have unsatisfactory results, with pain, instability and limitation of joint movement. Interposition of torn components of the acromio-clavicular joint, such as ligaments, capsule or articular disc, make this method of treatment unpredictable.

There are at least twenty-eight operative methods for correction of acromio-clavicular joint dislocation. Introduction of Kirschner wires across the joint as recommended by Murray (1940), reconstruction of the conoid and trapezoid ligaments by stainless steel wire or fascia as described by Bunnell (1928), or primary excision of the outer end of the clavicle as proposed by Gurd (1941), all have their place, for they can give good results if the technique is carried out perfectly. Nevertheless we have had unfortunate experiences with two of these methods. We have observed that most working men display some weakness in the abducting mechanism of the shoulder after removal of the outer end of the clavicle; this is particularly true in the final degrees of abduction. In addition, we have had the disappointing experience of Kirschner wires cutting through the acromion with loss of position, despite the anatomical reduction of the acromio-clavicular dislocation two weeks before. These difficulties have led us to use the Bosworth (1941) lag-screw operation. We believe, however, after noting the severe disruption of the acromio-clavicular joint at the time of operation, that in any surgical attack on this lesion arthrotomy of the acromio-clavicular joint is an essential part of the operation. This ensures healing of ligaments and periarticular structures with the joint accurately reduced.

Critics of the lag-screw technique of coraco-clavicular fixation consider that certain important elements of shoulder joint function are removed once the clavicle becomes firmly fixed to the coracoid. They point out that rotation of the clavicle occurs on its long axis when the shoulder is abducted and that pain consequently occurs when the arm is carried beyond 90 degrees. We have found that these criticisms are invalid, inasmuch as most of our patients have full painless abduction. In addition, the clavicle in such a patient does rotate on its long axis, but with the scapula as one unit. We will enlarge on this later.

**TECHNIQUE OF OPERATION**

A standard technique has been adopted for this procedure after certain errors in our earlier cases. We wish to stress the necessity of adherence to this exact technique, whereby many of the pitfalls of coraco-clavicular fixation may be avoided.

As originally described by Bosworth, the method consisted of fixation of the clavicle to the coracoid process, the operation being carried out under local anaesthesia without arthrotomy of the acromio-clavicular joint. We believe that this original technique neglects two important steps. The joint must be clearly seen and the coracoid process must be sufficiently exposed in order to identify its broad base. Arthrotomy is necessary, for in many of our cases severe disruption of the joint was noted, with tearing of the articular disc and interposition of fragments of the acromio-clavicular ligament. In addition, “blind” screwing of the coracoid is hazardous. The success of the procedure depends on a firm grip by the lag screw into the broad base of the coracoid. This can be secured only under direct vision or with radiographic control. An axillary view of the coracoid is helpful. A screw that looks in perfect position in the antero-posterior view may be found to be poorly placed in the axial view (Fig. 2). The screw should be placed vertically. In some of our earlier cases, introduction
of the screw was from a position too far lateral; this led to the use of a longer screw than was necessary, and made engagement of the base of the coracoid difficult.

With the patient in a semi-sitting position, an S-shaped incision is made to expose the acromio-clavicular joint, the outermost quarter of the clavicle, and the coracoid process. It is unnecessary to detach completely the entire clavicular origin of the deltoid; preservation of the more medial part will greatly enhance the speed of recovery of the muscle after operation.

![Figure 2](image2.png)

Figure 2—Screw has failed to engage the coracoid process as demonstrated in axial view.

![Figure 3](image3.png)

Figure 3—Screw introduced from lateral position results in engagement of tip rather than base of coracoid.

![Figure 4](image4.png)

Full abduction despite marked over-production of bone in conoid and trapezoid ligaments.

The coracoid process is carefully identified, the acromio-clavicular joint is freed of interposing soft tissue; the torn conoid and trapezoid ligaments are purposely preserved in the hope that calcification and ossification will occur along them later. A drill equal in diameter to the thread diameter of the screw is passed through the outermost quarter of the clavicle, in a vertical plane, directly towards the base of the coracoid process. A smaller drill, of the same diameter as the root diameter of the screw, is then introduced and made to penetrate the cortex of the
coracoid process. A screw of suitable length is driven home; it should maintain adequately the reduction of the joint, should be vertical in position, and should penetrate both cortices of the coracoid process, well back at its base. If the least doubt arises whether the lag screw is accurately placed, an axial radiograph should be taken on the table.

RESULTS

We have no comparative series treated by any other standard method with which to compare our early results. In our series of twenty-seven cases followed for only a four-year period the following statistical observations were made. Using the ratings of anatomical, functional, economic, and cosmetic, with 4 as the highest rating, our series appeared as:

anatomical, 3-7; functional, 3-6; economic, 3-7; cosmetic, 4. Several patients returned early to heavy manual work. A bricklayer returned to full work in six weeks; a butcher in eight weeks was able to lift 200 pounds of meat; a football player injured when tackling in October turned out for basketball practice in December; a professional hockey player was back with his team six weeks after operation. The age of our patients varied from sixteen to sixty-seven, the average being thirty-four years.

Excessive calcification and ossification along the conoid and trapezoid ligaments did not seem to influence the late results (Fig. 4): nor did over-correction of the deformity at the time of operation. As our series developed it became the practice to preserve if possible the torn conoid and trapezoid ligaments, even in a ragged state, and also purposely to over-correct the deformity at operation.

All of the five patients with indifferent results were over the age of fifty. Of the nineteen patients with good results, all were young athletic individuals who were quickly rehabilitated with the least discomfort. In three of the younger patients the result was only fair. In two of these, mistakes were made in operative technique: one screw missed the coracoid as seen in the axial view; another passed obliquely from a very lateral position into the tip of the coracoid.

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FUNCTION OF THE ACROMIO-CLAVICULAR JOINT

An analysis of our patients has led us to reconsider the exact function of the acromio-clavicular joint. A well performed coraco-clavicular fixation, with subsequent ossification along the conoid and trapezoid ligaments, of necessity creates an extra-articular fusion of the acromio-clavicular joint and eliminates this component of the shoulder mechanism (Fig. 5).

Two movements have been described at the acromio-clavicular joint: a gliding movement as the shoulder joint flexes and extends; and an elevation and depression movement to conform with changes in relationship between scapula and humerus during various phases of abduction. Neither of these movements seems essential.

Inman and his associates (1944) have contributed basic work on the function of the shoulder. They have stressed that complete abduction is dependent on free movement in all joints of the shoulder complex—namely, the sterno-clavicular, acromio-clavicular, scapulo-
thoracic, and scapulo-humeral joints. In addition, they have shown that during abduction the clavicle rotates on its longitudinal axis to a marked degree. This was strikingly demonstrated by passing a Kirschner wire horizontally into the clavicle and watching it gain 55 to 60 degrees of elevation as the arm reached full abduction. The greatest degree of rotation occurred after 90 degrees of abduction. From these observations Inman et al. warned

against fusion of the acromio-clavicular joint for any condition. Since Inman's original publication these reflections have often been repeated by others, all condemning screw fixation.

Since it was obvious that in essence we were creating an extra-articular fusion of the acromio-clavicular joint, and since most of our patients nevertheless regained full abduction (Fig. 4), misgivings about carrying out coraco-clavicular fixation seemed unwarranted. Kirschner wires introduced into a normal clavicle and into one which has undergone coraco-clavicular fixation show no difference in their excursion (Figs. 6 and 7). This observation has
been repeatedly confirmed on fresh cadavers. The transfixed clavicle of the cadaver compares favourably with the rotating mechanism of the opposite clavicle. It must be assumed that this transfixed clavicle undergoes rotation but does so synchronously with the rotating scapula.

To demonstrate this point further, Kirschner wires were placed in the scapular spine and clavicle and movements observed; it was observed that on both normal and transfixed sides movements of clavicular rotation and scapular rotation were synchronous during abduction of the shoulder. The degree of elevation of the clavicular wires corresponded to the degree of depression of the scapular wires (Figs. 8 and 9). Rotation of the scapula and clavicle did not occur to any marked degree before 90 degrees of abduction or forward flexion.

From these experiments we can conclude that fusion of the acromio-clavicular joint does not prevent clavicular rotation but rather creates a synchronous scapulo-clavicular rotation. Although we found in our experiments that the normal shoulder simulates this synchronous movement, we believe nevertheless that individual movements of rotation can normally occur at both clavicle and scapula.

In the normal shoulder various stages of tension have been observed in the conoid and trapezoid ligaments. Tension of these ligaments can be altered only by rotation of the clavicle on the scapula. Indifferent results in our older patients must be attributed to failure of the shoulder mechanism to adapt itself to synchronous scapulo-clavicular rotation. The acromio-clavicular joint of the patient over fifty must rely to some extent on the slight 'play' allowed by changes in tension of the coraco-clavicular ligaments. When this is removed by coraco-clavicular fixation or fusion of the acromio-clavicular joint, the extremes of abduction are painful. This phenomenon was not observed in our younger patients, in whom synchronous scapulo-clavicular rotation invariably allowed rapid, full, and painless abduction.

CONCLUSIONS

1. Screw fixation of clavicle to coracoid process, with subsequent calcification and ossification along the conoid and trapezoid ligaments, creates an extra-articular fusion of the acromio-clavicular joint.

2. Though the follow-up is admittedly early, excellent results can be obtained in the young healthy adult. It is possible to return an athlete to competitive sports and a heavy labourer to full work in a surprisingly short time.

3. The operation is of doubtful value in older patients.

4. A precise operative technique is most important in producing a successful result.

5. Screw fixation introduces a new movement into the abduction mechanism of the shoulder: synchronous scapulo-clavicular rotation.

REFERENCES


