THE TRAUMATIC ANATOMY AND TREATMENT OF ACUTE ACROMIO-CLAVICULAR DISLOCATION

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It has long been recognised that complete dislocation of the acromio-clavicular joint is often followed by persistent pain and disability. An extensive literature testifies to the unsatisfactory results of treatment (Bowers 1935, Eikenbary and LeCocq 1933, Girard 1944, Haggart 1933, Hamill 1920, Hart 1941, Key and Conwell 1942, Moffat 1925, Riddel 1926, Schneider 1933, Vargas 1942). However, with few exceptions, the literature is based on the results of operations performed many months after the injury or on the varying results of treatment by closed methods. In either case, the essential underlying pathology has remained obscure and the methods of treatment advocated have therefore lacked a sound anatomical basis. Surgeons who have practised early operation have largely confined their attention to the acromio-clavicular joint itself and have limited their objectives to the retention of a reduction of the dislocation by means of internal fixation (Bosworth 1941, Bowers 1935, Cadenat 1917, Mitchell 1926, Murray 1940, Phemister 1942, Vere-Hodge quoted by Watson-Jones 1943).

For many years we practised conservative treatment of acromio-clavicular dislocation. Although the dislocation invariably persisted, a full or nearly full range of movement at the shoulder was rapidly restored. The cosmetic defect was not regarded by most male patients as important. However, when these patients were followed up, it became clear that many of them, including most of those engaged in heavy manual work, continued for an indefinite time to complain of pain and weakness of the affected shoulder.

The symptoms became manifest chiefly during the performance of two activities. Resisted forward flexion at the shoulder, as in lifting a loaded shovel, was weak and produced pain over the anterior fibres of deltoid. The power of raising or carrying a heavy object held in the hand was impaired and the action caused pain over the superior aspect of the shoulder. Clinical examination suggested that the symptoms arose from damage to the deltoid and trapezius muscles. In order to ascertain the precise nature of the lesion and to work out a method of treatment capable of eliminating the residual disability, a policy of surgical exploration at the acute phase was instituted.

Nine patients have been operated on within a few days of injury and the findings have been so uniform, so consistently in accord with the clinical picture, and so illuminating in regard to the mechanism of the injury, that it is considered worth while to present them.

TRAUMATIC ANATOMY

The pattern of the injury, as seen at operation, became apparent as soon as the skin incision had been deepened through the deep fascia and the skin edges undermined. As is frequently the case in traumatic surgery, the essential dissection had been done by the violence of the injury. The most striking feature, present in every case, was the damage sustained by the deltoid and trapezius muscles. The deltoid had been avulsed from the outer end of the clavicle, leaving it stripped and bare for a distance varying between two and five centimetres (Fig. 1). In some cases the fascia overlying the site of avulsion was still intact and, until divided, concealed the lesion. The trapezius had been split in the direction of its fibres, which are nearly horizontal in this situation, so as to leave a gap between the superior segment of the muscle gaining insertion to the clavicle and the segment

immediately below gaining insertion to the spine of the scapula and to the acromion (Fig. 2). The deep fascia overlying the trapezius was rolled over the free edges of the split.

The outer extremity of the clavicle, with its covering of articular cartilage, was lying free immediately under the skin. The short capsular fibres of the acromio-clavicular joint were completely disrupted, and when an intra-articular meniscus existed it always retained

FIG. 1

Traumatic anatomy as seen from the front after reflecting the skin flaps. The end of the clavicle is lifted up by a bone hook and the torn ends of the coraco-clavicular ligaments are held in the dissecting forceps. The avulsed anterior segment of deltoid, A, is seen in the lower part of the wound. The lower edge of the split in trapezius, B, is overlying the acromial facet of the acromio-clavicular joint.

FIG. 2

Traumatic anatomy as seen from the back. The split in the trapezius muscle is marked A.

an attachment to the acromion; in most cases it had been partly extruded. In four instances the lower free edge of the split trapezius had fallen across the acromial aspect of the acromio-clavicular joint and made closed manipulative reduction quite impossible. In one case, in which the coraco-clavicular ligaments were very obliquely disposed, they were intact. In all the other cases both conoid and trapezoid ligaments had been completely ruptured. The

tearing had occurred with relatively little fraying at about the middle of each ligament, but in one patient, in whom the ligaments were unusually thick and strong, they had been avulsed from the coracoid (Fig. 1).

MECHANISM OF INJURY

The findings suggest that the injury is produced by a blow on the point of the shoulder so that the violence acts through the acromion in the long axis of the limb. The muscles of the shoulder girdle, and particularly the trapezius, are tense at the moment of impact. The downward thrust on the scapula is transmitted, through its ligamentous attachments, to the clavicle. Contraction of the clavicular fibres of the trapezius resists this thrust and the ligaments are disrupted. The continuing violence carries the scapula and upper limb downwards away from the clavicle, splitting the trapezius into clavicular and scapular components and tearing the deltoid from the clavicle (Figs. 3 and 4).

FIG. 3

FIG. 4

Figure 3—Diagrammatic representation of the mechanism of injury, as seen from the front. The arrow represents the direction of the applied force. The extent of the avulsion of the anterior segment of deltoid from the clavicle is shown. Figure 4—Diagrammatic representation as seen from the back. The arrow indicates the direction of the applied force. The splitting of the trapezius between its clavicular and acromial components is shown.

The essential difference between subluxation and complete dislocation of the acromio-clavicular joint is possibly that in the former only ligaments are torn, the muscles of the shoulder girdle remaining intact and so preventing wide separation of clavicle from the acromion. The muscle fibres that can most efficiently hold the clavicle in contact with the acromion are precisely those anterior fibres of the deltoid which are usually avulsed in complete dislocation.

TREATMENT

An assessment of the persistent symptoms of pain and weakness after conservative treatment leads to the conclusion that they arise chiefly from damage to the deltoid and trapezius muscles. The split in the horizontal fibres of the trapezius and the gap between the clavicle and the avulsed anterior segment of the deltoid must fill with scar tissue which is subjected to stretching with every movement of the upper limb, particularly when forward flexion at the shoulder and long axis traction are resisted. These are the movements which are most noticeably weak and painful in cases treated conservatively. Repeated stretching

of "unconsolidated" scar tissue as a source of persistent pain and weakness is well known in other regions—notably in the rotator cuff of the shoulder, the extensor mechanism of the knee, the tendo calcaneus, and the flexor origin of the forearm muscles after avulsion of the medial epicondyle.

If these conclusions are correct, then treatment should aim primarily at securing reposition and healing of torn and avulsed muscle. However, since in complete acromio-clavicular dislocations the clavicle is widely separated from the scapula, it is clear that the muscles cannot be repaired unless the clavicle is first returned to its normal position and retained there until healing is sound. A rational approach would therefore be to reduce the dislocation and prevent redisplacement, and then to repair the torn muscles. Our findings suggest that these aims can be achieved only by a full surgical exploration at the acute phase.

The avulsion of the deltoid cannot be remedied except by direct suture. A limited operative approach, such as transfixion of the acromio-clavicular joint with Kirschner wires (Murray 1940, Phemister 1942), cannot influence muscle healing and, moreover, it invites stiffness of the acromio-clavicular joint. This is of some importance because Inman and others have shown that 20 per cent of the total range of upper extremity abduction is dependent upon movement at the acromio-clavicular joint (Inman, Saunders and Abbott 1944). Similar defects are inherent in the operation designed to secure reduction by screwing the clavicle to the coracoid process (Bosworth 1941, Vere-Hodge quoted by Watson-Jones 1943).

Even the limited and, we consider, secondary objective of securing accurate reduction often cannot be achieved without a clear exposure of the joint. In more than half our cases the presence of muscle or partly extruded meniscus in the joint constituted a real barrier to closed or semi-closed reduction. Urist (1946) found, when operating in cases in which closed treatment had been unsuccessful, that fibrous tissue, torn menisci and capsular ligaments lying in the joint had prevented reduction. He advocated excision of the outer end of the clavicle, though he admitted that neither functionally nor cosmetically were the results uniformly satisfactory.

We now support the view that all manual workers with complete dislocation of the acromio-clavicular joint, and with clinical evidence of muscle damage, should have a full and systematic operative repair carried out at the earliest opportunity.

The diagnosis of complete dislocation rests upon a suitable history, a clinically obvious "step" between the clavicle and the acromion, and significant widening of the space between the clavicle and the coracoid process seen in a radiograph taken with the patient erect and the arms hanging by the side (Fig. 5). The diagnosis of the characteristic muscle lesions rests upon marked tenderness below the outer end of the clavicle and above the outer end of the spine of the scapula, together with pain in these regions produced by contraction of the anterior fibres of the deltoid and the superior fibres of the trapezius.

Technique of operation—The incision follows the outer third of the clavicle, crosses the acromio-clavicular joint and runs medialwards along the horizontal fibres of the trapezius (Fig. 6). The full extent of the injury is displayed, the integrity or otherwise of the coraco-clavicular ligaments is established, and any obstacle to reduction that there may be in the acromio-clavicular joint is removed. When ruptured, the coraco-clavicular ligaments are exposed, if necessary by extending medially the gap between clavicle and avulsed deltoid muscle by dividing a sufficient length of the deltoid origin, leaving a fringe attached to the clavicle to facilitate suturing. A suture is passed through the torn ends of the coraco-clavicular ligaments and the ends of the suture are left long. A suture of wire or some other strong material is passed vertically through the clavicle and acromion about a centimetre from the joint. The dislocation is reduced and the suture is then tightened and secured. This retains the reduction, and the suture uniting the coraco-clavicular ligaments can now be tied and cut short.

All that now remains is to repair the damaged muscles. The split in the trapezius is closed with one or two interrupted sutures. The avulsed segment of deltoid is replaced by mattress sutures passed either round or through the clavicle.

In the patient in whom the coraco-clavicular ligaments had been avulsed from the coracoid (Figs. 7 and 8) it was considered that suture alone would be inadequate. Accordingly,

FIG. 5

Radiograph in the case of acromio-clavicular dislocation illustrated in Figure 1.

FIG. 6

The result in the patient shown in Figure 1 eight weeks after operation. The placing of the incision is shown by the scar.

a figure-of-eight wire loop was passed round the clavicle and round the coracoid process and tightened after the retaining suture had been placed across the acromio-clavicular joint. The suture which had previously been placed between the avulsed coraco-clavicular ligaments and the soft tissues on the coracoid process was then tied.

After operation, the arm is bandaged to the side for six weeks; thereafter active mobilising exercises are encouraged.

FIG. 7

The method of repair used in the case shown in Figure 1. A wire suture, A, has been placed across the acromio-clavicular joint and a wire loop, B, has been placed around the clavicle and the coracoid process. Sutures have been placed between the avulsed ends of the coraco-clavicular ligaments and their stumps on the coracoid process, and the sutures have been left long, C. After the two wire sutures have been tightened, the non-absorbable sutures in the coraco-clavicular ligaments will be tied and cut short.

FIG. 8

FIG. 9

Figure 8—Immediate post-operative radiograph showing the wire sutures in position. Same case as that illustrated in Figures 1 and 7. Figure 9—Eight weeks after the operation, when full movements had been regained, the wires were shown to be broken and slight subluxation of the acromio-clavicular joint had recurred.

RESULTS

With one exception all patients regained full movements and returned to work within three weeks of the removal of the bandages (nine weeks after operation). The exception was the patient in whom the coraco-clavicular ligaments were found at operation to be intact. He failed to regain the last 15 degrees of abduction at the shoulder and the post-operative radiograph showed new bone formation along the coraco-clavicular ligaments. This suggested that the ligaments had escaped rupture by stripping the periosteum from the under-surface of the clavicle and confirmed Inman's finding that full movement of the clavicle in relation to the scapula is essential for full shoulder movements.

All the patients operated on rapidly regained full power and none complained of pain. A radiological follow-up revealed an interesting sequel. Whenever wire sutures had been used, they were found to have broken within a few weeks of resumption of activity (Fig. 9). We interpret this as indicating that normal movement had been restored between clavicle and scapula, the wires having broken as a result of repeated bending and twisting.

Another radiological finding was that slight subluxation of the acromio-clavicular joint usually recurred after the wires had broken (Fig. 9). Displacement was not detectable clinically (Fig. 6) and was not accompanied by symptoms. It suggested that the ligaments binding the clavicle to the scapula had healed with some lengthening. The absence of symptoms supports our view that disability arises largely or entirely from the muscle lesion.

SUMMARY AND CONCLUSIONS

1. The lesions chiefly responsible for persistent pain and weakness after acromio-clavicular dislocations are tears of the trapezius and deltoid muscles.
2. These tears cannot be adequately treated except by open operation.
3. There are often physical barriers making closed manipulative reduction impossible.
4. Open reduction and repair of torn ligaments and muscle is advocated for manual workers.

My thanks are due to my surgical colleagues for their co-operation and to Messrs N. R. Gill and C. Richardson of the Photographic Department for the illustrations.

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