ACUTE DISLOCATION OF THE
ACROMIOCLAVICULAR JOINT

TRAUMATIC ANATOMY AND THE IMPORTANCE OF DELTOID AND TRAPEZIUS

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We report a prospective study of 46 patients with acute complete dislocation of the acromioclavicular joint. They were all treated by suture of the deltooid and trapezius over the clavicle with no repair of the coracoclavicular ligaments, using only temporary fixation with two wires. At operation 43 patients (93.5%) had damage to the trapezius or deltooid or both. The coracoclavicular ligaments were intact in six (13%).

Follow-up was from 2 to 7.9 years (mean 5.8), and at the latest review only five patients (10.9%) had redisplacement, due to premature removal of wires for infection in one, to migration of the wires in another and to partial failure of the muscle repair in three.

We consider that the deltooid and trapezius attachments are important clinical stabilisers of the clavicle and that their repair, with reinforcement, is a useful addition to any method of surgical treatment.

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Allman’s (1967) classification of injuries of the acromioclavicular joint (ACJ) is accepted although the definition of displacement in grade III is not completely agreed (Kawabe, Watanabe and Sato 1984), because total dislocation of the ACJ is possible without complete rupture of the coracoclavicular ligaments (Urist 1946; Horn 1954; Rosenørn and Pedersen 1974; Fukuda et al 1986).

It is accepted that conservative treatment is indicated for grade-I and grade-II injuries (Kawabe et al 1984; Post 1985), but there is still some controversy about the management of grade-III lesions (Rockwood 1984; Post 1985). Conservative treatment is regarded as satisfactory by some (Bjerneld, Hovelius and Thorling 1983; Galpin, Hawkins and Grainger 1985; Larsen, Bjerg-Nielsen and Christensen 1986; Dias et al 1987), but most authors recommend surgery, especially in young and active patients (Kennedy and Cameron 1954; Kennedy 1968; Dewijze 1979; Dawe 1980).

The primary stability of the ACJ is provided by the superior acromioclavicular ligament and the attachments of the trapezius and deltooid muscles (Urist 1963; Copeland and Kessel 1980; Fukuda et al 1986; Larsen and Hede 1987) and some surgeons choose not to repair ruptured coracoclavicular ligaments (Lancaster, Horowitz and Alonso 1987; Taft, Wilson and Oglesby 1987; Bannister et al 1989; Tsou 1989).

Several authors recommend suture of the deltooid and trapezius about the clavicle (Budens and Cook 1961; De Palma 1973), but Rockwood (1984) also repairs the coracoclavicular ligaments.

We have studied the effect of early surgical repair of the muscle lesions, with supraclavicular imbrication but without repair of the coracoclavicular ligaments. Our aim was to establish the clinical relevance of damage to the deltooid and trapezius to the stability of the clavicle.

PATIENTS AND METHODS

From 1984 to 1989, 103 consecutive patients with acute acromioclavicular injuries were seen at the General Hospital, Elda. All patients aged between 18 and 65 years with complete acromioclavicular dislocation treated within 72 hours were included in the study. They had no previous shoulder symptoms and no specific contraindications to operation.

Complete dislocation meant a painful deformity which did not reduce on 90° abduction of the arm (Glorion and Delplace 1973). Standard anteroposterior radiographs of both shoulders were taken (Jäger and Wirth 1983). Complete radiographic dislocation was diagnosed (Lancaster et al 1987) if the distance between the coracoid process and the inferior surface of the clavicle was greater than 11 mm (Tossy, Mead and Sigmond 1963; Bearden, Hughston and Whatley 1973; Shoji, Roth and Chuinard 1986) or if the distal end of the clavicle was elevated by...
at least 75% of the width of the articular surface of the acromial process (Imatani, Hanlon and Cady 1975; Rockwood 1984; Larsen et al 1986). In all cases the diagnosis was confirmed by stress radiographs with 5 kg on each wrist with the patient standing and pulling back both shoulders (Tossy et al 1963; Jäger and Wirth 1983).

The preoperative and postoperative radiographs and those of the contralateral normal shoulder were examined separately by each of three observers. Mean values were recorded in millimetres for the distance between the coracoid process and the clavicle (CC), the width of the articular surface of the acromion (AP) and the elevation of the clavicle in relation to the inferior edge of the acromion (CL/AP) (Table I).

Of the 103 patients, 54 had complete dislocation, but six of these had conservative treatment because of lack of consent for operation or specific surgical contraindications; 48 patients were treated by the technique to be described. Two patients were excluded later, one because of an associated fracture of the clavicle and the other because he was only 14 years of age.

All 46 patients were followed up for a mean period of 5.8 years (2 to 7.9). There were four women and 42 men; their mean age at the time of injury was 32.4 years (18 to 64, so 13.5) and all were employed or active. There were 27 right shoulders and 19 left shoulders, with no predilection for either the dominant or the non-dominant side. The cause of injury was a fall in 11 patients, sport in 6, and a traffic accident in 29 (21 were motor-cycle drivers). Preoperative radiographs (Table I) showed a mean elevation of the clavicle by 133% of the width of the acromion (78 to 283, so 39.8).

Operative technique. All patients were operated on within ten days of injury. An S-shaped skin incision is made over the lateral third of the clavicle and the acromion process. Damage to the trapezius and deltoid is recorded, and the attachments of these muscles are elevated subperiosteally from the clavicle and reflected widely. The coracoclavicular ligaments are explored, but not repaired. The ACJ is debrided and the meniscus removed. The dislocation is then reduced and held by two 1.8 mm percutaneous Kirschner wires passed through the acromion into the clavicle.

The articular capsule and the superior acromioclavicular ligament are repaired and the trapezial muscular flap is sutured above the clavicle on to the disinserted edge of the deltoid, using interrupted mattress sutures of No. 2 absorbable Vicryl (Ethicon Ltd, Edinburgh, UK). The repair is augmented by suture of the superficial aponeuroses.

A suction drain is used for 24 hours, and the arm is protected in a simple sling for three weeks. The K-wires are removed after four to five weeks, and progressive mobilisation of the shoulder is then allowed.

Review. Clinical and radiographic follow-up was at 3, 6, 12 and 24 weeks, then at one and two years. Long-term evaluation of all results was at 2 to 7.9 years.

### Table I. Measurements on preoperative radiographs

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coracoclavicular distance (CC) in mm</td>
<td>8.9</td>
<td>2.4</td>
<td>5 to 17</td>
</tr>
<tr>
<td>Injured</td>
<td>17.6</td>
<td>5.0</td>
<td>12 to 30</td>
</tr>
<tr>
<td>Width of acromion (AP) in mm</td>
<td>8.5</td>
<td>2.0</td>
<td>5 to 14</td>
</tr>
<tr>
<td>Elevation of the clavicle (CL) in mm</td>
<td>11.2</td>
<td>3.6</td>
<td>5 to 25</td>
</tr>
<tr>
<td>CL/AP (%)</td>
<td>133.3</td>
<td>39.8</td>
<td>78 to 283</td>
</tr>
</tbody>
</table>

Functional results were rated on the scale of Imatani et al (1975), which scores for pain (40 points), function and strength (30), and range of motion (30). The maximum is 100 points; above 90 is an excellent result, 81 to 90 good, 61 to 80 fair, and less than 60 is poor. The range of motion, combining shoulder abduction, forward and lateral flexion, and both rotations was measured by goniometer, and the strength of the arm was compared with the normal side (Berson, Gilbert and Green 1978; Bannister et al 1989).

Standard radiographs were taken at each review, with stress radiographs from 12 weeks onwards. The quality of the reduction and the presence of post-traumatic degenerative changes were assessed on each film, recording heterotopic ossification as absent, minor (small and isolated) or major (complete or almost complete bridging) (Dias et al 1987).

Statistical analysis was by the chi-squared test, taking p ≤ 0.05 as significant.

RESULTS

Operative findings. Details of the local injuries in each case are shown in Table II. In all cases there was disruption of both the articular capsule and the acromioclavicular ligaments, with torn tissues interposed below the end of the clavicle. In 43 patients (93.5%) the trapezius or the deltoid or both muscles were injured; in only three patients were the muscles apparently intact, although the coracoclavicular ligaments had ruptured in all three.

The coracoclavicular ligaments were ruptured in 40 patients (87%); the remaining six had intact ligaments but all six had some muscular injury.

The articular meniscus was uninjured in eight patients (17.4%); the other 38 had separation of the meniscus from the clavicular surface. Eight had tears within the detached meniscus.

Clinical and radiographic results. The K-wires were removed at a mean of 31.4 days (13 to 35), but this mean was higher for uncomplicated cases. One patient had the wires removed prematurely for infection at 13 days, and another had external migration of both wires at 16 days.

The late functional results were excellent in 40 patients (87.0%), good in 3 (6.5%), and fair in 3 (6.5%). Table III shows the functional results at six weeks, three months, and at latest review at a minimum of two years.
Table II. Injuries found at operation in 46 cases of complete ACJ dislocation

<table>
<thead>
<tr>
<th>Muscle injury</th>
<th>Injured (n = 40)</th>
<th>Intact (n = 6)</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trapezius only</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>19.6</td>
</tr>
<tr>
<td>Deltoid only</td>
<td>18</td>
<td>0</td>
<td>18</td>
<td>39.1</td>
</tr>
<tr>
<td>Both trapezius and deltoid</td>
<td>12</td>
<td>4</td>
<td>16</td>
<td>34.8</td>
</tr>
<tr>
<td>None</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>6.5</td>
</tr>
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</table>

Table III. Changes in the functional results with time in 46 cases (number, percentage)

<table>
<thead>
<tr>
<th></th>
<th>6 weeks</th>
<th>3 months</th>
<th>Latest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full range of motion</td>
<td>40 (87.0)</td>
<td>46 (100)</td>
<td>46 (100)</td>
</tr>
<tr>
<td>Pain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>31 (67.4)</td>
<td>36 (78.2)</td>
<td>42 (91.3)</td>
</tr>
<tr>
<td>Slight/occasional</td>
<td>11 (23.9)</td>
<td>7 (15.2)</td>
<td>1 (2.2)</td>
</tr>
<tr>
<td>Weakness</td>
<td>4 (8.7)</td>
<td>3 (6.5)</td>
<td>3 (6.5)</td>
</tr>
<tr>
<td>Normal activity</td>
<td>36 (78.2)</td>
<td>46 (100)</td>
<td>46 (100)</td>
</tr>
</tbody>
</table>

Full movement had been regained by six weeks in 40 patients (87.0%) and in all 46 by 12 weeks. At the latest review 42 patients had no pain (91.3%), one had slight and occasional pain but no other disability, and three (6.5%) had mild pain and weakness at extreme movements. All patients had returned to their previous occupation by 12 weeks.

We assessed late stability of the clavicle by radiography at the latest review (Fig. 1) when the elevation of the clavicle in relation to the width of the acromion process was measured. Thirty-four patients (73.9%) showed clavicular elevation of less than 1.5 mm (less than 20% of the width of the acromion process) and seven (15.2%) had elevation of between 2.0 and 3.5 mm (less than 40%), similar to that in the uninjured shoulder. Five patients (10.9%) showed elevation of greater than 4 mm (over 50%) and were recorded as real redisplacement.

In the 41 patients with less than 3.5 mm displacement, the functional results were excellent or good, except in one patient who had had medial migration of one wire. The other five (10.9%) had significant loss of the original reduction, with excellent and good results in two and fair results in the three discussed above.

Forty-two patients were very satisfied, two fairly satisfied and two dissatisfied.

Complications. Deep wound infection required early removal of the wires in one case, which settled with drainage and antibiotics, but the outcome was redisplacement, extrinsic calcification and only a fair functional result. One patient had medial migration of a wire, and another had early lateral migration of both wires; both results were fair.

Early degenerative changes were seen in two young patients (25 and 29 years), but this did not influence the good functional results. There was extrinsic ossification in 12 patients (26.1%), appearing between 3 and 12 weeks postoperatively, but all cases were symptomless. In eight of these patients it involved the coracoclavicular ligaments (major in 2, minor in 6); in three there was minor involvement of the acromioclavicular ligaments. One patient had ossification at both sites. Ossification had no significant influence on functional results.

DISCUSSION

Some satisfactory results can be achieved by any method of treatment but conservative management, especially in young and active patients, gives a 17% to 28% incidence of painful sequelae due to meniscal damage, interposition of fibrous tissue or persistent instability (Horn 1954; Jacobs and Wade 1966; Kawabe et al 1984; Galpin et al 1985; Larsen et al 1986).

Most surgical methods also leave 9% to 28% of patients with residual pain, sometimes due to complications of an osteosynthesis. A redisplacement rate of 9% to 11% has been reported after coracoclavicular fixation (Lancaster et al 1987; Tsou 1989), and a 5% rate after acromioclavicular fixation (Larsen et al 1986). Galpin et

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Figure 1a – Radiograph showing an acute complete acromioclavicular dislocation in a 41-year-old man. Figure 1b – Three weeks after operation. Figure 1c – After six years the clavicle remained stable and the functional result was excellent.
al (1985) found no significant differences in strength between conservatively treated patients and those treated by coracoclavicular fixation, although both were worse than after acromioclavicular fixation.

We considered that many unsatisfactory results could be due to lack of repair of the trapezius and deltoid. We aimed to study the importance of the muscles for stability of the clavicle, and therefore used only temporary acromioclavicular fixation until the soft tissues had healed.

Bargren, Erlanger and Dick (1978) and Rockwood (1984) recommend that an intact meniscus should be left untouched but we agree with Jacobs and Wade (1966) and Kawabe et al (1984) that it should be excised to allow easy reduction, since the results are little different (Lancaster et al 1987).

Like Jacobs and Wade (1966) and Weaver and Dunn (1972) we consider that early acromioclavicular degeneration is not caused by articular perforation with wires: it is also seen after conservative treatment and coracoclavicular fixation (Kawabe et al 1984; Taft et al 1987). Such arthritis seems to cause little pain or dysfunction at long-term review (Lazzcano, Anzel and Kelly 1961; Smith and Stewart 1979; Taft et al 1987), and in our series two young patients with early changes both had satisfactory results, but require longer follow-up.

Ossification of ligaments is often seen after any treatment at about four to six weeks (Urist 1963; Post 1985); we found a 27% incidence but as reported elsewhere the functional results were not altered (Vandekerckhove et al 1985; Warren-Smith and Ward 1987; Skjeldal, Lundblad and Dullerud 1988).

Urist (1946) showed that complete dislocation was possible when the articular capsule, the superior acromioclavicular ligament and the muscular attachments of the trapezius and deltoid were cut. Division of the coracoclavicular ligaments alone produced only subluxation (Horn 1954; Fukuda et al 1986; Taft et al 1987). Six of our patients (13%) had complete dislocations with muscular damage but intact coracoclavicular ligaments, although three (6.5%) had ligament rupture and no muscular injuries.

Both Urist (1946) and Galpin et al (1985) believe that the prime stabilisers of the ACJ are the superior acromioclavicular ligaments and the muscular attachments of the trapezius and deltoid. The muscles control horizontal movements, and constrain posterior displacement and axial rotation of the clavicle. The coracoclavicular ligaments, especially the conoid ligament, oppose only vertical displacement of the clavicle (Fukuda et al 1986). In our series, 93.5% had muscle injuries, most commonly (74%) of the anterior fascicle of the deltoid.

Supraclavicular repair and reinforcement of musculotendinous lesions achieve adequate stability. Healing is relatively quick and the repair directly opposes the vertical displacement of the clavicle. Coracoclavicular ligament suture is slower to heal and associated fixation has to resist tension in its longitudinal axis; loosening of the screw of a Bosworth repair is seen in up to 17% of cases (Tsou 1989).

We believe that repair of the coracoclavicular ligaments has no bearing on the final stability of the clavicle and that supraclavicular reinforcement by suture and overlap of deltoid and trapezius is sufficient. In our series 74% had no loss of reduction and 15% lost less than 40% of acromial overlap. This has been accepted by many authors (Roper and Levack 1982; Lancaster et al 1987; Warren-Smith and Ward 1987; Bannister et al 1989; Ferris, Bhamra and Paton 1989). Of the five patients (11%) with true redisplacement, in two it was due to complications, leaving only three (6.5%) with failure of fixation, but with fair results.

Supraclavicular suture of the deltrotrepezial muscle complex is a successful method of stabilising the clavicle. It can also be used to supplement any other surgical technique used to treat complete acromioclavicular dislocation.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES


