THE EFFECT UPON THE INFERIOR RADIO-ULNAR JOINT OF EXCISION OF THE HEAD OF THE RADIUS IN ADULTS

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It is well known that some adult patients, after removal of the head of the radius, develop subluxation of the inferior radio-ulnar joint. The purpose of this paper is to record the incidence of this happening and to remark upon its mechanism.

MATERIAL

Fifty-eight adults were reviewed in whom the radial head had been excised, either for comminuted or severely depressed marginal fractures (forty-six cases), or after fracture-dislocations of the elbow (twelve cases). The average follow-up was seven and a half years. There were thirty-two men and twenty-six women, and, as in other reported series, the highest incidence was between thirty and fifty years of age. Because the population of the Oxford area is a moving one, follow-up was impossible in many instances, and of all the cases suitable for study only 58 per cent were available. Consequently this is a heterogeneous series and it is not permissible to draw any statistical conclusions. This review deals only with patients who were operated upon for radial head fracture within four weeks of injury and patients with fractures of the shafts of the forearm bones have not been included. Our records do not reveal a case in which fracture-dislocation of the head of the radius was combined with inferior radio-ulnar dislocation as described by Curr and Coe (1946) and Essex-Lopresti (1950).

Antero-posterior and lateral radiographs at the extremes of rotation were taken of the affected elbow in fullest extension and in right-angled flexion. Comparative radiographs of the normal and the affected wrists were taken in maximum pronation with the arm adducted to the trunk and the elbow at right-angled flexion in order to prevent deceptive rotation at the shoulder.

TABLE I

THE INCIDENCE OF SYMPTOMS OF DISTAL RADIO-ULNAR JOINT SUBLUXATION IN FIFTY-EIGHT MEN AND WOMEN AFTER EXCISION OF THE HEAD OF THE RADIUS

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of excisions</td>
<td>58</td>
<td>32</td>
<td>26</td>
</tr>
<tr>
<td>Radiological subluxation</td>
<td>37</td>
<td>21</td>
<td>16</td>
</tr>
<tr>
<td>Total with symptoms</td>
<td>29</td>
<td>18</td>
<td>11</td>
</tr>
<tr>
<td>Weakness only</td>
<td>11</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Symptoms other than weakness:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>9</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Moderate</td>
<td>7</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Severe</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

CLINICAL FEATURES

Patients with subluxation of the inferior radio-ulnar joint seldom attributed their pain to the elbow operation, and it was surprising that many of them had accepted their wrist symptoms without undue complaint.
The main symptoms were weakness of the wrist, with or without stiffness, slight swelling and diffuse aching pain on the ulnar side of the wrist especially after tasks involving forearm rotation, and an increase of pain in cold weather was a common finding. Pain and tenderness to pressure were not usually localised to the distal radio-ulnar joint, and no one complained of symptoms suggestive of a torn triangular cartilage.

We classified symptoms as mild, moderate or severe (Table I). Symptoms other than weakness were present in 34 per cent of the men and 27 per cent of the women. Wrist symptoms appeared within eighteen months after operation in three-quarters of the patients and in two to four years in the rest. The late appearances of symptoms probably accounts for the lack of recognition of the disorder.

When the lower end of the ulna is unduly prominent the diagnosis is obvious, but minor displacement is more difficult to detect. Symptoms may be reproduced when pronation of the flexed forearm is actively resisted, and this manoeuvre may render the displacement more evident (Figs. 1 and 2), though this was not a constant physical sign. The symptoms produced by the subluxation, which usually was one of a few millimetres only, did not seem to depend

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**Figure 1**—Radiograph of a woman of forty-three, eight years after operation showing the degree of subluxation on voluntary pronation.

**Figure 2**—The same patient showing the increase in displacement when pronation was resisted.

**Figure 3**

The wrists of a woman of fifty-eight, twelve years after excision. The displacement shown on the left caused no symptoms other than weakness in the non-dominant limb.
on the degree of the displacement but on the demands of use (Fig. 3). Minor old subluxation may be followed by arthritic changes in the joint, but moderate symptoms can also be present in the absence of radiographic evidence of degeneration. As this was a retrospective study, and the disorder showed marked inconsistencies between the clinical picture and the radiographic degree of degeneration, no attempt was made to estimate the relation between the time after operation and the development of arthritic changes in the joint. In eight patients there were no symptoms despite subluxation that was demonstrated radiologically at the follow-up examination. The reason for the lack of symptoms was not clear.

THE MECHANISM OF DISTAL RADIO-ULNAR JOINT SUBLUXATION AFTER EXCISION OF THE HEAD OF THE RADIUS

In the normal forearm there is some up and down movement of the radius during pronation and supination (Ogilvie 1930). When the radial head has been removed this movement is increased due to reduction in length of the radius, and this may be further reduced by resorption at the neck. This abnormal excursion of the radius was seen in pronation and supination radiographs of the elbow (Figs. 4 and 5). McDougall and White (1957) attributed the absence of proximal displacement of the radius to the state of tension in the interosseous membranes of different individuals. In five of our cases, in which the resection had been performed low down on the radial neck or resorption of the stump had been marked, follow-up radiographs taken in full extension and pronation showed that a considerable gap still existed between the radius and the capitulum, which itself showed porosity probably from lack of contact stimulus.

These findings agree with the idea that proximal displacement of the radius occurs by the “taking up of slack” in the interosseous membrane. It is unlikely that tearing of the interosseous membrane takes place at the time of injury and we have not encountered evidence suggestive of it. Further, the radiographs have not shown bone changes at the attachments of the interosseous membrane to support such a hypothesis.

Jeffery (1950) observed that premature epiphyseal fusion was not an uncommon occurrence after displaced radial neck fractures in childhood, though he made no reference to any distal joint changes from loss of radial length. With this point in mind we reviewed fifteen adults who had suffered severely displaced radial neck fractures in childhood. Difference in length,
measured radiologically, was present in nine patients but in no instance was the subluxation accompanied by symptoms, though comparable displacements may be attended by moderate symptoms when the radial head has been removed in adult life. By contrast, excision of the proximal end of the radius in children is to be avoided as the loss of the contribution to growth of the proximal epiphysis may result in severe wrist changes (Fig. 6).

When the radial head has been excised the restraining action of the annular ligament will be lost if, as is usual, the line of bone division is below the ligament or if stump resorption is marked. In these circumstances flexion and pronation may result in anterior stump subluxation

(Figs. 7 and 8), and this abnormal movement will be reflected distally though in the opposite direction. Further, all the twelve patients with marked anterior stump subluxation complained of some weakness in the elbow. We have not observed an attempt to re-form the radial head in these patients as described by Sutro (1935).

In normal forearm pronation the carrying angle is gradually reduced as the radius moves around the ulna and the rotation axis becomes parallel to that of the humerus. A slight increase in the carrying angle is inevitable after the radial head has been removed, but estimations of the degree of valgus will be inaccurate when extension and supination are restricted. The tendency towards valgus will accentuate the distal changes, but the "sliding" effect will only...
become significant towards the limit of supination, a movement which is usually restricted to a greater or lesser degree after operative treatment of radial head fractures.

The disordered forearm mechanics which follow removal of the head of the radius are obviously complex and it is unlikely that in all instances each of the above components will play an equal role in the production of joint derangement. It is clear that the joint disorder cannot be viewed properly, either clinically or radiologically, in a static sense; the displacement occurs during movement, the greatest excursion being produced in forearm pronation and elbow flexion. This is in agreement with clinical progress, patient’s complaints running parallel with the amount of use to which the limb is subjected.

**DISCUSSION**

The incidence and clinical significance of wrist complications resulting from excision of the head of the radius have, in our opinion, been underestimated by previous writers on these injuries (Murray 1940; Burton 1942; Gaston, Smith and Baab 1949). Symptoms referable to the distal radio-ulnar joint were present in half of the patients reviewed in this paper and although they were not always severe they were an added disability to the residual elbow symptoms. Weakness alone in the wrist was present in 20 per cent of the patients and it is quite possible that these patients may develop more severe symptoms in the future. These findings are in general agreement with those of McDougall and White (1957) who reported wrist symptoms in twelve out of forty-four patients after excision of the radial head though these authors did not discuss the problem of loss of power alone in the affected wrist.

Carstam (1950) reported symptoms arising from the inferior radio-ulnar joint in only five of thirty-five patients following radial head excision for fracture, though proximal displacement of the radius was evident in the radiographs of twenty-seven of these patients. Similarly, Dickson (1962) noted wrist symptoms in seven of forty-five patients who were subjected to removal of the radial head for fracture, and radiological subluxation in sixteen patients. The apparent disparity between the findings of Carstam and Dickson on the one hand and of McDougall and White and those reported in this paper on the other is probably due largely to the preponderance of women patients in former reported groups where they outnumbered the men by two to one. It appears that men are more prone to develop significant symptoms than women, and it is likely that this sex distribution is related to the more powerful muscle forces acting in the male forearm.

When a decision is made to excise the head of the radius there are no effective measures which can be adopted to prevent the later occurrence of distal radio-ulnar joint subluxation. The annular ligament is a slender structure and repair is not often feasible. Although this may be possible, annular suture and plication of the periarticular soft tissues are not likely to be of great value when countered by the relentless pull of the flexor-pronator group of muscles when the elbow is mobilised. A corollary to this is that resection of the head of the radius should always be as conservative as possible though often the line of bone division is dictated by the fracture.

Although prosthetic replacement of the fractured radial head has not been performed in this series, an operation of the type described by Cherry (1953) has several possible advantages. The artificial radial head would maintain full radial length and the carrying angle; it is also possible that the proximal stabilising effect would prevent anterior subluxation of the proximal end of the radius. However ideal this procedure may appear on theoretical grounds, such an approach must be tempered by past experience with replacement prostheses elsewhere in the body. Frequently they create more problems than they were originally designed to solve and from this study there does not appear to be any clear indication for their use in management of radial head fractures. Another complication is the known high incidence of severe damage
to the capitulum which might preclude satisfactory results from replacement surgery. In these respects it is not possible to assign a definite role to an artificial radial head in these injuries, but if it were to be employed perhaps it could be used to the best advantage as a secondary procedure if disabling wrist symptoms appeared.

Excision of the head of the radius is the treatment of choice at most centres in this country for badly comminuted fractures. However, the results of non-operative treatment may be satisfactory (Lumsden 1951, Vertongen 1961), and the conservative approach obviates the possibility of ensuing disorder in the distal radio-ulnar joint (O’Connor and Taylor 1962).

SUMMARY AND CONCLUSIONS
1. Fifty-eight adult patients who had been treated for radial head fractures by excision of the head of the radius have been reviewed at periods varying between two and nineteen years after operation.
2. Symptoms referable to the inferior radio-ulnar joint were present in half of the patients and the mechanisms of the disorder in these patients are discussed in the light of a radiographic study.
3. We feel it justifiable to conclude from our observations that this complication of surgical treatment of radial head fractures deserves greater attention than has been given to it in the past, and that it is of sufficient importance to be taken into consideration when planning the management of these fractures, especially the less severe injuries.
4. Prosthetic replacement of the proximal end of the radius is the logical and, indeed, the only way in which the distal radio-ulnar joint subluxation can be avoided, but no clearly defined indications for the routine use of a prosthesis as a primary procedure can be suggested on the basis of this investigation.

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REFERENCES