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FRACTURE OF THE RADIAL NECK IN CHILDREN

A Long-Term Follow-up Study of 43 Cases

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A series of 43 radial neck or head fractures in children was analysed with respect to the type of fracture and whether conservative or surgical treatment had been employed. Thirty-seven patients were examined after a follow-up period of 1–18 years (average 8 years). Tilting of the radial head, the length of the radius and the size of the radial head were measured roentgenologically to evaluate any growth disturbances. The results were good in 24, fair in 10 and poor in 3 cases. In the 14 patients treated surgically results were good in five, fair in six and poor in three cases. All but two of these patients had an angulation of the radial head of 30° or more. The result was good in 20 of the 23 patients who were treated conservatively because the angulation was less than 30° after reduction. In fair and poor cases the function was impaired by the limitation of motion. Disturbances in growth were generally slight, but an enlargement of the radial head was observed in 16 cases at the follow-up.

Key words: fracture; radial neck; children; long-term follow-up

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Fractures of the radial neck or head are relatively uncommon in children. The frequency varies between 4.5 and 10 per cent of all fractures in the elbow region (Blount 1955, O'Brien 1965, Henrikson 1969, Tachdjian 1972). A fall on the outstretched arm compresses the capitellum against the outer side of the head of the radius, tilting and displacing it outwards and forwards. The valgus strain can cause an avulsion of the ulnar epicondyle (Dunlop 1935), a rupture of the ulnar collateral ligament or capsule or even a fracture of the olecranon or the upper shaft of the ulna (Jeffery 1950). In about half of the cases of radial neck fracture the proximal radial epiphysis is also involved (Jones & Esah 1971). When the fracture line is lower, a greenstick fracture of the neck of the radius may occur (Jeffery 1950, Watson-Jones 1955). According to the authors mentioned above fracture of the radial head rarely occurs in children.

The following complications have been described in the literature:

1) New bone formation and deformity of the radial head with enlargement (Blount 1955, Fielding 1964, O'Brien 1965, Jones & Esah 1971).

2) Avascular necrosis of the radial head and/or premature fusion of the epiphyseal plate resulting in a shortening of the radius. A cubitus valgus deformity may be the result (Jeffery 1950, O'Brien 1965, Henrikson 1969, Jones & Esah 1971). On the other hand Reidy & van Gorder (1963) did not find any shortening of the radius in spite of premature fusion of the upper radial epiphysis.

3) Fibrous adhesions or crossed synostosis between the radius and ulna limiting the rotation mobility (Fielding 1965).

4) A combination of two or more of these complications, resulting in most cases in a crippling deformity.

In our series we have analysed the long-term results of radial neck or head fractures in children treated conservatively or surgically. Special attention was given to any growth complications and the causes of possible restrictions of motion. The prognostic radiological criteria in the evaluation of the end results and the indications for surgical treatment are discussed.

PATIENTS AND METHODS

Patients

The present series consists of all fractures of the radial neck or head in children under 15 years of age treated as inpatients at the Aurora Children's Hospital, Helsinki, Finland, during the years 1957–1975. Of the total number of 43 patients, 37 were examined by the authors in 1976. The remaining six patients were followed up as outpatients until the fracture had healed and the motion of the elbow was satisfactory, but because a personal after-examination was lacking, these six patients were excluded from the follow-up study. The ratio of boys to girls was 18:25. The age of the patients at the moment of injury varied from 5 to 14 years with an average of 10 years. The highest frequency of fractures was found in the 9–11 age group. The distribution of left and right sides was 23/20. Sport or traffic injuries were the cause of injury in 7 patients, 17 patients fell on the outstretched arm and 19 patients fell from a height.

Type of fracture

There were no open fractures. There were 21 cases of fracture-separation of the proximal epiphysis and 21 cases of greenstick fracture of the neck with angulation. The remaining case was a small marginal fracture of the radial head.

The tilting of the radial head or fragment was radial in 42 cases and medial in only one case. In 25 cases the radial head was tilted anteriorly and in ten cases (23 per cent) posteriorly. In seven cases the radial head was completely displaced with total separation of the epiphysis.

Associated injuries

Associated injuries of the elbow were found in 34 per cent (16/43). Five patients had an avulsion fracture of the ulnar epicondyle. Four patients had fractures of the olecranon, one patient a fracture of the upper part of the shaft of the ulna. Posterior luxation of the arm occurred in two cases. Avulsion fractures of the coronoid process, intra-articular avulsion fracture of the lateral proximal part of the ulna (insertion of the ligamentum annulare), and fracture of the capitellum of the humerus were found in one case each. There was partial radial paresis in one case but it regressed completely within 8 weeks. The nerve was not explored. There were no vascular complications in this series.

Treatment

Closed reduction was done in 19 cases; ten cases with angulation less than 25° were immobilized without reduction. Of the total number of patients 32 per cent (14/43) were treated surgically. Open reduction was indicated when the angulation of the radial head could not be corrected up to 25° in both planes by closed means. An operation was also performed in cases of a complete epiphyseal separation or a dislocated marginal fragment of the radial head. There were only two exceptions to these indications. One case with radial tilting of only 20° was operated on, because of radial and anterior displacement of about one half of the bone diameter. One case treated elsewhere was first seen in our hospital 4 weeks after the injury. The remaining case with radial tilting of 65° was left and no operation was performed.

Fixation of the radial head was done with catgut in 10 cases and a Kirschner wire through the radiohumeral joint in three cases. A small marginal fragment was removed in one case. One reoperation was performed in a case of failure of the reduction position after the first operation, in which the totally anteriorly displaced radial head was fixed with catgut sutures through the soft tissues.

Plaster immobilization was used in 42 cases and a cuff and sling in only one case. The average time in plaster was 33 days, range 15 to 63 days. There were no passive physical exercises.

Methods of investigation

Tilting of the radial head was measured on both the antero-posterior and lateral projections of both arms on the date of injury, at the end of treatment and at the follow-up. Measurements were made to an accuracy of 5°. The differences in these angles compared with the values of the healthy arm were

registered. The size of the radial head was also measured at the follow-up. Differences of more than 2 mm between the fractured and non-fractured sides were recorded. The primary radiographs of all 43 patients and those of the 37 patients followed up were compared.

At the clinical after-examination the carrying angle and the lengths of the radius and the ulna were measured. If there was any suspicion of a difference in the lengths of the two arms, the lengths of the radius and ulna were measured roentgenologically. The range of motion of the elbow was measured on both arms.

Follow-up examination

The follow-up period ranged from 1 to 18 years with an average of 8 years. The age of the patients at follow-up varied between 8 and 19 years, average 17 years.

The end result was to be judged good, if restriction of any of the movements of the elbow joint was less than 10° compared with that on the healthy side, or the difference in the carrying angle (CA) was less than 10°. Values from 10 to 30° were graded fair, and the end result was classified as poor if restriction of any of the movements was more than 30°.

RESULTS

In this series the radial angulation of the normal contralateral radial head varied between 0 and 15°, average 12.5°. The angulation of the normal radial head forwards or backwards varied from 10° forwards to 5° backwards, being 3.5° forwards on average.

The end results according to the criteria mentioned above (Table 1) were good in 65 per cent (24/37), fair in 27 per cent (10/37), and poor in 8 per cent (3/37). The type of treatment in the various classifications of primary angulation is also seen in Table 1. Six of the ten fair cases and all the three poor cases were treated surgically. Out of eight operatively treated cases with total primary displacement the end result was good or fair in five cases.

Correction of angulation

The spontaneous correction of the angulation of the radial head was generally 10° or less during the period of growth, with an average 9.3°.

Complications

There were three poor results in this series, two cases of synostosis between the radius and ulna with complete limitation of rotation and one case of aseptic necrosis of the radial head. In the latter case the arm was dislocated posteriorly and the radial head totally displaced anteriorly. Because of redislocation of the radial head, reoperation was performed, but an aseptic necrosis occurred. The radial head was excised, but fibrous adhesions limited rotation to 60°. The same type of injury with posterior dislocation was present in another operatively treated case resulting in radio-ulnar synostosis (Figure 1). Resection of the synostosis and the radial head resulted in 80° of rotational movement. In the second case of synostosis operative reduction failed with an anterior and radial displacement of the radial head of about half of the diameter of the radial neck. A large mass of callus and

Table 1. End results at the follow-up

Primary angulation (degrees)	Good		Fair		Poor		Total
	Non-op.	Op.	Non-op.	Op.	Non-op.	Op.	
<30	14	1	3	0	0	1	19
30–60	5	1	0	4	0	0	10
>60	0	3	1	2	0	2	8
Total	19	5	4	6	0	3	37
	24 (65 %)		10 (27 %)		3 (8 %)		

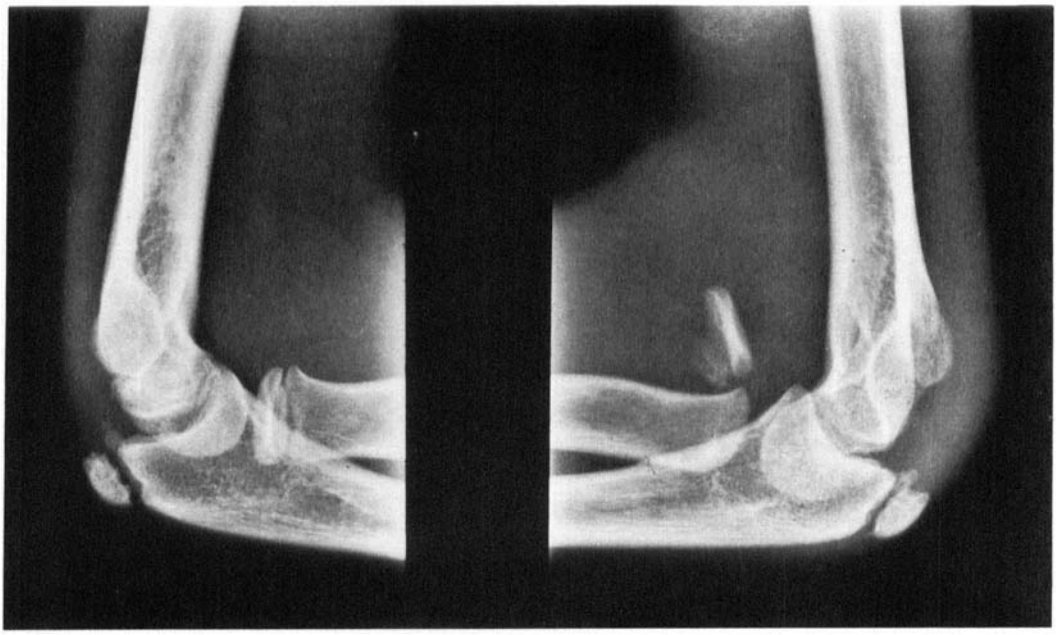
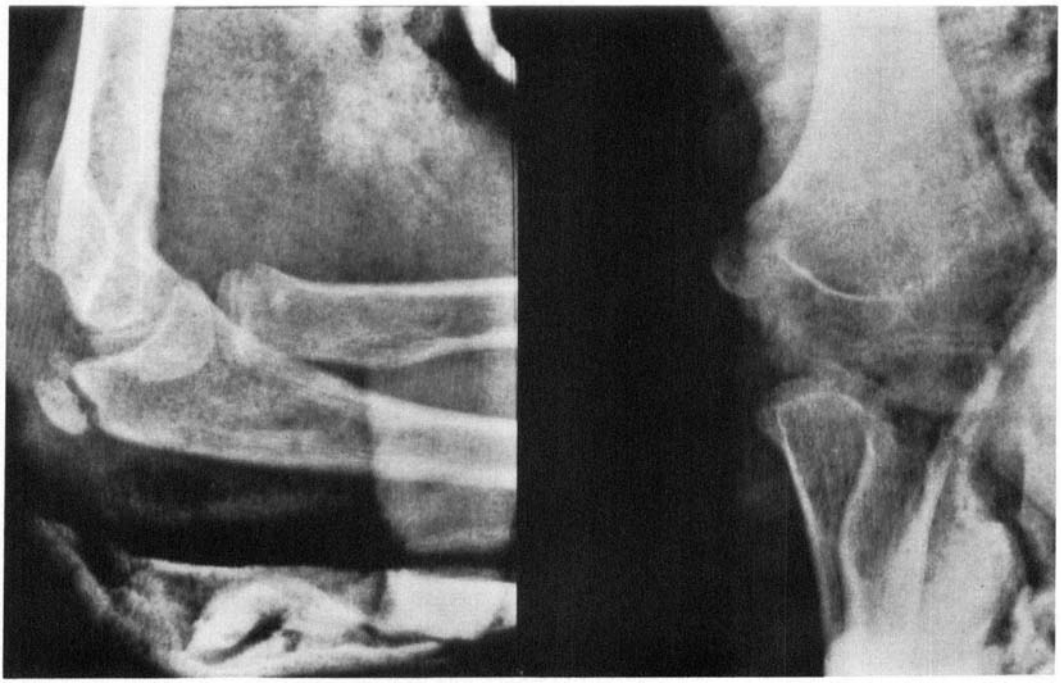


Figure 1A. A 14-year-old boy. Fracture of the left radial neck with epiphyseolysis and total anterior displacement. Lateral projection. There was also posterior dislocation of the elbow which was reduced in the emergency room.



B. A good position of the fracture after surgical reduction.

C. On the twenty-third day when the plaster was removed, signs of myositis ossificans can be seen.

D. After 2 years. Synostosis is present between the ulna and radius together with myositis ossificans. The end result was poor because of total limitation of rotation. Flexion and extension movements are normal. Resection of the synostosis and the radial head was performed later.

myositis ossificans developed. A resection operation similar to that performed in the other case of synostosis is planned for the end of the growth period in this case.

In 43 per cent (16/37) enlargement of the radial head was observed. The increase was from 3 to 14 mm. The limitation of rotation amounted to more than 30° in three of these patients, while a limitation of 15–30° was observed in seven patients. In three patients it was less than 15° and in three patients there was no limitation of motion. In ten cases open reduction was performed. The distribution of the primary displacement of these 16 cases was almost the same as in the three displacement groups.

Myositis ossificans (M.O.) was found in 32 per cent (14/43). In most cases the signs of M.O. on the radiograph were situated in front of the proximal part of the ulna corresponding to the ulnar insertion of the supinator muscle. Seven patients were treated surgically. In three of these and in four cases treated conservatively the signs of M.O. had disappeared at the follow-up and the end result was good. In the remaining seven cases slight changes indicative of M.O. were observed on the radiographs at the follow-up, with limitation of motion lowering the end result grading to fair or poor. However the combination of synostosis, or necrosis of the radial head, and M.O. was the main cause of poor results in this series.

In two cases the radial head was excised and in four other cases the radius was 3–9 mm shorter than on the healthy side. The cubital carrying angle varied between 5 and 25°, the difference being 10° or less than on the healthy side. The average carrying angle was 12.5° on the healthy side, and 14.8° on the injured side.

DISCUSSION

The reported incidence of other injuries in the elbow region associated with fracture of the radial neck is between 12 and 30 per cent (Jeffery 1950, Reidy & van Gorder 1963, O'Brien 1965, Jones & Esah 1971). In our series it was 34 per cent. Posterior luxation of the arm was found primarily in two of the cases later classified as poor and seemed to indicate a poor prognosis in fracture of the radial neck.

An enlargement and deformity of the radial head were found in 43 per cent (16/37) of our cases. This phenomenon was reported by O'Brien (1965) in 12 per cent (15/125) and by Jones & Esah (1971) in 13 per cent (4/30). The higher incidence in our series may be due to the strict criteria used for measuring the radial head in both projections. The deformity of the radial head generally caused slight limitation of rotation.

The serious complication, avascular necrosis of the radial head, seems to occur quite infrequently and generally in less than 10 per cent of cases. Jeffery (1950) reported one case of excision of the radial head (1/24). Reidy & van Gorder (1963) reported one aseptic necrosis of the radial head (1/30) and Jones & Esah (1971) three cases (3/34). This complication occurred in one case (1/37) in our series.

A premature fusion of the epiphyseal plate may be expected in epiphyseal injuries of the radial neck (Jeffery 1950). O'Brien (1965) reported this complication in as many as 40 out of a total of 125 cases. However this complication seldom resulted in marked shortening of the radius and/or cubitus valgus, and was of no clinical significance (Reidy & van Gorder 1963, O'Brien 1965, Henrikson 1969, Jones & Esah 1971). O'Brien (1965) found shortening of the radius in only five cases (5/125). We also agree that this complication poses no serious problems. This may be due to the fact that the radius grows mainly from the distal epiphysis.

Fibrous adhesions or crossed synostosis between the radius and ulna limit the rotation mobility (Fielding 1964). O'Brien (1965) found synostosis in six cases (6/125), Henrikson (1969) in three cases (3/55) and Jones & Esah (1971) in one case (1/30). This severe complication was present in two cases (2/37) in our series. Resection of the synostosis and the radial head was performed later, at the end

of the growth period, in one case, resulting in satisfactory rotation.

Myositis ossificans changes did not cause serious problems. In half of the cases with M.O. the calcifications disappeared; if they remained the motion was slightly limited.

Henrikson (1969) and Jones & Esah (1971) reported poor results in 15 and 23 per cent of their cases. Using similar criteria we found poor end results in 19 per cent.

In order to prevent the complications mentioned above, Stankovic et al. (1975) suggested operative treatment when tilting amounted to 20° or more. Other authors prefer conservative reduction in cases of tilting between 30 and 60°, and reserve open surgery for cases with tilting of more than 60° (Jeffery 1950, Blount 1955, O'Brien 1965, Jones & Esah 1971, Sharrard 1971, Tachdjian 1972).

In conclusion we suggest the following treatment guidelines.

1. In cases with angular displacement of less than 30° the need for reduction is questionable. A plaster or sling immobilization for 2–3 weeks is sufficient.
2. Cases with angular displacement between 30 and 60° should be treated by closed reduction. If this is not successful, surgical reduction is indicated.
3. Cases with displacement of more than 60° usually require surgical intervention.

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