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FRACTURES OF THE LATERAL CONDYLE OF THE HUMERUS IN CHILDREN

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Accepted 1.xi.73

Among fractures of the elbow during childhood those of the lateral condyle of the humerus make up almost one-fifth (Blount 1955). Today, the great majority of surgeons prefer operative treatment of these fractures, if they are appreciably displaced, without first trying closed reduction as recommended by Watson-Jones (1955). The difficulty consists in drawing the limit between fractures which one chooses to treat conservatively by immobilization in plaster without preceding reduction, and those which require open reduction and internal fixation.

Blount (1955) warned against the tendency of even slightly displaced fractures of the lateral humeral condyle to secondary displacement in the course of conservative management. Jeffery (1958) and Flynn (1971) pointed out that a number of fractures of the lateral humeral condyle with little displacement result in non-union, stating that the incidence of non-union is higher among the slightly displaced fractures than among the severely displaced ones—simply because the latter are treated more adequately than the former.

The important question is whether it is possible to estimate with sufficient accuracy from the primary X-ray films which fractures are stable and which are not.

The avulsed fragment of the condyle, consisting of the capitulum

Figure 1. Fracture of the lateral condyle of the left humerus with external rotation of the capitulum. Normally, the axis of the capitulum, drawn between the ulnar corner of the capitulum and the middle of its radial margin (a), is parallel to the epiphyseal line of the trochlea (b) or a few degrees internally rotated. (In a smaller series of normal elbows the authors have found that the angle between (a) and (b) is always the same on both sides, even though the X-ray projection has been altered up to 10° in any direction.) (H = right, V = left).

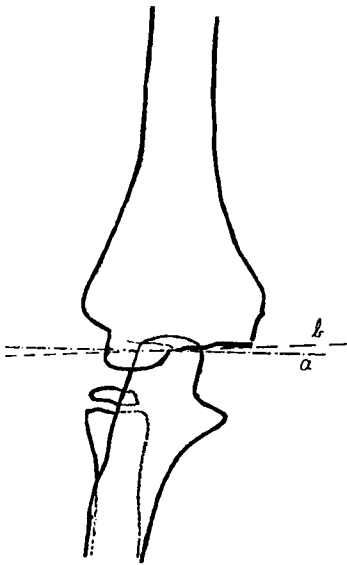
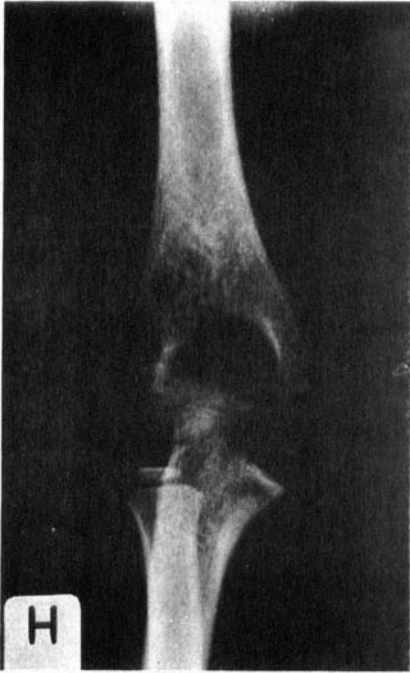


Figure 1 (H).

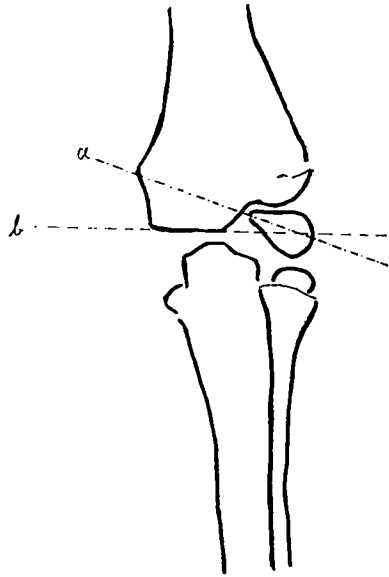


Figure 1 (V).

of the humerus with the adjacent part of the trochlea and a lateral chip of the metaphysis, is unstable when the aponeurosis from the common extensor muscles to the metaphysis is ruptured proximally to the fracture line. The first sign of such a rupture is rotation of the capitulum around the sagittal axis corresponding to the intact lateral collateral ligament (Wilson 1936, Watson-Jones 1955). This rotation may be minimal, but as the primary rotation takes place in the frontal plane it is disclosed by uniform AP X-rays of the fractured as well as unaffected elbow (Figure 1).

Thus, the primary displacement is definitely of decisive importance to stability and thereby to the risk of further displacement and possibly mal-union or non-union during conservative treatment. On the other hand, the possible causal relationship between mal-union and the disturbances of growth so common in the elbow after these fractures is still a matter of dispute (Wilson 1936, Salter & Harris 1963, Wadsworth 1964).

In an effort to elucidate further the relationship between the primary therapeutic results and the known late complications, a follow-up study was performed on a series of conservatively treated as well as operatively treated fractures of the lateral condyle of the humerus, of which all except one had shown some degree of primary displacement.

M A T E R I A L

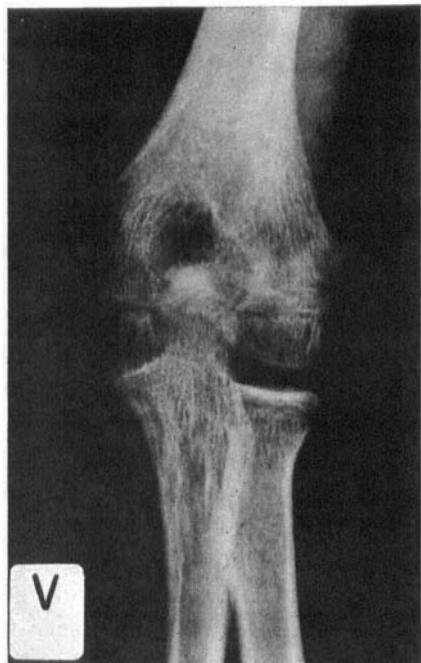
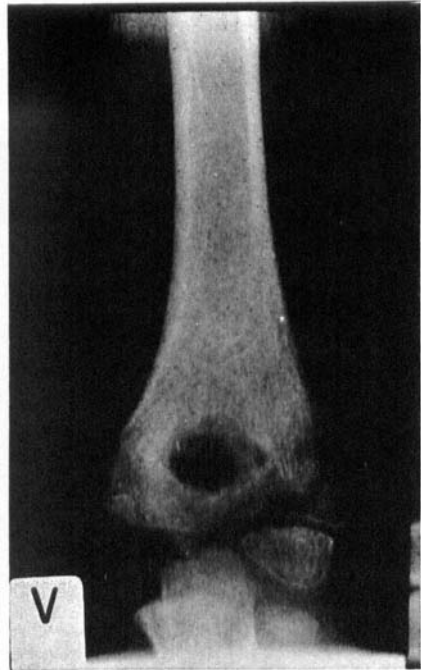
During the period 1955-1972 40 fractures of the lateral condyle of the humerus in children were treated, 39 were seen at follow-up. One patient living abroad could not be traced and was therefore excluded.

Seven girls and 32 boys aged 2-13 years, average 6.5 years, had been treated. 15 fractures were on the right side and 24 on the left side. From the case records it is impossible to state anything definite about the mechanism of the fracture in each individual case.

In addition to the fracture of the lateral humeral condyle 9 patients had other injuries of the elbow, most often dislocation.

The diagnosis and classification of the fractures was based upon the original X-ray films of the injured elbow compared with the opposite elbow in the two standard views, revised by the authors during the present study. In the course of this critical revision of the primary radiographs one fracture was found to be in a good position, i.e. without any displacement, and 9 to be in a fair position, i.e. slightly displaced, viz. laterally 2 mm or less, with no rotation. These fractures were considered stable. In the remaining 29 cases the position of the fractures was poor, viz. showing more than 2 mm lateral displacement and in 25 of these cases also rotation of the capitulum. These fractures we classified as severely displaced and unstable.

Figure 2. Severely displaced fracture of the left lateral condyle which was not reduced. Remodelling of the fracture at follow-up 2½ years later. Note premature calcification of the trochlear ossification centre on the affected side. No angulation.



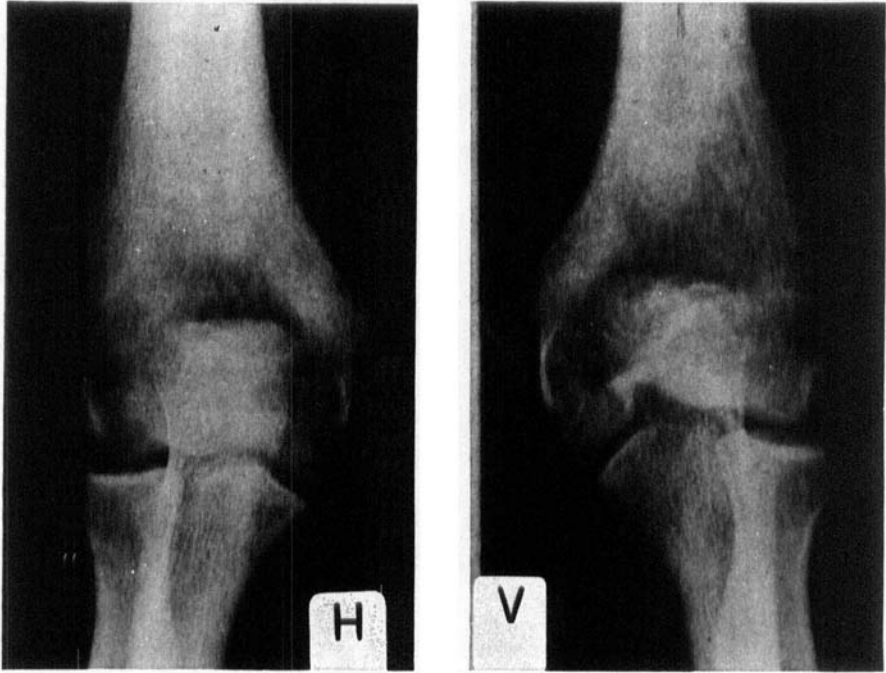


Figure 3. United left-side fracture of the lateral condyle with overgrowth of the radial head as well as the capitulum of the humerus and fish-tail deformity. Carrying angle of 0°.

METHOD AND RESULTS

No reduction had been performed in 19 cases. In the original X-ray reports nearly all these fractures were described as showing no or negligible displacement. Closed reduction had been carried out in 6 cases, and 16 fractures, including two which secondarily became displaced in the course of non-operative treatment, were treated by open reduction and osteosynthesis, using either catgut suture, metal suture, screw, nail, or Kirschner wire.

After the primary treatment the position of the fracture was, as is apparent from Table 1, good in one-third of the cases, fair in one-third, and poor in one-third.

Secondary displacement did not occur in the course of non-operative treatment of non-displaced or only slightly displaced fractures, but in 2 of the 15 severely displaced fractures which were first tentatively treated without operation. In one of these cases the secondary dis-

Figure 4. Premature epiphysiodesis in a right-side fracture of the lateral condyle of the humerus united in a good position, 8 years after osteosynthesis. No angulation.



Table 1. Results of primary treatment (X-ray findings)

Treatment	Position of fracture	Before treatment	After treatment	Secondary displacement
No reduction	Good	1	1	
	Fair	9	9	
	Poor	9	9	1
Closed reduction	Good	0	1	1
	Fair	0	3	
	Poor	6	2	
Open reduction and osteosynthesis	Good	0	13	
	Fair	0	1	
	Poor	16*	2	

* Including the two secondarily displaced fractures.

placement occurred just over one week after closed reduction to a good position and in the other case more than 5 weeks after plaster immobilization of a fracture showing only a slight rotary displacement of the lateral condyle. Both were thereafter successfully treated by open reduction and osteosynthesis.

The mean period of immobilization for operated as well as non-operated elbows was 4 weeks. Infection did not occur. All fractures but one united within 4-6 weeks.

FOLLOW-UP

All the patients were examined clinically and radiologically 1-17 years after the treatment, average follow-up period 7.5 years.

Although nearly one-third of the fractures had united in a poor position (Table 1), less than one-sixth exhibited a corresponding radiographic deformity at follow-up. Thus, a certain re-modelling of the fractured condyle had taken place after union (Figure 2).

A small bony prominence on the lateral aspect of the elbow was a common finding, and correspondingly the X-ray films in 23 cases showed overgrowth in the radial part of the joint—usually of the radial as well as humeral capitulum (Figure 3). Nine of these elbows showed a varus deformity of up to 5°. Most often there was a question merely of a 0-degree carrying angle which the patient had not even noticed. Only 2 of these 9 elbows had been treated by operation.

Cubitus valgus was observed in 4 cases. This deformity was 15° in an elbow with non-union, and less than 10° in the other three.

Premature closure of the epiphyseal line of the capitulum of the humerus occurred in 6 elbow joints. In 3 of these cases the fracture had healed in a good position (Figure 4), in the other three in a poor position. There was no change in the carrying angle in three of the elbows after a follow-up period of 6-10 years. Of the remaining ones, 2 resulted in a 0-degree carrying angle and one in a valgus deformity of less than 5°.

In practically all cases in which the trochlear ossification centre had ossified at follow-up there was a notch between the trochlea and the head of the humerus, the so-called "fish-tail deformity". This phenomenon occurred in well-reduced as well as in poorly reduced fractures and may be due to deficient development of that part of the trochlea which is formed from the epiphyseal centre of the fractured capitulum (Wadsworth 1964). However, the deformity was always

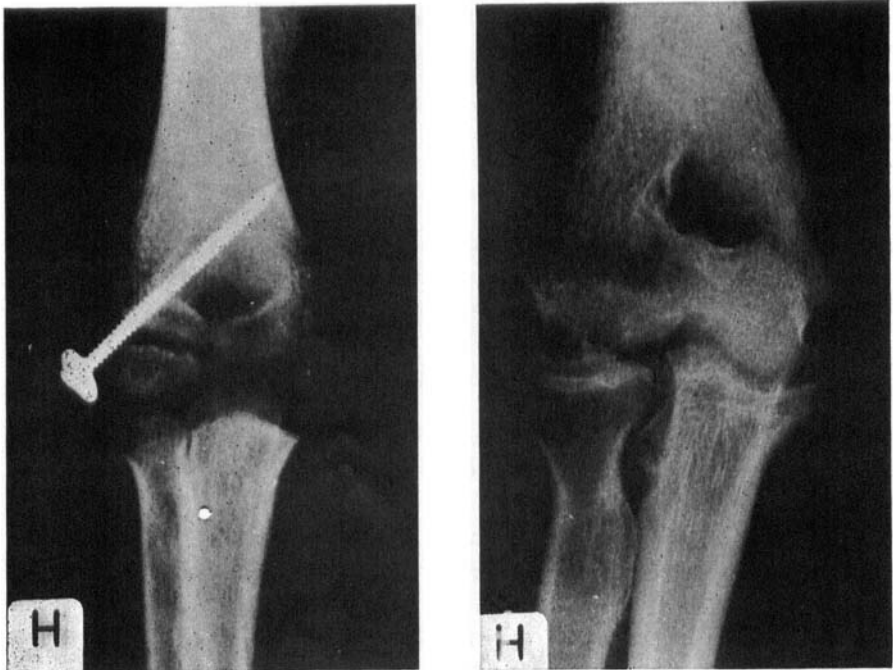


Figure 5. Right-side fracture of the condyle, reduced to a good position and fixed by a screw which just passes the epiphyseal line. Twelve years later osteoarthritis developed because of healed osteochondritis dissecans in the capitulum of the humerus.

most marked when the capitulum had united in rotary deformity and in cases with overgrowth of the lateral condyle (Figure 3).

The end results were assessed according to a modification of Hardacre et al.'s (1971) classification:

24 were good, i.e. without limitation of motion, without valgus or varus deformity, and without complaints.

12 were fair, i.e. $\leq 15^\circ$ extension or flexion defect or $\leq 10^\circ$ valgus or varus deformity, no signs of osteoarthritis, no neurological symptoms, and no pain.

3 were poor, i.e. $> 15^\circ$ extension or flexion defect or $> 10^\circ$ valgus or varus deformity or osteoarthritis, or ulnar neuritis or non-union or avascular necrosis of the capitulum or pain.

The 3 poor results will be described in greater detail:

Case 1: A 9-year-old boy with a severely displaced fracture and dislocation of the elbow was treated by closed reduction of the fracture as well as the dislocation. Owing to secondary displacement of the fracture, operation was performed 8 days after the accident, and a good reduction was obtained. At follow-up 10 years later there was ossifying myositis on the anterior aspect of the elbow joint and a flexion defect of 55° .

Case 2: A 10-year-old boy with a severely displaced fracture was treated on the 6th day by open reduction and osteosynthesis using a screw. Six years later radiography of the elbow showed osteochondritis dissecans in the capitulum of the humerus. At follow-up 12 years later the osteochondritis had healed, but distinct arthritic changes were found in the joint (Figure 5). The patient had no pain, but an extension defect of 20° .

Case 3: A 9-year-old boy with a severely displaced fracture was treated by closed reduction with a fair result. 17 years later follow-up showed non-union, an extension defect of 25° , and a valgus deformity of 15° .

DISCUSSION

As was found by Hardacre et al. (1971), really non-displaced fractures of the lateral humeral condyle were far less common in this material than displaced ones.

Fractures showing slight rotary displacement can no doubt be treated conservatively as with non-displaced or only slightly displaced fractures. However, this involves the risk of secondary displacement and non-union, and as a rule it is better to perform open reduction and osteosynthesis primarily, as a delayed operation may be difficult and may entail complications (Speed & Macey 1933, Blount 1955).

In Salter & Harris' classification of epiphyseal injuries in children, fracture of the lateral condyle of the humerus is a classic example of

the serious type IV injury (Salter & Harris 1963), and it is generally assumed that mal-union often entails inhibition of growth in the lateral epiphysis and thereby a progressive cubitus valgus (Speed & Macey 1933, Wilson 1936, Jeffery 1958, Salter & Harris 1963). In the present material, however, premature closure of the lateral epiphyseal line, like the "fish-tail deformity", occurred not only in cases that united with deformity, but equally often in cases where the fracture united in a good position. Like Wadsworth (1964), the present authors do not believe that a good result of reduction and solid fixation affords any guarantee against these disturbances of growth. On the other hand, we have encountered only a few, and clinically rather unimportant, cases of cubitus valgus in connection with premature epiphysiodesis of the capitulum and fish-tail deformity. Overgrowth radially in the elbow joint has been described by Blount (1955) as a consequence of delayed open reduction, whereas Hardacre et al. (1971) found overgrowth to be in most cases a consequence of delayed union. In our series overgrowth of the radial and humeral heads occurred in the majority of severely displaced fractures, regardless of the treatment. Correspondingly, a mild varus deformity of the elbow was recorded more than twice as often as a valgus deformity.

SUMMARY

Thirty-nine fractures of the lateral condyle of the humerus were examined at follow-up an average of 7.5 years after primary treatment. It is suggested that condylar fractures showing more than 2 mm lateral displacement and/or external rotation of the capitulum be interpreted as unstable fractures and therefore treated by operation. Ten stable fractures were treated conservatively with good results. Among 15 unstable fractures which were treated primarily without operation, 2 became re-displaced and one ended in non-union. Disturbances of growth in the elbow occurred independently of the treatment and the result of the reduction, but did not entail major deformities of the elbow.

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