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DISPLACED SUPRACONDYLAR FRACTURES OF THE HUMERUS IN CHILDREN

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In a 3-year period, 101 children were admitted to hospital with supracondylar fractures of the humerus. Eighty-six were examined an average of 3.7 years after the injury.

Forty-seven cases were treated with closed reduction and plaster bandage. After an unsuccessful attempt at closed reduction, 39 cases were treated with percutaneous K-wire pinning and plaster.

The cases treated with percutaneous pinning thus include the most severe fractures. Nevertheless, the results at follow-up in these cases easily equalled those obtained by closed reduction of the less displaced fractures. They were also comparable with reported results of extension treatment and, in contrast, required only a few days of hospitalisation.

Key words: children; humeral supracondylar fractures; percutaneous fracture fixation

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For years the management of supracondylar fractures of the humerus in children has been debated. Fractures without displacement cause no difficulty as nearly all heal successfully after 3–4 weeks in plaster. In displaced fractures some authors have recommended reduction and plaster (Jensenius 1948), whereas others prefer traction by means of a screw or a Kirschner wire in the olecranon (D'Ambrosia 1972, Dodge 1972, Dunlop 1939, Lund-Kristensen & Vibild 1976). In the last few years osteosynthesis has gradually become more popular (Alonso-Llames 1972, Danielson & Pettersson 1980, Krebs 1980). In the Department of Orthopedic Surgery T-2, Gentofte Hospital, displaced supracondylar fractures of the humerus in children were treated with reduction and plaster fixation when it was possible to obtain a good position and stability. If this was not the case, internal fixation by means of two crossing Kirschner wires was applied percutaneously.

PATIENTS AND METHODS

In the period 1971–1974, 101 children were admitted and treated for displaced supracondylar fractures of the humerus. Eighty-six attended the follow-up examination 2–6 years (average 3.7 years) after admission. Of the remaining 15 patients, 7 had emigrated, 7 could not be traced, and one had died. There was 59 boys and 27 girls, aged 2–15 years (average 6.6 years) at the time of the accident. The left humerus was fractured in 54 cases, the right in 32. All were extension type fractures.

Non-displaced supracondylar fractures of the humerus, which were primarily treated with immobilisation on an outpatient basis, were excluded from this study. Only patients requiring general anaesthesia for the reduction of the fracture were admitted to hospital, and thus only these patients were selected for this study.

The fractures were classified according to Holmberg (1945) as shown in Table 1.

At first, closed reduction under general anaesthesia, with the aid of an image-intensifier, was tried. If satisfactory reduction and stability were obtained in this manner the fracture was immobilized in plaster with the elbow in 90–100 degrees of flexion.

If a stable reduction could not be obtained after two or three attempts, internal fixation was performed, and

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Table 1. Eighty-six dislocated supracondylar fractures of the humerus grouped according to Holmberg's classification and the method of treatment

		Patients treated by closed reduction	Patients treated by operative pinning
Grade 1:	minimal dislocation	10	0
Grade 2:	some dislocation, but without rotation	21	2
Grade 3:	some dislocation including rotatory deformity	6	5
Grade 4:	total dislocation without contact between the fragments	10	32
		47	39

the fracture was pinned with two Kirschner wires applied through the skin at the medial and lateral epicondyles of the humerus. The pins thus crossed each other and preferably made contact with the opposite compacta (Figures 1a, b and 2a, b). After verification of the reduction by X-ray examination and if the condition of the hand and fingers was satisfactory, the patients were discharged from hospital. In the beginning of the period the cast and wires were removed in hospital after 5 weeks – later on this was done in the outpatient clinic after 3 weeks. The patients stayed 4.4 (2–12) days in hospital for the initial treatment and 3.0 (1–6) days on the second occasion.

On admission the radial pulse was not palpable in 5 patients. After reduction with or without internal fixation the pulse became palpable in 4, whereas the fifth patient required operative exploration of the brachial artery. No lesions of the artery were found and the pulsation became normal after the operation. In 3 patients signs of slight affection of the ulnar or median nerve were observed, but these symptoms regressed fully without special treatment within 3 days, 4 weeks and 1 year, respectively. Affections of nerves and arteries were all found in patients with grade 4 fractures according to Holmberg's classification (1945). No persistent complications, no infections and no injury to nerves were caused by the pinning.

Table 2. Results of treatment of supracondylar fractures of the humerus according to Dodge (1972). All angles are indicated as the difference between the normal and the fractured elbow

Excellent:	0–5°	change of the carrying angle
	≤10°	and/or restriction of motion
Good:	6–15°	change of the carrying angle
	11–20°	and/or restriction of motion
Poor:	>16°	change of the carrying angle
	>20°	and/or restriction of motion

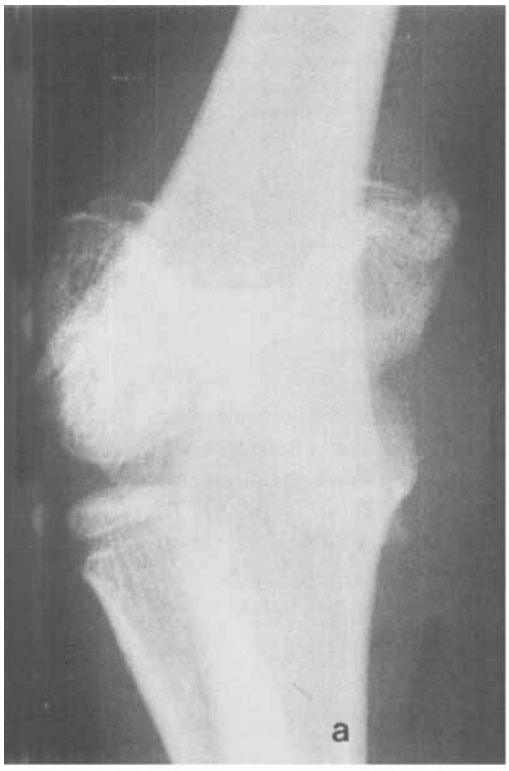
For the evaluation of the final results of treatment the criteria suggested by Dodge (1972) have been used. These are listed in Table 2.

RESULTS

In Table 1 the fractures are graded according to the system introduced by Holmberg (1945). It is obvious that most of the cases treated by operation belong to the most dislocated fractures.

Table 3. Mobility and position of the fractured elbow in 47 patients treated non-operatively. All angles indicate the difference between the fractured and the normal side at the follow-up examination

	No. of patients	Average defect in degrees	Range
Limitation of flexion	28	11.5	(5–25)
Limitation of extension	2	5.0	(5–5)
Hyperextension	14	10.5	(5–20)
Angular deviation in varus	24	13.5	(4–32)
Angular deviation in valgus	8	7.4	(2–14)
Defect in rotation	1		
Normal	3		



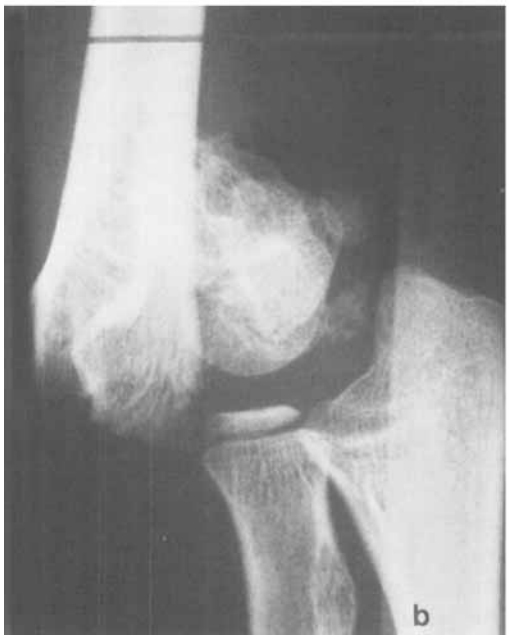
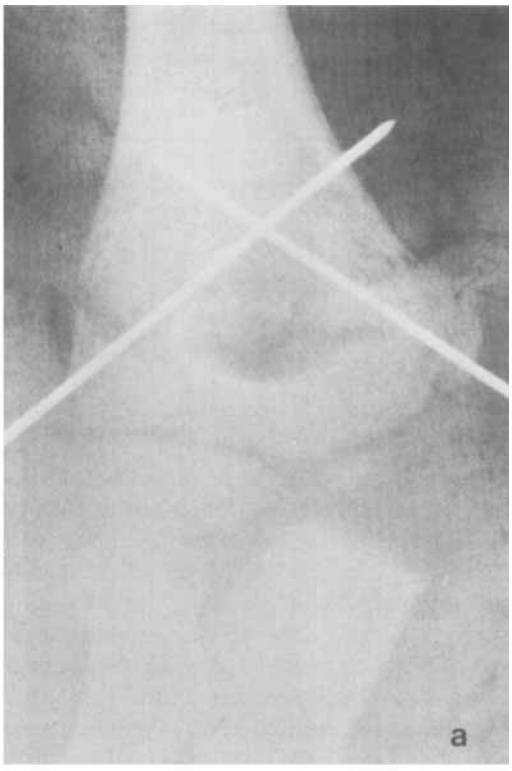


Figure 1a, b. A grade 4 supracondylar fracture of the humerus.



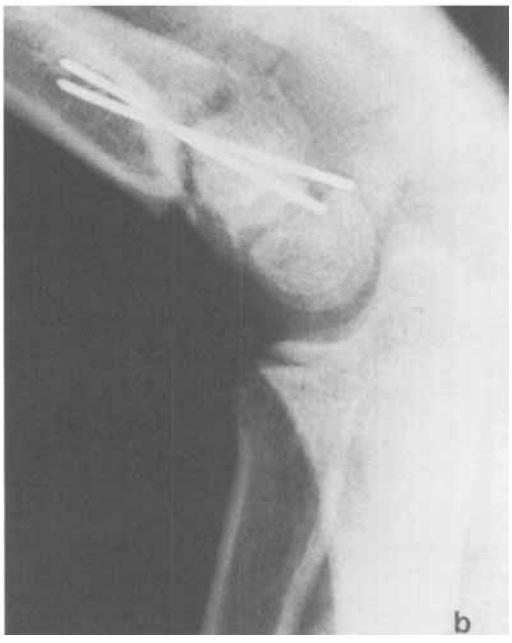


Figure 2a, b. The same elbow after reduction and fixation with two K-wires applied percutaneously.

Table 4. Mobility and position of the fractured elbow in 39 patients treated by operative means. All angles indicate the difference between the fractured and the normal side at the follow-up examination

	No. of patients	Average defect in degrees	Range
Limitation of flexion	16	7.8	(5–15)
Limitation of extension	5	11.0	(5–25)
Hyperextension	4	12.5	(5–20)
Angular deviation in varus	27	10.2	(2–32)
Angular deviation in valgus	6	5.0	(2–10)
Defect in rotation	0		
Normal	5		

Table 3 illustrates the mobility and angulation of the elbow in the 47 non-operated cases. Only 3 cases revealed a full range of motion together with a normal carrying angle of the elbow. Twenty-eight elbows had an average limitation of flexion of 11 degrees. Only 2 cases had an insignificant limitation of extension, but 14 showed hyperextension of about 10 degrees. Angular deviation was most common in varus, with 24 cases having an average reduction of the normal angle of 13.5 degrees, but only in 16 of these cases did it result in a true cubitus varus – in the remaining 8 cases a small varus deviation was found. In one patient we found a pronation defect of 45 degrees and an extra supination of 30 degrees.

Table 4 presents the results of the 39 operated cases. In this group 5 elbows showed a normal range of motion and a normal carrying angle. Sixteen patients had a minor limitation of flexion – averaging 8 degrees. Twenty-seven patients showed an angular deviation in varus with an average reduction of 10 degrees but only in 13 cases did it result in a true cubitus varus – in the remaining 14 cases a smaller varus deviation was found. No patient in the operative group had a rotation defect.

As shown in Table 5 the results were excellent or good in 85 per cent of the operative and in 78 per cent of the non-operative cases.

Table 5. Final results in the two groups according to Dodge's criteria

	47 patients with closed reduction		39 patients with percutaneous pinning	
	No. of patients	per cent	No. of patients	per cent
Excellent:	18	38	16	41
Good:	19	40	17	44
Poor:	10	22	6	15
	47	100	39	100

DISCUSSION

In the follow-up examination special attention was paid to varus angulation. Comparison was made with the contralateral elbow, where the valgus angulation was 0–14° (average 8°), and thus a moderate varus angulation does not necessarily result in true cubitus varus, but only in a reduction of the anatomical valgus angle. This was the case in 14 of the 39 operatively treated cases and in 8 of the 47 patients not requiring operation.

As shown by Smith (1960) cubitus varus is due to poor reduction or poor fixation of the distal fragment, which will then heal with medial rotation and varus angulation. Cubitus varus is seldom due to disturbances in growth. The displacement is usually not observed before normal motion of the elbow is achieved and the angulation does not progress during continued growth (Dowd & Hopcroft 1979). In this series the growth of the physis was not disturbed by the pinning. Even though the patients with cubitus varus were annoyed because of the visible deformity, no one complained of poor function. Though the operative group (Table 1) consisted mainly of severely displaced Grade 4 fractures,

the final result was fully equal to that in the non-operative group of less dislocated fractures.

The results of treatment in the present series were comparable with those of other methods. Thus Siris (1939) found 70 per cent and El-Sharkawi & Fattali (1965) found 85 per cent excellent and good results after reduction and plaster fixation, whereas Lund-Kristensen & Vibild (1976) found 67 per cent excellent and good results after traction treatment requiring 3–4 weeks of hospitalisation. Others have achieved results as good as 80–90 per cent excellent and good by traction treatment (Dodge 1972), but this treatment requires 3 to 4 weeks hospitalisation whereas our patients only stayed an average of 7 days in hospital, and this was divided into two periods. The method described is, in contrast to open reduction and osteosynthesis, rather simple and we have found the risk of injuring the ulnar nerve to be minimal. However, Gjerløff & Søbjerg (1978) described one case of partial transection of the nerve by the K-wire and therefore recommended percutaneous lateral pinning only. No serious complications have occurred in the present series.

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