

SUPRACONDYLAR FRACTURES OF THE HUMERUS IN CHILDREN

A Follow-up with Particular Reference to Late Results after Severely Displaced Fractures

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A follow-up of 73 cases out of a 10-year material of 90 children with supracondylar fractures of the humerus is described. Forty-three children had fractures with gross displacement, whereas 30 children had undisplaced or slightly displaced fractures. This last group all achieved excellent results after simple conservative treatment. Twenty-three cases among the group with severe displacement were treated with vertical extension, 17 cases with one or more attempts at manipulative reduction and plaster fixation, and three with operation using Kirschner wires. The functional results were approximately the same in the first two groups and were satisfactory in 85–100 per cent. The results with varus deformity were better in the group treated by extension (82 per cent as opposed to 50 per cent in the group treated by manual reposition). We conclude that extension in a vertical direction is the most suitable method of treatment of these often severely displaced fractures.

Key words: humerus; supracondylar fracture; overhead traction

Accepted 15.iv.76

The management of undislocated or slightly dislocated supracondylar fractures of the humerus seldom gives rise to difficulty, whereas severely dislocated fractures give great problems and often leave the surgeon undecided as to the best treatment.

Since Jensenius (1948) followed up the results in 75 children with supracondylar fractures (s.c.f.) treated non-operatively and concluded that a better technique of reposition was desirable, various other methods have become commonplace. This department has treated a relatively large number of children with s.c.f. over a 10

year period. Since a method of vertical extension, instead of repeated reposition and plaster fixation, has been used with increasing frequency, follow-up of these cases has been found to be of value.

MATERIAL AND METHODS

During the years 1962–1971, 90 children with s.c.f. were admitted to this hospital. Age and sex are shown in Figure 1, and are similar to the proportions in other series.

Retrospectively, the fractures have been classified as described by Holmberg (1945). Grade 1 comprises undislocated fractures, grade 2 fractures with slight lateral displacement, grade 3 fractures with rotational displacement, and

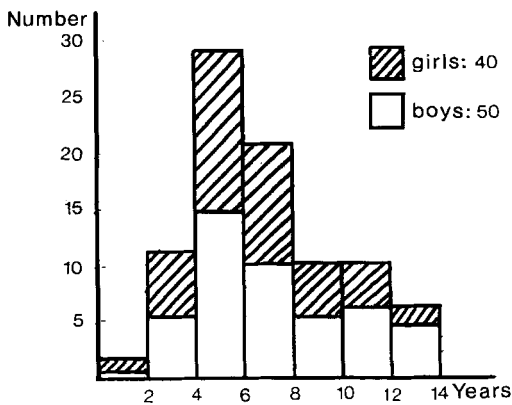


Figure 1. Age and sex distribution in 90 children admitted with supracondylar fractures.

grade 4 fractures with gross displacement without contact between the fragments.

Forty children had undisplaced or slightly laterally displaced fractures (grades 1 and 2). These were treated by plaster splints, in some

cases after reduction. The remaining 50 children had various degrees of rotational deformity, most of them (45/50) with additional complete lateral displacement without bony contact (grades 3 and 4). All were of the extension-fracture type.

Twenty-six children were treated by so-called overhead traction with the aid of a Kirschner wire through the olecranon. Reposition was performed under full anaesthesia in all cases; if a satisfactory position could not be maintained by plaster fixation with the elbow in 70° flexion, traction by a Kirschner wire through the olecranon was performed immediately. The skin was disinfected with 5 per cent iodine, and the wire introduced through a small incision on the ulnar side. The arm was positioned over the patient's neck and head, so that the hand pointed towards the top corner on the opposite side of the bed. Soft tissue traction on the upper arm was used as counter traction (Figure 2). After X-ray control on the following day, any necessary alterations in the traction could be made, and a lateral displacement could be corrected by careful pressure without discomfort to the patient. The aim of the traction was to obtain



Figure 2. Position of an arm with s.c.f. treated with overhead traction. Traction is by a Kirschner wire through the olecranon. Counter-traction applied to the upper arm. The arm is pointing towards the top corner on the opposite side of the bed with the aid of soft tissue traction.

Table 1. Varus deformity measured radiologically at the proximal humero-ulnar angle in 41 children with grade 3 and 4 supracondylar fractures.

Difference in proximal humero-ulnar angle on the two sides	Fractures treated by vertical extension	Fractures treated by reduction and plaster fixation	Internal fixation
0- 5°	14	6	3
6-10°	4	2	
11-15°	1	6	
over 15°	3	2	
Total	22	16	3

as exact a correction of angular deformity and rotation as possible, particularly with reference to the profile views, from which it could be judged whether or not the anterior cortical edges were continuous with each other. These objectives seem to be achieved, as no patients treated by traction were later treated by other methods because of unsatisfactory reduction. In 19 cases traction was applied on the day of injury, whereas seven cases began with this treatment after a delay of 3-7 days, among them five children transferred from other departments because of unsatisfactory reduction. Traction was maintained for 2-3 weeks, depending on the radiological and clinical signs of union, and was followed by a dorsal plaster slab for another 2 weeks, after which mobilisation with active movements was begun.

Twenty-four children were treated by reduction and a plaster slab for 5 weeks, among these 24 was the only child in this series with an open fracture. Three of these children were later treated by internal fixation after the failure of conservative treatment. Two cases were operated upon because of suspected arterial compression, but in both cases only a fasciotomy was performed. Both were then treated by extension. In the group treated by

plaster fixation, neurolyses of the ulnar nerve was carried out in one case 3 weeks after the accident because of diminished nerve function.

Seven of the children treated by extension had signs of superficial infection; because of this three of these cases continued treatment with plaster fixation (on the 12th, 14th and 17th day). There were no cases of deeper infection or osteitis.

Signs of ulnar irritation from the Kirschner wire were present in four cases (two with paraesthesia and two with hyperaesthesia). One of these cases was subsequently treated by plaster splint. There were no cases of Volkmann's contracture.

FOLLOW-UP

Seventy patients were assessed clinically and radiologically after an interval of between 1 to 10 years (an average of 7 years 3 months). In three cases we received only the answer to a questionnaire, whereas 17 patients did not reply either to the outpatient appointment or to the questionnaire. Among the 40 children in

Table 2. Flexion in the elbow in 43 children after supracondylar fractures.

Movement	Fractures treated by vertical extension	Fractures treated by reduction and plaster fixation	Internal fixation
Normal flexion	16	14	1
5-10° lack of flexion	4	2	2
Over 10° lack of flexion	3	1	0
Total	23	17	3

Table 3. Extension in the elbow in 43 children after supracondylar fractures.

Movement	Fractures treated by vertical extension	Fractures treated by reduction and plaster extension	Internal fixation
Normal extension	19	15	1
5-10° lack of extension	3	2	0
Over 10° lack of extension	1	0	2
Total	23	17	3

groups 1 and 2, 30 were examined and the results in all cases were normal anatomically and functionally.

In the group of 50 children with fractures, primarily in groups 3 and 4, 43 were reviewed and of these 41 were X-rayed.

Table 1 shows the results with reference to varus deformity, which was more than 10° in four children treated by extension, and in eight children treated by reposition and plaster. Results in this respect could be described as excellent or good in 82 per cent (18/22) and 50 per cent (8/16), respectively.

Tables 2 and 3 show the final flexion-extension movements. Here the results are approximately the same, with 87 per cent (20/23) and 94 per cent (16/17), respectively, excellent or good results for flexion, and 96 per cent (22/23) and 100 per cent (17/17) for extension.

Pronation-supination was normal in all cases, with the exception of two of the three children treated by osteosynthesis. Myositis ossificans developed in only one child, and it was treated by osteosynthesis. Six children complained in the questionnaire of reduced arm strength, and five of these had been treated by traction. Five children, all belonging to the group treated by plaster fixation, complained of tenderness localised to the ulnar nerve, and two of these had paraesthesia in the ulnar distribution of the hand.

DISCUSSION

As in other series (Holmberg 1945, Hammond 1952, Høyer 1952, Smith 1960) our follow-up of 73 children with s.c.f. shows that the functional result is satisfactory in almost all cases, including cases with gross displacement, of which there were 50 in this series. On the other hand, both in our series and in other published articles there are a certain number of cosmetically poor results, almost all of them due to alteration in the bearing angle of the arm with resulting varus deformity (gunstock deformity). The incidence of this is given as between 9 and 57 per cent (Høyer 1952). In our series this deformity was seen in 12 of the 43 children with serious fractures (28 per cent).

Smith (1960) has argued convincingly that this varus deformity can develop only as the result of the distal fragment tipping sideways compared to the humeral shaft; neither rotation nor lateral deformity, but the combination of an oblique fracture line and muscle pull can lead to secondary tilting. As a result of this, treatment with continuous traction must be particularly suitable in preventing varus deformity; this is supported by other authors (Andersen & Jacobsen 1967, Bakalim & Wirppula 1972) and seems to be confirmed by our results.

Many modifications of extension treatment have been described. Supporters of the so-called side traction (Maylahn &

Fahey 1958, Bates & Taylor 1971) consider this an easy method for the patient, in that it gives sufficient elevation and at the same time a possibility for controlling the forearm, and therefore the rotation of the distal humeral fragments (Windfeld 1948, Madsen 1955, El Sharkawi & Fattah 1965). Madsen (1955), for instance, has emphasised the significance of reduction with lateral traction and simultaneous lateral rotation of the arm, followed by plaster fixation in the "hurrah position". The majority of authors, however, are supporters of traction in a vertical direction (Baumann 1931, Hammond 1952, Smith 1960, Edmann & Löhr 1963, Shubert & Forberger 1971, D'Ambrosia 1972). D'Ambrosia (1972) has found from cadaveric experiments that flexion of the forearm in pronation contributes to the prevention of varus deformity, and that rotating the hand over the head corrects the rotational deformity. Another advantage of vertical extension is the simultaneous treatment of the frequently massive oedema, and there is easy access for clinical observation, X-ray control and, if necessary, adjustment of the extension. The disadvantage is the length of time in bed and the period in the hospital, and the risk of infection and damage to the ulnar nerve, which must not be forgotten.

According to Smith (1960) the infection rate can be reduced by the use of a Kirschner wire with a screw thread, which does not move in the bony canal in the ulna. These difficulties are presumably the reason why conservative treatment is still the most popular method.

The simplest and possibly the best method is Charnley's (1968) collar-and-cuff, where the arm is fixed with fully flexed elbow; as long as this position is maintained, the reduction is secure. The complications are partly the increase of oedema because of the hyperflexed elbow, and partly, that the bandage works loose, resulting in a new displacement at

the fracture site. The danger of redislocation is greater, if the elbow is simply immobilised at a right angle in a plaster cast, even though Böhler's (1938) technique is used with fixation in a position of maximal pronation.

Plaster fixation in greater flexion increases the danger of arterial dysfunction with the following risk of ischaemia of the forearm and hand. We consider that this risk also contraindicates the use of circular plasters in these fractures.

Lastly, open reduction with or without internal fixation is fairly frequent and Holmberg (1945) found 61 per cent good results after fixation with Rissler pins followed by plaster. Others emphasised the significance of so solid an internal fixation as to make plaster unnecessary (Haddad et al. 1970).

Carcasone et al. (1972) found up to 97.5 per cent satisfactory results in a series of 40 children treated by operation. They recommend an operative technique using an anterior approach through the already damaged brachialis muscle, thereby protecting the triceps brachii. In our series operation was only used in three cases, which does not permit any conclusion as to its viability in the treatment of these fractures.

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