

REDUCTION OF DISPLACED SUPRACONDYLAR FRACTURE OF THE HUMERUS IN CHILDREN BY MANIPULATION IN FLEXION

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Sixty-one children with posteriorly displaced supracondylar fractures of the humerus were treated by manipulation with the elbow flexed 40°–60°. This method proved to be safe, easy to apply and was followed by a high rate of success. The elbow was immobilized using a collar-and-cuff or a broad sling and binding of the arm to the forearm with zinc oxide adhesive plaster. In difficult children, the limb was put under the child's clothing to avoid its being used. Redisplacement occurred in only 8.2 per cent of the patients and in none of these was it severe enough to justify remanipulation.

Key words: supracondylar fracture; humerus

Accepted 5.x.77

Many different methods have been described for the treatment of displaced supracondylar fractures of the humerus in children. Similarly, methods of fixation vary widely. This paper reports a method for reduction and fixation which has proved easy to utilize, and is more reliable and safer than the other methods described.

MATERIAL

Sixty-one children with posteriorly displaced supracondylar fracture of the humerus (Grade III fractures in which there is no contact between the fragments) were treated by the author and followed up during the period from 1970 to 1976. There were 43 boys and 15 girls. Their ages ranged from 1.8 to 15 years. Treatment was carried out 3 to 48 hours from the time of injury. In seven patients, previous attempts at reduction had been made, and in four of these reduction was tried more than once. In six patients the elbow region was grossly swollen.

Associated injuries included:

- i) *Skin and soft tissues:* Bruising on the medial side of the elbow was present in 42 patients

(68.9 per cent). In 18 of these (42.9 per cent) the skin was perforated by the sharp lower end of the proximal fragment.

- ii) *Vascular injuries:* One patient presented with a cyanotic hand and forearm (1.6 per cent). In 15 patients (24.6 per cent) the radial pulse was not palpable but there was normal capillary circulation in the nail beds.
- iii) *Nerve injuries:* Six patients (9.8 per cent) had nerve injuries. Two of them showed median nerve compression and in four the radial nerve was involved.

METHODS

Method of reduction

Reduction was carried out under general anaesthesia as soon as the child was considered to be fit. Traction was applied to the forearm, with the elbow flexed 40°–60°, against counter traction from the axilla (Figure 1). This was continued until the upward displacement was corrected. Lateral displacement was then corrected by lateral pressure between the thumb and fingers of one of the operator's hands, the other hand maintaining traction (Figure 2). With traction still maintained, the posterior displacement was corrected next. The

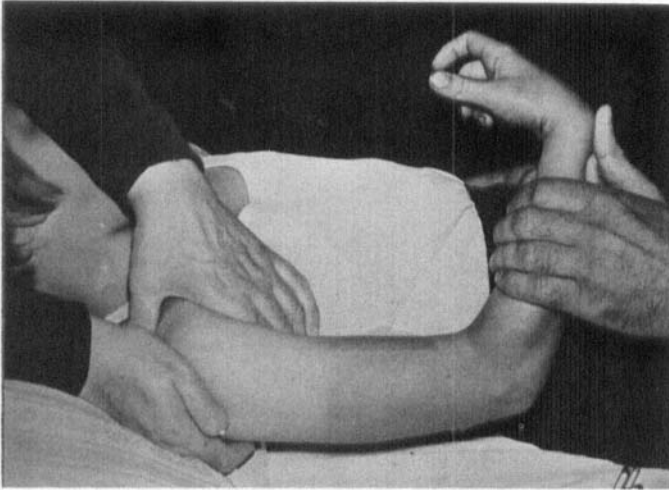


Figure 1. First step in manipulation: reduction of the upward displacement.

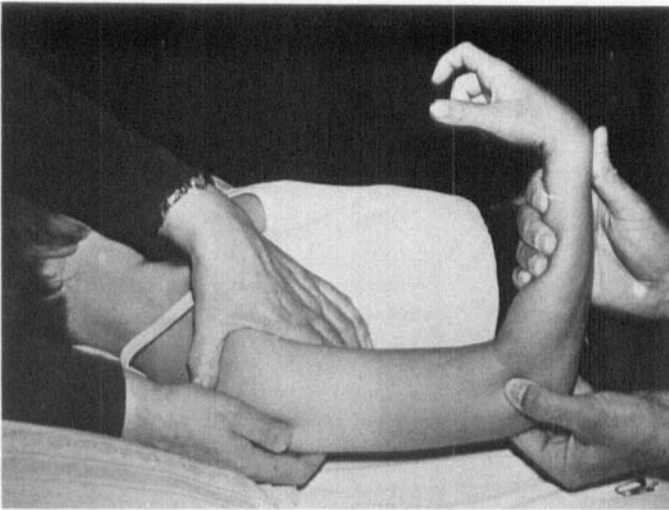


Figure 2. Second step in manipulation: reduction of lateral displacement.

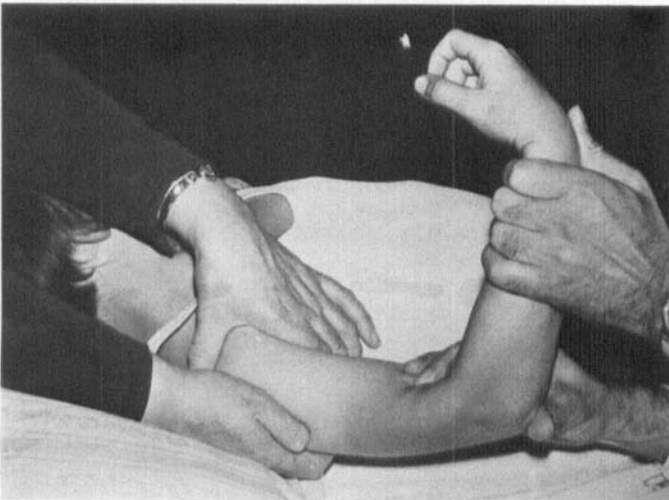


Figure 3. Third step in manipulation: reduction of posterior displacement.

thumb of the surgeon's manipulating hand was placed behind the olecranon, pushing it and the distal fragment anteriorly, while the fingers of the same hand pushed the front of the proximal fragment posteriorly (Figure 3). At this stage, rotational displacement should have been corrected by the tenseness of the tissues around the fracture (Charnley 1968). If this had not occurred, the distal fragment was rotated externally until the epicondyles were re-aligned with the epicondylar ridges of the proximal fragment (McLaughlin & Stimson 1959). Following the above steps, and in the presence of clinical evidence that the fracture had been reduced, the elbow was flexed as far as possible without obliteration of the radial pulse, usually to 120°.

During the initial stages of reduction, traction was carried out with the forearm in pronation (Wainwright 1962). Towards the end of manipulation and before flexing the elbow, the forearm was abducted on the arm and brought into supination (Blount 1955).

In four patients (6.4 per cent), three of whom had had manipulations twice previously, swelling of the elbow rendered immediate reduction impossible. Skin traction and elevation was applied for 48 hours after which reasonable reduction was achieved by manipulation.

Assessment of reduction

Clinically the fracture was considered reduced when:

- a) The concavity seen on the posterior aspect of the elbow before reduction had disappeared.
- b) The elbow could be flexed to greater than a right angle without obliteration of the radial pulse.
- c) The "point" of the elbow was felt to lie in the line of the long axis of the humerus or even in front of it.
- d) The epicondyles on the distal fragment were re-aligned with epicondylar ridges on the proximal one.

Radiologically the fracture was considered reduced when all elements of displacement were corrected both in the anteroposterior (axial infero-superior - Clarke 1964) and lateral views (Figure 4a and b).

Assessment of the carrying angle

Clinically the carrying angle was considered restored when:

- a) The epicondyles were re-aligned with the epicondylar ridges of the proximal fragment.

- b) The relation between the three bony prominences of the elbow, to the long axis of the humerus, as seen from behind with the elbow flexed, was comparable to that on the normal side ("The visual method of Smith" 1960). This indicates the position of the distal fragment in relation to the proximal one.

Radiologically, the carrying angle is restored when the cortices of the two fragments are continuous with each other in the absence of any rotation or angulation of the distal fragment.

Fixation

Reduction was maintained by zinc oxide adhesive plaster, binding the flexed forearm to the arm just above the elbow. A collar-and-cuff holds the elbow in the optimum position of flexion (Figure 5). The limb was then placed under the clothes to prevent the child from using his arm. This was continued for about 3 weeks. Flexion of the elbow was increased on the second or third day in patients who presented initially with grossly swollen elbows.

RESULTS

Assessment of results

The follow-up period ranged from 8 months to 6 years, the average time being 39 months.

- a) *Clinically* - on completion of follow-up.
 - i) Excellent: Normal appearance and function of the elbow joint with up to 5° change in the carrying angle and 5° limitation of extension.
 - ii) Good: Change in the carrying angle of up to 5-10° but not beyond cubitus rectus, and up to 5-15° limitation of extension.
 - iii) Poor: Any alteration in shape or function of the elbow greater than the above limits.
- b) *Radiologically* - post-reduction X-rays.
 - i) Excellent: Correct anatomical alignment with no visible displacement.
 - ii) Good: No more than 3-4 mm lateral or posterior displacement, but with normal alignment.
 - iii) Poor: Any rotation or angulation deformity persisting even if slight.

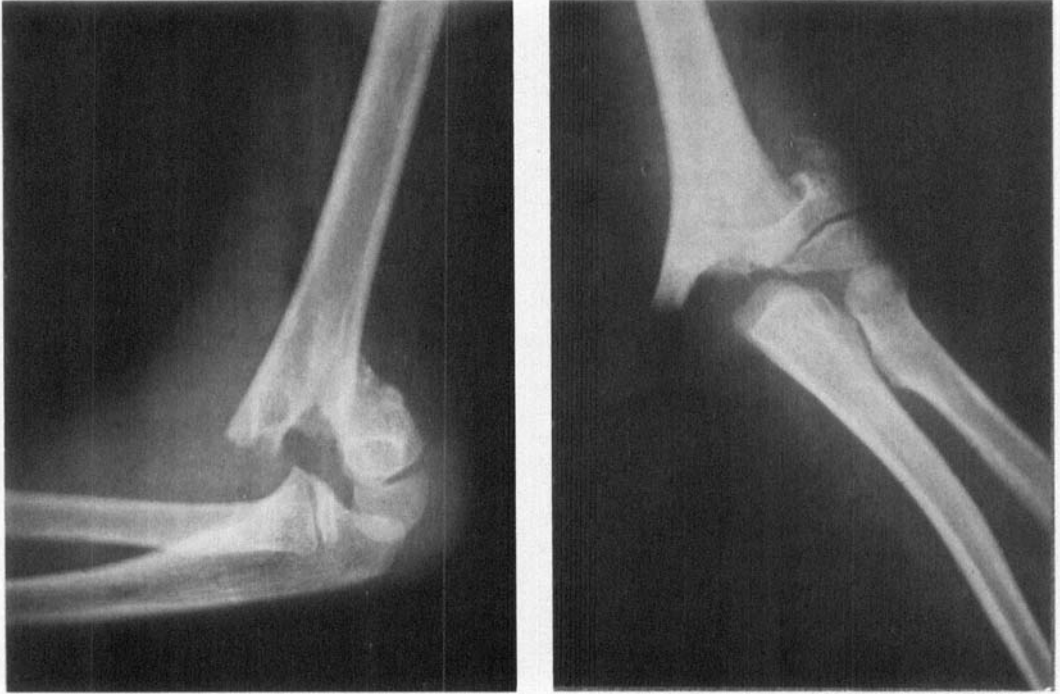


Figure 4a. Pre-reduction X-rays, lateral and a-p views.



Figure 4b. Example of excellent reduction, lateral and a-p views.



Figure 5. Post-reduction fixation. Note the edge of the adhesive plaster has been partially divided.

Clinical results

The results after the most recent follow-up examination were excellent in 45 patients (73.8 per cent), good in 11 (18 per cent) and poor in 5 (8.2 per cent).

All the vascular complications seen on the first examination improved and no ischaemic contracture resulted.

The neurological complications recovered except in one patient where a pointing index finger deformity persisted.

Five patients developed sepsis at the site of puncture of the skin by the lower end of the proximal fragment. Two of these patients developed osteitis at the fracture site.

Radiological results

At the time of the post-reduction X-ray examination, there were excellent radiological results in 40 patients (65.7 per cent), good in 12 (19.7 per cent) and poor in 9 (14.6 per cent).

Redisplacement occurred in five patients (8.2 per cent) on the fourth or fifth day after reduction but was not sufficiently severe to justify remanipulation.

The poor results

a) *Clinically*: Two patients developed osteitis at the fracture site and ended up with an ankylosed elbow joint. In the three other patients, the fracture had been manipulated more than once previously. Varying degrees of cubitus varus were present. One of these patients showed also hyperextension of the elbow due to uncorrected posterior displacement of the distal fragment. In addition, one patient showed limitation of both flexion and extension of the elbow; the possible range of movement being 40°–110°. One other patient showed limitation of the last 30° of extension.

b) *Radiologically*: Of the nine poor results encountered, four had had previous attempts at reduction. They presented grossly swollen elbows. In two more patients, the swelling was so severe that flexion of the elbow to greater than a right angle was not possible and redisplacement occurred. In the remaining three patients, reduction was unstable, although swelling was not marked and residual displacement had to be accepted.

DISCUSSION

In the treatment of any fracture, the objective is reduction into an anatomically acceptable and stable position without inflicting additional trauma. In addition the method of reduction recommended should if possible be easy to apply and should not require prolonged stay in hospital. In the treatment of supracondylar fracture of the humerus in children, closed manipulative reduction has been preferred to the other methods described in the literature. Skin traction (Dunlop 1939) is

often inconvenient to the patient. It may be difficult to apply in young children (Conwell & Reynolds 1961) and may result in distraction or over-riding with the resultant dangers (Staples 1959). Skeletal traction (Hart 1942) has the danger of infection of the pin tract, possible damage to the ulnar nerve (Wainwright 1962), and distraction at the fracture site (Staples & Hanover 1958). Open reduction may be complicated by infection and the incidence of joint stiffness is definitely higher than with other methods (Hammond 1952). In addition, these methods require a relatively longer stay in hospital than is necessary after closed manipulative reduction.

The technique of closed manipulative reduction described by other authors consists of traction on the injured limb from the wrist against counter-traction from the axilla (Blount 1955) with the elbow straight (Charnley 1968). Sharrard (1971) advised traction with the elbow slightly hyperextended. This however, proved to be unsafe as it was followed on occasions by rupture of the median nerve and injury to the brachial artery (Bristow 1923, Platt 1928) by the sharp edge of the distal end of the proximal fragment (Griffiths 1968). These disadvantages are obviated if manipulation is carried out with the elbow flexed 40° – 60° . This technique has other advantages also. Reduction of the posterior displacement is easier by this method as the posterior structures ("the posterior hinge") only are tightened. The tissues in front of the elbow remain lax and give way in front of the distal fragment whilst it is moulded forward by the tightening posterior hinge. It allows maximum traction to be effected at the site of the fracture without subjecting the neurovascular bundle to overstretching. Unlike manipulation in extension, during which the surgeon has to lean backward to effect maximum pull, he leans forward during manipulation in flexion. This enables him to maintain traction with one hand whilst manipulating the fracture with the other hand; thus the need for a second assistant is obviated.

Immobilization is carried out with a collar-

and-cuff or broad sling with the elbow in the Jones' position. In this way the forearm is left exposed for observation of the radial pulse. It is also more convenient than the other methods described in the literature. The application of zinc oxide adhesive plaster about the elbow (Figure 5) and putting the limb under the child's clothing are particularly useful in difficult children. As slight displacement occurred in only five patients (8.2 per cent), and did not require remanipulation, it is concluded that the method is safe and effective. Zinc oxide adhesive plaster when applied must not encircle the limb completely, and it is preferable to partially divide its upper edge to avoid cutting into the skin (Figure 5).

The use of the Jones' position has been blamed for inadequate assessment and restoration of the carrying angle. It is important to realize that the carrying angle is best restored and maintained by achieving accurate reduction. The impingement of the cortices of both fragments indicates and maintains reduction, and hence the carrying angle. Restoration of the carrying angle can be assessed with the elbow flexed when there is re-alignment of the epicondyles with the epicondylar ridges and by the Smith visual method (Smith 1960). The Jones' position also provides "the natural splint position" where the tightened posterior hinge moulds the condylar fragment in place and diminishes the possibility of redisplacement.

Conclusions

- 1) Manipulation of supracondylar fracture of the humerus by traction on the forearm with the elbow flexed 40° – 60° avoids stretching of the neurovascular bundle across the distal end of the proximal fragment. It also facilitates reduction.
- 2) The carrying angle is best restored and maintained by achieving accurate reduction. With the elbow flexed, it can be judged by the re-alignment of the epicondyles with the epicondylar ridges and the visual method described by Smith (1960).
- 3) A collar-and-cuff with the elbow in the

Jones' position provides an efficient and easy means of fixation of the reduced supracondylar fracture.

ACKNOWLEDGEMENT

Some of the illustrations contained in this article are published with the kind permission of the Egyptian Orthopaedic Journal to whom the author is grateful.

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