SUPRACONDYLAR OSTEOTOMY FOR CUBITUS VARUS
THE VALUE OF THE STRAIGHT ARM POSITION
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Supracondylar osteotomy for traumatic cubitus varus is usually considered to be difficult, and to have a significant incidence of complications. Most difficulty is in maintaining correction after operation.

We report 20 osteotomies performed by a modification of French's technique and managed postoperatively with the elbow extended. When a plaster splint was used only three of seven cases had good or satisfactory results, two requiring revision. Postoperative management by straight arm traction maintained correction and achieved a good or satisfactory result in all 13 cases. This new technique is recommended.

Cubitus varus is by far the most common complication of supracondylar fracture of the humerus in children. Reports as to its incidence following severely displaced fractures range from 4% (Piggot, Graham and McCoy 1986) to 58% (Hoyer 1952) with an average of around 30% (Smith 1960). Although functional impairment is rare, the deformity is significant; parents often request a corrective operation. Cubitus varus is now accepted to result from medial tilt of the distal fragment (Smith 1960; Langenskiöld and Kivilaakso 1967; Dowd and Hopcroft 1979). Earlier views that the cause was residual rotation (French 1959) or growth disturbance (Siris 1939; Holmberg 1945) have now largely been discounted. Despite the fact that most children's fractures show a remarkable capacity for remodelling, an established varus deformity does not improve with time.

Several corrective operations have been described. Siris (1939) advocated a cuneiform osteotomy, while King and Secor (1951) recommended a medially-based opening wedge held with pins and a clamp. French, in 1959, first described a lateral wedge osteotomy held with screws and a figure-of-eight wire, and this remains the most popular method of correction. More recently, a number of workers have reported the use of variations of French's osteotomy (Carlson and Rosman 1982; Bellemore et al. 1984) but some authors had an unacceptable incidence of residual varus (Alonso-Llames, Diaz Peletier and Moro Martin 1978; Oppenheim et al. 1984). Many of the authors who reported a significant incidence of residual varus had immobilised the elbow postoperatively in a flexed position. This causes difficulty, because the carrying angle of the elbow cannot be accurately assessed unless the elbow is fully extended and the forearm supinated (Rang 1974). An extended arm also allows better control of the carrying angle than is possible in flexion (Piggot et al. 1986). In addition, the dynamic effect of straight arm traction provides further stabilisation and permits the use of less extensive internal fixation. We report our experience of 20 corrective osteotomies, 13 of which were managed in straight arm traction after operation.

MATERIALS AND METHODS
From November 1980 until January 1987, 20 corrective osteotomies for cubitus varus were performed on 13 girls and five boys; two were repeat operations, one for loss of fixation, and one for residual varus. All but one of the patients had been treated in flexion for their original fractures.

The average age at the time of fracture was 5.9 years (range 2.5 to 12.7 years) and at the time of operation it was 10 years (range 5.2 to 14.9 years). Pre-operative varus deformity averaged 15.6° (range 5° to 27°). This was graded by severity: Grade I was loss of the physiological valgus angle; Grade II was 0° to 10° of varus; Grade III, 11° to 20° and Grade IV more than 20°. There were two Grade II deformities, 14 Grade III and three Grade IV (one repeat procedure was performed for loss of fixation and not for varus). The right elbow was involved in 11 cases, the left in seven.

Technique of operation. All osteotomies were performed by a modification of French's method (1959). The humerus is approached through a small lateral incision directly over the supracondylar ridge, which is exposed subperiosteally. The size of the wedge is determined from pre-operative radiographs, and two screws, preferably of the Sherman type, are inserted through one cortex only,
above and below the proposed wedge (Fig. 1). In several cases, where rotational deformity was an additional feature, correction was attempted by placing the screws in different positions in the sagittal plane. The wedge is cut with an oscillating saw, leaving the medial cortex intact (Fig. 2) to be "cracked", as a hinge, thereby approximating the screws (Fig. 3). The screws are then wired together in a figure-of-eight fashion. The wound is closed, with subcuticular suture for the skin. Considerable correction is possible (Fig. 4).

Postoperatively, the arm is maintained in the extended position for two weeks. For the first seven cases, a long arm backslab was used but, in the more recent 13 cases, straight arm traction has been more satisfactory. After release from traction, elbow flexion is rapidly regained (Fig. 5).

At review from three months to four years after operation the degree of correction, the range of flexion and extension and the appearance of the scar were assessed, while any other problems with the elbow were also recorded.

RESULTS

We considered a good result to be the restoration of physiological valgus with no loss of range of flexion or extension and an acceptable scar.

In the six patients treated entirely in plaster, the average pre-operative deformity was 17° (five Grade III, one Grade IV). Mean correction was to 1° varus and in only one case was physiological valgus restored. In four cases, the end result was a straight arm (cubitus rectus). In one of these, the operation had to be repeated because of loss of fixation. The sixth case in this group had relapse into varus and required a revision operation, after which management in traction gave a satisfactory outcome with the restoration of a normal valgus angle. One of the cases treated in plaster had scarring from a superficial wound infection and was considered to have a poor result on this basis. The postoperative range of flexion/extension was similar to the pre-operative, but mean recurvatum was decreased by 4°. On the criteria given above, only one patient in this group had a good result, two were satisfactory, having straight arms and three were poor (two had revision and one had a keloid scar).

In all, 13 patients were treated in traction, 12 immediately after the first operation and one after relapse in plaster and re-operation. The average pre-operative varus deformity was 14° (three Grade II, eight Grade III and two Grade IV). Mean correction was to 9° valgus (range 4° to 15°). The range of flexion/extension was increased on average by 5°, with a 9° reduction in recurvatum. In one case treated in traction, the figure-of-eight wire broke, but, without further operation and with maintenance of traction, a correction to 5° valgus was achieved. Ten of the patients in the traction group achieved a good result, and three had a satisfactory result. In two of these cases there was loss of more than 10° of flexion/extension, but one of these patients was assessed after only five months and further improvement could be expected. One patient had a florid scar but an otherwise good result. There were no poor results in the traction group. No nerve palsy was seen in either group and there were no other significant complications.

DISCUSSION

The high rate of complications reported in some series (Sweeney 1975; Oppenheim et al. 1984) deters many surgeons from operating to correct traumatic cubitus varus, and this reluctance is reinforced by the fact that it is performed for cosmetic reasons, and hardly ever to
position, the adequacy of the correction can be seen during operation and, if necessary, adjusted.

We believe that postoperative management is critical. As Rang (1974) maintains, the true carrying angle cannot be determined until the arm is fully extended and supinated. This makes postoperative management in the flexed position inadvisable. Initially, we believed that plaster would maintain an adequate correction, but found that considerable loss of correction was occurring, with four of our six cases relapsing to a neutral position, and one into a varus position which required re-operation. The weight of the plaster exerts a varus force, and seems to be a major factor in the loss of correction.

It is our policy to treat severely displaced fresh supracondylar fractures in straight lateral traction as originally described by Dunlop (1939), and our results have been very satisfactory (Piggot et al. 1986). Straight arm traction gives excellent control of the carrying angle and, when it is used after a corrective osteotomy, allows the use of less rigid internal fixation than would be required with the elbow in flexion. This, in turn, reduces the operative risks of nerve injury and infection.

When fresh fractures are treated in straight lateral traction, there is often a considerable delay before full elbow flexion is regained, since this will depend heavily on remodelling. The capacity for remodelling is reduced in the older child undergoing osteotomy, and for this reason, the medial “hinge” is an important feature of the osteotomy. This hinge, with the screws and wire acting as a bone suture, ensures that anatomical alignment is maintained. Remodelling is not needed and elbow flexion is rapidly regained especially since the fixation allows mobilisation to start after two weeks rather than the three weeks required for fresh fractures.

Our modification of French’s osteotomy, with a period in traction, has given superior results to those of most other series, traction affording good control of the carrying angle. Even if fixation fails, as in one of our cases, traction can still control the position. This simple technique virtually eliminates many of the complications which have previously been reported and we strongly commend its use.

**REFERENCES**


VITAMIN K\textsubscript{1} LEVELS IN PROXIMAL FEMORAL FRACTURES: BRIEF REPORT

L. KLENERMAN, B. D. FERRIS, J. P. HART

There is still controversy as to whether the two types of proximal femoral fractures have different aetiology or pathogenesis. Recently, in studying the detailed structure of bone, it was shown that, with subcapital fractures, the orientation of the proteoglycans at the fracture site was abnormal (Kent et al. 1983); however, with trochanteric fractures, the same abnormality was found at the site of the fracture (Ferris et al. 1987).

In seeking other potential differences between these fractures, attention was focused on the abnormally low circulating levels of vitamin K\textsubscript{1} in patients with subcapital and spiral crush fractures (Hart et al. 1985). Vitamin K\textsubscript{1} is involved in the \gamma\-carboxylation of glutamic acid residues in osteocalcin and other bone Glu-proteins (Price 1983) which are required for the binding of calcium for mineralisation. It therefore seemed relevant to test whether or not a similar circulating deficiency of vitamin K\textsubscript{1} occurred in patients with trochanteric fractures.

Samples of blood (20 ml) were taken within 48 hours from nine patients who had sustained trochanteric fractures (as detailed in Table 1). The plasma was separated and assayed for vitamin K\textsubscript{1} content by electrochemical detection after separation by high performance liquid chromatography (Hart et al. 1985). The mean value was 59 pg/ml (range, 20 to 110 pg/ml).

In a control group of 15 patients of comparable age and sex, the circulating level measured by the same procedure was 335 (range, 284 to 386 pg/ml). This depressed level was comparable to that in patients who sustained subcapital fractures. Thus, with respect to the deficient circulating levels of this bone-forming vitamin, as with the defective orientation of the proteoglycans, trochanteric fractures closely resemble subcapital fractures.

<table>
<thead>
<tr>
<th>Proximal femoral fractures</th>
<th>Number</th>
<th>Age in years (range)</th>
<th>Sex ratio (M:F)</th>
<th>Mean level ( \pm ) s.e.m. (pg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trochanteric</td>
<td>9</td>
<td>84 (65–100)</td>
<td>3:6</td>
<td>59 ( \pm ) 13</td>
</tr>
<tr>
<td>Subcapital*</td>
<td>14</td>
<td>77 (63–83)</td>
<td>1:13</td>
<td>71 ( \pm ) 9</td>
</tr>
<tr>
<td>Control*</td>
<td>15</td>
<td>63 (51–81)</td>
<td>5:9</td>
<td>335 ( \pm ) 51</td>
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REFERENCES


