

SUPRACONDYLAR HUMERAL FRACTURES - A REVIEW OF THE OUTCOME OF TREATMENT

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ABSTRACT

Fractures around the elbow are common injuries in children. We studied 77 children who had sustained supracondylar fractures around the elbow during the period 1989-1993. The aim of this study was to compare the outcomes of supracondylar fractures following 3 modes of treatment, namely manipulation and reduction, open reduction with internal fixation and percutaneous pinning.

In our study, we have found that the most common cause for injury in supracondylar fractures was a fall on the outstretched hand. A possible reason would be that children usually try to break the force of a fall by extending their elbows.

Treatment results in all 3 groups were satisfactory in this study. There were no vascular problems or Volkmann's contractures. For operative treatment, percutaneous pinning had the most consistent outcome in terms of restoration of function and cosmesis. Open reduction and internal fixation as a method of treatment had poor outcome for both function and cosmesis.

Keywords: supracondylar fracture, humerus, internal fixation, manipulation and reduction, percutaneous pinning

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INTRODUCTION

Supracondylar fractures constitute one of the most important fractures of childhood. They commonly occur in the first decade of life with peak incidence at 5 to 8 years.

Potential problems associated with this injury include Volkmann's ischaemia and malunion in a position of cubitus varus. These complications must be considered when evaluating the effectiveness of any treatment modality.

Opinions vary widely as to the best method of treatment for displaced supracondylar fractures in children. The undisputed objectives, however, are to obtain and maintain an adequate reduction, as well as restoration of function.

Deformity is affected by three factors: (1) the adequacy of the initial reduction; (2) the maintenance of that reduction; and (3) the effect of epiphyseal re-modelling, if any. This study evaluated the achievement and maintenance of reduction in fractures treated by three methods: manipulation and reduction, open reduction and internal fixation and percutaneous pinning. We took the restoration of function and residual clinical deformity in the three treatment groups as a basis for comparison.

MATERIALS AND METHODS

A retrospective study of supracondylar fractures around the elbow in children who were treated at the Toa Payoh Hospital between January 1989 and December 1993 was carried out. The case-records of 77 such patients were assessed.

The ages of the patients ranged from 1 to 14 years with a mean age of 8 years. In our cohort, there were 44 boys and 33 girls. Of these fractures, 44 occurred on the right side and 33 occurred on the left.

All the supracondylar fractures were either Type III with rotation of the distal fragment and partial contact, or Type IV with no contact at all according to the LaGrange and Rigault

classification reference⁽¹⁾. Most of the cases were admitted on the day of injury or a few days after. All the cases were treated by initial traction (Modified Dunlop's). If they did not respond to the initial treatment, surgical treatment was then carried out. The hospital stay varied between 3 and 7 days.

Of these fractures, 27 cases were treated by manipulation and reduction, 42 were treated by open reduction and internal fixation with Kirschner wires, and 8 were treated by percutaneous pinning.

For manipulation and reduction under general anaesthesia, the method⁽²⁾ was as follows:

Traction was applied with the elbow in extension and the forearm in supination. An assistant stabilised the proximal fragment. After traction had been applied and the length regained, the fracture was then hyperextended to obtain apposition of the fragments. With traction being maintained, any varus or valgus angulation along with rotation of the distal fragment was corrected. Once the length and alignment had been corrected, the elbow is flexed. Pressure was then applied over the posterior aspect of the olecranon to facilitate reduction of the distal fragment. The distal fragment is finally "secured" to the proximal fragment by pronating the forearm.

The follow-up period for our cohort ranged from 1 to 6 years. The mean follow-up period was 4 years.

The factors assessed in this study included pain, deformity, degree of restoration of function as well as the mechanism of injury. The range of motion about the elbow was measured with goniometer for flexion, extension, and also any varus and valgus. The latter two measurements were taken with the elbow at 0° flexion. Post-reduction radiographs were also assessed for degree of alignment.

The following criteria by Sutton et al⁽³⁾ was used for assessment of functional and cosmetic results (Tables I & II).

RESULTS

The patients were classified into 3 groups according to the mode of treatment they received.

Group I

Twenty-seven of our patients with supracondylar fractures underwent manipulation and reduction under general anaesthesia.

Post-manipulation radiographs were then taken to assess the adequacy of reduction (Figs 1a and 1b). If the fracture was clinically stable and satisfactorily reduced, the elbow was then immobilised in flexion with the forearm in full pronation to

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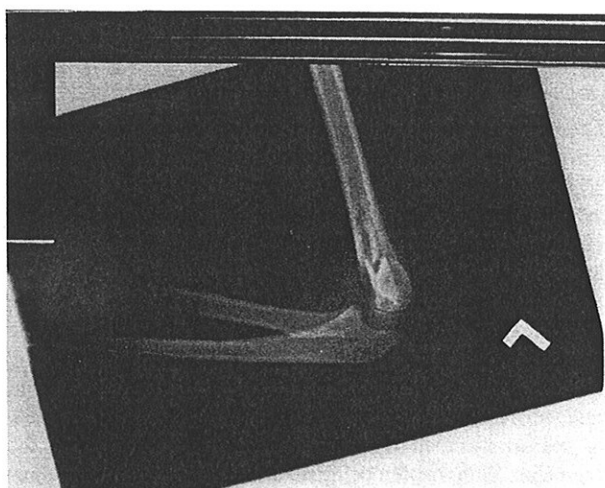
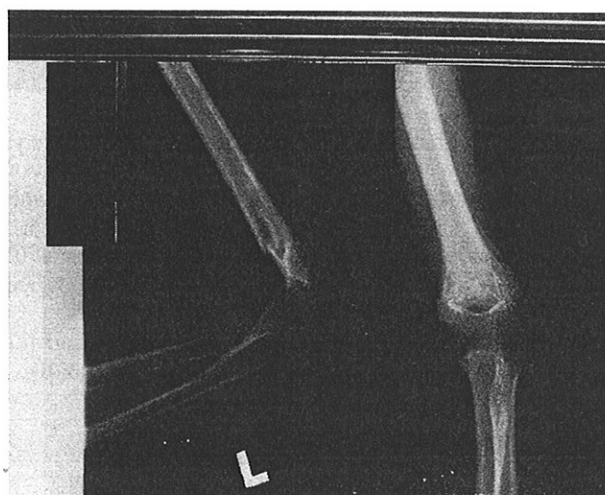
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Table I – Criteria for grading functional results

Result	Function (Loss of elbow flexion/extension)
Excellent	0 – 5°
Good	6 – 10°
Fair	11 – 15°
Poor	> 15°

Table II – Criteria for grading cosmetic results.

Result	Cosmetic (Change in carrying angle)
Excellent	0 – 5°
Good	6 – 10°
Fair	11 – 15°
Poor	> 15°

Fig 1a – Results of M & R - pre-treatment**Fig 1b – Results of M & R - post-treatment**

maintain the reduction.

Our patients were then followed-up regularly to assess for range of motion, pain, neurovascular defects and deformity.

The results from our patients treated with manipulation and reduction at mean follow-up period of 4 years (Table III) showed that 67% had excellent elbow function while 11% had poor elbow function. The mean loss of flexion was 4° while the mean loss of

Table III – Functional results for manipulation and reduction.

Result	Number	%
Excellent	18	67
Good	3	11
Fair	3	11
Poor	3	11
Total	27	100

Table IV – Cosmetic results for manipulation and reduction.

Result	Number	%
Excellent	18	69
Good	3	26
Fair	0	0
Poor	6	5
Total	27	100

extension was 1°. In all the cases, there were none with residual neurovascular deficit.

With regards to cosmetic sequelae (Table IV), 22% had varus deformity while 4% had valgus deformity. Mean loss in carrying angle was 3°. However, all 27 patients had no complaints of residual pain.

Group 2

Forty-two of our patients with supracondylar fractures were treated via open reduction internal fixation (posterior approach) with Kirschner wires ('K' wires). Radiographs were taken after open reduction to assess the adequacy of internal fixation (Figs 2a and 2b). If the alignment was deemed satisfactory, the patient was subsequently assessed at regular intervals to monitor range of motion, presence of pain and to exclude any neurovascular deficits. The 'K' wires were then removed when union had been confirmed by radiological evidence.

For these fractures, the mean loss of flexion was 12° while that of extension was 4° (Table V). The mean loss in carrying angle was 3° (Table VI).

In all our cases, there was no residual pain, neurovascular deficits or any infection.

Group 3

Eight of our patients underwent percutaneous pinning with Kirschner wires (Figs 3a and 3b). This was done under general anaesthesia, with the help of fluoroscopy.

The fracture was reduced and internally fixed with Kirschner wires that were inserted in a crossed fashion. The period of pin retainment varied from 3 to 6 weeks. External immobilisation was achieved by holding the elbow at 90° flexion in a posterior splint or backslab.

The patients were then followed-up at regular intervals to monitor the improvement in functional range of movement, pain, neurovascular problems, infection or deformity (Tables VII and VIII).

All our patients had good resultant elbow function with mean loss of flexion of 5° and mean loss of extension of 2°. The mean loss in carrying angle was 5°. None had residual pain, neurovascular deficit or infection.

DISCUSSION

Age is the key factor in the incidence of supracondylar fractures. They occur almost exclusively in the immature skeleton,

Fig 2a – Kirschner wires - pre-treatment



Fig 2b – Kirschner wires - post-treatment



primarily in the first decade of life.

There are 3 major factors that may contribute to the unique predisposition of the juvenile humerus to supracondylar fractures, namely ligamentous laxity, relationship of the joint structures during elbow hyperextension and bony architecture of the supracondylar area.

Henrikson⁽⁴⁾ found that in victims with supracondylar fractures, more had hyperextension of the normal elbow. They were also found to have increased susceptibility to repeated supracondylar fractures than the general paediatric population.

Ashhurst⁽⁵⁾ and Abraham⁽⁶⁾ have respectively demonstrated the mechanism of hyperextension in juvenile supracondylar

Table V – Functional results for open reduction and internal fixation.

Result	Number	%
Excellent	21	50
Good	8	19
Fair	9	21
Poor	4	10
Total	42	100

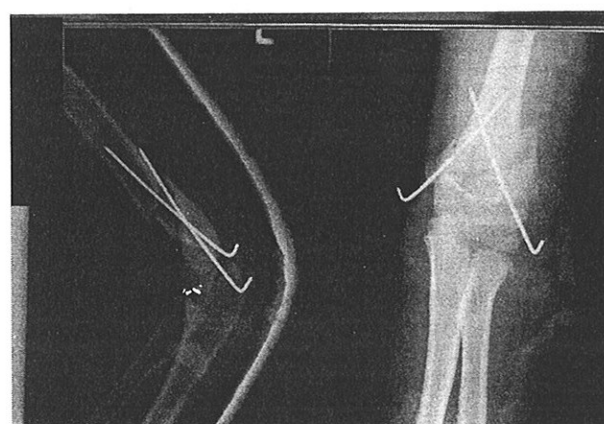
Table VI – Cosmetic results for open reduction and internal fixation.

Result	Number	%
Excellent	30	76
Good	3	7
Fair	3	7
Poor	4	10
Total	42	100

Fig 3a – Percutaneous pinning - pre-treatment



Fig 3b – Percutaneous pinning - post-treatment



fractures. In view of their ligamentous laxity, their elbow hyperextends, resulting in the conversion of the linear force applied along the extended elbow to a bending force. This bending force is then concentrated by the olecranon into the supracondylar area. Furthermore, in hyperextension, the anterior capsule and collateral ligaments become taut and exaggerate the tension forces acting on the supracondylar area.

In our study, we have compared the results of the various

Table VII – Functional results for percutaneous pinning.

Result	Number
Excellent	4
Good	3
Fair	0
Poor	1
Total	8

Table VIII – Cosmetic results for percutaneous pinning.

Result	Number
Excellent	4
Good	3
Fair	0
Poor	1
Total	8

modes of treatment for supracondylar fractures in childhood.

Among our patients with supracondylar fractures, those treated with manipulation and closed reduction exhibited a mean loss of elbow flexion of 4.07° while those that underwent percutaneous Kirschner wire fixation had comparatively good results with loss of flexion of 5° . Unfortunately, those who underwent open reduction internal fixation had poorer results with loss of elbow flexion of 13.45° .

With regard to loss of elbow extension, the results of manipulation and closed reduction were comparable with those following percutaneous Kirschner wire insertion. The former had 1.30° while the latter had 1.88° loss of extension. However, open reduction resulted in loss of extension of 4.29° .

With respect to cosmetic sequelae, the closed reduction group showed a change in carrying angle of 2.59° . Those with open reduction showed a 3.24° change in carrying angle while those with percutaneous Kirschner wiring had a change of 5.75° carrying angle. Thus, there is relatively good cosmetic result irrespective of the method of treatment.

The outcome showed that percutaneous pinning had the most consistent outcome in terms of good and excellent results. This is so for both restoration of function and cosmesis. Percutaneous pinning for such fractures was first described by Swenson⁽⁷⁾ and subsequent studies by Flynn et al⁽⁸⁾ and others⁽⁹⁻¹²⁾ have reported good results with this technique.

The poor results in open reduction and internal fixation in terms of both function and cosmesis are secondary to imperfect reduction or collapse of the medial pillar and is progressively unmasked as extension of the elbow is regained. It is seldom due to epiphyseal injury.

The critical zone for the prevention of cubitus varus is at the junction of the epiphysis and the medial pillar. Rotation does not cause cubitus varus, but lack of contact in the critical zone predisposes to overriding. The result is a medial tilt causing the varus deformity.

Pinning does not disturb the growth of the epiphysis. There are several reports on the use of 'K' wires to stabilise supracondylar fracture in children. In our case, we have used

parallel 'K' wires.

Currently, open reduction and internal fixation should only be recommended if anatomical reduction is not possible and should be carried out by a surgeon with great experience.

Another interesting feature is the incidence of associated injuries. There were 3 cases of distal radius fractures, 2 cases with absent radial pulse, 4 cases with radial nerve palsy and 2 cases of median nerve palsy. Fortunately, the neurovascular problems all resolved with time while the associated fractures were treated with open reduction and internal fixation.

In our study cohort, supracondylar humeral fractures is the commonest fracture around the elbow in the paediatric population. The best results were obtained with percutaneous pinning. Advantages of percutaneous pinning include easy management of ipsilateral forearm fractures and the possibility of placing the elbow in less flexion, therefore reducing the risk of compromising circulation by an already markedly swollen arm. In spite of the merits of percutaneous pinning, the numbers in our cohort were comparatively fewer than the other 2 groups. The disadvantages of percutaneous pinning include the need for general anaesthesia, the potential for pin-track osteomyelitis and a greater risk of neurologic injury. In our study, treatment via manipulation and reduction, open reduction internal fixation and percutaneous pinning have proved to be safe and effective.

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