

Original Research Article

A clinical study of closed reduction and percutaneous Kirschner wire fixation of displaced supracondylar fractures of humerus in children

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ABSTRACT

Background: Supracondylar fractures of the humerus are the most common fracture pattern of the elbow in children. Displaced supracondylar fractures are notorious for difficulty in reduction, maintenance of reduction and frequent involvement of neurovascular structures. The purpose of this study was to evaluate the results of stabilization of these fractures by closed reduction and percutaneous Kirschner wire fixation.

Methods: Thirty cases of displaced supracondylar humerus fractures were included in the study. The mean age of the patient was 8.3 years [ranges from 4-14 years]. The male to female ratio was 2:1 and left side was involved in 23 cases whereas 7 had right sided injuries. All fractures were of extension type [Gartland's type III]. Posteromedial displacement was noted in 22 cases whereas 8 fractures were posterolaterally displaced. In 20 cases, lateral entry wires alone were used whereas in 10 cases one lateral and one medial K-wire were used. K-wires were removed after 3 weeks post-operatively and follow-up was done at 6 weeks, 12 weeks, 6 months and 12 months, when they were evaluated according to Flynn's criteria.

Results: Results were graded using Flynn's criteria. Excellent results were achieved in 18 [60%], good in 6 [20%] fair in 4 [13.3%], while poor results were seen in 2 [6.7%] patients.

Conclusions: Closed reduction and percutaneous fixation using Kirschner wires is a safe and efficient method for fixation of displaced supracondylar fractures of the humerus in children.

Keywords: Displaced supracondylar fracture of humerus, Percutaneous Kirschner wire, Closed reduction

INTRODUCTION

Supracondylar fracture of humerus accounts for 60% of all fractures of the elbow in children and represents approximately 3% of all fractures in children. The rate of occurrence increases steadily in the first five years of life to peak at 5-7 years of age.¹

Supracondylar fracture of humerus is one of the commonest fractures in children. Displaced supracondylar fractures of humerus have always presented a challenge in their management.² If the fracture is not treated properly it may give rise to

many complications like Volkmann's ischemic contracture, nerve injury, myositis ossificans, stiffness of elbow and malunion.

Displaced supracondylar fractures are notorious for difficulty in reduction, maintenance of reduction and frequent involvement of neurovascular structures.³ The management of displaced supracondylar fracture of the elbow is one of the most difficult of the many fractures seen in children.⁴

There is no controversy about management of the non-displaced fractures. But many methods have been

proposed for the treatment of displaced supracondylar fractures of humerus in children such as closed reduction and plaster of paris slab application, skin traction, overhead skeletal traction, open reduction and internal fixation and closed reduction and percutaneous pin fixation.⁵

Closed reduction with splint or cast immobilization has traditionally been recommended for displaced supracondylar fractures, but loss of reduction and necessity of repeated manipulations is likely to go for malunion producing varus or valgus deformity of elbow and elbow stiffness.⁶

Traction (skin or skeletal) which has also been used for many years has been shown to be safe and reliable, but it has the drawback of requiring a long stay in the hospital.⁵

Open reduction and internal fixation has generally been reserved for specific indications mainly for an open fracture, a fracture requiring vascular exploration or an irreducible fracture.⁵

The present study was undertaken with the objectives to study anatomical and functional results of treatment of displaced supracondylar fractures of humerus with closed reduction and percutaneous Kirschner wire fixation and the complications of procedure.

METHODS

This study was conducted in the department of Orthopaedics at Khaja Banda Nawaz Teaching and General Hospital, Kalaburagi, for a period of 2 years from May 2014 to April 2016. The study received clearance from ethical committee of the institution. In this prospective study thirty cases of displaced extension type of supracondylar fractures (Gartland's type III) of the humerus in children were treated by closed reduction and percutaneous fixation with Kirschner wires.

The inclusion criteria were age less than 15 years and fresh closed supracondylar fractures of humerus and exclusion criteria were age more than 15 years, open supracondylar fractures of humerus and fracture with neurovascular complications.

A detailed history was elicited from the patient. All the patients were examined for associated fractures if any. The vascular status of the limb examined. The X-rays were advised. The standard anteroposterior and lateral views of the elbow were taken and Fractured part was splinted temporarily. The fractured pattern seen in the X-ray was classified according to Gartland's classification as given in Table 1.²

Before surgery the necessary laboratory investigations were done. Closed reduction and percutaneous K-wire fixation was done in all patients within 3 days of trauma.

Table 1: Gartland's classification

Type	Characteristics
Type I	Non-displaced
Type II	Minimally displaced with intact posterior cortex.
Type III	Completely displaced with no cortical contact a) posteromedial b) posterolateral

Operative technique

Under general anaesthesia the patient was placed in the supine position on the operating table. Closed reduction was done under image intensifier. Traction was given with elbow in extension and forearm in supination, longitudinal traction was given with an assistant applying counter traction by holding proximal portion of the arm, medial or lateral displacement was corrected by lateral or medial force respectively at fracture site. The posterior displacement of the distal fragment was then corrected by applying a force to its posterior aspect while the elbow was gently hyperflexed. During the entire procedure the radial pulse was observed at regular intervals. X-ray were taken in antero-posterior and lateral views and reduction assessed. Lateral view is taken while rotating the x-ray rather than rotating the arm. Reduction was assessed by assessing the extent of flexion and by assessing the carrying angle. If the reduction is acceptable, then the assistant holds the elbow in flexed position and fracture were fixed with 1.5 mm to 2.0 mm Kirschner wires according to age of the patient. The medial pin is inserted through the medial epicondyle by avoiding the ulnar nerve in the ulnar groove. The lateral pin was inserted through the lateral epicondyle.

In the coronal plane the K-wires were placed with an angle of 40° with long axis of the humerus medially and 10° posteriorly. Both the K-wires were placed percutaneously engaging the far cortex to ensure stable fixation. After the pins are placed the elbow was extended and the carrying angle was measured and compared with the normal side. The fixation was checked radiologically and stability assessed. The K-wires were cut and bent outside the skin to prevent migration.

Post-operatively, the extremity was placed in well-padded posterior above elbow slab, with elbow in 80–100° flexion. A cuff and collar sling was given. The patient observed in the hospital for any neurovascular deficit at regular intervals. Immediate postoperative radiographs were taken to determine the maintenance of reduction.

The patients were discharged to come for regular follow-up. The follow-up examination consisted of measuring range of motion and carrying angle.

After 3 weeks the posterior slab and k-wire were removed and x-ray repeated. The carrying angle assessed and active range of motion exercises started. Patients were followed up at regular intervals of 6 weeks, 3 months, 6 months and 1yr and each time the carrying

angle and the functional range of movements assessed and noted. The final results were evaluated by Flynn's criteria.⁷ The results were graded as excellent, good, fair and poor according to loss of range of motion and loss of carrying angle. Cases were followed upto 12 months.

Table 2: Flynn's grading system.

Results	Rating	Cosmetic factor: Carrying angle loss (degrees)	Functional factor: Loss of range of motion (degrees)
	Excellent	0 – 5	0 – 5
Satisfactory	Good	6 – 10	6 – 10
	Fair	11 – 15	11 – 15
Unsatisfactory	Poor	Over 15	Over 15

RESULTS

In the present study, the age of the patient ranged from 4–14 years with a mean age of 8.3yrs. There were 20 males and 10 females. The left elbow was involved in 23 cases and right in 7 cases. In our study, the major cause of fracture was fall on outstretched hand. Of the 30 patients, 22 had posteromedial type of displacement and 8 had posterolateral displacement.

In our study 3 patients had associated fractures. All cases were fresh fractures, the average interval between injury and surgery was 2.33 days [2–3 days]. The average hospital stay in our study was 3.3 days [3–4 days]. There were 2 cases of superficial pin tract infection which were treated by antibiotics. We had 2 cases of iatrogenic ulnar nerve palsy which recovered completely within 5–6 months. In our study there were 2 cases of cubitus varus deformity.

Carrying angle loss

The carrying angles were measured on follow-up and compared with that of the normal side. At the final follow-up 0-5° carrying angle loss of the affected extremity was noted in 19 (63%) patients. More than 15° carrying angle loss was noted in 2 patients (7%). The mean loss of carrying angle was 5.73° in our study as shown in Table 3.

Table 3: Carrying angle loss.

Carrying angle loss (degree)	No. of cases (%)
0 -5	19 (63%)
6 -10	5 (17%)
11 -15	4 (13%)
>15	2 (7%)

Loss of range of motion

At the final follow-up 0-5° loss of range of motion of the affected extremity was noted in 20 patients (66%) and more than 15° loss of range of motion was noted in 2

(7%) patients and mean loss of range of motion was 5.8° as shown in Table 4.

Table 4: Loss of range of motion.

Loss of range of motion (degree)	No. of cases (%)
0 -5	20 (66%)
6 -10	8 (27%)
11 -15	0 (0%)
>15	2 (7%)

Functional results

Each patient was followed up for 1 year and the final results were evaluated by Flynn's criteria. In our study 28 (93.3%) of patients had satisfactory results. Of these 28 patients, 18 (60%) were rated as excellent, 6 (20%) were rated as good and 4 (13.3%) were rated as fair. Only 2 patients (6.7%) had unsatisfactory results which were rated as poor. The poor results were due to cubitus varus deformity, due to improper reduction or loss of reduction post-operatively as shown in Table 5 and Figure 1 & 2.

Table 5: Functional results according to Flynn's grading system.

Treatment outcome	Flynn's criteria		
	Rating	Loss of movement and carrying angle (degree)	No. of cases (%)
Satisfactory	Excellent	0-5	18 (60%)
	Good	6-10	6 (20%)
	Fair	11-15	4 (13.3%)
Unsatisfactory	Poor	>15	2 (6.7%)

DISCUSSION

Supracondylar fracture of humerus is a common injury in children. There is no controversy about the management of the non-displaced fractures. But many methods have

been proposed for the treatment of displaced supracondylar fractures of humerus in children such as closed reduction and plaster of Paris slab application, skin traction, open reduction and internal fixation.

Primary open reduction and internal fixation is one alternative method of treatment but joint stiffness and infection are the problems in open reduction, because of these problems, the major indications for a primary open reduction include an open fracture, failure to achieve closed reduction or vascular compromise that worsens especially with the manipulative technique.⁸ Hence closed reduction and percutaneous Kirschner wire fixation has become a popular method recently.

The present study was conducted to assess the results of closed reduction and percutaneous Kirschner wire fixation for displaced extension type of supracondylar fractures of humerus in children.

In the present study we had 2 cases of superficial pin tract infection which was treated by antibiotics. 2 cases had iatrogenic ulnar nerve palsy and 2 cases had cubitus varus deformity which required corrective osteotomy later. Boyd and Aronson prefer two parallel laterally inserted K-wires for percutaneous fixation if fracture is stable, if it is unstable, they prefer crossed medial and lateral K-wires.⁹ In their study 70 of 71 cases had satisfactory results, 6 patients had neurovascular complications which completely recovered by the time of follow-up evaluation.

In our study the mean loss of range of motion was 5.8°. Nacht et al noted mean loss of range of motion of 7.8° at the final follow-up examination in their study.¹⁰

In our study, at the final follow-up more than 15° carrying angle loss was noted in 2 patients (7%) and mean loss of carrying angle was 5.73°. Nacht et al noted mean loss of carrying angle loss of 5.8° in 20 patients and increased carrying angle in 4 patients by an average of 6.8° at the final follow-up examination.¹⁰ Flynn et al reported mean loss of carrying angle of 6.2°.⁷

The final results were evaluated by Flynn's criteria. In our study 28 (93.3%) of patients had satisfactory results. Only 2 patients had unsatisfactory result. Flynn et al reported 52 patients treated by closed reduction and percutaneous pin fixation.⁷ 51 (98%) patients had satisfactory results by their own criteria. Ayengar et al reported 28 patients treated with closed reduction and percutaneous K-wire fixation, 24 (85.72%) had excellent results, good in 3 (10.3%) cases and only 1 (3.57%) case had a poor result.¹¹

Pirone et al reviewed 230 patients treated by different methods.⁵ The highest percentage of excellent results were achieved by percutaneous Kirschner wire fixation (78%), skeletal traction (67%) and open reduction with internal fixation (67%).

Lee et al reported that lateral pinning technique was far to be more beneficial than the medial and lateral crossed pinning technique for the supracondylar fracture of the humerus in children.¹²

In our study all fractures united around 3- 4 weeks. We had 2 cases of superficial pin tract infection which healed by antibiotics. We had 2 cases of iatrogenic ulnar nerve palsy resulting from the medial pin due to stretching of ulnar nerve over pin or due to improper pin insertion. Both the iatrogenic ulnar nerve palsy recovered completely after 5 -6 months. Woratanarat et al reported that lateral pinning is preferable to cross pinning for fixation of paediatric supracondylar humerus fractures as a result of decreased risk of ulnar nerve palsy.¹³

The main goal of the treatment of displaced paediatric supracondylar humerus fractures is to achieve an anatomic reduction which should be supported by a fixation with a good stability and less morbidity. When all these are taken into consideration we believe that closed reduction and percutaneous pinning is an efficient, reliable and stable method.

CONCLUSION

From our study we conclude that closed reduction and percutaneous Kirschner wire fixation is a safe and efficient method for fixation of displaced supracondylar fractures of the humerus as it gives excellent functional and cosmetic results.

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Ethical approval: The study was approved by the institutional ethics committee

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