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Original article

Close reduction and percutaneous pinning in displaced supracondylar humerus fractures in children

Basant Kumar Bhuyan M.S*

Clinical Associate Professor, Department of Orthopaedics, R D Gardi Medical College, Agar Road, Surasa, Ujjain 456006, Madhya Pradesh, India

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ABSTRACT

Background: Displaced supracondylar fractures of the humerus in children are common pediatric injuries treated by orthopedic surgeons. They also have a high rate of complications if not reduced and stabilized in optimal position which may lead to serious neurovascular injuries and residual deformity. Amongst the various methods used for treating these fractures, closed reduction and percutaneous pinning has shown improved results. **Method:** Between March 2005 and April 2010, 277 cases of supracondylar humeral fractures (Gartland grade II and III) with less than 1 week old were included in this study. They were treated with closed reduction and percutaneous pinning with crossed Kirschner wires under image intensifier control. Clinical outcome were assessed according to Flynn's criteria.

Results: The mean age at the time of operation was 6 years (range 2–10 years) and the average duration of follow-up was 4.6 years (range 2.1–7.2 years). The Flynn's criteria were excellent in 202, good in 68, fair in 5 and only 2 with poor results.

Conclusion: Closed reduction and percutaneous pinning is a sound and effective treatment for displaced supracondylar fractures.

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1. Introduction

Supracondylar fracture is one of the commonest fracture in children account for 60% of all fractures around the elbow joint^{1,2} and represent approximately 3% of all fractures in children.³

Displaced supracondylar fractures of humerus have always presented a challenge in their management.⁴ Many methods have been proposed ranging from closed reduction and plaster cast immobilization, Dunlop's skin traction, skeletal traction, closed reduction and percutaneous pinning to open reduction

and Kirschner wire fixation.^{5–7} Treatment of this displaced fracture is fraught with many complications including Volkmann's ischemic contracture, nerve injury, arterial injury, myositis ossificans and cubitus varus deformity.^{8,9}

Closed reduction and percutaneous pinning was initially described by Swenson and later popularized by Flynn et al. It is a simple procedure with excellent results and biomechanically most stable as compared to other pin configurations.^{10,11}

The purpose of the study was to evaluate the role of closed reduction and percutaneous pinning in displaced supracondylar fracture of humerus in children.

* Tel.: +91 97551 59569 (mobile).

E-mail address: drbasantkr@gmail.com.

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2. Materials and methods

In a prospective study closed reduction and percutaneous pinning for 277 displaced supracondylar fractures of the humerus was performed at our Institute.

The indication for crossed pin fixation was Gartland grade II and grade III displaced fractures. Out of the total 277 of fractures, 192 were grade II and 85 were grade III. The usual cause was a fall on the outstretched hand. Fractures older than 1 week were not included. There were 166 males and 111 females. The age of the patients ranged from 2 to 10 years (mean age 6 years). Left elbow was involved in 168 cases and right side in 109 cases. 178 had posteromedial displacement and 99 had posterolateral displacement. Associated injuries and complications were distal forearm fractures in 27 cases, median nerve injury in 13 cases, radial nerve injury in 10 cases, absent/feeble pulses in 23 cases and impending compartment syndrome in 10 cases.

Traction was given under general anesthesia with the elbow in extension and forearm in supination, longitudinal traction was given with an assistant applying counter traction (Fig. 1a). The fracture was thus disimpacted and then the

medial or lateral displacement was corrected by applying a varus or valgus force. The angulations were corrected by flexing the elbow with continued traction. During the entire procedure, the radial pulse was observed at regular intervals. Reduction was checked by fluoroscopy and radiological

Fig. 1 – (a) Reduction by traction in extension under general anaesthesia. (b) Passing of K-wires under C-arm control.

Fig. 2 – (a) Passing of K-wires under C-arm control (lateral view). (b) Passing of K-wires under C-arm control (A-P view).

assessment of reduction was done by calculation of Bauermann's angle.

If the reduction was clinico-radiologically acceptable the assistant held the elbow in the same position and the Kirschner wires (1.5–2.0 mm) were passed from the lateral epicondyle through a stab wound (Fig. 1b). The pin was directed upward and medially at an angle of 35–40° to the sagittal plane of the humerus and 100° posterior to the coronal plane of humerus. The pin thus passed through the distal fragment and medullary cavity of the proximal fragment to engage the cortex of the proximal fragment about 3 cm above the fracture line. The medial pin was inserted through the center of the medial epicondyle in a similar manner. The pins should cross each other 1.5–2 cm above the fracture line. The ulnar nerve in the ulnar groove was easily avoided. Final

reduction and pin placement was checked by both A-P and lateral view image under C-arm image intensifier control (Fig. 2a and b). The pins were cut off subcutaneously and clinical assessment was done by checking the amount of flexion possible and by measuring the carrying angle of the forearm.

An above elbow plaster slab in 80–100 degree of flexion with full supination was applied. Radiological assessment was carried out by comparing pre operative fracture pattern (Figs. 3a and 4a and b) with post operative reduction (Figs. 3b and c and 4c) and to check for any redisplacement. Patients were discharged after 72–96 h and first follow-up was done after 1 week.

The patients were reviewed at weekly intervals. Kirschner wires were removed when clinico-radiological union was

Fig. 3 – (a) Gartland grade-III supracondylar fracture A-P and lateral view. (b) Close reduction and cross K-wire fixation (A-P view). (c) Close reduction and cross K-wire fixation (lateral view).

Fig. 4 – (a) Gartland grade-III supracondylar fracture (A-P view). (b) Gartland grade-III supracondylar fracture (lateral view). (c) Close reduction and cross K-wire fixation A-P and lateral view.

found satisfactory and active exercises were started. Thereafter follow-up evaluation was done at weekly intervals for 6 weeks, monthly intervals for 6 months and 3 monthly intervals for 2 years. At each review, patients were assessed clinically and radiologically and results were evaluated on the basis of Flynn's criteria.

Patients having impending compartment syndrome were treated by fasciotomy prior to fracture fixation. In these cases limb was splinted in extended position. After surgery limb elevation and active finger movements were advocated. After 48–72 h dressing of fasciotomy wound was changed and position of limb was changed to 90° flexion and full supination and the remaining follow-up was done in same manner.

The results were calculated according to Flynn's criteria (Table 1).

Table 1 – Flynn's criteria.

Results/ rating	Cosmetic factor carrying angle loss (degrees)	Functional factor movement loss (degrees)
Excellent	0–5	0–5
Good	5–10	5–10
Fair	10–15	10–15
Poor	>15	>15

3. Observations

There were 97.47% good to excellent results and 2.52% fair to poor results (Table 2).

All the fair to poor results were attributed to cosmetic factor, but with good to excellent function. In all these patients fair to poor results were due to technical error in initial treatment. In six patients anatomical reduction of the fracture was not obtained because of persistent rotation between the fragments. They had undergone open reduction and cross K-wire fixation as the fragments were comminuted and soft tissue interposition was present. In three patients the wires were crossing too close to fracture site leading to secondary displacement and in two patients one of the wires

Table 2 – Results.

Result	Cosmetic	Functional	Overall result
Excellent	202	207	202
Good	68	70	68
Fair	05	–	05
Poor	02	–	02

was put unicortical leading to secondary displacement due to inadequate fixation. They were revised with close reduction and percutaneous pinning.

The time required for clinico-radiological union ranged from 2 to 6 weeks with an average of 4 weeks. Radiological evaluation was done to assess union and measure Baumann's angle. The difference of more than 5° in Baumann's angle between the two sides correlated with fair to poor results. The carrying angles on follow-up were measured and compared with that of the normal. The average carrying angle was 10.65° (range 4–15°) on the affected side and 12.62° (range 8–18°) on the normal side.

Pin tract infection of very mild nature was detected in 32 patients but usually it did not lead to any complication because in most of the cases Kirschner wire were removed in 3–5 weeks and infection healed without any active intervention. Ulnar nerve injury was found in 26 cases. Of these 26 cases, 18 cases were detected in the immediate post operative period. Eight cases were detected as delayed neuropathy of ulnar nerve due to its stretching over the medial pin. In all the cases nerve injury was mainly of sensory type, no exploration of the nerve was tried in any case. All the cases recovered spontaneously without any neurological deficit with in 3–6 weeks after removal of Kirschner wires.

4. Discussion

Displaced supracondylar fracture is a common fracture seen in the pediatric population. Anatomical reduction and its maintenance is essential for obtaining good cosmetic results and functional recovery.

Various methods of treatment have been advocated in the form of closed reduction and above elbow plaster cast application, skin/skeletal traction, primary closed reduction and percutaneous pinning and open reduction and internal fixation by Kirschner wires.^{2,4,5} Of these methods used, traction requires a longer period of hospital stay but is less reliable in children and has no added advantage over immediate closed reduction and percutaneous pinning except in cases who has gross swelling. Infection and joint stiffness usually are the problems in open reduction. Hence closed reduction and percutaneous pinning is the preferred treatment in grade II and grade III displaced supracondylar fractures.

Percutaneous pinning after closed reduction of supracondylar fractures has got several advantages. Immediate fixation of these fractures reduces the duration of hospital stay. If the fracture is fixed immediately after closed reduction it can be splinted in a safe position without any fear of loss of reduction. This minimizes the risk of compartment syndrome and maximizes circulation.¹²

Swenson reported excellent results using crossed pin fixation, but others have suggested the pins placed from the lateral condyle in a parallel or crossed configuration to minimize the risk of iatrogenic ulnar nerve injury.¹ Although injury to ulnar nerve from the medial pin is a major concern, especially when fracture is associated with swelling its incidence is estimated to be 2%–3%.⁶ Direct injury to ulnar nerve as well as delayed neuropathy possibly due to stretching of nerve over the medial pin is a known complication. Recent studies

comparing the relative strength of fixation afforded by different configurations of pin placements have crossed medial and lateral pins to be the most stable configurations biomechanically.^{13,14}

From the present study it could be concluded that closed reduction and percutaneous pinning is a sound and effective modality for the treatment of displaced supracondylar fractures even in the presence of swelling. With the advantages of decreased duration of hospital stay, stable fixation and early mobilization resulting satisfactory functional outcome and cosmesis. It also reduces the incidence of cubitus varus deformity if the surgical technique is followed strictly.

Conflicts of interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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