

# Displaced Supracondylar Fracture Humerus in Children- Short Term Outcome of close Reduction and Percutaneous Pin Fixation having Different Pin Configurations

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## Abstract

**Introduction:** Displaced supracondylar fractures of the humerus in children are common pediatric injuries treated by orthopedic surgeons. They are notorious for difficulty and maintenance of reduction, frequent involvement of neurovascular structures and also have a high rate of complications like serious neurovascular injuries and residual deformity if not reduced and stabilized in optimal position. No general agreement on the treatment is evident with controversy prevailing regarding the ideal timing of surgery, method of maintenance of reduction and configuration of the pin fixation. Amongst the various methods used for treating these fractures, closed reduction and percutaneous pin fixation has shown improved results. The aim of this study was to assess the short term outcome of treatment of this fracture using closed reduction and percutaneous pin fixation having different pin configuration.

**Materials and Methods:** 32 children (25 boys, 7 girls), of displaced supracondylar humeral fractures (10-Gartland type II and 22- Gartland type III) with fracture age less than 10 days, were included in this study. Duration of the study was between January 2018 and April 2019 (16 months). Mean age at the time of operation was 5 years (range 3-13 years), They were treated with closed reduction and percutaneous pin fixation with Kirschner's wires having different configurations (Crossed wires, two lateral parallel wires, two lateral divergent wires, two lateral and one medial wires, trans olecranon fossa wires having four cortex fixation) under anaesthesia (general anaesthesia in 25 and brachial plexus block in 7 relatively older cooperative children), assuming fracture anatomy and post reduction stability under C arm image intensifier control. The ulnar nerve function and vascular status were examined preoperatively, intraoperatively, following reversal from anesthesia, at the time of discharge, at the end of one week and at the time of pin removal (average at 35 days, range 30-42 days). Each patient was kept in hospital for only one day. The average duration of follow-up was 8 months (3-16 months). The range of motion of the elbow was assessed clinically with goniometer. The results were evaluated according to the criteria of Flynn et al.

**Results:** Union was achieved in all the patients (100%). Transient ulnar nerve palsy occurred in two patients (6.25 %), which showed complete clinical improvement in three months. Superficial pin tract infections were seen in two patients (6.25 %) that resolved after one week antibiotic treatment), and cubitus varus of 8-17 degrees in nine patients (28.12%). Myositis ossificans, deep infection or compartment syndrome were not encountered. According to the criteria of Flynn et al., the results were excellent in 23 (71.88%), good in 5 (15.62%), fair in 2 (6.25%), and poor in 2 patients (6.25%).

**Conclusion:** Closed reduction and percutaneous pin fixation having different configurations assuming fracture personality proved an efficient, reliable, and safe method in the treatment of displaced supracondylar fractures of the humerus in children irrespective of pin configuration

**Key words:** Displaced supracondylar fractures, closed reduction, Percutaneous pin fixation, transolecranon pinning, four cortex fixation

## INTRODUCTION

Supracondylar fracture is one of the commonest fractures in children and accounts for 60% of all fractures around the elbow joint<sup>[1,2]</sup> and represents approximately 3% of all fractures in children<sup>[3]</sup>.

Displaced supracondylar fractures of humerus have always presented a challenge in their management<sup>[4]</sup>. 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's wire fixation<sup>[5,6,7]</sup>. Treatment of this displaced fracture is fought with many complications including Volkmann's ischemic contracture, nerve injury, arterial injury, myositis ossificans and cubitus varus deformity<sup>[8,9]</sup>. Closed reduction and percutaneous pinning (CRPP) has been considered to be the best approach due to avoidance of high expense during the hospital stay, delayed bone union and some complications caused by the open reduction<sup>[10]</sup>.

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 different pin configurations<sup>[11, 12]</sup>.

The purpose of this study was to assess the short term outcome of treatment of displaced supracondylar fracture of humerus in children using closed reduction and percutaneous pin fixation having different pin configurations.

### Materials and Methods

In a prospective study closed reduction and percutaneous pin fixation for 32 displaced supracondylar fractures of the humerus were performed at our Institute and in some private hospitals. Inclusion criteria were - Age 3-13 years, Gartland grade II and III fractures and Extension type of fracture. Exclusion criteria were- Age below 3 and above 13 years, Gartland grade I fracture, Flexion type of fracture, Open fractures, Fractures with impending compartment syndrome, Fractures with neurovascular injury. Out of the total 32 fractures, 10 were Gartland grade II and 22 were grade III. The usual cause was a fall on outstretched hand (fall from tree-20, fall from bicycle-8 and sports injury-4). There were 25 boys and 7 girls. The age of the patients ranged from 3 to 13 years (mean age 5 years). Left elbow was involved in 12 cases and right elbow in 20 cases. 19 had posteromedial displacement and 13 had posterolateral displacement. Distal forearm fractures were associated in 5 cases.

### Operative Procedure

Under anesthesia (general or brachial plexus block) elbow was semiflexed, arm was abducted to 90 degrees and forearm in supination, gentle longitudinal traction was given with an assistant applying counter traction. The fracture was thus disimpacted and then the medial or lateral displacement was corrected by applying a varus or valgus force with thumb. The posterior angulations were corrected by flexing the elbow and by milking maneuver over triceps and by simultaneous pushing over the distal fragment with thumb without much traction while the assistant maintains arm in abduction and fore arm in supination. Finally elbow was acutely flexed to impact the reduced fracture. Reduction was checked by C arm image in anteroposterior view (Jones's view), lateral view, medial oblique and lateral oblique views to assess the medial and lateral column respectively. Position of elbow was not changed rather C arm was rotated round the elbow to prevent loss of achieved reduction.

If the reduction was clinico-radiologically acceptable the assistant held the elbow in the same position after placing a folded towel under elbow for the ease of handling the power drill and Kirschner's wires inserted.

In cross Kirschner's wires configuration- First Kirschner's wire (1.5–2.0 mm) was passed from the lateral epicondyle through a small stab wound. The pin was directed upward and medially 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 but here elbow was semiextended and ulner nerve was pushed posteriorly with thumb to avoid iatrogenic ulner nerve injury. The pins should cross each other above the fracture line and never at fracture line to achieve stability. Final reduction and pin placement was checked by both anteroposterior and lateral view with C-arm image. The stability of fixation was checked by real time video mode of the C arm by flexing and extending the elbow. If the stability is questionable then reduction was done again and another pin configuration chosen. The pins were cut off outside the skin and clinical assessment was done by checking the amount of flexion and extension possible and by measuring the carrying angle of the forearm. Final assessment of vascular status was done clinically and long arm back slab was applied in elbow at or below 90 degree flexion (obtuse angle) and fore arm in full supination.

In two lateral Kirschner's wires configuration- First pin was inserted just lateral to lateral margin of olecranon passing obliquely in the same manner described earlier so that the pin crosses the olecranon fossa and finally engages the medial cortex of the proximal fragment (Trans olecranon fossa four cortex fixation). The second pin was inserted through the lateral epicondyle parallel to or in a divergent fashion in relation to the first pin in a similar way. Pins were placed as apart as possible. Final (vascular and radiological) assessment was done before applying plaster in the same fashion.

If the reduction seems unstable in real time video mode of C-arm, a third pin was inserted through medial epicondyle in the same manner as of cross pin configuration.

In some cases two lateral and one medial pin were used.

### Evaluation

Patients were discharged after 16-22 hours after rechecking neurovascular status and first follow-up was done at one week. Every patient was encouraged to do active shoulder and finger movements at the time of discharge.

The patients were reviewed at weekly intervals for four weeks, then biweekly for eight weeks and then monthly. Kirschner's wires were removed when clinico-radiological union was found satisfactory (average at 35 days, range 30-42 days) and active elbow exercises were started. Patients were reviewed periodically. At each review, patients were assessed clinically and radiologically and results were evaluated on the basis of Flynn's criterion.

*Flynn's criterion:*

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

*Results (n=32):*

Result	Cosmetic	Functional	Overall result
Excellent	23	25	23
Good	5	7	5
Fair	2		2
Poor	2		2

All fair to poor results were attributed to cosmetic factor, but with good to excellent function. In four patients anatomical reduction of the fracture was done but there occurred some sorts of displacement and rotation at post operative period due to convergent lateral pin position in one case and the wires were crossing too close to fracture site in three cases leading to secondary displacement. The parents denied further manipulations.

The time required for clinico-radiological union ranged from 3 to 5 weeks (average 4 weeks). Radiological evaluation was done to assess union and to 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 side.

## DISCUSSION

Displaced supracondylar fracture is a common fracture seen in the pediatric population. Anatomical reduction and its maintenance are essential for obtaining good cosmetic results and functional recovery<sup>[2]</sup>.

Various methods of treatment have been advocated in the form of closed reduction and above elbow plaster cast application, skin or skeletal traction, primary closed reduction and percutaneous pinning and open reduction and internal fixation by Kirschner's wires<sup>[2,4,5]</sup>. 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 that have 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<sup>[6,7]</sup>.

Percutaneous pin fixation 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<sup>[13]</sup>.

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 [14,15,16]. But our study did not show any notable difference. Most important is stability of fixation after pinning as evident by video mode of C arm on elbow movement.

## CONCLUSION

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 irrespective of pin configuration. 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.

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Some cases of Supracondylar fracture

