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## Supracondylar Humerus Fracture Treated With Closed Reduction and Percutaneous Cross Pinning Technique in Children

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### Abstract

Supracondylar fractures of the humerus are the most frequently occurring elbow fractures in children. They account for approximately 50-70% of all fractures around the elbow. The peak incidence is between 5 and 6 years of age. The incidence of supracondylar fractures amongst girls on the rise.

**Patients and Methods:** 75 patients with a closed supracondylar humerus fracture were treated by closed reduction and percutaneous crossed Kirschner wire fixation (2 lateral and 1 medial entry technique). All fractures were treated by general orthopaedic surgeons with no specialised training in paediatric orthopaedic surgery.

**Results:** Out of the 71 children available for follow-up, the outcomes were excellent in 55 patients, good in 10, fair in 4, and poor in 2 patients.

**Conclusions:** We found closed reduction and percutaneous cross-pinning for the treatment of Type II and III supracondylar fractures of humerus in children (Modified Gartland Classification) to be an effective method of treatment. The outcomes obtained in our study suggest that childhood supracondylar humerus fractures can be managed successfully by general orthopaedic surgeons with comparable results to those achieved in tertiary centres dedicated to paediatric orthopaedic care.

**Key words:** Children; Humerus; Supracondylar fracture.

### Introduction

Supracondylar fractures of the humerus (SCH) are the most frequently occurring elbow fractures in children. They account for approximately 50-70% of all fractures around the elbow [1]. The peak incidence is between 5 and 6 years of age [2]. The incidence of supracondylar fractures amongst girls is on the rise. The left or nondominant side is more frequently injured in most studies [3, 4, 5, 6]. Many treatment modalities have been devised including closed reduction and plaster immobilization in flexion, Dunlop's traction, overhead olecranon skeletal traction, closed reduction and percutaneous pinning and open reduction and internal fixation. The current standard of care for closed SCH in children is closed reduction followed by

percutaneous crossed or lateral only pinning [7-9]. The vast majority of the existing literature originates from tertiary children's hospitals with highly trained paediatric orthopaedic surgeons as the main care providers. The aim of this study was to investigate whether comparable outcomes could be obtained by general orthopaedic surgeons employing similar management principles.

### Patients and Methods

We conducted a retrospective to assess the clinical and radiographic outcomes of all closed SCH fractures in children admitted to our institution over a two-year period from July 2014 to June 2016. We included all children less than 12 years of age presenting within 1 week from the date of injury with closed Type II and III fractures according to the Modified Gartland Classification (Table 1) and amenable to closed reduction with percutaneous pinning. Open fractures, those associated with other ipsilateral limb injuries and children with neurovascular compromise or compartment syndrome were excluded.

The children were managed by a total of 12 orthopaedic surgeons of which 3 were senior consultants with more than 10 years of experience, 3 surgeons had completed 5-10 years and the remained were within 5 years after completion of postgraduate training. None of the treating surgeons had undergone fellowship training in paediatric orthopaedics; though all were routinely managing fractures in children.

Closed reduction and percutaneous pinning was performed under general or regional anaesthesia. Fractures were reduced in the following sequence: longitudinal traction in 30 degrees of elbow flexion, correction of lateral inclination, medial impaction or rotation, and lastly, extension was corrected by flexion to 90 degrees with thumb pressure over the olecranon. Reduction was checked in AP and lateral view by rotating the c-arm. Two lateral K-wires of 1.6 mm to 2 mm were inserted. The elbow was then extended to 45 degrees for

insertion of a single medial pin. Radial pulse was checked at the end of the operation. An above-elbow plaster slab was applied keeping the elbow flexed at 90-100 degrees. Wires were cut and left proud outside the skin for removal in the outpatients at 4 weeks or radiological union.

All patients were reviewed at 1 week and 4 weeks postoperatively. Wires were typically removed at 4 weeks once radiological union was confirmed. Active range of movement exercises were encouraged followed by gradual return to normal activity.

Collected data included patient demographics, fracture description, neurovascular status, postoperative clinical condition and outcome. Clinical outcome was graded according to Flynn's Criteria.

### Results

During the study period, 85 children were treated for Type II and III SCH fractures in our institution. 10 patients (11%) required open reduction and were thus excluded from the study. Open reduction was carried out due to failure to achieve a satisfactory closed reduction. There were no open SCH fractures in our cohort. 75 patients were eligible to be included in the analysis. Four children were lost to final clinical follow up.

Out of the 71 remaining patients, 35 (50%) were between the ages of 6 and 10 years at the time of injury, 29 (40%) were less than 5 years and 7 (10%) over the age of 11 years (mean age 6.7 years). There were 54 boys representing a M:F ratio of 3:1. The mechanism of injury was a simple fall at home or whilst playing sports in 58 children (82%) and the remaining were due to vehicular accidents. The Right elbow was involved in 54% of cases. All were extension-type supracondylar fractures. There were 62 children with Gartland Type III fractures and 9 were Type II injuries. Posteromedial displacement was most frequently seen (63% of children). The majority of children (83%) were admitted within 24 hours of the injury. 49 children (70%) were operated within 48 hours from the time of injury, with a delay of up to 96 hours in some cases (5 children). The average hospital stay was 4.25 days. The mean pin duration was 3 weeks. Bony union was achieved in 48 children (68%) by 6 weeks postoperatively. At the time of final follow-up at 6 months, loss of carrying angle was between 1 and 5 degrees (carrying angle of the unaffected elbow was 5-15 degrees). Mean Baumann angle of the distal humerus on the operated limb was 74 degrees compared to 70 degrees on the normal side. In a majority of cases (77%)

Table 1: Modified Gartland Classification Types

I	Undisplaced fracture
II	Displaced fracture with intact posterior cortex
III	Completely displaced
IV	Multidirectional instability with circumferential periosteal disruption

Table 2: Flynn criteria

Result	Rating	Carrying angle of the elbow (degrees)	Motion loss (degrees)
Satisfactory	Excellent	0 – 5	0 – 5
	Good	6 – 10	6 – 10
	Fair	11 – 15	11 – 15
Unsatisfactory	Poor	Over 15	Over 15

postoperative loss of motion was 0-5 degrees (average 6.6 degrees across the entire series).

According to Flynn's criteria (Table 2), 93% of patients had excellent or good results. 6 patients showed cubitus varus deformity. There were no instances of neurovascular injury pre- or postoperatively. No complications such as pin site infection, myositis or severe post-traumatic stiffness were seen. Fair and poor results occurred principally due to loss of carrying angle and loss of movement of 11-15 degrees.

## Discussion

Displaced supracondylar fracture of the humerus is a common childhood elbow injury that frequently necessitates operative management to prevent complications including cubitus varus, stiffness, neurovascular compromise and compartment syndrome [11, 12]. Closed reduction and casting is less invasive provided the reduction is maintained until bony union [8]. However, it is difficult to maintain the reduction with casting in Type II and III supracondylar fractures due to the need for hyperflexion of an already swollen elbow. Other treatment methods include skeletal traction, closed reduction with percutaneous pinning, and open reduction and internal fixation (ORIF) [13]. ORIF has its own demerits such as greater soft tissue trauma, increased surgical time, longer duration of hospitalization and higher risk of elbow stiffness postoperatively [14].

The technique of percutaneous pinning for supracondylar fractures was introduced by Swenson in 1947 [14]. This work remained relatively unknown until the publication of longer-term experience by Flynn and co-workers in 1974. Good outcomes following closed reduction and percutaneous pinning has been validated by multiple authors subsequently [15, 16, 17]. A substitute to medial and lateral Kirschner wires is lateral-only pinning that reduces the risk of iatrogenic ulnar nerve injury. However, lateral-only pinning may not provide sufficient fixation for all Gartland types III and IV fractures.

The demographic characteristics and fracture pattern in this study are consistent with previously published work on paediatric supracondylar humerus fractures [1, 18, 19, 20, 22, 23, 24]. The majority being posteromedially displaced

Type III fractures, we chose a standardized configuration of crossed pinning with 2 lateral and 1 medial wire in all cases to ensure maximal fracture stability. We ensured safe passage of the medial wire by extending the elbow prior to insertion, the fracture having been partially stabilized by 2 lateral wires. The absence of iatrogenic injury to the ulnar nerve in our patients supports the continued use of this method.

Our clinical and radiographic results showed unsatisfactory outcomes in only 2 out of 71 children. Time to definitive fixation was greater than 48 hours from injury in around one-third of children in this study. But functional outcomes do not appear to have been compromised by the delay. Various socioeconomic factors caused delay in initial presentation and institutional constraints such as operating room availability impacted the time to surgery. Our results suggest that if closed reduction and stable fixation can be achieved, a delay of up to 96 hours from the time of injury does not necessarily compromise the outcome. Early mobilization following pin removal at 3 to 4 weeks ensures satisfactory restoration of elbow motion.

Our study has several limitations. It is retrospective in nature and the children were managed by a large number of general orthopaedic surgeons of varying experience. We standardized the pin configuration and criteria for an acceptable closed reduction, in order to reduce inconsistencies in management. Our institution is located in a semi-rural area of a developing nation that caters to a large population of patients from the lower socioeconomic strata. This resulted in delays in presentation and time to surgery. In spite of these constraints, we were able to demonstrate clinical and radiographic outcomes that are comparable to those achieved in well-resourced orthopaedic departments with specialist paediatric orthopaedic surgeons.

## Conclusion

Closed reduction and percutaneous cross-pinning can be successfully employed for the majority of Type II and III supracondylar fractures of humerus in children. It provides good results in the hands of a general orthopaedic surgeon provided the technique is standardized within the institution, care is taken to avoid iatrogenic injury to the ulnar nerve and stable fixation is ensured with pin removal at 3 weeks and early mobilization of the elbow joint.

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