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## Dr. Abhijit Gholap

Assistant Professor, Department  
of Orthopedics, Smt. Kashibai  
Navale Medical College and  
General Hospital, Narhe, Pune,  
Maharashtra, India

## Dr. Ashim Wokhlu

Assistant Professor, Department  
of Orthopedics, Smt. Kashibai  
Navale Medical College and  
General Hospital, Narhe, Pune,  
Maharashtra, India

## Dr. Prashant Gholap

Assistant Professor, Department  
of Orthopedics, Dr. D.Y. Patil  
Medical College, Hospital and  
Research Center, Pimpri-  
Chinchwad, Maharashtra, India

## Gartlands type III supracondylar humerus fractures- cross k-wiring versus lateral k-wiring: A preliminary study

Dr. Abhijit Gholap, Dr. Ashim Wokhlu and Dr. Prashant Gholap

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### Abstract

**Introduction:** Supracondylar humerus fracture is one of the commonest fractures of upper limb in children. The commonly accepted treatment of this fracture is closed reduction with percutaneous pinning, although controversy persists regarding the optimal pin-fixation technique. The aim of this study was at comparing the functional outcome of percutaneous crossed pinning with lateral pinning for the treatment of type 3 Supracondylar humerus fractures in children.

**Materials and Methods:** The study was a single center, prospective, randomized controlled clinical trial in 30 cases. Study included Children in the age group of 3-18 years with closed fractures without any prior neurological deficit. All percutaneous pinning were done according to a uniform standardized technique. An analysis of result with regards to the ulnar nerve injury, carrying angle and range of motion was made in 15 children each with lateral pinning and crossed pinning. The primary study end points were major loss of reduction and iatrogenic ulnar nerve injury. Secondary study end points included radiographic measurements, clinical alignment, Range of motion, function and complications.

**Results:** There was no statistically significant difference with regards to functional outcome and range of motion, between the two groups. The average change in carrying angle was 2.6 degrees for crossed pinning and 2.8 degrees for the lateral pinning group. Pin tract infection (6.6%), ulnar nerve palsy (3.33%) and loss of reduction (5%) occurred as complications.

**Conclusion:** If a uniform standardized operative technique is followed, then the results of both the percutaneous fixation methods will be same in terms of safety and efficacy.

**Keywords:** Fracture, humerus, pediatrics, supracondylar, pinning

### Introduction

Supracondylar fractures of humerus are the most common elbow injuries in children and makes up 50-70% of all elbow injuries<sup>[1]</sup>. Treatment of supracondylar fractures has included closed reduction and casting in hyper- flexion, traction, open reduction and fixation with K-wiring and closed reduction and fixation with K-wiring. The high rate of complications associated with non-operative treatment led to the evolution of current techniques of percutaneous pinning for these difficult fractures over the past three decades. The commonly accepted treatment for type III fracture in children is closed reduction with percutaneous pinning, although controversy persists regarding the optimal pin-fixation technique.

The aim of present study is towards assessing and comparing the results of two methods of pinning – crossed K-wiring and the lateral K-wiring - presently followed in the management of these difficult fractures.

### Materials and Methods

This is a prospective interventional study of 30 cases done over a period of 2 years in patients aged between 3- 18 years of age having Gartland's Type III supracondylar humerus fractures without any prior neurovascular injury. All patients not fulfilling the above criteria and those with open fractures were excluded.

Immediately after the patient's arrival to the hospital a detailed clinical examination including a thorough neurovascular assessment was carried out. Standard antero-posterior and lateral radiographs of the involved elbow were taken and the fracture type was noted.

### Corresponding Author:

#### Dr. Prashant Gholap

Assistant Professor, Department  
of Orthopedics, Dr. D.Y. Patil  
Medical College, Hospital and  
Research Center, Pimpri-  
Chinchwad, Maharashtra, India

The cases were treated with closed reduction and percutaneous K-wiring, under the guidance of C-arm image intensifier. General anesthesia was employed for all cases. The patient was positioned supine on the operating table with affected limb being placed on a side table or over the sterile draped C-arm image intensifier. Then a stepwise closed manipulation was performed.

Assessment of reduction was done clinically by assessing the carrying angle and radiologically by taking antero-posterior, lateral and Jone's views. Maintenance of reduction was achieved either by passing two crossed K-wires from both the medial and the lateral epicondyles or by passing two K-wires from the lateral condyle in a parallel or crossed fashion. When crossed pinning was employed, the lateral pin was inserted first so that the medial pin can be placed with the elbow in less flexion so as to avoid injury to the ulnar nerve.

Once the pins were in place, the elbow was slightly extended and the adequacy of reduction was assessed with Antero-posterior and lateral images. After leaving about 1cm of the pins outside the skin, pins were cut off and bent and a well-padded posterior above elbow slab was applied with elbow flexed to 90 degrees or less as tolerated.

Immediately in the postoperative period, the neurovascular status of the limb was assessed. The 'K' wires were removed in 3 weeks' time as an out-patient procedure after assessment by Antero-posterior and lateral radiographs. The slab was continued till the end of 3 weeks. Active elbow exercises were started from third week as tolerated by the child. Passive motion and forceful manipulation were avoided. Follow – up was done regularly at 3 weeks, 3 months and 6 months.

During the follow-up period, pain, restriction of motion and satisfaction with appearance of elbow was assessed. Carrying angle and the range of flexion and extension of both the injured and the normal elbow was measured with a goniometer and recorded. A neurological examination was performed to note recovery in case of a neural deficit being noted previously.

Follow-up X-rays were done in the immediate post-operative period, at 3 weeks and at subsequent visits, to note any displacement, mal-alignment and fracture union.

Finally, the functional outcome was assessed on the basis of Mitchell and Adams criteria<sup>[1]</sup>. The outcome was considered excellent, when the elbow had normal shape and movement of the elbow with a change in carrying angle of less than 5 degrees and limitation of elbow movement of less than 10 degrees. Results were graded as good, when the change in the carrying angle was between 5-15 degrees and limitation of movement between 10-20 degrees. When the change in carrying angle was more than 15 degrees and limitation of movements more than 20 degrees, the results were considered poor.

**Table 1:** Mitchell and Adam Criteria

Result	Loss of ROM	Loss of CA
Excellent	<10 degrees	<5 degrees
Good	10-20 degrees	5-15 degrees
Poor	>20 degrees	>15 degrees

## Results

A total number of 30 cases were included in this study. Age ranged from 3- 18 years with mean age of 6.83 years. 21 (70%) males and 9 (30%) females were included. Left elbow was more affected than right side. 23 (76.66%) had Postero-medial displacement and 7 (23.33%) had postero-lateral displacement. 15 patients underwent cross K-wiring and 15 underwent lateral K-wiring.

**Table 2:** Fracture type

Fracture type	No. of patients	Percentage (%)
Postero-Medial (PM)	23	76.66
Postero-Lateral (PL)	7	23.33
Total	30	100

Analysis revealed that the mean loss of range of motion in cross K-wiring group was 7 degrees and that in the lateral K-wiring group 8.33 degrees, which was not statistically significant ( $t=1.092$ ,  $p>0.05$ ).

**Table 3:** Loss of ROM

Type of Fixation	N	Mean	Std. Deviation	T
MLP	15	7	2.646	$t=1.092$
LP	15	8.33	3.922	$p>0.05$ NS

The mean loss of carrying angle in the cross K-wing group was 2.8 Degree and that in lateral K-wiring group was 2.3 degrees, which was also not statistically significant ( $t= 0.274$ ,  $p>0.05$ ).

**Table 4:** Mean Loss of Carrying Angle

Type of Fixation	N	Mean	Std. Deviation	T
MLP	15	2.8	1.859	$t=0.274$
LP	15	2.6	2.131	$p>0.05$ NS

The following complications were observed in our study were Pin tract infection (2 cases), Ulnar Nerve Injury (1 case) and Loss of Reduction (1 case), occurred as the complications.

**Table 5:** Complications

Type	Frequency	Percentage (%)
Pin Tract Infection	2	6.66%
Ulnar nerve injury	1	7%
Loss of Reduction	1	7%
Nil	26	86.66%

There were 13 excellent and 2 good results in Crossed K-wiring group and 12 excellent and 3 good results in Lateral K-wiring group. No poor results were seen in any groups. The difference in functional outcome in the both the groups was not statistically significant (Chi-square (df) = 0.240,  $p>0.05$ ).

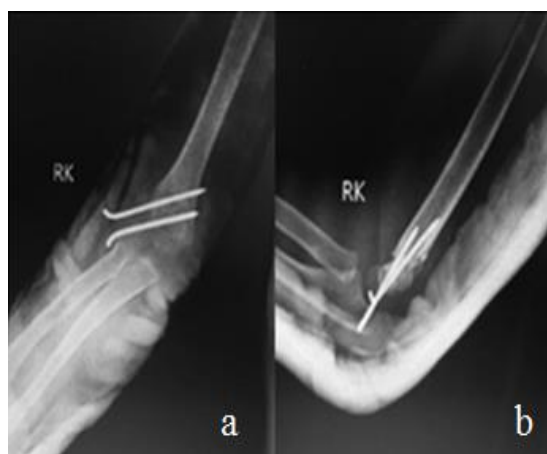
**Table 6:** Functional Outcome

Type of Fixation	MLP	LP
Good	2	3
Excellent	13	12

\*Chi-square (df) = 0.240 (1),  $p>0.05$  (Not Significant)



**Fig 1:** Post-op Cross K-wiring



**Fig 2:** Post-op Lateral K-wiring Radiographs (a) AP and (b) Lateral views

## Discussion

Extension supracondylar fractures are the most common fractures around the elbow in children and adolescents. The treatment of more severely displaced (Gartland type II and type III) fractures remains controversial. Primary closed reduction and percutaneous pinning is the preferred treatment for type-III injuries with the lowest rate of compartment syndrome of the forearm and residual deformity<sup>[2]</sup>.

The technique of pinning is controversial. Percutaneous cross pinning is theoretically the more stable biomechanical construct<sup>[3]</sup>. A precise technique of medial pinning avoids injury to the ulnar nerve. On the other hand, many cases of palsy of the ulnar nerve have been reported with the use of a medial percutaneous K-wire, causing direct injury to the nerve or a delayed neuropathy possibly due to contusion of the nerve with oedema, or stretching of the nerve over the medial pin<sup>[4-6]</sup>.

Lateral pinning technique by two parallel pins has to be strictly parallel and separated by a distance of more than 10 mm<sup>[2]</sup>. If wires are positioned too closely it is equivalent to single wire construct that allows rotation of the distal fragment around the axes of the wire<sup>[7]</sup>.

Cross pinning technique was performed after an open medial approach because of its ease and safety to ulnar nerve by taking precautions such as inserting the lateral pin first and avoiding hyper-flexion of elbow and visualizing the ulnar nerve by taking a small incision over the medial epicondyle before medial K-wire placement.

Our treatment protocol gave excellent or good results in all of results of our treatment protocol with other published series,

we consider it to be a safe method, even when undertaken by less experienced surgeons.

Erin Madsen in 1955, advised three conditions to be present for a good end result-an exact reduction, a safe fixation and a careful follow-up care<sup>[8]</sup>.

Bajaj *et al.* in 1997, in a review of different modalities of management of displaced supracondylar fractures in children, proposed that treatment with a cast is inappropriate in the management of these fractures either as initial or the subsequent method of treatment. Crossed medial and lateral percutaneous K wire fixation is advocated as the treatment of choice for the majority of displaced fractures keeping two lateral 'K' wires for the swollen elbow in which medial condyle is barely palpable<sup>[9]</sup>.

In a comparison of percutaneous crossed medial and lateral pinning with lateral pin fixation alone using two parallel pins, we did not find any clinically significant biomechanical advantage of one pinning technique over the other, confirming the experience of Topping *et al.*<sup>[10]</sup>.

Skaggs *et al.*<sup>[23]</sup> in 2001, studied results of operative treatment of supracondylar fractures in children and the consequences of pin placement. Their results showed that there was no difference with regard to maintenance of fracture as seen on anteroposterior and lateral radiographs between the crossed pins and lateral pins. The configuration of pins did not affect maintenance of reduction. They concluded that fixation with only lateral pins is safe and effective for both type II and type III fractures. The use of only lateral pins prevents iatrogenic ulnar nerve injury. They did not recommend the routine use of crossed pins. If a medial pin is used, the elbow should not be hyperflexed during its insertion to avoid ulnar nerve injury<sup>[11]</sup>.

In our series, the mean loss of range of movement was 7 degrees (range 0-16degrees) for Crossed K-wiring group. This compared favorably with series by Nacht *et al.*<sup>[12]</sup> (7.8 degrees). For Lateral K-wiring group, the mean loss of range of movement was 8.33 degrees (range 0-14 degrees) which compares favorably with the series by Aronson and Prager<sup>[13]</sup> which demonstrated a loss of range of movement of 10 degrees.

Pin tract infection with pin loosening occurred in two patients in our series which was treated with appropriate antibiotics and regular wound dressing. Infection was fully eradicated in both the patients. There was one case of iatrogenic ulnar nerve injury following cross K-wiring leading to paraesthesia along the Ulnar nerve distribution, which subsided spontaneously.

Though the number of patients were relatively small, all operations were performed by or under the direct supervision of one surgeon and at a single institution, thus the results may not be reproducible by other surgeons or at other institutions. On the other hand, the results showed that both the techniques provides good results with minimal morbidity.

## Conclusion

In our study we did not find any significant advantage of cross pinning over lateral percutaneous pinning. Lateral pinning proved to be a safe and relatively easier approach in the treatment of displaced supracondylar humerus fractures in children without any risk of injuring the ulnar nerve and did not have any significant difference in terms of the results of functional outcome and cosmetic deformity.

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