

**Original Article**  
**Orthopaedics**

# A PROSPECTIVE STUDY OF CROSSED VERSUS LATERAL PINNING IN THE TREATMENT OF DISPLACED FRACTURES OF SUPRACONDYLAR HUMERUS IN CHILDREN

Vinaykumar Babaleshwar<sup>1</sup>, Ramanagouda Biradar<sup>2</sup>, O.B. Pattanashetty<sup>3</sup>, Abhishek Shenoy<sup>4</sup>

<sup>1</sup>- Assistant Professor of Orthopedics, Shri B.M. Patil Medical college hospital and Research Centre, Bijapur

<sup>2</sup>- Associate Professor of Orthopedics, Shri B.M. Patil Medical college hospital and Research Centre, Bijapur

<sup>3</sup>- Professor and HOD of Orthopedics, Shri B.M. Patil Medical college hospital and Research Centre, Bijapur

<sup>4</sup>- Junior Resident, Department of Orthopedics, Shri B.M. Patil Medical college hospital and Research Centre, Bijapur

**Corresponding Author:**

Dr. Ramanagouda Biradar

Associate Professor of Orthopedics,  
Shri B.M. Patil Medical college hospital and Research Centre,  
Bijapur

Email: biradarrb97@gmail.com

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**Abstract:**

**Background-** Pediatric age group has the highest incidence of supracondylar fracture of humerus, the most common being the extension type. A precise evaluation and planning is required for deciding the modality of treatment for these fractures. They are most widely managed by utilizing two methods; closed reduction with crossed pinning and closed reduction with lateral pinning. The task at hand remains to determine the superiority of either of these techniques over the other.

**Materials and methods-** A prospective, single blinded, randomized control trial with 68 cases, out of which 46 were boys and 22 were girls was conducted. Gartland Type III supracondylar fractures were included in this study. A detailed primary post-operative assessment for loss of reduction and iatrogenic ulnar nerve injury was done. Clinical outcome, elbow range of motion, radiographic measurement, Flynn's grading and complications were the secondary parameters which were assessed.

**Results-** Both groups exhibited no major loss of reduction. Change of Boumann angle was statistically insignificant. Metaphysial-Diaphysial angle, Flynn grade, carrying angle and total elbow range of motion between the two groups showed no statistically significant difference.

**Conclusion-** Lateral pin fixation offers parallel results in terms of functional and radiological outcomes and nearly equal mechanical stability compared to crossed pinning without the added shortcoming of possibility of iatrogenic

ulnar nerve injury.

**Key words:** Supracondylar fracture, cross pinning, lateral pinning, children

## Introduction

Pediatric age group between 4 to 7 has the highest incidence of supracondylar fracture of humerus, the most common being the extension type (95%)<sup>1</sup>. The most commonly used classification is based on degree of displacement which is known as Gartland classification<sup>2</sup>. According to this classification they are classified as follows: Type 1-Undisplaced, Type 2-Displaced with intact posterior cortex and Type 3-Displaced with no cortical contact.

A precise evaluation and planning is required for deciding the modality of treatment for these fractures<sup>3</sup>. The current treatment of choice for most displaced supracondylar fractures in children is closed reduction followed by percutaneous pinning under fluoroscopic guidance<sup>4,5</sup>. Percutaneous pinning has proven to be the least invasive and safest techniques for bone healing. Crossed Medial and Lateral pinning technique and Lateral pinning technique have been most widely used for management. It is characterized by a low incidence of complications (2%–8%) and mainly consisting of pin migration under the skin, pin infections and loss of fracture reduction<sup>6,7</sup>. The task at hand remains to determine the superiority of either of these techniques over the other.

The aim of this study is evaluation and comparison of the two techniques with respect to parameters such as Stability, Functional outcome and Complications.

## Materials And Methods

A prospective, single blinded, randomized control trial in the Department of Orthopaedics, Shri B.M. Patil Medical College Hospital and Research Centre, Vijayapura, Karnataka, India from July 2014-

November 2017 was conducted after obtaining approval from College Ethics Committee. Written informed consent was undertaken from parents/legal guardians before enrollment to the study.

Inclusion criteria for the study were as follows- Age- 4 to 12 years, Closed Gartland type 3 supracondylar humerus fracture, duration of injury- Less than 4 days and intact neurological and vascular status of affected limb. Exclusion criteria were as follows- Undisplaced fracture, Flexion type supracondylar humerus fractures, Open fractures, associated ipsilateral limb fracture and previous ipsilateral elbow injury.

A total of 68 patients with displaced supracondylar humerus fractures were admitted to the orthopaedic ward either on outpatient or emergency basis. Patients were selected for lateral entry or medial-lateral entry using a randomization table. The study included 46 boys and 22 girls with a mean age of 8.4 years. All patients enrolled had Type 3 supracondylar humerus fractures based on Gartland Classification<sup>2</sup>. Above elbow slabs were applied to all patients upon admission. All patients were operated within 72 hours by operating surgeons on or above the post of Assistant Professor with more than 3 years experience.

Rockwood and Wilkins standard technique was used for closed reduction<sup>8</sup>. Reduction was confirmed in both True Antero-Posterior and Lateral plane using an image intensifier. Standard surgical techniques in terms of size and location of pin as well as position of the elbow for pin placement were used. Surgery was performed under general anaesthesia with injured upper limb on the side of the table.

## Method of lateral pinning

After reduction evaluation, two pins were inserted from the lateral aspect of the elbow. The pins were parallel or divergent and engaged the medial cortex. For insertion of lateral pins, the elbow was kept hyperflexed and in pronation. Fracture reduction and stability was assessed, after fully extending the elbow, clinically as well as radiologically under image intensifier.

## Method of Crossed pinning

After reduction evaluation, the lateral pin was inserted first using a approach similar to lateral pinning technique. After extending the elbow to less than 90 degree position, the medial pin was inserted. The surgeon palpated the ulnar nerve and pushed it posteriorly with the thumb for medial pin insertion. Two patients required a separate incision over the medial epicondyle to explore the ulnar nerve. To avoid skin migration, the excess length of the pin was cut and bent. Post operative radiographs were taken immediately to determine the maintenance of reduction. With the elbow in 90 degree flexion, an above elbow slab was applied.

All the crossed medial-lateral pinning was done according to the mini-open technique described by Green et al.<sup>9</sup>. All the lateral entry pinning was done according to the technique described by Arosen and Prager<sup>10</sup>.

The patients were discharged on 2<sup>nd</sup> post operative day. Removal of both slabs and pins were done after 5 weeks following which elbow range of motion exercises were encouraged. They were followed up at weeks and subsequently at 6 months for clinical evaluation of carrying angle, elbow range of motion, neurovascular

complications and pin tract infections along with a radiological evaluation of fracture displacement, Boumann angle and humero-capitellar angle.

Flynns criteria (Table 1) was used to grade the results at the end of 6 months<sup>11</sup>. The results were graded as excellent, good, fair or poor

The final outcome was compared between the two pinning techniques based on Flynns criteria. SPSS version 13.0 was used for data

analysis. Descriptive statistics such as frequency, percentage, mean and standard deviation was used. To compare the categorical data, Chi square test and fishers exact test was used. Independent sample t-test was used to compare continuous data between two groups with level of significance set at p=0.05.

### Results

The study consisted of 68 patients

amongst which 38 were treated with lateral pinning and 30 were treated with cross pinning technique based on randomization. The two groups had no noteworthy differences based on baseline characteristics such as age, gender and type of fracture (Table 2). Fracture union among the patients had a mean period of 5.2 weeks.

**Table 1- Final outcome based on Flynns criteria**

Results	Lateral		Crossed		p value
	N	%	N	%	
Excellent	33	86.8	18	60.0	0.039
Good	4	10.5	9	30.0	
Fair	1	2.6	3	10.0	
Total	38	100.0	30	100.0	

**Table 2- Mean age group**

Mean Age (Yrs)	Lateral		Crossed		p value
	Mean	SD	Mean	SD	
		6.7	1.9	7.4	1.7

**Table 3- Gender**

Sex	Lateral		Crossed		p value
	N	%	N	%	
Male	25	65.8	22	73.3	0.504
Female	13	34.2	8	26.7	
Total	38	100.0	30	100.0	

**Table 4- Loss of Baumann angle**

Baumann angle loss	Lateral		Crossed		p value
	N	%	N	%	
<3°	10	26.3	12	40.0	0.075
3-4°	11	28.9	5	16.7	
5-6°	16	42.1	8	26.7	
>6°	1	2.6	5	16.7	
Total	38	100.0	30	100.0	

**Table 5- Range of motion angle loss at elbow**

ROM angle loss at elbow	Lateral		Crossed		p value
	N	%	N	%	
<3°	20	52.6	14	46.7	0.316
3-4°	9	23.7	4	13.3	
5-6°	5	13.2	4	13.3	
>6°	4	10.5	8	26.7	
Total	38	100.0	30	100.0	

**Image (1) showing pre-operative and post operative X-ray of supracondylar fracture treated by crossed pinning**



**Image 1**

**Image (2) showing pre-operative and post operative X-ray of supracondylar fracture treated by lateral pinning**



Baseline characteristics of patients who underwent either lateral pinning or cross pinning (n=68) using Flynn's criteria. Amongst the patients who were treated with Lateral pinning technique, 33 (86.8%) patients had an excellent outcome, 4 (10.5%) patients had a good outcome while 1 (2.6%) had fair outcome. Correspondingly, amongst patients treated by the cross pinning technique, 18 (60%),

9 (30%) and 3 (10%) were accorded excellent, good and fair outcomes respectively. Superficial Pin Tract infections developed in four patients which were treated effectively with regular dressings and oral antibiotics. Iatrogenic Ulnar nerve injury wasn't observed in any of the patients who underwent the crossed pinning technique. None of the patients among both the groups developed any neurovascular complications during the follow up

### Discussion

Among the fractures around the elbow in the Paediatric age group, Supracondylar fracture of Humerus is the most common.<sup>12,13</sup> Neurovascular complications are commonly associated with these fractures<sup>14,15</sup>. In order to avoid severe complications, aggressive and apt treatment is advised. Type I fractures according to Gartland classification can be treated conservatively by immobilization using an above elbow cast<sup>16,17</sup>. The treatment of Gartland type II (displaced) is controversial. Traction, closed reduction and casting, closed reduction and percutaneous pinning and open reduction and pinning are the various methods which have been described for the treatment of displaced (Gartland Type II) Supracondylar Humerus fractures.

Parikh et al. suggested closed reduction and casting for the treatment of Extension Type II Supracondylar Humerus fractures.<sup>18</sup> Dorgan's Technique (Lateral cross pinning technique) was also recommended by some authors.<sup>19,20,21</sup> Nevertheless, we don't have any familiarity with this technique. Li et al. suggested a minimally invasive technique for reduction of severely displaced supracondylar Humerus fractures

using a mosquito forcep<sup>22</sup> Fahmy et al. described the treatment of extension type Supracondylar Humerus fractures using a Posterior intrafocal pinning technique. A biomechanical model to evaluate the four osteosynthesis techniques for management of Supracondylar fractures was described by Weinberg et al. which found external fixators as a good substitute to cross pinning when fracture reduction is tricky due to swelling<sup>23</sup>.

A few Studies suggested that the timing of surgery for an uncomplicated displaced supracondylar humerus fracture can be delayed upto 24 hours.<sup>3,24</sup> In a study by Ramachandran et al. they cautioned against delaying the surgery in uncomplicated supracondylar fracture of Humerus due to the threat of development of compartment syndrome<sup>25</sup>. In our study, none of the study participants had any evidence of neurovascular complications upon presentation to the hospital as well as during hospital stay and all of them were operated within 24 hours of Hospitalization. An intact posterior periosteum prevents rotational misalignment among Type II fractures but the fractures are completely displaced and are innately unstable in Type III fractures. To add to this, the presence of a comminution of medial cortex which is generally seen adds to this instability. This is by far the most important reason put forth by the followers of crossed pinning technique along with its higher torsional rigidity<sup>26,27</sup>. Many studies propose that the lateral pinning is as good as crossed pinning<sup>28,29,30</sup> which also diminishes the incidence of Iatrogenic Ulnar nerve injury.

The occurrence of iatrogenic ulnar nerve injury varies significantly based on type of pin insertion technique. A systematic review done by Brauer et

al. found the probability of iatrogenic nerve injury to be 1.84 times higher in patients who undergo crossed pinning techniques compared to patient who underwent lateral pinning<sup>31</sup> Nonetheless, none of the patients who underwent crossed pinning technique in our study had any incidence if iatrogenic ulnar nerve injury. In addition, a separate medial incision is advocated to explore the ulnar nerve for medial pin insertion. However, only two patients in our study who had gross swelling required a medial incision as the swelling hindered the palpation of the Ulnar nerve. The Ulnar nerve was palpated and pushed posteriorly with the thumb in the rest of the patients before the insertion of the medial pin.

There was no significant disparity between the two methods of pinning techniques used in this study based on the clinical and functional outcome. The results of this study advocate the use of lateral pinning for displaced Supracondylar humerus fractures (Gartland type II and type III). Prospective design, standardized protocol for reduction of fracture, pin placement and follow up of the patients is the strength of this study. The limitations of this study is the lack of randomization regarding the selection of pinning technique as this was decided by the operating surgeon at the time of surgery. A relatively shorter follow up further weakens this study. Nonetheless this study strengthens the conclusions of other authors<sup>28,29,30</sup> with respect to the usage of lateral pinning technique in displaced supracondylar fractures of humerus in children.

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