

A Comparative Study of Pinning by Kirschner Wire (K-WIRE) to Manage Supracondylar Fracture of Humerus in Children, Criss Cross (Medial and Lateral) Versus Lateral Approach at a Tertiary Care Centre

Dr. Manjunath G.¹, Dr. Purushotham K.², Dr. Krishnamurthy T.³

¹Postgraduate, Department of Orthopaedics, Ambedkar Medical College, Bangalore, India

²Professor and Head of the Department, Department of Orthopaedics, Ambedkar Medical College, Bangalore, India

³Assistant Professor, Department of Orthopaedics, Ambedkar Medical College, Bangalore, India

Abstract: ***Aim of the study:** The commonly accepted (gold standard) treatment of type II and III extension type supracondylar fracture of humerus in children is closed reduction with percutaneous pinning. The present study aimed at comparing the functional outcome of percutaneous criss-crossed pinning with lateral pinning. **Materials and Methods:** An analysis of results with regard to ulnar nerve injury, carrying angle and range of movements was made in 15 children with lateral pinning and 15 children with crisscross pinning. Functional outcome was graded according to Flynn's criteria. **Results:** There was no statistically significant difference with regard to functional outcome between the two groups. Both methods produced satisfactory results in all cases. There was no incidence of ulnar nerve injury. The difference in the loss of carrying angle and difference in loss of motion between two groups was not statistically significant. **Conclusion:** Percutaneous pinning is an excellent method of treatment for type II and III supracondylar fractures in children. We found that if a uniform standardized operative technique is followed in each method, then results of both percutaneous fixation methods will be same in terms of safety and efficacy.*

Keywords: crisscross pinning, humerus, lateral pinning supracondylar fracture

1. Introduction

Supracondylar humeral fractures (SCHFs) are one of the most common types of elbow fractures in the paediatric population between 5 and 8 years old¹. It has been reported that SCHFs occur with almost equal frequency comparing females and males². It's known for accounting approximately 10% of all fractures in children³ and 70% of all paediatric elbow injuries⁴. Children are susceptible to this fracture, due to the bending function of the elbow, the weak metaphyseal sclerotin of the distal humerus, and the thin ridge of the metaphyseal bone between the coronoid fossa and the olecranon fossa. It maybe associated with complications including neurovascular injuries, elbow stiffness, fascial compartment syndrome, malunion and especially, elbow varus deformities⁵. It has been reported that more than 95% of all SCHFs are extension-type injuries that occur during falls on an outstretched hand⁶. An SCHF has a great impact on the function and appearance of the elbow joint in children^{7,8}. The main treatments for SCHF include closed reduction and internal fixation using percutaneous pinning. But, there are still some arguments regarding the choice of pinning configuration for fixating the fractures. Although crossed pinning or lateral pinning using two or three pins is the most common pinning configuration for SCHF, surgical outcomes of these two methods in terms of which one method produces the best functional outcomes remains controversial^{9,10}. The two key factors for comparing the functional outcomes of the methods are elbow stability and the potential risk of iatrogenic ulnar nerve injury^{11,12}.

Medial/ lateral crossed pinning fixation was reported to have better mechanical stability than lateral fixation¹¹. However, iatrogenic injury of the ulnar nerve after medial pinning is a potential complication. Although several meta-analyses of medial/lateral crossed pinning versus lateral pinning for SCHF have been reported^{11,12,13,14,15,16}, the conclusions drawn were based on the results from nonrandomized controlled trials (nRCTs), increasing the likelihood of biases. This study was aimed to analyse the effect of lateral pinfixation and medial/lateral crossed pin fixation on iatrogenic injuries, functional outcomes, and complications in children with SCHFs.

2. Materials and Methods

This was a prospective, comparative study in the Department of Orthopaedics, DR. B.R Ambedkar Medical College, Bengaluru from August 2019 to December 2020. after obtaining ethical committee approval. Full written informed consent was taken from parents/legal guardian before participating in this study. In this study 30 patients aged 3-12 years, with supracondylar fracture of humerus were treated with either later pinning or both lateral and medial pinning by K wire.

Inclusion Criteria:

- Children and adolescent patients from 3 to 12 years with Xray evidence of Type 2 or Type 3 supracondylar fracture of humerus.
- Children who are medically fit for surgery.

Volume 11 Issue 8, August 2022

www.ijsr.net

Licensed Under Creative Commons Attribution CC BY

- Duration of injury <4 days, and
- Competent neurological and vascular status of the affected limb.

Exclusion Criteria:

- Patients less than 3 years of age and more than 12 years of age.
- Patients with type 1, supracondylar fracture of humerus.
- Children who are medically unfit/ unwilling for surgery.
- Children with congenital anomaly/bone disease
- Duration of injury >4 days,
- Inability to take part in postoperative rehabilitation,
- Open fractures, medical contraindications to surgery, fracture
- requiring open reduction or neurovascular exploration, previous ipsilateral elbow fracture, and floating elbow injury.

A total of 35 patients with supracondylar humerus fractures were admitted to the orthopedic wards either through the outpatient department or emergency services. Of the 35 patients, 5 were excluded from the present study as they did not fulfill the inclusion criteria. These included compound fractures (1 case), aged >12 years (2 cases), were not fit for surgery/refused surgery (1 case), were associated with ipsilateral forearm fractures (6 cases), or were being treated conservatively for Gartland I fracture (1 case). The remaining 30 patients were enrolled in the study. The method of patient selection for lateral entry or medial-lateral entry was random, analysis included 30 patients who were followed up for at least 6 months at 3 weeks, 6 weeks and 6 months. All the children with suspected supracondylar fractures of the elbow were assessed for vascular and neurological status. Anteroposterior and lateral radiographs were performed. All displaced supracondylar fractures were admitted and the injured elbow was immobilized in an above-elbow splint with the elbow at 30–45 of flexion and limb elevation. Surgical techniques were standardized in terms of pin location, pin size (weight <20 kg size 1.5 mm; more than 20 kg size 2 mm), stability on the table and the position of the elbow for pin placement. Surgery was performed by a senior orthopedic surgeon who was well trained in this technique. General anesthesia was used for all patients with the injured upper limb on the side of the table. The injured elbow was placed on the plate of the image intensifier which was adequate for the surgery due to the small size of the elbow. Closed reduction was performed and confirmed by the image intensifier. First, longitudinal traction was applied with the elbow in hyperextension and the forearm in supination. While the traction was maintained, the medial or lateral displacement was corrected by applying a valgus or varus force at the fracture site. The posterior displacement of the distal fragment was then corrected by applying a force to the posterior aspect while the elbow was gently hyperflexed and the elbow was secured in hyperflexion, and the reduction was confirmed by the image intensifier. The medial pin was placed directly through the apex of the medial epicondyle. The lateral pin was placed at the center of the lateral epicondyle. For the lateral fixation technique, two or three pins were inserted from the lateral aspect of elbow across the lateral cortex to engage the medial cortex keeping the elbow in hyperflexion.

Pins were placed either in parallel or divergent configuration with adequate separation at the fracture site. For the medial-lateral fixation technique, first the lateral pin was inserted from lateral cortex to engage the medial cortex keeping the elbow in hyperflexion. The elbow was then extended to <90 degree and the ulnar nerve rolled back with the opposite thumb and the medial pin was inserted to engage the lateral cortex with the elbow in >90 degree of flexion. The pin configuration was considered to be acceptable if one pin was placed in the lateral column and another in the central or medial column. If this was not achieved, we realigned the configuration by changing the pin placement. In the coronal plane, the pins were placed at an angle of 30 with the long axis of the humerus.

After the pins were placed, the elbow was extended and the carrying angle was measured and compared with that on the non affected side. The adequacy and stability of the reduction were checked under image intensification. The pins were bent to prevent migration and cut off outside the skin to allow removal in the outpatient clinic.

A single preoperative parenteral dose of cefuroxime was given at the time of induction and postoperatively, and oral cefuroxime was given for five days at the time of discharge. Postoperatively, the extremity was placed in a well padded posterior splint with the elbow flexed to <90. Any patients with immediate postoperative ulnar nerve deficit were investigated and the pin was placed in another location. For all patients, immediate postoperative radiographs were taken to determine the maintenance of the reduction. The operated limb was elevated and carefully observed at regular intervals for any neurovascular deficit. During follow-up in the outpatient department, clinical radiological evaluation was performed for maintenance of reduction (at first follow-up) and functional outcome, which included passive range of motion, measurement of carrying angle, Baumann angle, metaphyseal–diaphyseal (MD) angle, neurovascular status, superficial and deep infection, and the necessity to re-operate. Clinical evaluation was graded according to carrying angle and elbow range of motion using the criteria of Flynn et al. (14). Radiographic evaluation was performed by anteroposterior and true lateral view at 1, 3, and 6 weeks and at 6 months. In the sixth week, the pins were removed without anesthesia. At 1.5 months and 6-month follow-up, the children were evaluated for full function, minor limitation of function and major loss of function. The final results were graded as excellent, good, fair and poor, according to the loss of range of motion and loss of carrying angle using the criteria of Flynn et al. Loss of reduction was graded by the loss of Baumann angle using the classification of Gordon et al. [5]

3. Observation and Results

All patients were followed until fracture union occurred. The follow up period ranged from 3 weeks to 6 months. Results were analyzed, both clinically and radiologically.

The results were evaluated according to the TENS SCORING SYSTEM used by FLYNN et al as shown in Table I.

Table 1: The Scoring Criteria for TENS

	Excellent	Successful	Poor
Limb length discrepancy	<1.0cm	<2cm	>2cm
Sequence Disorder	5°	10°	>20°
Pain	Absent	Absent	Present
Complications	Absent	Mild	Major Complication / Increased Morbidity

Majority of the patients i.e. 16 (66%) were in the age group of 4-6 years. The youngest patient was 3 years and the oldest was 12 years and the mean age of study was 10.2 years

Table 2: Age Incidence

AGE	Number of Patients		Percentage	
	CP	LP	CP	LP
3-6 yrs	6	10	40%	66.66%
7-9 yrs	7	4	46.66%	26.66%
10-12 yrs	2	1	13.33%	6.66%

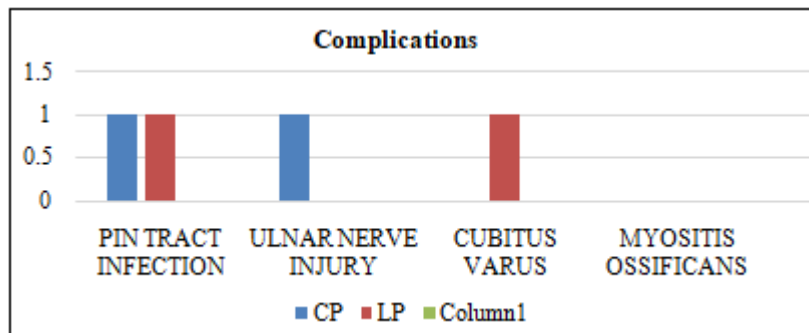


Table 3: Complications

	Frequency		Percentage	
	CP	LP	CP	LP
Pintract Infection	1	0	6.66%	0
Ulnar Nerve Injury	0	0	0	0
Cubital Varus Deformity	0	1	0	6.66%
Myositis Ossificans	0	0	0	0
Total	1	2	6.66%	6.66%

4. Conclusion

In our study we observed that close reduction and percutaneous pinning is an excellent method of treatment in type II and III supracondylar fractures in children.

This study shows that there is no significant difference with respect to fracture characteristics, loss of reduction on follow-up, pin tract infection except for risk of iatrogenic ulnar nerve injury in traditional criss cross pinning. Functional outcome in both the groups appears to be the same. In conclusion we found that if a uniform standardized operative technique is followed in each method then the results of both of percutaneous fixation methods will be same in terms of safety and efficacy.

However the stability of fracture cannot be decided on preoperative radiographs.

If the fracture is grossly unstable on intra operative stress testing it is necessary to fix the medial side as well.

References

- [1] Cheng JC, Lam TP, Maffulli N. Epidemiological features of supracondylar fractures of the humerus in Chinese children. *J PediatrOrthop B*. 2001;10(1): 63-7.
- [2] Lu D, Wang T, Chen H, Sun LJ. Management of pin tract infection in pediatric supracondylar humerus fractures: a comparative study of three methods. *Eur J Pediatr*. 2017;176(5):615-20.
- [3] Piskin A, Tomak Y, Sen C, Tomak L. The management of cubitus varus and valgus using the Ilizarov method. *J Bone Joint Surg Br*. 2007;89:1615-9.
- [4] Otsuka NY, Kasser JR. Supracondylar fractures of the humerus in children. *J Am AcadOrthop Surg*. 1997;5(1):19-26.
- [5] Gadgil A, Hayhurst C, Maffulli N, Dwyer JS. Elevated, straight-arm traction for supracondylar fractures of the humerus in children. *J Bone Joint Surg Br*. 2005;87:82
- [6] Mahan ST, May CD, Kocher MS. Operative management of displaced flexion supracondylar humerus fractures in children. *J PediatrOrthop*. 2007;27(5): 551-6.
- [7] Kocher MS, Kasser JR, Waters PM, Bae D, Snyder BD, Hresko MT, et al. Lateral entry compared with medial and lateral entry pin fixation for completely displaced supracondylar humeral fractures in children. A randomized clinical trial. *J Bone Joint Surg Am*. 2007;89(4):706-12.
- [8] Farrow L, Ablett AD, Mills L, Barker S. Early versus delayed surgery for paediatric supracondylar humeral fractures in the absence of vascular compromise: a systematic review and meta-analysis. *Bone Joint J*. 2018;100- B(12):1535-41.

- [9] Dekker AE, Krijnen P, Schipper IB. Results of crossed versus lateral entry Kwire fixation of displaced pediatric supracondylar humeral fractures: a systematic review and meta-analysis. *Injury*. 2016;47(11):2391–8.
- [10] Lee KM, Chung CY, Gwon DK, Sung KH, Kim TW, Choi IH, et al. Medial and lateral crossed pinning versus lateral pinning for supracondylar fractures of the humerus in children: decision analysis. *J PediatrOrthop*. 2012;32(2):131– 8.
- [11] Zhao JG, Wang J, Zhang P. Is lateral pin fixation for displaced supracondylar fractures of the humerus better than crossed pins in children? *Clin OrthopRelat Res*. 2013;471(9):2942–53.
- [12] Zionts LE, McKellop HA, Hathaway R. Torsional strength of pin configurations used to fix supracondylar fractures of the humerus in children. *J Bone Joint Surg Am*. 1994;76(2):253–6.
- [13] Loizou CL, Simillis C, Hutchinson JR. A systematic review of early versus delayed treatment for type III supracondylar humeral fractures in children. *Injury*. 2009;40(3):245–8.
- [14] Lin G, Zhang XN, Yang JP, Wang Z, Qi Y, Shan Z, et al. A systematic review and meta-analysis of two different managements for supracondylar humeral fractures in children. *J Orthop Surg Res*. 2018;13:141.
- [15] Na Y, Bai R, Zhao Z, Han C, Kong L, Ren Y, et al. Comparison of lateral entry with crossed entry pinning for pediatric supracondylar humeral fractures: a meta-analysis. *J Orthop Surg Res*. 2018;13(1):68.
- [16] Woratanarat P, Angsanuntsukh C, Rattanasiri S, Attia J, Woratanarat T, Thakkinstian A. Meta-analysis of pinning in supracondylar fracture of the humerus in children. *J Orthop Trauma*. 2012;26(1):48–53.