

Comparison of cross pinning versus lateral three pins in type three supracondylar fracture of distal humerus in children



Krishna Sapkota¹, Krishna Wahegaonkar², Niraj Ranjeet¹, Pabin Thapa³, Upendra Jung Thapa, ³Pratyenta Raj Onta³

¹Assistant Professor, Department of Orthopedics, Manipal Teaching Hospital, Phulbari, Pokhara, Nepal, ²Associate Professor, Department of Orthopedics, Manipal Teaching Hospital, Phulbari, Pokhara, Nepal, ³Lecturer, Department of Orthopedics, Manipal Teaching Hospital, Phulbari, Pokhara, Nepal

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ABSTRACT

Background: Supracondylar fracture of distal humerus is the most common paediatric fracture. Type III supracondylar fractures should be treated with anatomical reduction and stable Kirschner wire (K- wire, pin) fixation to prevent the cosmetic deformity. The configuration of wires is debatable. Although two crossed K-wires are bio-mechanically stable, there is a risk of iatrogenic ulnar nerve injury. Lateral 3 K-wires is a good alternative. This study was done to compare the outcome of cross K- wire and lateral 3 K-wires in terms of stability. **Materials and Methods:** This is a prospective study done in Manipal Teaching Hospital. All the Gartland type 3 supracondylar fractures of the distal humerus were treated with closed reduction and stabilized with K wires. In Group I, fractures were stabilized with cross K wire fixation and in group II they were stabilized with 3 lateral K-wires. The patients were followed up at 4-5 weeks for wire removal and at 3 months and 6 months after surgery. Baumann's angle, a functional outcome as per Flynn's criteria, and range of motion were recorded in each visit. Outcomes were compared in term of displacement of fracture. **Result:** Seventeen children in each group were taken up for the study. There were no significant differences in term of patients and fracture character. No patients had significant loss of reduction at final follow up. There is no statistically significant difference seen in mean changes of Bauman's angle. According to Flynn's criteria good result was seen in more than 95% of cases in both groups. **Conclusion:** Both cross K-wires and Lateral 3 K-wires provide good stability. Fixation of supracondylar fracture from lateral side had an advantage of no risk of iatrogenic Ulnar nerve injury. Addition of third K-wire from lateral side provides good stability as that of cross K- wire fixation.

Key words: Gartland's Type 3 supracondylar fracture in children; Lateral 3 Kwires fixation; Baumann's angle; Flynn's criteria

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INTRODUCTION

Supracondylar fracture of distal humerus is one of the common paediatric fractures that are encountered in orthopaedics practice. Eighty-five percent of children are between 4-11 years of age. It accounts for around 6 % of all pediatrics fractures.^{1,2}

Untreated type III supracondylar fractures are the common cause for cubitusvarus deformity. ³The main

aim of treatment in supracondylar fracture is to prevent such varus, and rotational deformity. There are various modalities of treatments that range from conservative to operative. Undisplaced fractures are treated conservatively. Gartland type III supracondylar fractures are very unstable fractures. ²They require proper reduction and stable fixation to prevent such deformity.⁴

Along with the use of an image intensifier, closed method of reduction is popular and is universally accepted;

Address for Correspondence:

Dr. Krishna Sapkota, Assistant Professor Department of Orthopedics Manipal College of Medical Sciences/Manipal Teaching Hospital. Phulbari, Pokhara, Nepal. **E-mail:** krishapkota@gmail.com **Tel No:** +977-9856031701

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however, a debate still exists regarding fixation with K-wire. Some use cross pins for stabilization, some surgeon prefer lateral pinning. There is a controversy about its stability.⁵ Many literatures suggest stable fixation by medial and lateral cross pins than two lateral pins, but there is risk a of ulnar nerve palsy in such fixation.^{6,7} Divergent lateral pinning methods also provide stable fixation providing maximal separation of two pins at fracture site.⁸ Placement of such pins in desired site is not possible always by 2 pins, so an extra third K-wire is required for stable fixation. Lateral 3 divergent or parallel pins provide safe and effective fixation.

Here we aim to compare the outcome of cross pinning and lateral 3 K-wires fixation for supracondylar fractures in children. We compare the post operative changes in Baumann's angle and carrying angle in our study.

MATERIALS AND METHODS

This is a prospective study done in Manipal teaching hospital, Nepal from July 2015 to July 2018. Children with extension type III displaced supracondylar fracture of distal humerus who presented in the hospital and met the inclusion criteria were included in the study.

Inclusion criteria

All children with Gartland type III supracondylar fracture of distal humerus presenting within a week were included.

Exclusion criteria

Open fracture Grade II or more
Associated vascular injury
Compartment syndrome
Failed closed reduction, requiring open reduction.

There were total of 34 patients included in the study. Seventeen cases were treated with cross K-wire fixation and another 17 patients were treated with lateral three k wire fixation. All cases were done under general anesthesia. Injection Ceftriaxone 50 mg/kg intravenous was given 1hr before the surgery. After giving anesthesia to the patient, closed reduction was done and both anterior-posterior and lateral views were seen in the image intensifier. Jones view and internal and external rotation view were seen to visualize both the medial and the lateral pillars for

satisfactory reduction. Two K-wires were inserted, first one from the lateral side and another from the medial side after taking the precaution of avoiding ulnar nerve injury in group I. In Group II, three K-wires were inserted from the lateral side after reduction of the fracture. The configuration of K-wires was such that at least 2 pins were in divergent or parallel alignment with maximum separation at the fracture site. After completion of procedure Baumann's angle was measured and noted. Then K-wires were bent outside the skin, the dressing was done and above elbow posterior slab was applied in elbow 90 degree position in both groups. A distal neuro-vascular evaluation was done after completion of procedure and rechecked after 3 hrs, 6 hrs and 12 hrs in all cases. All patients were discharged by the next day. At 4-5 weeks follow up K-wires were removed, a range of movement was encouraged for all children after removal of pins.

Maintenance of fracture reduction was assessed by comparing peri-operative Bauman's angle taken during the procedure and the Bauman's angle taken at the time of fracture union. A change in the relationship between the peri-operative radiographs and those made at the time of fracture-healing indicated a loss of reduction. The range of motion of elbow, neurological status and presence of deformity were assessed after 12 weeks of pin removal. X-ray AP views of both the elbows were also taken at that time to compare ulno-humeral angle. Outcomes were analysed on basis of Flynn's criteria.⁴

STATISTICAL METHODS

The data was entered in the SPSS 16.0 system and analyzed. The Student t - test was used to determine the significance of any change in the Baumann's angle. The association between outcome and other variables was assessed and P-value of 0.05 was considered significant.

RESULTS

A total of 34 patients were included in the study. There were 17 children in cross K-wire fixation group and 17 children in lateral 3 K-wire fixation group. The demographic profile of patients and fractures in both group are shown in Table 1.

Table 1: The demographic profile of patients and fractures in both groups

Parameters	Cross K-wire fixation	Lateral 3 K-wire fixation	p_value
Age of patients	7.59±1.661	7.53±2.211	0.146
Sex			
Male	11 (64.7%)	10 (58.8%)	0.508
Female	6 (35.3%)	7 (41.2%)	
Time duration from trauma to surgery (days)	1.88±0.781	1.76±0.970	0.255
Union times (weeks)	4.71±0.588	4.59±0.712	0.231

There are no significant differences between the two groups considering their age, sex, operation time and healing duration. All patients had union of fracture by the end of 5 weeks. The outcome according to Flynn's criteria is shown in Table 2 and 3.

According to Flynn's criteria in both the groups more than 95 percent of cases had good to excellent results. Table 4 shows the comparison of the mean change in Bauman angle in both groups, intra-operatively and post operatively. There was no statistical significance in comparing Baumann's angle after the intervention and on the last follow up examination. Comparing the mean changes seen in both the groups there was no significant change in Baumann's angle. (Table 5)

There were 4(11.76%) cases with nerve palsy associated with supracondylar fracture. Three patients had radial nerve palsy and 1 had median nerve palsy. One patient had iatrogenic ulnar nerve injury following fixation with cross K-wires. All of them recovered completely by 3 months. Superficial pin track infection was detected in five cases at the time of pin removal. It subsided completely in a week with dressing and oral antibiotics.

DISCUSSION

The Supracondylar fracture of distal humerus is one of the most common paediatric elbow injuries accounting for more than 75% of all elbow fractures. The peak incidence is when the child is 5 to 11 years of age.¹² In our study mean age was 7.56 ± 1.93 years (range from 5 to 12 years). There were no significance differences in age between the two groups.

Proper anatomical reduction and stable fixation of fractures prevents the displacement at the fracture. Postoperative deformity which is as high as 17% after various mode of fixation is due to inadequate stability.^{3,4,9}

Results	Cosmetic factor change in carrying angle	Functional factor Loss of flexion and extension
Excellent	0 - 5	0 - 5
Good	6 - 10	6 - 10
Fair	11 - 15	11 - 15
Poor	>15°	> 15°

Outcome	Cosmetic factor change in carrying angle		Functional factor loss of flexion and extension	
	Cross K wire fixation	Lateral 3 K wire fixation	Cross K wire fixation	Lateral 3 K wire fixation
Excellent	14	14	11	12
Good	3	3	5	4
Fair	0	0	1	1
Poor	0	0	0	0
Total	17	17	17	17

Biomechanical studies have shown that cross pinning provides more torsional stability than lateral pinning but carries a greater risk of iatrogenic ulnar nerve injury.^{6,10} However, a study by Lee YH et al demonstrated that two lateral divergent pins offer more stability in extension loading than two crossed pins.⁹ Two divergent lateral-entry pins provide greater stability in varus and valgus loading than do the two parallel lateral-entry pins. The lateral 2 divergent pins, which were more widely separated at the fracture site and engaged both the medial and the lateral column provide more stable fixation.^{5,6,8,11,12} However this ideal placement is not possible all the time. Addition of the third pin provides adequate stability.^{9,11}

In our study there was no significant change in Baumann's angle in both the groups. The functional and cosmetic outcome was same in both the groups which is similar to the study of Gopinath NR et al. Three lateral divergent pins were equivalent to cross pin fixation and both these constructs were stronger than two lateral divergent pins.¹³

The rate of iatrogenic ulnar nerve injury associated with cross pin fixation has been reported to be from 0% to 6%.^{10,14,15} Many surgeons recommended two lateral pins in order to avoid an ulnar nerve injury.^{6,7,9,10} Although ulnar nerve injury was recovered in most of the cases, there are several reports of permanent ulnar nerve injury.^{10,14,15} In our study one patient had an ulnar nerve injury, which was seen in cross K-wires fixation. There was recovery of nerve palsy after 13 weeks.

Studies show that three lateral pins are recommended in older children, for stable fixation. The use of 3rd pin will have entry through joint and will create crowding; hence there is more chance of infection.^{13,15} None of our cases had severe infection. Superficial pin track infections was seen in five cases (2 in cross K-wires and 3 in lateral three K-wires) but were managed with oral antibiotics. All cases had an excellent or good result with respect to cosmetic and functional factors.

CONCLUSION

In the treatment of type III supracondylar fracture in children both methods of fixation were good in term of

Table 4: Comparison of Baumann's angle

Group	Intraoperative Baumann's angle	Post operative Baumann's angle	p_value
Cross K wire fixation	73.06±4.08	78.71±3.35	0.041
Lateral 3 K wire fixation	73.29±4.12	78.3 5±4.27	0.000

Table 5: Shows the comparison of changes in intra-operative Baumann's in both the group

Methods of fixation	N	Mean	Std. deviation	p_value
Cross K wire fixation	17	5.6471	3.77394	0.063
Lateral 3 K wire fixation	17	5.0588	2.63322	

functional and cosmetic outcome. Lateral 3 pins provide as good stability as does of cross K-wires without risk of iatrogenic ulnar nerve injury. Additional third pin from lateral side provides more stability. It is a safer and stable method of fixation in type III supracondylar fracture.

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Authors Contribution:

KS-Concept and design, review of literature, statistically analysis and interpretation, manuscript preparation and revision; **KW**- Manuscript revision and literature review; **NR**-Data collection, statically analysis and manuscript revision; **PT**-Literature search and review; **UJT**- Data collection and literature review; **PRO**- Data collection, literature search and review.

Work attributed to:

Department of Orthopedics, Manipal Teaching Hospital, Phulbari, Pokhara, Nepal.

Orcid ID:

Dr. Krishna Sapkota - <https://orcid.org/0000-0002-2277-8556>
 Dr. Krishna Wahegaonkar - <https://orcid.org/0000-0001-7274-7099>
 Dr. Niraj Ranjeet - <https://orcid.org/0000-0001-5460-5839>
 Dr. Pabin Thapa - <https://orcid.org/0000-0003-1336-5837>
 Dr. Upendra Jung Thapa - <https://orcid.org/0000-0003-1980-5610>
 Dr. Pratyenta Raj Onta - <https://orcid.org/0000-0002-6013-4014>

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