

ORIGINAL ARTICLE

Outcome of Lateral Pinning versus Cross Pinning Technique for Displaced Type 3 and 4 Supracondylar Humerus Fracture in Children: A Prospective Comparative Study

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ABSTRACT

BACKGROUND

Supracondylar humerus fracture (SCHF) is common injury in children where displaced type 3 and 4 types require reduction and K wire fixation. But the use of lateral only or crossed pinning configuration is debatable.

METHODS

A prospective comparative study was conducted for a period of two year (2021 and 2022) at National Trauma Center, Nepal in patients less than 16 years presenting with closed Gartland type 3 and 4 supracondylar humeral fracture. Cases were randomly assigned to crossed pinning (CP) and lateral pinning (LP) with K wires after closed reduction of SCHF. Functional outcome, complications, loss of reduction and Baumann angle was assessed at 3 months follow up.

RESULTS

Total of 80 cases were enrolled. Lateral pinning and cross pinning had 32 and 48 assigned respectively. The groups were comparable in terms of age, gender, mechanism of injury, types and duration of injury. The mean age was 6.40 years (SD 1.36), ranging from 4 to 9 years. CP had longer surgery duration ($p = 0.000$). Ulnar neuropraxia was present in 3 cases (3.8%) of CP, whereas LP had none. The Flynn's criteria, time to union, loss of Bauman angle and loss of elbow motion were comparable between groups.

CONCLUSION

The lateral or crossed pinning in type 3 and 4 SCHF have similar radiological and functional outcomes. The Ulnar neuropraxia was present in CP groups but overall complications were comparable between both groups.

KEYWORDS

closed fracture reduction; kirschner wires; nerve injury; supracondylar distal humerus fractures; ulnar nerve

INTRODUCTION

Supracondylar humerus fracture (SCHF) are among the most common injuries in children younger than 15 years, accounting to about 75% of pediatric elbow injuries.^{1,2} Following the reduction of Gartland type 3 and 4 SCFH k wires are placed but the construct with lateral only entry or crossed pinning remains debatable.³

Brauer et al reported 5 times increased risk of ulnar nerve injury in crossed pinning when compared to the lateral entry configuration.² Whereas, Abdel et al reported cross pinning to be superior with no nerve injury.⁴ Retrospective data showed crossed wires provided increased stability but prospective data

didn't provide statistical significance to this.⁵

The aim of this study was to compare the functional and radiological outcome and associated complications between crossed vs lateral pinning configuration of K-wire fixation in type 3 and 4 SCHF in children less than 16 years.

METHODS

A prospective comparative study was conducted for a period of two year (2021 and 2022), after obtaining ethical approval (384/2078/79) dated September 16, 2021, from Institutional Review Board of National Academy of Medical Sciences (NAMS), Kathmandu. Informed consent was taken from the parents or the legal guardian of the child. Children less than 16 years presenting to National Trauma Center, Kathmandu, Nepal with closed Gartland type 3 and 4 supracondylar humeral fracture whose parents or guardians consented for the procedure and the enrollment in the study were included in the study.^{5,6} Pathological fractures, polytrauma patients, open fractures, flexion-type

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fractures, fractures requiring open reduction and neurovascular exploration, and patients unable to take part in follow-up were excluded from the study.

All the cases fulfilling the inclusion criteria were taken as a whole sampling method. Informed consent was taken. The patients were randomly assigned into two groups using the lottery system. The parents were asked to choose among the two folded chits having the method of surgery mentioned and patient underwent surgery accordingly. There was no blinding of patients or the surgeons.

All preoperative workup was done in form of thorough clinical and radiological examination in the emergency department. Radiological assessments of all the fractures were done. After the closed reduction of the fracture was achieved with fluoroscopic guidance, in the crossed pinning group K wires were placed each from lateral and medial side of the distal humerus in crossed configuration. Whereas in the lateral pinning group 2 k wires were placed from lateral side only. Care was taken to protect the Ulnar Nerve in medial entry by inserting in extension of the elbow. The reduction and stability were assessed fluoroscopically on the full range of motion of the elbow and if it was not stable 1 more k wire was inserted laterally, but the case was excluded from the study. Following the procedure, cases were followed up as per routine care, but outcome scores were noted at 3 months. At six weeks, the pins were removed without anesthesia. At 3 month follow-up, the children were evaluated clinically and radiologically using the Flynn Criteria.⁷ Flynn criteria is divided into two components, the functional and the cosmetic component and both are further sub-divided as excellent, good, moderate and poor at an interval of five degrees. The functional component consists of measuring the arc of motion in sagittal plane which includes flexion and extension, whereas the cosmetic further measures the carrying angle which indicates the coronal movements at the elbow joint. Greater loss of movements in both, the sagittal as well as coronal plane indicates unsatisfactory outcome.

Bauman angle was measured by an independent orthopedic surgeon using a goniometer as the angle formed by one line down the humeral shaft axis and another line along the physis of the lateral condyle.⁸ Similarly, the range of motion of elbow was measured clinically with the goniometer. The change in Bauman angle more than 6 degrees post-operatively was considered "loss of reduction".⁹

Statistical Analysis

Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used to assess parameters such as demographic and patient characteristics, operation-related variables, complications, and functional outcomes. The independent sample t-test was used to compare the post-operative variables between the lateral and crossed pinning techniques. Pearson correlation was calculated for comparison of categorical variables. A p-value of < 0.05 was considered statistically significant at a 95% confidence interval. The statistical analysis was conducted using JASP (version 0.19.1).

RESULTS

A total of 80 patients were enrolled in the study, meeting the

inclusion criteria. Of these, 48 patients (60%) were in the cross-pinning group, while 32 patients (40%) were in the lateral-pinning group (Table 1). The mean age of the patients was 6.40 years (SD 1.36), ranging from 4 to 9 years. The average time for fracture union was 5.99 weeks (SD 0.19). Postoperative loss of range of motion was observed to be 4.06 degrees (SD 3.65). At the final follow-up of 3 months, the mean Bauman's angle was 6.50 degrees (SD 1.79), with a range of 3 to 9 degrees.

Complications were noted in 10 cases (12.5%) following surgery. Ulnar neuropraxia was present in 3 cases (3.8%), all of which were from the cross-pinning group, and none were with lateral pinning. All 3 cases recovered within the follow up period of 3 months.

Table 1: Descriptive data of the patient characteristics (n= 80).

Variables		Number (%)
Groups	Lateral pinning	32 (40)
	Cross pinning	48(60)
Sex	Female	34 (42.5)
	Male	46 (57.5)
Side of involvement	Right	33 (42.5)
	Left	47 (58.8)
Mechanism of injury	Fall on outstretched hand	69 (86.3)
	Road traffic accident	11(13.8)
Duration of fracture from trauma to surgery in days	1 day	73 (91.3)
	2 day	7 (8.8)
Gartland Classification	IIIA	52 (65)
	IIIB	28 (35)
Complications Post-operative	Pin loosening	4 (5)
	Pin site infection	2 (2.5)
	Superficial infection	1 (1.3)
	Ulnar neuropraxia	3 (3.8)
	None	70 (87.5)
Post-operative Flynn Criteria at 3 months	Excellent	25 (31.3)
	Good	51 (63.7)
	Fair	4 (5)
	Poor	0 (0)

The two groups of cross pinning and lateral pinning were comparable in different variables like age, duration of fractures, sex, side of injury, mechanism of injury and Gartland classification. (Table 2 and 3)

The postoperative Flynn's criteria were excellent in 17 (35.42%) and good in 31 (64.58%) cases of cross pinning group and in lateral pinning excellent in 8 (25.00%), good in 20 (62.50) and fair in 4(12.50%) cases and was significantly different among both groups. (Table 2)

Table 2. The comparison of the group's characteristics (categorical variables) in cross pinning group (n= 48) versus lateral pinning groups (n= 32).

Variables	Pearson correlation coefficient (X ²)	p value
Sex	2.46	.12
Side of injury	.01	.93
Mechanism of injury	.07	.79
Gartland classification	.15	.70
Flynn Criteria	6.68	.04***
Presence of Complications	.48	.49

*** - Statistically significant

Table 3. The comparative of the group's characteristics (continuous variables) in cross pinning group (n= 48) versus lateral pinning groups (n= 32).

Variables	Groups	Mean (SD)	95% CI †	p value‡
Age	Cross pinning	6.29 (1.35)	-.88, .35	.39
	Lateral pinning	6.56 (1.37)		
Duration of fractures	Cross pinning	1.06 (0.25)	-.19, .07	.34
	Lateral pinning	1.13 (0.34)		
Surgery duration in minutes	Cross pinning	28.08 (4.04)	3.85, 7.50	.000***
	Lateral pinning	22.41 (3.99)		
Time to union in weeks	Cross pinning	6.02 (0.14)	-.00, .17	.06
	Lateral pinning	5.94 (0.25)		
Loss of motion in degrees at final follow up	Cross pinning	3.75 (3.79)	-2.44, .88	.35
	Lateral pinning	4.53 (3.45)		
Loss of Baumann angle at 3 months follow up	Cross pinning	6.52 (1.82)	-.76, .87	.89
	Lateral pinning	6.47 (1.76)		

*** - Statistically significant

† - Independent sample t- test

The time to union was also comparable between the two groups (p=0.06). The loss of motion postoperatively in both the groups were comparable so the effectiveness of one over another could not be assessed. The duration of surgery in cross pinning was

higher when compared to lateral pinning (p= .000).

DISCUSSION

In our study, both cross pinning and lateral pinning had comparable groups of patients. Both groups were effective in achieving satisfactory clinical and radiologic outcomes in treating displaced supracondylar fractures like other study.¹⁰⁻¹⁴ However, cross pinning demonstrated a higher proportion of excellent functional outcomes as per Flynn criteria with an increased but manageable risk of ulnar nerve injury.

Dekker et al. in a systematic review reported nearly equal rate of loss of reduction with LP (12.4%) and CP (11.6%) but CP had increased chance of iatrogenic ulnar nerve injury (4.1% vs. 0.3%). Different studies have illustrated higher loss of reduction rate in LP than CP implying that LP was less stable construct.^{2,15,16} Our study also found better mechanical stability with CP. But in another study with pooled prospective data, stability of the CP groups did not show statistical significance so the finding of more stable construct may just be by chance.⁵ Flynn criteria revealed that CP group had more excellent outcomes (35.42%) than in the LP group (25.00%), though the overall score was correlated in both the groups. This implies that functional outcome and patient satisfaction was better in the CP group.

The CP group have 5 times higher probability of ulnar nerve injury than with LP group.² In agreement with the previous studies, our observation found that ulnar neuropraxia occurred exclusively in the CP group (3.8%), signifying the elevated risk of nerve injury with this technique.^{12,13,17} But LP also has risk of ulnar neuropraxia.¹⁵ In another study ulnar neuropraxia was present in LP rather than CP, but the cases were performed by junior doctors in their first 3 years of training.⁴ The increased risk of ulnar nerve injury with CP is an important factor to be considered even though they may have provided better mechanical stability, as by the higher incidence of such injuries shown in studies by Jessica et al. and Gaston et al.^{18,19} To prevent such complications we have to avoid hyperflexion of the elbow while medial pinning, insertion in extension, insertion through medial epicondyle but anterior to ulnar groove with ulnar nerve rolled back with thumb or mini open at the medial epicondyle.^{12,19-21} Na et al analyzed 24 studies and recommended insertion of three divergent lateral pins.²² But adding 1 more lateral k wire the radiological and functional outcome didn't change and the radiation exposure increased.²³ Studies have concluded that both CP and LP techniques achieved comparable functional and radiological outcomes.^{19,24}

In our cases, both techniques demonstrated comparable outcomes in terms of Baumann's angle (mean 6.50°) and time to union (mean 5.99 weeks), consistent with the findings of Skaggs et al.²⁰ This is comparable with the findings of Naik et al., Gaston et al and Prashant et al., all of whom reported similar functional and radiological outcomes for both techniques.^{12,19,21} The loss of Baumann's angle at the final follow up was comparable in both the groups which was also shown in another study.¹² However, we observed that the mean operative time was significantly longer for CP (28.08 minutes) compared to LP (22.41 minutes, p=0.000), signifying better efficiency with LP. Similar findings is reported in another study.²¹ There is loss of motion at elbow but the functional scoring is good so this might not have affected the patient.

Our study had similar groups and cases were randomly assigned.

But the surgeon could not be blinded leading to bias. Also, this was simple random process and cases were unequally distributed in two groups. We have excluded the cases of open reduction as this might influence the outcome. But some cases might have been missed as type 3 and 4 SCHF may go into open reduction. We did not adhere to "intention to treat" analysis as the cases unstable after pinning underwent 1 extra lateral pin, and were excluded from the analysis. But we did not notice such cases in our study. We had a short follow up, longer follow up to capture the late outcomes may be required.

CONCLUSION

The lateral or crossed pinning in type 3 and 4 SCHF have similar radiological and functional outcomes. The Ulnar neuropraxia was present in CP groups but overall complications were comparable between both groups.

CONFLICT OF INTEREST

None

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