

Comparative Evaluation of Results of Cross Pin Fixation by Conventional Method with Dorgan's Method in Displaced Supracondylar Fracture in Children

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Abstract

Introduction: Closed manipulation and percutaneous K-wire fixation are the standard treatment of displaced supracondylar fractures of the humerus in children. The most common complication is an injury of the ulnar nerve during insertion of medial K-wire. In this study, two fixation methods, the traditional cross wire (medial and lateral) and the Dorgan's percutaneous lateral cross-wiring technique will be evaluated.

Purpose: The aim of the study is to compare the results by two different modalities of management.

Methods: The study was done in our institution over a period of 1½ year. The inclusion criteria are displaced fracture (Gartland Type II and III) without any neurovascular deficits. We exclude open fractures, pathological fractures, more than seven days old fractures. Patients are followed up for a period of 12 months.

Results: Among the 97 patients, full follow-up is available for 85 patients. Among them, 45 patients are treated with conventional cross pin method and 40 patients are treated by Dorgan method. We have found there are no statistically difference results between two groups.

Conclusion: The conclusion is that close reduction and percutaneous fixation techniques are the standard methods by providing rigid stability and good union rate. Dorgan's lateral cross-wiring technique has the advantage of both-stability of cross wire fixation and avoiding the ulnar nerve injury. Although the results are not statistically significant.

Key words: Children, Conventional medial-lateral pinning, Dorgan's method, Supracondylar humerus fracture

INTRODUCTION

Supracondylar fracture of the humerus is among the most common fractures in children, and completely displaced fractures usually necessitate surgical treatment.¹ Supracondylar area is most vulnerable to fracture because or tubular shaft of humerus becomes triangular in this area leads to stress raiser, and thin cortical bone due to coronoid

fossa and olecranon fossa.² The standard mode of treatment for the displaced fracture in children is closed reduction and percutaneous pin fixation.³⁻⁵ Completely displaced fractures usually necessitate surgical treatment. Different pin fixation techniques have been described including medial lateral 2 cross pins and lateral 2 pins.⁶ It has been proved that cross pin fixation is superior than lateral pin fixation.⁷⁻⁹ Although ulnar nerve injury up to 6% from use of a medial pin is common, and this possibility is most likely to occur when the medial epicondyle cannot be palpated in swollen elbows.¹⁰ There are many techniques for Kirschner wire fixation. The incidence of cubitus varus deformity after treatment was about 5% according to Flynn while Arino reported that it was almost 21%. In a prospective study, Chai reported that 8 (15%) of 54 patients developed iatrogenic ulnar nerve deficit after treatment with medial-

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lateral pin fixation. In supracondylar humerus fracture among them conventional K-wire fixation is a most popular surgical method. Controversy exists about the optimal K-wire configuration in displaced Type II and III fracture. In present study an alternate method of fixation with very minimum complications. In our study, we compare the outcome of displaced supracondylar fractures fixed by a conventional cross K-wire technique in one group, and another group of patients operated by two cross K-wire from the lateral side was used.

MATERIALS AND METHODS

This is a prospective randomized controlled study conducted at Institute of Post-Graduate Medical Education & Research) from February 2011 to March 2014 after getting ethical permission. The catchment area of the Institute is Kolkata and its suburban area. All the patients with displaced supracondylar fracture (Garland Type - II and III) were included in this study. The guardians of the children were properly counseled about advantages, disadvantages, and possible complication of the procedure. After getting proper written consent from the guardian, children were included in the study. The inclusion criteria are displaced supracondylar fracture (Garland Type - II and III), close fracture without any distal neurovascular deficit and fracture occurring within 1 week. The patients with open fracture, pathological fracture, fracture associated with other co-morbid condition, previous fracture in either elbow and concomitant fracture or other injury in the same limb that will alter the treatment protocol of the supracondylar fractures were excluded.

Every patient was thoroughly examined at the time of admission. The first step was to assess the vascular status of the limb. Once, the case was deemed to be without vascular deficit (defined as absent or feeble <50% of the volume on the other side), and then evaluation was done using other exclusion and inclusion criteria. The median (with anterior interosseus) radial and ulnar nerves were tested and the finding documented. The skin condition and the amount of swelling were assessed. Fractures classifications were done by radiographs.

Check radiographs of the elbow were taken again if required in the anteroposterior and the true lateral planes if possible. The elbow was immobilized in a posterior long arm plaster of paris slab in the comfortable position of 50-60° of flexion. Analgesics were given, and the arm elevated to decrease swelling. The main investigator would perform the randomization by drawing lots – odd numbers signify medial-lateral pin fixation while even numbers would be treated by two lateral pin fixations by Dorgan method.

All patients were operated in supine position under general anesthesia within 48 h of admission. Tourniquet was not applied. The first reduction manoeuvre was performed with traction applied to the forearm with an assistant applying counter traction. First, the medial or lateral displacement of the fracture was corrected. After that rotational displacement was reduced with pronation and supination of the forearm. Final, fixation by smooth K-wire into the medial condyle from the lateral side. The medial condyle should not be penetrated to avoid ulnar nerve injury, but cortical involvement could be achieved (Figure 1). The principal is that the wires should cross above the fracture line. The similar way, conventional method of cross fixation was done (Figure 2).

Post-operative immediate neurological assessment for median, ulnar, and radial nerves, and anteroposterior and lateral X-rays were performed.

The patients with iatrogenic ulnar nerve lesions in both groups were followed up without any treatment. The mean hospitalization period was 1.7 days (range 1-5 days). We

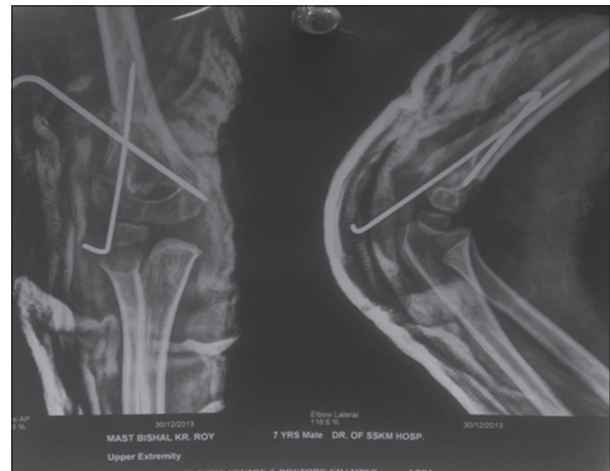


Figure 1: X-ray photograph of Dorgan method of fixation



Figure 2: X-ray photograph of cross pin method of fixation

removed the cast K-wires after three weeks and started gentle active elbow exercises. At the last follow-up, we evaluate a range of motion and carrying angle by goniometer at both elbows. We evaluate the functional and cosmetic results according to the criteria proposed by Flynn *et al.* (Table 1).

RESULTS

In the present study, 97 treated patients for displaced supracondylar fracture were considered. Later 12 patients were drop out in follow-up. Among the 85 patients, we have treated 40 patients by Dorgan method and rest 45 patients have treated by conventional cross pin fixation method. The mean age of patients 7.51 years (range from 3 to 12 years) with standard deviation 0.08 years. The duration of injury to admission to the hospital was 0.33-72 h with mean 7.02 h. The interval from injury to surgery range from 10 to 80 h (mean, 32.98 h). Both groups under study had a similar pattern of duration from injury to surgery (Table 2). Among the 45 patients of crossed pin fixation group, 9 patients having Type-II fracture, 22 patients having Type III (post medial), and 14 patients Type III (post lateral) fracture. Among the 40 patients of Dorgan method group, 8 patients have Type II, 20 patients having Type III (post medial), and 12 patients have Type III (post lateral) fracture (Figure 3). 40 patients of Dorgan group, 23 patients have right elbow injury and 27 patients of cross pin fixation group having the right side supracondylar fracture humerus.

Sixty six out of 85 patients (33 on each group) had a carrying-angle loss of 0-4.9°, which was considered to be an excellent result (Figure 4). Of the eleven patients rated as having achieved a good result, nine had crossed pin fixation while two had Dorgan pin fixation. There were

only six patients in whom the result was rated as fair; two had crossed pin fixation, and four had Dorgan lateral pin fixation. Of the two patients rated as poor, 1 patient on each group. The mean loss of elbow extension was 7.21° (range, 2.15-16.4°) in cross pin fixation patients, while in Dorgan lateral pin fixation patients was 7.11° (range, 3.70-17.91°). Similarly, the mean loss in elbow flexion was 8.68° (range, 0.04-17.32°) and 11.28° (range, 0.86-21.66°) in conventional cross pin fixation and Dorgan lateral pin fixation patients respectively (Figure 5 and Table 3).

In 10 patients, the capitellum and medial epicondylar epiphyses had already fused at follow-up. So, 74 patients were available for measurement The Baumann angle loss and MEE angle. The mean Baumann angle loss in the cross pin fixation group and the Dorgan method of pin fixation group was 5.96° and 5.30°, respectively. The mean MEE angle loss in the cross pin fixation group and the Dorgan pin fixation group was 6.07° and 6.93°, respectively. Analyses of both the Baumann angle loss and the MEE angle loss using Student *t*-test showed no significant differences (Table 4).

Five (of all 97 patients) neurologic deficits were diagnosed on admission. One patient had ulnar nerve palsy while the other had median nerve injury. Of the 85 patients available

Table 1: Modified Flynn's criteria to evaluate outcome of treatment

Outcome	Loss of elbow ROM (°)	Loss of carrying angle (°)
Excellent	0-5	0-5
Good	6-10	6-10
Fair	11-15	11-15
Poor	>15	>15

Rom: Range of motion

Table 2: Duration injury to surgery for two methods of pin fixation

Injury to surgery interval (h)	Cross pin fixation	Dorgan method	Total
0-23.9	10	9	19
24-47.9	27	22	49
48-71.9	6	8	14
>72	2	1	3
Total	45	40	85

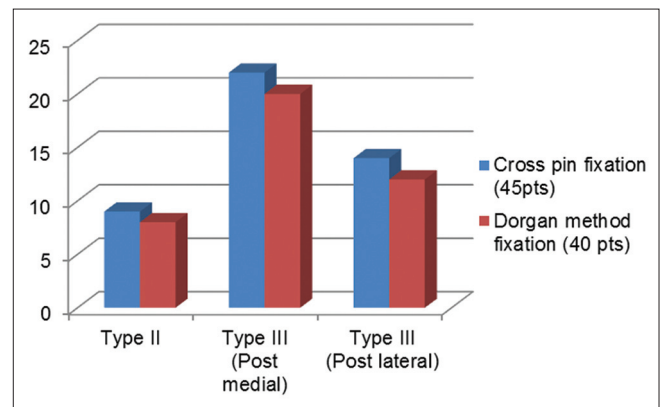


Figure 3: Distribution of type of fracture

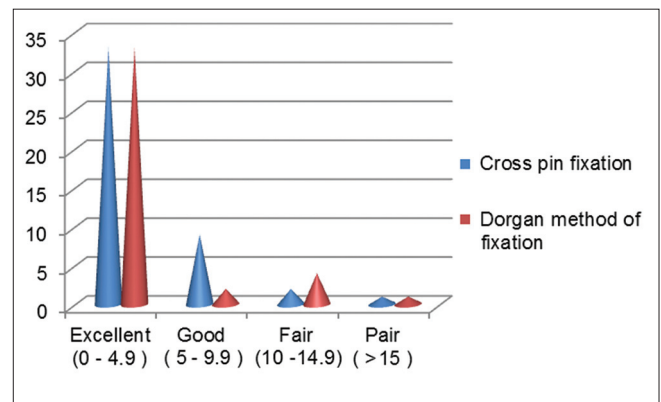


Figure 4: Analysis of results of carrying angle loss

for outcome evaluation, seven ulnar nerve injuries (five patients in the cross pin fixation group and two patients in the Dorgan lateral pin fixation group) were detected after the treatment procedure. Three radial nerve injury were found in Dorgan pin fixation group. These patients were followed up 6 weekly in the clinic, and all of them recovered completely within six.

We use crossed table method and Fisher's exact test to analyses the data of iatrogenic ulnar nerve injury between the two groups. The $P = 0.428$. Hence, there is no significant difference in the incidence of ulnar nerve injury.

Pin tract infection was found in five patients. Two of the patients were treated with cross pin fixation. All the patients were antibiotics orally. They all recovered at the subsequent follow-up. We have not encountered any vascular injury or deficit during and after surgery. We have found that patients with vascular deficit have good capillary refilling of the fingers and the radial pulse eventually reappeared after surgery. We have not found compartment syndrome or Volkmann ischemic contracture on the last clinical review.

In our study, according to Flynn criteria, among the 40 patients treated with Dorgan method 15 patients have excellent and 12 patients have a good result. In comparison to 21 patients have excellent and 14 patients have a good result by a conventional method (Figure 6). By applying student t -test, there was no statistical difference between the two groups (Table 5).

DISCUSSION

The mean follow-up duration of the 85 patients was 8.93 months (range, 3.13-14.73 months). Some patients

had developed elbow stiffness which was recovered by proper physiotherapy during follow-up. All the fractures were reduced under image intensifier. The Baumann angle and carrying angle was measured and compared with opposite side. There was no loss of reduction in both coronal and sagittal during healing time. The enrolment of both groups was randomized, and no statistical difference was found. So, there was no difference in stability providing by two methods of fixation between two groups.

Thirty seven patients had carrying-angle loss of 10° or more compared to the opposite elbow (16 of the patients in cross pin fixation, and 21 in Dorgan lateral pin fixation group). These patients would develop cubitus varus deformity which must be treated. Malunion in the sagittal plane rarely requires surgical correction. Sagittal plane deformity would not cause any functional disability and some improvement also happened due to remodeling of bone. So, it did not require any treatment.

Five patients in medial-lateral pin fixation group while two patients in Dorgan pin fixation group had ulnar nerve injury. We analyze the data by using the crossed table method and Fisher's exact test. The $P = 0.24$. Therefore, there was no statistical difference. We need a larger sample for bringing

Table 3: Analysis of results of carrying angle, elbow flexion and extension loss by student t -test

Parameters	Mean±SD		P value (student t -test)
	Cross pin fixation	Dorgan method of pin fixation	
Carrying angle loss (°)	3.58±4.5	3.7±4.24	0.913
Elbow lexion loss (°)	7.14±9.2	7.1±9.2	0.991
Elbow extension loss (°)	8.6±8.64	11.26±10.4	0.322

SD: Standard deviation

Table 4: Comparison of Baumann angle loss and MEE angle loss

Parameters	Mean±SD		P value (student t -test)
	Cross pin fixation	Dorgan method of pin fixation	
Baumann angle loss (°)	5.96±5.5	5.3±5.0	0.646
MEE angle loss (°)	6.07±5.2	6.93±6.6	0.597

SD: Standard deviation

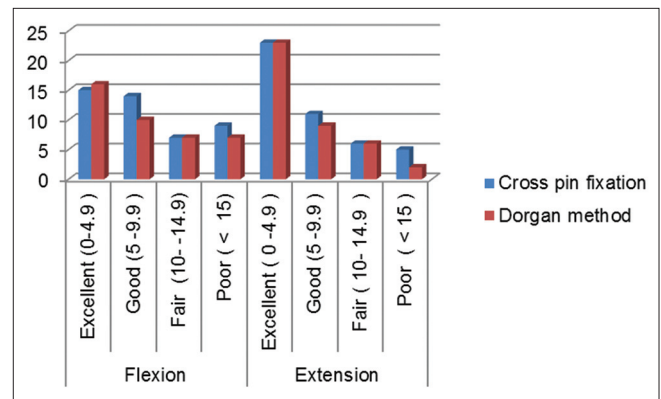


Figure 5: Analysis of results of flexion and extension loss

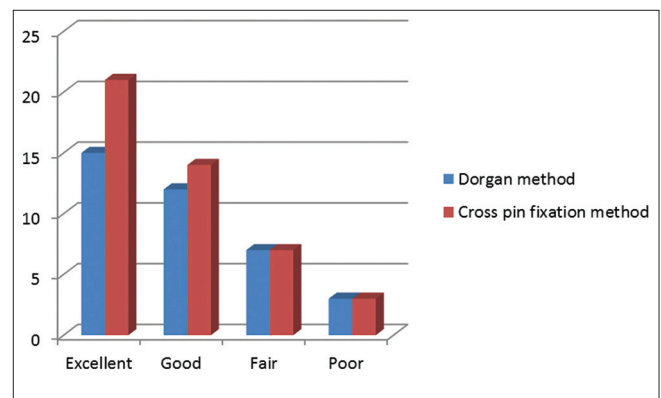


Figure 6: Analysis of result by Flynn criteria

Table 5: Comparison of result of two groups according to Flynn criteria

Parameter by Flynn criteria	Dorgan method (n=40)	Cross pin fixation (n=45)	P value
(Excellent+good)	27	35	<0.05
(Fair+poor)	13	10	<0.05

certainty in this issue. There was only one iatrogenic radial nerve injury in the Dorgan-lateral pin fixation. The value is too small to be analyzed. All nerve injuries in this study were most likely neuropraxia or axonotmesis. All patients were recovered without exploration or repair within 6 months after the operation. None of the patients in our series developed evidence of ischemic contracture to suggest muscle necrosis at follow-up.

CONCLUSION

From this prospective study, we come to conclusion that both methods provide rigid stability in both coronal and sagittal plane with negligible chance of nerve injury which has no statistical significance. However, further studies with a larger and more varied ethnic and occupations group may be warranted to bring certainty in this dilemma.

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