

Outcome of Type III Supracondylar Fracture Humerus in Children Treated By Percutaneous Pinning Technique versus Open Reduction Internal Fixation-A Single Center Experience.

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Abstract

Background:

Supracondylar fracture of the humerus is the second most common fracture in children. These fractures are classified, according to Gartland's criteria, as nondisplaced fractures (type I), partially displaced fractures with the posterior cortex intact (type II) and completely displaced fractures (type III). Even though the treatment guidelines for type I and II fractures have been well established, controversies still persist for the treatment of type III fractures. Many modalities have been recommended for the treatment of type III fractures including closed reduction and cast immobilisation, traction by various methods and reduction via closed or open means and fixation by Kirschner (K) wires.

Materials And Methods: The aim of this study was to evaluate the outcomes of two different treatment options (primarily closed reduction and percutaneous pinning versus primarily open reduction with pinning) for type III fractures. A prospective study of 60 patients is mentioned here. Open reduction and internal fixation was done in 36 patients (24 male and 12 female patients, who attended OPD or ER after 2nd day of injury). Closed reduction and percutaneous pinning was done in 24 patients (16 male and 8 female patients, who attended OPD or ER within the 2nd day of injury).

Results: This study reveals that the cosmetic and functional outcomes were almost similar between the two groups. Based on Flynn's criteria (Table 1), 36 patients of ORIF group gave satisfactory result in 94.4% of the cases (excellent in 16 patients, good in 12 patients and fair in 6 patients), only two patients with suture line infection, had poor result. In CRPP group (total 24 patients), 83.3% had satisfactory results (excellent - 12 patients, good - 6 patients and fair - 2 patients). Four patients had pin tract infection, with poor result. According to Flynn's criteria the outcomes of the open and closed reduction groups were not statistically significant ($p = 0.273$, Table 4).

Conclusion: Although the outcomes of closed reduction showed no superiority over open reduction, it should be the preferred method of treatment due to its lower morbidity and shorter hospital stay.

Keywords: Supra-condylar fracture of Humerus, Gartland's classification, Flynn's criteria, k-wires, closed reduction, open reduction.

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I. Background

Supracondylar fracture of the humerus is the second most common fracture in children (16.6%) and the most frequent before the age of 7 years¹. These fractures are classified, according to Gartland's criteria, as nondisplaced fractures (type I), partially displaced fractures with the posterior cortex intact (type II) and completely displaced fractures (type III)^{2,3}. Completely displaced (type III) fractures may be associated with neurovascular injuries^{1,4,5}. The surgical treatment of type III fractures is complicated and technically demanding for orthopaedic surgeons. Further, the treatment may be complicated by malunion, elbow stiffness, myositis ossificans, iatrogenic neurovascular injury and compartment syndrome^{4,6,7}. Even though the treatment guidelines for type I and II fractures have been well established, controversies still persist for the treatment of type III fractures^{8,9}. Many methods have been recommended for the treatment of type III fractures including closed reduction and cast immobilisation, traction by various methods and reduction via closed or open means and fixation by Kirschner (K-) wires^{9,10}.

II. Materials And Methods

The aim of this prospective study was to evaluate and compare the outcomes of two different treatment options for Gartland type III extension fractures, closed reduction with percutaneous pinning, with 2 parallel K-wires (CRPP) and open reduction and internal fixation (ORIF), with 2 parallel K-wires.

This study was conducted at Department of Orthopaedics, Calcutta National Medical College between, January 2017 and December 2018, after approval from the ethics committee. Study population comprised of sixty patients (forty males and twenty females), who were drawn from all the closed Type III supracondylar fractures presenting at the ER or OPD of Calcutta National Medical College and Hospital, in accordance with the inclusion and exclusion criteria. The patients who attended the ER or OPD before the 2nd day of injury, were treated by CRPP and those who attended after the second day till the fifth day of injury were treated with ORIF.

Inclusion criteria

All children with displaced i.e. Type III supracondylar fractures of the humerus in the age group of 3 to 10 yrs, till the fifth day of injury.

Exclusion criteria

- Open fractures.
- Associated fracture in, the ipsilateral upper limb.
- Fractures complicated with Neuro vascular injury, or associated with multisystem injury.
- Fractures more than five days old.

The patients who were selected for the study were managed temporarily by a long arm slab, with elbow in flexion, to maintain immobilization(after rechecking the neuro vascular status), till the definitive procedure .

Surgery was performed by at least 4 senior orthopaedic surgeons, well versed with management of trauma cases. Surgical choices were either closed reduction and percutaneous pinning, with K-wires (CRPP) under image intensifier(CRPP group) or open reduction and internal fixation by K-wires (ORIF group), depending on the patient presenting within 2 days or from 3 to 5 days following injury respectively.

Closed reduction and percutaneous pinning group(CRPP)

Once an anatomic or nearly anatomic reduction was achieved under C arm, further stabilization was done by percutaneous pinning using two K-wires introduced through the lateral side parallel to each other. The final reduction and position of the pins were checked under image intensifier. The ends of the pins cut off, bent and left out through the skin. A long arm plaster of paris (POP) back slab was applied with elbow in 90 degrees of flexion

Open reduction and internal fixation group (ORIF)

With the patient supine, the limb was draped and tourniquet applied on the arm. The fracture was approached through lateral incision starting just below the lateral condyle and carrying it proximally for about 3-6 cm, along the lateral border of the humerus. The fracture was exposed through the space created by retracting brachioradialis anteriorly & triceps posteriorly. The fracture site was cleared of the haematoma, fragments were reduced under direct vision. The fracture was then stabilized using two lateral K-wires inserted parallel to each other. The ends of the pins were cut off, bent and left out through the skin. In these cases also a long arm plaster of paris (POP) back slab was applied with elbow in 90 degrees of flexion.

After checking the post-operative x-rays, patients were discharged the day after the surgery in the closed reduction group whereas the patients of the open reduction group were discharged after wound inspection on the 4th day. The supporting POP slabs were discarded after two weeks of surgery, in both the groups, along with removal of sutures in the ORIF group, and the patients were advised active ROM(range of movement) exercises for elbow, wrist, hand and shoulder. The pins were removed after 4 weeks in both the groups.

Thereafter the patients were followed up at four weeks interval till 3 months, and then at three month intervals for another 12 months.

The period of follow-up ranged from 12 months to 15 months. During the final follow-up the loss of motion and the loss of carrying angle of the affected elbow on comparison of the normal elbow were noted. The final results of the treatment were assessed using the criteria of Flynn et al (1974)(Table 1) based on cosmetic and functional criteria.

Statistical analysis:

Data were analysed using SPSS (Statistical Package for Social Scientists) version 20.0, IBM, Armonk, New York, USA. Unpaired T-test and Chi-square test were applied at 5% significance level.

III. Results

In the present study, 60 patients with displaced (Gartland type III) supra condylar fracture of humerus were included. Age of the patients ranged from 3 to 10 yrs .

There were 40 male patients and 20 female patients, a finding which is not statistically significant ($P=0.068$, Table 2). Among the 60 patients, 36 patients (60%) were treated by ORIF and rest 24 patients (40%) were treated by CRPP. There were 24 male patients (66.67%), and 12 female patients(33.33%) among 36 patients of ORIF group (Table 2). Among the CRPP group there were 16 male patients (66.67%) and 8 female patients (33.33%) among 24 patients of CRPP group (Table 2).

Fracture was in the left side in 38 patients (63.33 %) and 22 in the right side (36.67 %)(Table 3).

Of the study group ($n=60$), 28 patients had excellent result (46.7%), 18 patients had good result (30%), 16 patients had fair result (13.3%) 6 patients had poor result (10%).Among the 36 patients of ORIF group, 16 had excellent result (44.4%), 12 had good result , 6 had fair result(16.7%), and 2had poor result(5.6%).On comparison, among 24patients of CRPP group, 12 had excellent result(50%) , 6 had good result(25%) , 2 had fair result(8.3%) and 4 had poor result(16.7%), statistically of no significance ($P=0.273$, Table 4).

Four patients with pin tract infection in the CRPP group and 2 patients with suture line infection, in the ORIF group were the complications which were noted . All of these were superficial and healed with removal of pins, alongwith oral antibiotics and regular dressing.

IV. Discussion

The main aim of the treatment of Supracondylar fractures is to gain a functional and cosmetically acceptable extremity^{10,11,12}. There is no gold standard treatment for Gartland type III Supracondylar fractures^{1,12,13}. Closed reduction with percutaneous pinning group(CRPP) had fewer complications such as infection and loss of movement and the hospital stay was reduced^{1,14}. On the other hand open reduction and internal fixation by pinning (ORIF) claims that good anatomical restoration of the displaced fractures but may result in joint stiffness and myositis ossificans rarely^{1,14}.

Open reduction of supracondylar fracture of humerus, in this study was done through a lateral approach^{15,16}. The approach brings to view the anterior, posterior, and lateral aspect of the humerus. By this method, we could align the fracture without much difficulty.

Controversy persists regarding the optimal configuration of pins across the fracture^{17,18}. Two primary modes include the use of lateral pins alone, and the use of crossed medial and lateral pins¹⁹. In this study, the fractures were fixed using two lateral pins only. The aims was to prevent iatrogenic ulnar nerve injury^{19,20}. We had no cases of iatrogenic ulnar nerve lesion, which can be attributed to the avoidance of medial pins during the fixation.

Another incidentally noted observation of this study was the late presentation (2-5 days) of 36 patients, at the OPD or ER as compared to 24 patients who presented within 2 days of injury. This was most probably due to the facts that, people in general are ignorant of the risks associated with the fracture, scarcity of trained personnel at the periphery to make the diagnosis and decide on timely intervention or referral and many patients coming from far off places.

V. Conclusion

It can be concluded that open reduction and internal fixation is an effective secondary treatment protocol for type III supracondylar fractures with results comparable to closed reduction and pinning. If the closed reduction fails initially, open reduction or skeletal traction and delayed percutaneous fixation can be preferred according to the surgeon's experience.

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TABLES

TABLE 1: Flynn’s criteria:

Result	Rating	Cosmetic factor Loss of carrying angle in degrees	Functional factor Motion loss in degrees
Satisfactory	Excellent	0-5	0-5
	Good	6-10	6-10
	Fair	11-15	11-15
Unsatisfactory	Poor	>15	>15

TABLE 2 : Gender wise distribution of cases

Gender	ORIF	CRPP	P value
Male	24 (66.67%)	16 (66.67%)	0.068
Female	12 (33.33%)	8 (33.33%)	
Total	36	24	

TABLE 3: Table showing side involvement

Side Involved	No of patients	Percentage
Right	22	36.67
Left	38	63.33
Total	60	100

TABLE 4: Comparison of outcome of ORIF & CRIF

Results	ORIF No. (%)	CRPP No. (%)	P value
Excellent	16(44.4%)	12(50%)	0.273
Good	12(33.3%)	6(25%)	
Fair	6(16.7%)	2(8.3%)	
Poor	2(5.6%)	4(16.7%)	

FIGURES



Figure 1: Radiograph showing Supracondylar fracture of Humerus (Gartland Type III)

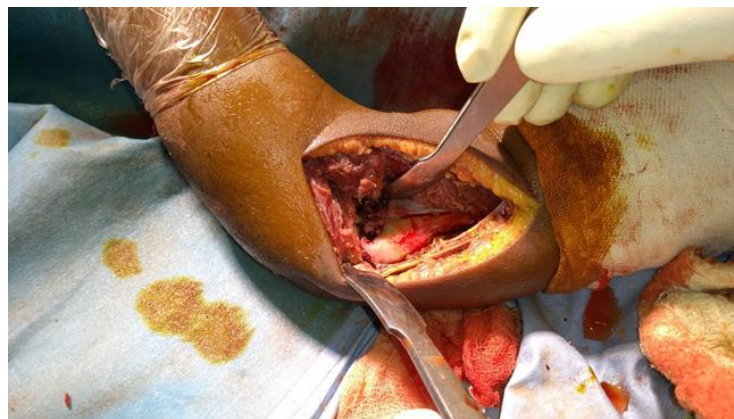


Figure 2 :Displaced supracondylar fracture, exposed through lateral incision



Figure 3:ORIF with 2 k-wires positioned laterally after reduction through lateral incision



Figure 4: Radiograph showing fixation by two k – wires placed laterally

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