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Results of treatment of displaced supracondylar fractures of humerus in children by closed reduction and percutaneous pinning

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Abstract

Background: Displaced supracondylar fracture of humerus is a common orthopedic problem in pediatric age group. The most common complications associated with these fractures are mal-union leading to cubitus varus, stiffness of elbow, myositis ossificans, compartment syndrome and neurovascular deficit. Different methods have been described for its management of which closed manipulation and percutaneous pin fixation results in good functional outcome.

Material and Method: Between January 2016 to January 2017, 30 patients with supracondylar fracture of humerus of Gartland type II & III were included in this study. These patients were treated by closed reduction of fracture and percutaneous fixation with K-wire under C-arm guidance. The outcome was assessed clinically by Flynn's criteria and radiologically by Skaggs's criteria.

Result: The result was excellent in 73%, good in 16%, fair in 7% and poor in 4%.

Conclusion: Closed reduction and percutaneous K-wire fixation is an effective treatment for displaced supracondylar fractures of Humerus in pediatric age group.

Keywords: Closed reduction, percutaneous fixation, supracondylar fracture of humerus

Introduction

Supracondylar fracture of Humerus is a common skeletal injury in pediatric age group. It accounts for 50% to 70% of all elbow injuries ^[1]. The rate of occurrence of this fracture increases steadily in the first five years of life to a peak at 5 to 7 years of age ^[2, 3]. The most common mechanism of injury is fall on out stretched hand. The elbow becomes fixed in extension, the forces are transmitted through the weakest portion of the Humerus which results in fracture. Magnitude of force leads to displacement of the distal fragment posteriorly and the proximal segment thus lies anteriorly, the relative position of these fragments determine the complications ^[4, 5]. The management of displaced supracondylar fracture of the Humerus is one of the most difficult of the many fractures seen in children. Different methods have been proposed, such as closed reduction and plaster of Paris slab application, skin traction, overhead skeletal traction, open reduction and internal fixation and closed reduction and percutaneous pin fixation ^[6]. Closed reduction with splint or cast immobilization was traditionally been recommended for displaced supracondylar fractures but loss of reduction and necessity for repeat manipulation was associated with malunion, myositis ossificans, neurovascular injury and elbow stiffness ^[7]. Open reduction and internal fixation yield good anatomical alignment but associated with complications like myositis mass, elbow stiffness, scar formation and other complications surgery. Closed reduction and percutaneous pin fixation as compared to Open Reduction and Internal Fixation is a simple procedure, has less incidence of elbow stiffness, cost effective, decreases hospital stay and other complications of open surgery ^[7].

This prospective study was undertaken to evaluate the result of closed reduction and percutaneous pin fixation in treating displaced supracondylar fractures of Humerus in children.

Material Methods

This is a prospective study, conducted on 30 patients admitted to the Department of Orthopaedics, VSSIMSAR, Burla with displaced supracondylar fracture of Humerus in

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children aged between 3-13yrs. The patients were followed up for a period of 3 years from January 2016 to January 2019. All those patients reporting with elbow injuries were evaluated. Any associated neurovascular injuries, fractures, compartment syndrome were noted. Radiograph of the elbow was taken in Antero-posterior and lateral views. The diagnosis was confirmed by radiological examination. The fractures were classified according to Gartland's classification. All patients were taken up for surgery as soon as possible after necessary routine preoperative hematological investigation.

Gartland's classification

- Type-I Non-displaced
- Type-II Minimally displaced with intact posterior cortex
- Type-III Completely displaced with no cortical contact
 - a) Postero-medial
 - b) Postero-lateral

Inclusion criteria

- Type II and III fractures

Exclusion criteria

- Type I fractures
- Compound fractures
- Associated fractures of ipsilateral upper extremity

The patients were laid supine on the operating table. The C-Arm image intensifier was placed at the head end of the table. Under general anesthesia, the part was prepared with

antiseptic lotion and draped properly. The fracture reduction was done by applying traction and counter traction for 2-3 minutes, with the elbow held in 20° flexion and forearm in supination. Once the fragments were disengaged, medio-lateral displacement and tilting are corrected. Then posterior displacement and tilt was corrected by controlled flexion at elbow with fingers controlling the lower part of Humerus and thumb pushing the distal fragment anteriorly. Radial pulsation and nail bed capillary filling after blanching was verified. Reduction was confirmed by AP, lateral and oblique views by rotating the C-Arm but not the limb. After satisfactory reduction, the fracture was stabilized with two 1mm to 2 mm K-wires depending on the age and bulk of arm of each patient. These pins were introduced from lateral to medial direction. After satisfactory fixation, the K-wires were bend and cut, protruding through the skin. Antiseptic dressing was done and posterior long arm Slab support was applied with the elbow in 90° flexion and forearm in supination. Patients were discharged from hospital on second postoperative day. Regular follow up was done at 1 week, 3 week and 5 week postoperatively. Posterior plaster slab was removed at 3 weeks and range of motion exercises started. K-wires were removed at 5 weeks. There after patients were followed at 8th week, 12th week and then after every 3 month. Radiological evaluation were done immediately after surgery and at 3, 5, 8 and 12th week. Clinical assessment was done according to Flynn criteria. Radiological assessment was made by assessing the Baumann's angle in the first and final X-rays. Displacement of 12° was graded as major, 6 to 12° as mild and less than 6° as no displacement as described by Skaggs.

Table 1: Flynn Criteria

Result	Rating	Cosmetic Factor: Loss of Carrying Angle in Degrees	Functional Factor: Loss of Motion in Degrees
Satisfactory	Excellent	0 - 5	0 - 5
	Good	6 - 10	6 - 10
	Fair	11 - 15	11 - 15
Unsatisfactory	Poor	> 15	> 15

Result

In this study 30 patients were taken up. 24 were male and 6 were female. The fracture was extension type in 30 patients. Left side was involved in 22 patients and right side in 8 cases. The age distribution was from 3 to 13 years with maximum patients in the 4 to 8 years of age group, the average age was 8.6 yrs. The presentation varied from few hours to 5days post injury. 22 patients presented within 24 hrs and 8 patients between 2 to 5 days. Based on Gartland classification 8 patients had type-II and 22 patients had type III pattern. The mode of violence was fall during play in the ground 26 patients and fall from height or bicycle in 4 patients.

Complications were noted in 3 patients, 2 with radial nerve injury, 1 with median nerve injury. As per Flynn Criteria 22 were excellent, 5 Good, 2 were fair and 1 remained poor. Results in our study were excellent in terms of carrying angle and functional outcome with attainment of full range of motion. 2 Patients developed myositis ossificans and both had restriction of elbow flexion and extension and graded fair. 5 patients reported pin tract infection. None had post-operative neurovascular compromise. Union was achieved without any serious complication. Patients with pre-manipulation nerve deficit recovered fully.

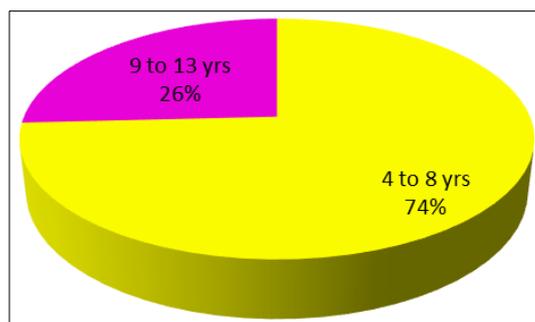


Fig 1: % of pt according to age group

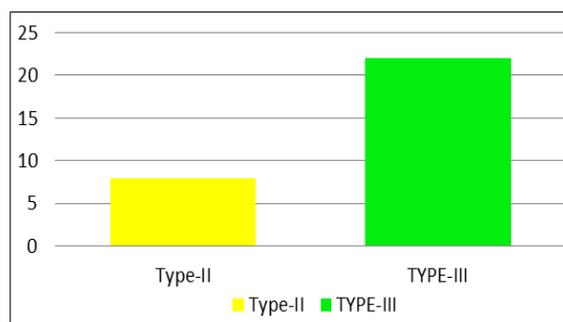


Fig 2: Distribution of fractures

Table 2: Pre-operative complications

Radial nerve palsy	2(6%)
Median nerve palsy	1(3%)

Table 3: Post-op complications

Pin tract infection	5 (17%)
Myositis ossificans	2 (7%)

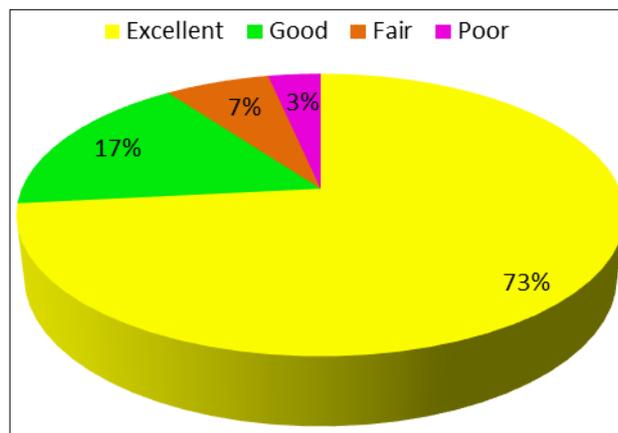


Fig 3: Functional Outcome

Case 1



Pre-op AP view



Pre-op lat view



Post-op AP view



Post-op clinical

Case 2



Pre-op view



Post-op AP



Post-op lateral



Healed AP view

Case 3

Pre-op AP View



Pre-op Lat. view



Post-op lat. view



Normal carrying angle

Case 4

Pre-op Lat. View



Pre-op AP view



Post-op AP view



Post-op Lat. view

Discussion

The treatment of supracondylar fracture of Humerus in children is quiet challenging. These fractures are very common in children between 5 to 10 years of age as reported in studies by Ziontes LE *et al.* [9]. In the present study, the average age was 8.6 years similar to other studies. The incidence of this type of fracture is reported to be more in boys than girls. In the present study, 24 (80%) were male patients and 6 (20%) were female. Supracondylar fractures result from a fall on an outstretched hand in up to 70% of patients [15]. 12 (40%) patients had fall from height and 18 (60%) had fall while playing. The non- dominant extremity was most commonly affected. In the present study, 28 (90 %) had left sided injury and 2 (10%) of them had right sided injury. Based on Gartland's classification, 8 (23%) patients had Type II fracture and 22 (77%) had Type III fracture. The average time for maximum recovery of movement was 13.45 weeks for type II fracture and 18.0 weeks for type III fractures. Skaggs D *et al.* studied consequences of pin placement in operative treatment of supracondylar fracture of Humerus in children and concluded that fixation with only lateral pins was safe and effective for both Gartland type II and type III fractures, moreover it prevented iatrogenic injury to ulnar nerve. They did not recommend routine use of crossed pins and if at all medial pin was used, the elbow

should not be hyper flexed during its insertion [8]. Boyd *et al.* preferred crossed medial and lateral pins and reported that out of 71 patients, 70 cases had satisfactory result and only 1 case had ulnar nerve palsy [15]. Ziontes *et al.* studied torsional strength of various pin configurations and concluded that two crossed pins provided maximum resistance against rotational displacement, followed by 3 lateral pins and 2 lateral pins. Ring D *et al.* [9] found two cases with compartment syndrome following closed reduction and cast immobilization [10]. In this study no cases of compartment syndrome was detected. Our results match with Williamson DM *et al.* who managed the supracondylar fracture by traction, manipulation, reduction and percutaneous pinning (PCP) [11] and with Harrington P *et al.* who observed 83% good to excellent results [12]. The incidence of deep infection and osteomyelitis was very low as reported by Mostafavi HR *et al.* and Gupta N *et al.* [13, 14]. In our study 8 patients had superficial Pin tract infection which resolved with oral antibiotics and removal of the pins. This infection may be attributed to personal hygiene as all patients with pin site infection were from poor socioeconomic status.

Conclusion

The results of our study show that under fluoroscopic guidance closed reduction and percutaneous pinning of displaced supracondylar fractures of Humerus in children is a

simple, cheap, safe and effective method of treatment with relatively fewer complication and reduced hospital stay.

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