

Comparative study between functional outcome of closed and open percutaneous K-wire fixation in Gartland type II and III extension type supracondylar humerus fractures in children

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Abstract

Background: Supracondylar fractures of humerus is one of the most common injuries in children. It requires great attention while treating as it is associated with neuro-vascular complications pre-operatively and intra-operatively. The aim of this study was to compare the functional outcomes of closed reduction and open reduction with cross-pinning percutaneous fixation in Gartland Type II and III supracondylar humeral fracture extension type.

Methods: In this prospective study, 120 children with type II and type III Gartland fracture extension type were treated with percutaneous k-wire fixation, between July 2009 to March 2016. 62 cases treated with closed reduction with cross pinning which formed group A and open reduction with cross pinning fixation were performed in 58 patients which formed group B.

Result: According to the Flynn's criteria group A showed 96.8% of satisfactory results and group B showed 96.6% of satisfactory results. The duration of surgery in group A was on an average 20 minutes (16 to 24 minutes) and in group B was on an average 39 minutes (35-45 minutes). There were 6 cases (10.34%) of delayed wound healing in Group B which were due to the soft tissue edema. There was 1 case of ulnar nerve neuropraxia in group A. We did not come across any case of pin tract infection.

Conclusion: Supracondylar fractures in children are difficult to treat because of its associated complications in fracture reduction. Various studies are there with different methods of fixation done for this fracture, but there is no clear consensus regarding the ideal treatment. In our study with open versus closed pinning for supracondylar fracture, we found no significant difference in final functional outcome after the study.

Introduction

Supracondylar humerus fractures are the most common elbow fractures seen in children, and the most common fracture requiring surgery in children. The peak age range at which most supracondylar fractures occur is 5 to 6 years.⁽¹⁾ Supracondylar fracture of humerus is known for its complications because of its inherent fracture instability, close vicinity to brachial artery and three major nerves of upper extremity and poor radiographs and poor interpretation of reduction and modality of maintenance of reduction.⁽²⁾

There are various modalities of treatment options available for the fracture like closed reduction and casting, Closed reduction with pinning and open reduction with percutaneous pinning.⁽¹⁾ Mildly displaced fractures can be reduced closed, using the intact posterior periosteum as a stabilizing force and then holding reduction by flexing the elbow greater than 120 degrees. Closed reduction and percutaneous pinning has become the standard treatment for reducible supracondylar fractures. However delay in presentation and the non-availability of image intensifier preclude successful closed management, both of which are common in developing countries.⁽³⁾ Although irreducible fractures are uncommon mostly due to interposition of the brachialis muscle, median nerve, and brachial artery, 2–12% require open reduction.⁽⁴⁾

There is no consensus regarding ideal methodology of treatment. The aim of our study is to evaluate and compare the functional outcome of closed reduction with k-wire fixation versus open reduction with k-wire fixation.

Materials and Methods

Between July 2009 to March 2016, 120 children with Gartland Type II and Gartland Type III supracondylar humeral fracture were managed with closed and open reduction, both with cross pinning fixation in our institution Mysore medical college and research Institute, Mysuru. The cases were immediately evaluated in casualty for neuro-vascular complication. X-ray evaluation involved antero-posterior and lateral views of the respective elbow joint. The study cohort includes 78 boys and 42 girls with an age range from 5 to 10 years. Most injuries were sustained due to trivial injured like fall from outstretched hand while playing(68%), and road traffic accidents (22%) fall from height (10%). All patient underwent surgery within 12 to 72 hours of presentation which fulfilled the following inclusion criteria - fresh fracture, age between 5 to 10 years, irreducible fracture with closed reduction. Exclusion criteria included the age below 5 and above 10 years, pathological fractures, intra-articular fractures, pre-existing sensory-motor diseases like polio and cerebral palsy.

All closed reductions with percutaneous pinning were done with one medial and two lateral pinning, under the C-arm guidance. Open reduction was done with posterior approach involving triceps muscle split. A K-wire of 1.6 mm to 2 mm diameter was used in all cases. Post op care included looking for tourniquet palsy of ulnar nerve, median and radial nerve injuries and regular dressing is done to prevent pin track and wound infection usually on postoperative day 2, appropriate antibiotic coverage was given. The period of hospitalization was 5-7days.

After one week, passive and active movements at the elbow joint were started. Patients were followed up weekly to look for the movements at the elbow and the x-rays were done at 4 weeks to look for callus formation and K wires removed at 4 weeks time. Patients were then followed up every month for next three months. At the last follow-up, patients were assessed radiological for fracture union and functional range of movements. According to Flynn’s criteria comparison of postoperative carrying angle and range of motion were performed.

Table 1: “Flynn criteria”⁽⁵⁾

	Cosmetic factor carrying-angle loss (degrees)	Functional factor movement loss (flexion and extension degrees)
Excellent	0-5	0-5
Good	6-10	6-10
Fair	11-15	11-15
Poor	>15	>15

Results

In our study there were 78 male children and 42 female children of age between 5 to 10 years. Among them 48(40%) were between the age of 6 to 9 years. The choice between open and closed k-wire fixation was done as per case to case basis. Group A were the patients treated with closed reduction and group B were the patients treated with open reduction.

The duration of surgery in group A was on an average 20 minutes (min 16 to max 24 minutes) and in group B was on an average 39 minutes (min 35 to max 45 minutes).

Group	Group A	Group B
Mean	20.56	39.14
SD	1.73	3.76
SEM	0.22	0.49
N	62	58

Table 2: Demographic Table

	Closed Reduction (Group A)	Open Reduction (Group B)
Males	40(51.28%)	38 (48.72%)

Females	22(52.38%)	20 (47.62%)
Total (n=)	62	58

Table 3: According to Flynn’s criteria following are the results for Group A

Results	Rating	No. of Patients	Percentage
Satisfactory	Excellent	30	48.38%
	Good	20	32.25%
	Fair	10	16.12%
Unsatisfactory	Poor	2	3.2%

Table 4: According to Flynn’s criteria following are the results for Group B

Results	Rating	No. of Patients	Percentage
Satisfactory	Excellent	27	46.55%
	Good	16	27.58%
	Fair	13	22.41%
Unsatisfactory	Poor	2	3.4%

There were 6 cases (10.34%) of delayed wound healing in Group B which were due to the soft tissue edema, which subsided on limb elevation, but lead to cosmetically unacceptable scar.

There was 1 case of ulnar nerve neuropraxia in group A which recovered on 3rd month of follow up. Average time of union in both groups was an average 4 weeks (3-6 weeks).

In both the cases we did not come across any case of pin tract infection. Restriction of movements at elbow joint was found in 3 cases in group A which regained good movements after 3 weeks of physiotherapy There were no cases of Volkmann’s ischemic contracture, or myositis ossificans.



Pre-Operative X-ray



Intra-Op X-ray of closed reduction



Post-Operative X-ray in closed reduction



Post-operative immobilization with above elbow slab



Intra-Operative pictures in closed reduction



Post-op range of movements in closed percutaneous pinning at 8weeks



Pre-Operative



Positioning

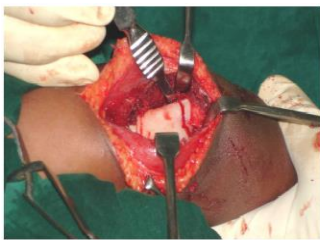


Paint



Drain

Pre-Operative pictures of open reduction



Fracture Site Exposed



Introducing 1st 'K' wire

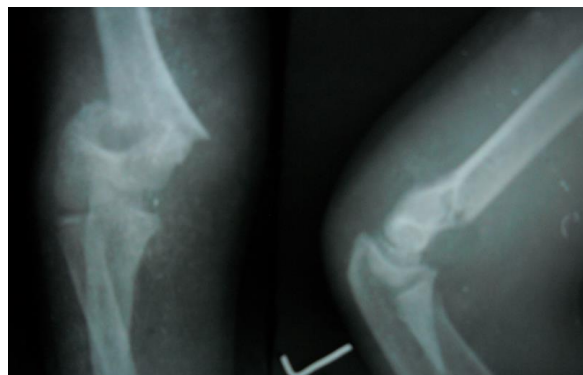


Triceps Closure

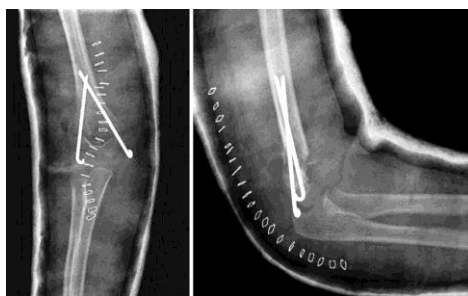


Skin Closure

Intra-Operative pictures of open reduction



Pre-op X-ray open reduction



Post-operative X-ray of open reduction



Post-Operative ROM in open percutaneous pinning at 12weeks

Discussion

Supracondylar fractures of the humerus represent 50-70% of all elbow fracture in children in the first decade of life.⁽⁶⁾ Out of the treatment options available, we followed the patients treated with closed reduction with pinning and open reduction with percutaneous k-wire fixation. All of our open cases were done with the posterior approach.

Table 5: Comparison between other modalities of treatment and present study

Year of publication/Author	Method	Number of cases	Inference
1995 Cheng, Jac CY.; et al	Closed reduction lateral pinning	111	High success rate
2000 Mulhall, K., et al	Open reduction internal fixation	16	Effective and safe method
2004 Özkoc, G., et al	Closed reduction versus open reduction	99	Closed reduction is superior
2006 Boparai R, et al	Open versus plaster cast	25	Open reduction is superior
2015 kumar et al	Open reduction internal fixation	25	Open reduction is preferred method
2016turkmen et al	Lateral vs posterior approach	38	Posterior approach is preferred
2016 present study	Open vs closed reduction	120	Both are equally efficient

Gonc Ozkoc et. al concluded that closed reduction and pinning is superior to open reduction and pinning for the treatment of pediatric supracondylar humerus fractures.⁽⁷⁾ Mulhall K J et al performed an outcome study of completely displaced supracondylar fractures in children in order to assess the outcome of primary open reduction and internal fixation for these injuries. They concluded that open reduction and internal fixation of these fractures is an effective and safe

method of primary treatment and is associated with good outcomes.⁽⁸⁾ Boparai R, Sharma R et al concluded primary Open reduction of type-III supracondylar fracture gives good functional and cosmetic results as compared to closed reduction with plaster cast.⁽³⁾ T P Cheng, Jack C. Y.; Lam, et al showed that the cross and lateral percutaneous pinning was found to be effective in the treatment of Gartland type III extension fractures with a high success rate and minimal complications 9.

Anandkumar et al concluded that open reduction and internal fixation provides good results in type III Gartland fractures.⁽¹⁰⁾ Turkmen et al concluded that triceps splitting posterior approach in open reduction is safe when compared to lateral approach with advantages of easier fracture reduction and short operating time.⁽¹¹⁾

In our study according to the Flynn's criteria group A showed 96.8% of satisfactory results and group B showed 96.6% of satisfactory results. The duration of surgery in group A was on an average 20 minutes (16 to 24 minutes) and in group B was on an average 39 minutes (35-45 minutes).

There were 6 cases (10.34%) of delayed wound healing in Group B which were due to the soft tissue edema. There was one case of ulnar nerve neuropraxia in group A. We did not come across any case of pin tract infection. There was one case of pulseless warm extremity immediately after closed reduction and internal fixation because of vascular compromise, which was managed with open reduction. Initially patients of Open reduction had some amount of movement restriction at elbow because of the delayed wound healing, but at the end of the study there was no significant movement restriction, and none of the patients had myositis ossificans, there was no much difference in functional outcome in the patients operated early or late.

In our study the demographic profile, timing of the surgery was similar to the above mentioned study, and the results obtained by our study showed no much difference in the functional outcome in both Group A and Group B.

Conclusion

Supracondylar fractures in children are difficult to treat because of associated complications and difficulty in reduction and maintaining of the same. There are various studies with different methods of fixation done for this fracture, but there is no clear consensus regarding the ideal treatment. In our study with open versus closed pinning for supracondylar fracture found no significant difference in final functional outcome, although there is significant difference in wound healing and scar formation initially in open reduction but on regular follow up at 4 weeks there was no much difference in functional outcome at last.

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