

FUNCTIONAL OUTCOMES IN FRACTURE OF SUPRACONDYLAR HUMERUS IN CHILDREN TREATED WITH PERCUTANEOUS PINNING WITH CROSS K-WIRES

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Abstract:

Background: Fracture of Supracondylar humerus is the most common elbow fractures in children. Percutaneous pinning is an effective modality of treatment, as it obliterates the problem of maintenance of reduction of the fracture .

Methods: 30 patients coming to the hospital during the period from October 2012 to October 2015 with closed Gartland type II and III supracondylar humerus fracture and managed with percutaneous pinning with two cross K-wires were included. Anteroposterior and lateral view X-rays of the affected as well as the normal elbow were taken and assessed regarding union, carrying angle, metaphyseal-diaphyseal angle. Mitchell and Adam's criteria were used for evaluation of the final functional outcome .

Results: The final functional outcome assessed according to Mitchell and Adam's criteria, was excellent in 86.66%, good in 10%, Unsatisfactory or poor in 3.33% patients.

Conclusion: Use of a medial entry pin for the treatment of fracture of supracondylar humerus in children by closed reduction and percutaneous pinning using cross K-wires is safe as far as iatrogenic ulnar nerve injury and vascular complications are concerned, if an adequate technique is followed. Closed reduction and percutaneous pinning with medial and lateral cross K-wires offers a practically feasible, economically viable and an effective treatment method for displaced fracture of supracondylar humerus .

Keywords – Supracondylar fracture , Gartland , Metaphyseal-diaphyseal angle, Mitchell and Adam's criteria

Introduction

Fracture of supracondylar humerus is the most common elbow fractures in children¹ and needs proper management. This fracture is common in the 1st decade of life² due to various causes, of which main is ligament laxity and anatomical structure of humerus tube (shaft) to flat transformation at the lower end of humerus. Boys have had a higher incidence of this fracture than

girls. The left or nondominant side is most frequently injured³.

Many different treatment modalities have been devised for supracondylar fracture of humerus in children, with closed reduction and immobilization in flexion, Dunlop's traction, overhead olecranon skeletal traction, open reduction and internal fixation and closed reduction and percutaneous pinning being the commonly

used modalities.

Goals of treatment are avoidance of complications and achievement of excellent functional results. In this aspect, percutaneous pinning seems to be useful and effective modality of treatment with least complication rate, as it obliterates the problem of maintenance of reduction of the fracture and minimizes the risk of circulatory insufficiency. The chances of cubitus varus deformity are markedly reduced, with marked reduction in the severe amount of swelling and hospitalization time.

Of all the complications associated with supracondylar fractures, nerve injury ranks highest, although reports of the incidence of specific neuropraxia vary. Nerve injury in supracondylar fracture humerus occurs in at least 7% cases and significant vascular injury is seen in 1% cases⁴. The radial nerve has been the most frequently involved nerve in older studies; however, the median nerve is much more commonly injured, particularly the anterior interosseous nerve, in more recent studies⁵. The ulnar nerve is most commonly injured iatrogenically during pinning or in a flexion-type of supra-condylar fracture.

Materials and methods

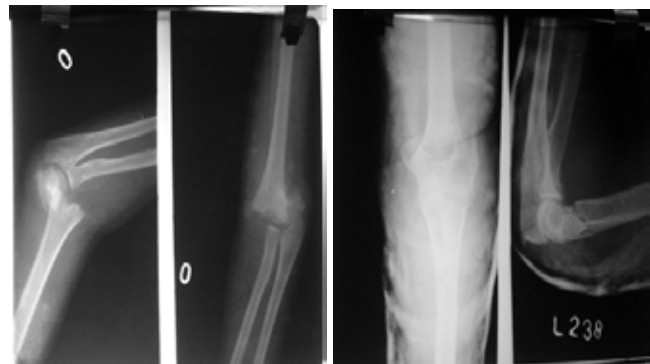
30 skeletally immature patients coming to the hospital during the period from October 2012 to October 2015 with closed Gartland type II and III supracondylar humerus fracture and managed with percutaneous pinning with two cross K-wires were included.

Patients with Gartland type I supracondylar fracture of the humerus, open fractures and supracondylar humerus fractures with neurological deficit were excluded from the study.

An informed consent was taken. All the 30 cases turned up for the final follow-up. All patients with supracondylar fracture of humerus were first seen either in emergency services or the orthopaedic outpatient department. They were assessed clinically with special reference to the neurovascular status of the involved limb. Antero-posterior and lateral view skiagrams of the affected elbow were taken (Fig. 1).

The X-rays were assessed regarding the type of fracture and the degree of displacement based on Gartland classification.

Patients were immobilized in an above elbow slab, and Gartland type II and III supracondylar fracture of the humerus were admitted to the hospital and scheduled for closed reduction and percutaneous pinning under general anaesthesia (Figs. 2–3). The arm was immobilized in 30–60 of flexion in an above elbow slab. The child was observed overnight and post-pinning antero-posterior and lateral view check X-rays of the affected elbow were taken and assessed regarding posterior, medial and lateral displacement as well as rotation of the distal fragment in sagittal, coronal and horizontal plane. Metaphyseal–diaphyseal angle were measured.



Type III **Type II**
Fig . 1 – Pre-operative X-ray

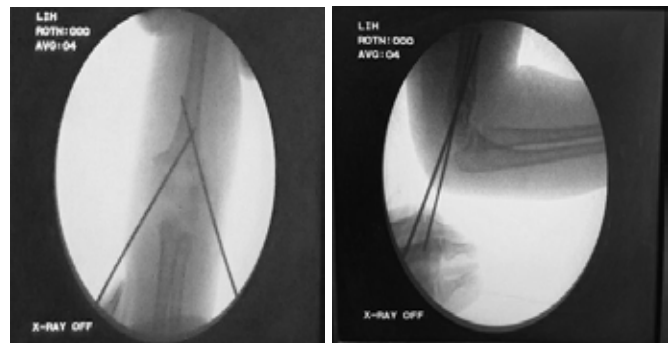


Fig . 2– intra – operative images after medial and lateral cross pinning with k - wire



Fig . 3 – post – operative images

Results

This study included 30 cases of fracture of supracondylar humerus treated with percutaneous pinning with two cross k-wire. The mean age at the time of injury was 7 years (Fig. 4). In this study, 23 patients had injury on the left side and 7 cases had injury on right side. 24 patients suffered injury due to fall while the remaining patients suffered injury in road accident. 23 patients came next day after the injury and 7 patient reported 2 days after injury. The post-reduction metaphyseal-diaphyseal angle was in the range of 83-85 degree in 5 cases, 85-88 degree in 21 cases, 89- 92 degree in 3 cases. 16 patients had carrying angle range from 13-15 degree, 13 patients had carrying angle range from 10-13 degree and 1 patient had carrying angle change 8 degree. The Final functional results were excellent in 26(86.66%) cases, good in 3(10%) case, and unsatisfactory or poor in 1 (3.33%) patient (Fig. 5). At final follow-up, 2 (6%) cases had full range of motion, 24(80%) cases had limitation of range of flexion 0-10 degree, 3 (10%) case had limitation of range of flexion 10- 20 degree and 1 (3.33%) case had limitation of range of flexion more than 20 degree.

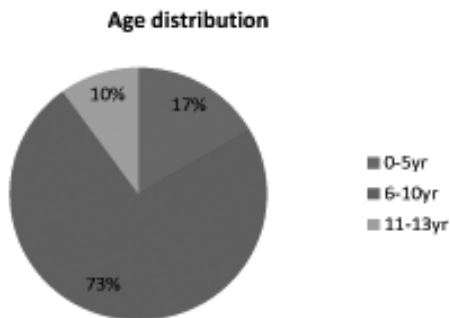


Fig. - 4

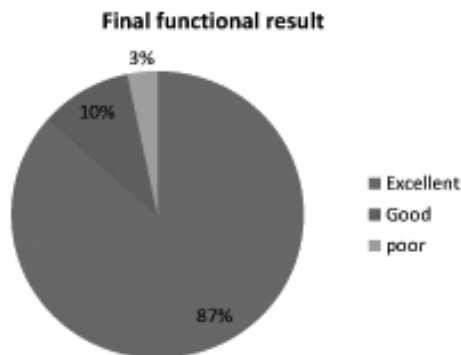


Fig. - 5

Discussion

In this study, the majority of the patients (23 patients) came next day after the injury and 7 patient reported 2 days after injury. In a study by Boparai et al.⁶, 31 patients attended emergency same day, 11 came next day, 5 within 2 days and rest 3 came in 2–7 days after injury. The cause for delay was due to the fact that the patients come from far off areas and they take initial domiciliary treatment in the form of massage or wooden splintage and tight bandage. 2 patients reported with the tight bandage and both of them reported on next day of injury but none of them had any signs of compartment syndrome. Patients were also having fear of operation in hospital.

In the present study 25 patients being operated within a delay of 2 day and 5 patients were operated more than 3 days after the injury.

Of the 25 patients, operated within 3 days of injury, 23 had excellent functional outcome, 2 had good outcome. Of the 5 patients operated after 3 days of injury, 3 had an excellent, 1 had good and one had poor outcome. Thereby showing no association of the final functional outcome with the increased time between presentation and surgery. This is comparable to the studies by Larson et al. (2014)⁷, Mehlman et al. (2001), Lett et al. (2002)⁸, Gupta et al. (2004)⁹, who concluded that increased time from presentation to surgery was not associated with increased morbidity from the injury or treatment complications.

The final metaphyseal–diaphyseal angle, in majority of 22 patients was in the range of 85–88 degree. 5 patients had final metaphyseal–diaphyseal angle ranging between 83–85 degree and the remaining 3 patient had a metaphyseal–diaphyseal angle in range of 89–92 degree. Normal angle is 90 degree. A variation of greater than 10 degree from the normal side is significant. Angle of more than 90 degree indicates varus angulation.

In this study, no case was admitted with nerve injury. Lawrence (1956)¹⁰, Eid (1978)¹¹ reported radial nerve injury most frequently. In a review of 61 major series by Wilkins (1991)¹², he observed 7.7% cases having neurological deficit with radial nerve being the most commonly injured. El- Sharkawi and Fattah (1965)¹³, and El-Ahwany (1974)¹⁴ found in their studies that median nerve had most common involvement.

None of the patients had any vascular compromise. Ottolenghi (1960)¹⁵, in a study reported vascular injury or compromise rate of nearly 5%, of which less than 1% developed Volkmann's ischaemic contracture. Krishna Kumar (2000)¹⁶ in his study, also reported no case of Volkmann's ischaemic contracture.

One case of post-operative ulnar nerve injury was observed as a complication of insertion of medial K-wire for stabilization of the reduced fracture. Mangwani et al. (2005)¹⁷, in a study of 291 children with supracondylar fracture humerus, found post-operative neurological deficit in nine patients, of which 3 required exploration of the ulnar nerve. Kwak-Lee et al. (2014)¹⁸ concluded that the use of a medial-entry pin for the treatment of paediatric supracondylar humerus fractures is safe as far as iatrogenic ulnar nerve injury and vascular complications are concerned, if an adequate technique is followed.

In most of the studies, chances of myositis ossificans were almost 0% due to early management with very less manipulation.

9 patients had a final carrying angle in a range of 10–13 degree, with majority of the patients (20) having a carrying angle in the range of 13–16 degree, while only 1 patient having a final carrying angle 8 degree.

The criteria used in the analysis of results have been the final range of motion. Holmberg (1945)¹⁹ stated that flexion continues to increase at a slow rate for up to 2 years. At final follow-up, 2 (6.66%) cases had full range of motion, 24 (80%) cases had 0-10 degree loss, 3 (10%) case had 10-20 degree loss and 1 (3.33%) case had more than 20 degree loss of flexion and extension. The findings of this study are almost comparable with those of Hernikson (1966)²⁰ who reported that less than 5% of cases have greater than 5 degree loss of flexion.

The final functional outcome assessed according to Mitchell and Adam's criteria (1961)²¹ was excellent in 26 (86.66%) cases, good in 3 (10%) case, and unsatisfactory or poor in 1 (3.33%) patient.

Table 1 – Comparison of final functional outcome with other series

Series	Satisfactory			Unsatisfactory
	Excellent	Good	Fair	Poor
Bhan et al. (2000)	81%	3.2%	11.3%	4.5%
Iyengar (2003)	85.5%	10.7%	3.1%	0.5%
Lee (2008)	91.8%	8.2%	0%	0%
Present study	86.66%	10%	0%	3.33%

The results of this study are comparable to those in the other series, in which the displaced fracture of supracondylar humerus was treated by percutaneous pinning. Swenson (1948)²² had good results in his 10 cases, Fowels and Kassab (1974)²³ 87.5% good results in 110 cases, Flynn et al. (1974)²⁴ had satisfactory overall results in 98% of his 52 cases. Ariño et al. (1977)²⁵ had 160 satisfactory results in 189 cases, Aronson and Prager (1987)²⁶ had 70 satisfactory results in 71 cases.

This study achieved 86.66% excellent results in 30 cases of displaced supracondylar fracture of humerus treated by closed reduction and percutaneous pinning with medial and lateral cross K-wires. One patient in the study developed iatrogenic ulnar nerve injury. None of the patient in this study developed myositis ossificans, thereby, proving closed reduction and percutaneous cross pinning an effective treatment method for displaced fracture of supracondylar humerus.

Conclusion

Fracture of Supracondylar humerus is a very common injury in children. Complications associated with this fracture warrant appropriate and optimum management of this injury. Closed reduction and percutaneous pinning with medial and lateral cross K-wires offers an excellent method to reduce and fix these fractures accurately. Some biomechanical studies advocate cross pinning technique as a more stable biomechanical construct. Increased time from presentation to surgery is not associated with increased morbidity from the injury or treatment complications. Early mobilization is an advantage with this treatment. The use of a medial entry pin for the treatment of paediatric supracondylar humerus fractures is safe as far as iatrogenic ulnar nerve injury and vascular complications are concerned, if an adequate technique is followed.

Immediate complications like compartment syndrome are rare and long-term complications are decreased. Chance of infection and implant failure are minimum with this method of treatment. Basic aim in supracondylar humerus fractures is to gain full range of motion of elbow and to obtain a normal appearance of elbow. This modality of treatment is associated with excellent functional outcomes by achieving a full range of motion at the elbow joint in majority of cases and no residual deformity due to malunion. Another advantage is that the removal of implant is an outdoor procedure.

Closed reduction and percutaneous pinning with medial and lateral cross K-wires offers a practically feasible, economically viable and an effective treatment method for displaced supracondylar fracture humerus.

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