

A Retrospective Study on Neurological Complications in Supracondylar Fracture of Humerus in Children

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How to cite this article:

Manjunatha A, Drvinay N, Anand Kumar BS, A Retrospective Study on Neurological Complications in Supracondylar Fracture of Humerus in Children. J orth. Edu. 2020;6(1):11-14.

Abstract

Introduction: Supracondylar fracture of humerus is most common of all the fractures around the elbow in children. They occur most commonly during the childhood in male child with the peak around 5-8 years. The neurovascular injuries are more common in this fracture type. **Aim and Objective:** To study the incidence and outcome of nerve injuries in supracondylar fracture of humerus. **Materials and methods:** A 4-year retrospective analysis was done among children with supracondylar fracture of humerus for nerve injuries. All the nerve injuries were documented and categorized. The type of fracture and the treatment given for the children with nerve palsy were recorded and analyzed. The follow up of the children were analyzed to know the complete/partial recovery of the nerve. **Results:** Out of 22 children, 8 children had traumatic, 1 unknown and 13 had iatrogenic nerve palsies in this study. The incidence rate of nerve palsy in our study was 13.92%. Radial, ulnar and median nerve palsy were seen in 7, 11 and 2 children. 2 patients who had open fracture developed both median and radial nerve palsy. The average nerve recovery rate for median, ulnar and radial nerve were 3.25, 3.63 and 3.7 months. **Conclusion:** The chances of nerve palsy should be kept in mind in the treatment of supracondylar fracture and proper counselling should be given pre-operatively. Ulnar nerve was most commonly injured and median nerve was most early to recover in our study.

Keywords: Supracondylar Humerus fractures; Elbow; Kirschner Wires; Ulnar nerve; Median nerve; Radial nerve.

Introduction

Supracondylar fracture of humerus is the commonest fracture of elbow in children. This fracture leads to many neurovascular complications at the time of fracture and also during the treatment of fracture. Neural injuries may happen due to stretching of nerve, entrapment, disruption and edema around the nerve.¹ Supracondylar fracture basically divided into two types, extension type which is most common and flexion type which is rare. Flexion type fracture leads to ulnar nerve injury.² Extension type fracture have posterior-medial displacement which leads to radial nerve palsy and posterior-lateral displacement which leads to median nerve injury.³ This study was used to analyze the nerve injury in supracondylar fracture and to assess the nerve recovery during the follow up of the patient.

Materials and methods

A retrospective observational study was conducted at Kodagu Institute of Medical Sciences, Madikeri among patients with neural complications of supracondylar fracture of humerus considering the inclusion and exclusion criteria. The institutional ethical committee clearance was taken before the start of this study. This retrospective study period was for 4 years conducted from April 2016 to March 2020.

Inclusion criteria

All children aged <14 years with supracondylar fracture cases with neurological complications.

Exclusion Criteria:

- a) All children >14 years

- b) Cases with other associated fractures around elbow
- c) Children who lost for follow-up

Methodology

All the children case reports with diagnosis of supracondylar fracture was evaluated carefully for nerve palsy. All supracondylar fracture cases with neurological complications were included in this study. All the demographic details of the children with supracondylar fracture were documented. The clinical details of the children were assessed for the nerve palsies. The median nerve was assessed by active flexion of the distal interphalangeal joint of the index finger and thumb. Radial nerve was assessed by looking for thumb extension, which was easy even for young child. Ulnar nerve assessment was done by analysing the first interosseous contraction. AP and Lateral view X-rays were analysed and type of fracture was classified according to Gartland’s classification. According to Gartland’s classification, Type I-Undisplaced, Type II-Displaced (with intact posterior cortex), Type III-Completely displaced (no cortical contact).⁴ The treatment given for the supracondylar fracture was recorded.

The children were treated in one of the 3 ways in our institution, closed reduction and POP slab application/closed reduction with percutaneous K-wire fixation/open reduction with percutaneous K-wire fixation. The pinning technique and associated nerve palsy due to pinning was also recorded. Any associated vascular injury was documented. If any nerve palsy occurred in the follow up period were recorded. The recovery time taken for the nerve palsy was documented.

Results

In this study, 158 patients were diagnosed with supracondylar fracture. 25 patients had neurological complications in our study. 3 patients were lost for follow up, so totally 22 patients were included in this study. 13 females and 9 male children were enrolled in this study. Gartland’s type 2 fracture was seen in only 4 patients and type 3 fracture was seen in 18 children (table 1). Among 18 children with type III fracture, 12 cases had posterior-medial displacement and 6 cases had posterior-lateral displacement (fig 1). In our study, 19 cases were closed supracondylar fractures and only 3 cases were open fractures. The incidence rate of

nerve palsy in our study was 13.92%. Radial nerve palsy was seen in 7 children. Ulnar nerve palsy was seen in 11 patients. Median nerve palsy was seen in 2 patients. 2 patients who had open fracture developed both median and radial nerve palsy. In our study 3 cases were treated conservatively, 11 with open reduction and percutaneous K-wire fixation and 8 cases with closed reduction and percutaneous K-wire fixation.

Table 1: Table showing the nerve palsy in Gartland’s type 2 and type 3 fractures.

Type of fracture	Nerve palsy			Total
	Radial	Ulnar	Median	
II (n=4)	0	4	0	4
III (n=12) (posteriomedial)	6	4	4	14
III (n=6) (posteriolateral)	3	3	0	6
Total	9	11	4	24

Table 2: Nerve palsy in the treatment for supracondylar fracture cases.

Type of Treatment	Nerve palsy			Total
	Radial	Ulnar	Median	
Conservative (n=3)	1	2	0	3
Closed reduction and K-wire (n=8)	3	4	1	8
Open reduction and K-wire (n=11)	5	5	3	13
Total	9	11	4	24

2 cases of open reduction had 2 nerve palsies.

Table 3: Nerve palsy in cross pinning and lateral pinning cases.

Pinning	Nerve palsy			Total
	Radial	Ulnar	Median	
Cross pinning (n=16)	7	8	2	17
Lateral pinning(n=3)	1	1	2	4

Each 1 case of medial and lateral pinning had 2 nerve palsy.

8 cases were traumatic nerve palsy, 13 were iatrogenic and 1 case was not known. Among 8 cases, 3 cases were treated by open reduction & K-wire fixation, 3 by closed reduction & K-wire fixation and 2 conservatively by POP slab after closed reduction (table 2). Among 13 iatrogenic cases, 7 cases were treated with open reduction and percutaneous K-wire fixation, 5 cases were treated with closed reduction & K-wire fixation and one case was managed conservatively. Among 19 cases where fracture was fixed with K-wire, cross pinning was done in 16 and lateral pinning was done in 3 cases (table 3 and fig 2). Complete

recovery was seen in 20 cases and 2 cases with both median & radial nerve palsy had partial recovery. In all the 22 cases, the average recovery was seen in 3.38 months. Radial nerve recovery was seen in 3.38 months. The average recovery of ulnar nerve was seen in 3.63 months. The average recovery of median nerve was in 3.25 months.

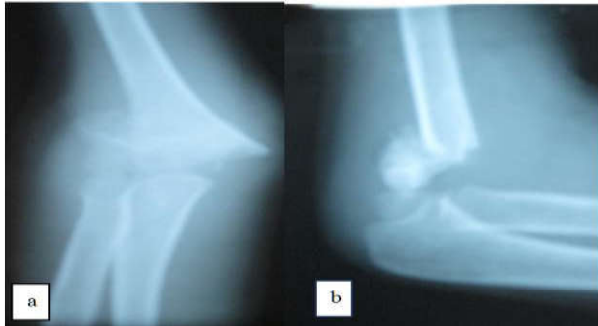


Fig. 1: X-ray showing the type III extension type supracondylar fracture of humerus. a. AP view, b. lateral view.



Fig. 2: AP and Lateral view X-ray showing Cross K-wire Pinning.

Discussion

Supracondylar humerus fracture is the most common elbow fracture which constitute 55% of all the elbow fractures.⁵ There are two peaks in the incidence of supracondylar fractures, one in 4-5 years and the other in 5-8 years of age. In this present study, the mean age of presentation was 6.63 years. According to Rene, the mean age of children with nerve palsy was 9 years.⁶ There was female predominance in this study.

The incidence of nerve palsy in this study was 13.92%. According to Brown's article the incidence of neural injuries was 12% in his study.⁷ In a study done by Maria, the incidence was reported to be 6.5% which was lower than our study.⁸ In a study done at Netherlands, the incidence of nerve injury was 9% and the incidence was 19% among patients with type III fracture.⁶ The incidence of neurological complications according to Taco Gosens in his

study was 16.5% which was more than the present study.⁹

Majority (50%) of children in this study had ulnar nerve palsy. 31.8% of children had radial nerve palsy. 9.1% children had median nerve palsy and 9.1% had both radial and median nerve palsy. In a study done by Brown and Zinar radial nerve was most common damaged followed by median nerve and ulnar nerve.⁷ In a study done by Mc Graw et al median nerve was most commonly affected followed by ulnar and radial nerve.¹ In Maria Valencia study 21% of cases had more than one nerve palsy which was higher than our present study 9% who had both median and radial nerve palsy.⁸

In the present study, majority 90.9% of the cases were Gartland's type 3 supracondylar fractures. Among type III fractures, 66.6% were posterio-medially displaced and 33.3% of cases were posterioro-laterally displaced. In our study, children with posterior-lateral displacement had radial and ulnar nerve palsy in equal no of cases. Posterio-medially displaced fractures in this study had all the 3 nerve palsies. In the Mc Graw study, posterio-lateral displacement fractures only had median nerve injury and posterio-medial displacement had all the 3 palsies similar to the present study.¹

In our study 13.63% of cases were treated conservatively, 50% with open reduction and percutaneous K-wire fixation and 36.36% cases with closed reduction and percutaneous K-wire fixation. 36.3% of cases were traumatic in origin in our study. 59% were iatrogenic due to pinning techniques done intraoperatively for fracture stabilization. 22.72% iatrogenic cases were reported in a study done by brown et al.⁷ In this study, cross K-wire pinning was done in 84.2% of cases & lateral K-wire pinning was done in 15.8% cases. Cross K-wire pinning provides a better biomechanical stability than unilateral pinning, so most of the cases in our study were operated with cross wire pinning.¹⁰ In a study done by Ronald, out of 143 cases of supracondylar fracture, 4 cases of nerve palsies were reported because of medial pinning.¹¹ According to the literature search, medial pinning leads to ulnar nerve injury as the pin may pass through the nerve. But Pirone et al in their study reported 78% excellent results with percutaneous pinning and no increased risk of ulnar nerve palsy with medial pinning.³ Flynn et al reported transient sensory ulnar neuropathy with medial pinning in his study.¹² In our experience the chances of ulnar nerve palsy with medial pinning is more. So to avoid ulnar nerve injury, blind pinning is avoided

and a small incision is given at medial epicondyle and a smooth K-wire is passed under vision. The position of the K-wire is checked with C-arm guidance and if the position is altered, the K-wire is removed and properly reinserted. All the patients in which medial pinning is performed immediate nerve examination is done in the post-operative ward to rule out ulnar nerve palsy. Delayed ulnar nerve palsy was reported in a study done by Royce due to undue stretching of the nerve due to K-wire or oedema around the nerve.¹³

In all the 22 cases, the average recovery was seen in 3.38 months. Radial nerve recovery was seen in 3.38 months. The average recovery of ulnar nerve was seen in 3.63 months. The average recovery of median nerve was in 3.25 months. The average recovery time according to Brown's study was 3.61 months.⁷ Ulnar nerve recovery was delayed and median nerve recovery was shorter in this study. In a study done by Valencia, the recovery time of median, radial and ulnar nerve were 2.5, 3 and 6 months.¹⁴ According to literature search, ulnar nerve had longer recovery period compared to median and radial.¹⁵ According to the literature search most of the nerve injury is because of neuropraxia and most of the nerve injuries recover in 6 months. In the present study, 90.9% of cases showed complete recovery and only 9.1% of cases had partial recovery. According to literature, the overall nerve recovery rate was 86-100%, which was 90.9% in our study.³ Electromyographic studies are recommended after 6 months if the nerve injury was not recovered. According to the literature review motor function of the nerve was early to recover than sensory function.^{16,11}

Conclusion

The chances of nerve palsy should be kept in mind in the treatment of supracondylar fracture and proper counselling should be given pre-operatively. K-wire should be passed under C-arm guidance to avoid nerve palsy. Ulnar nerve was most commonly injured and median nerve was early recovered in our study. Complete nerve recovery was seen in 90.9% of cases in this study.

Funding: None

Conflict of interest: None declared

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