

ORIGINAL ARTICLE

MEDIAN NERVE INJURY IN CHILDREN AGED 2-11 YEARS PRESENTING WITH CLOSED SUPRACONDYLAR FRACTURE OF HUMERUS

Alam Zeb Khan, Shoaib Zardad, Muhammad Adeel, Javed Iqbal

Department of Orthopaedics, Ayub Medical Institution, Abbottabad-Pakistan

Background: The supra-condylar humeral fractures are commonest fractures at the elbow in children and represent a third of all limb fractures in children under the age of 7 years. These fractures are associated with neurological deficit and any of the three long nerves of upper arm can be involved in these fractures. This study was conducted to determine the frequency of median nerve injury in children aged 2–11 years presenting with closed supracondylar fracture of humerus. **Methods:** This descriptive cross-sectional study was conducted at the department of orthopaedics and trauma, Ayub Teaching Hospital Abbottabad from July 2016 to June 2018. One hundred and seventy-one patients with supracondylar fracture of humerus were enrolled. They were treated as per department protocols and the outcome in terms of neurological damage was noted for each study participant. **Results:** The frequency of neurological damage was 21.05% with median nerve affected most commonly (13.45%). A statistically strong association was found between damage to median nerve and type of fracture, arm involvement and sex of patients ($p < 0.05$) while no statistically significant association with age was obtained. **Conclusion:** Neurological damage is a common complication of supracondylar humeral fractures with median nerve being the most commonly affected nerve in these fractures.

Keywords: Median Nerve; Supracondylar Fracture; Humerus; Open Reduction; Motor Deficit

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INTRODUCTION

The supra-condylar humeral fractures are the most common fractures at elbow in paediatric population and represent one half to almost three-fourths of all fractures at elbow joint in addition to accounting for approximately 30% of all limb fractures in paediatric population under the age of 7 years.^{1,2} The reported incidence of supra-condylar humeral fractures is 308 fractures per 100,000 population per year in the general population.³ The age range at which most of the supra-condylar humeral fractures occur is between 5–8 years of age.⁴

Of the two types of supra-condylar fractures of humerus, the extension type fractures are the most common fractures representing up to 95% of all paediatric supracondylar fractures of the humerus, the remained being flexion type supra-condylar fractures of humerus.⁵ These fractures are rarely life-threatening but are associated with an increased morbidity, absenteeism and increased disability adjusted life years (DALY) in addition to severe emotional suffering.⁶ A number of immediate and late complications of supra-condylar humeral fractures have been identified. The immediate complications of supra-condylar fractures can be life threatening by causing as they commonly affect the neuro-vascular bundle, whereas the late complications of supra-condylar fractures affect the functional status of the patient.⁷

About 10–20% children with supra-condylar humeral fractures present with some kind of neurological deficit and in type-III supra-condylar fractures, a neurological deficit as high as 49% has also been reported.^{8,9} Though the risk of radial nerve injury is highest after an extension type supra-condylar fracture of humerus in children, median nerve injury has been reported to be more common following such fractures.⁷ A recent study reported a 10% (n=22) frequency for neurological damage following supra-condylar humeral fractures in children with median nerve injury being the most common neurological deficit (n=15; 68.18%).²

In view of scarcity of data related to the frequency of median nerve injury from this region, this study was designed and conducted with a view to collect and analyse data from patients with closed supracondylar fracture of humerus presenting to Ayub Teaching Hospital Abbottabad and to determine the frequency of median nerve injury in children aged 2-11 years presenting with closed supracondylar fracture of humerus.

MATERIAL AND METHODS

This was a descriptive cross-sectional study conducted in the Department of orthopaedics and trauma, Ayub Teaching Hospital Abbottabad from July 2016 to June 2018. The study enrolled 171 children aged 2–11 years with a supra condylar fracture of humerus and this number was arrived at using anticipated frequency of

median nerve injury following supracondylar fractures of humerus as 68.18%² using a confidence interval of 95% and an absolute precision of 7%. The study sample was completed using a consecutive (non-probability) sampling technique. Children with age between two and eleven years belonging to either sex were enrolled in the study and children with supracondylar fractures of humerus who were either critically injured, who refused to participate in study, who had pathological fractures and patients lost in follow-up had to be excluded from the study. The sample size was completed by recruiting further study participants in case of patients lost to follow up. Following approval from hospital ethical and research committee, the study was initiated. A thorough medical history and detailed clinical examination was carried out following obtaining an informed consent. The physical examination of each patient focused on identification of arterial pulse in brachial, radial and ulnar arteries as well as neurological examination to identify damage to median nerve as well as the radial and ulnar nerves.

For this study, supra-condylar fractures of humerus were defined as fractures of the distal humerus just above the epicondyles diagnosed on X-ray of elbow joint, AP and lateral views. Injury to the median nerve was diagnosed on the presence of characteristic clinical features following a supracondylar fracture of humerus such as "Loss of pronation of forearm, weakness in flexion of the hand at the wrist, loss of flexion of radial half of digits and thumb, loss of abduction and opposition of thumb. Presence of an ape hand deformity when the hand is at rest, due to hyper-extension of index finger and thumb, and an adducted thumb. Presence of benediction sign when attempting to form a fist, due to loss of flexion of radial half of digits." Sensory deficits characteristic of median nerve injury such as decreased or absent sensations in the lateral three and half digits (thumb, index and middle finger) including their nail beds, and in the thenar area were also used for the diagnosis of injury to median nerve.

The closed supracondylar fractures were be managed & treated in accordance with the standard management protocols of the department. Data was entered into and analysed using SPSS Version 16.0. Mean and standard deviation (mean±SD) were calculated for all the quantitative variables, i.e., age. Frequencies and percentages were calculated for categorical variables such as sex, type of fracture, arm involved neurologic damage, the type of nerve damaged and the damage to median nerve. The outcome variable i.e., presence of median nerve injury was stratified according to age, sex, type of fracture, site of fracture and neurologic damage to see effect modification. Post-stratification chi-square test was applied and a *p*-value ≤0.05 was taken as significant.

RESULTS

The mean±SD age of study participants was 6.7±2.27 years with a range of 3–10 years. There were 133 (77.78%) male and 38 (22.22%) females in the study. Neurological damage was seen in 36 (21.05%) patients with damage to median nerve most common (n=23;13.45%), followed by damage to radial (n=9;5.26%) and ulnar nerves (n=4; 2.34%). Extension type fracture was most common, present in 96.49% study participants. A statistically significant association was found between damage to median nerve and sex (male more than females), type of fractures (extension type fracture >flexion type fractures) and the arm involved (right arm >left arm) (*p*<0.05). No statistically significant association was found between age of study participants and damage to median nerve.

Table-1: Cross tabulation of damage to median nerve with sex of study participants

Damage to Median Nerve	Sex		Total	<i>p</i> -value
	Male	Female		
Yes	22	1	23	0.027
No	111	37	148	
Total	133	38	171	

p ≤ 0.05

Table-2: Cross tabulation of damage to median nerve and type of fracture in study population

Damage to Median Nerve	Type of fracture		Total	<i>p</i> value
	Extension Fracture	Flexion Fracture		
Yes	20	3	23	0.008
No	145	3	148	
Total	165	6	171	

p ≤ 0.05

Table-3: Cross tabulation of damage to median nerve and arm involvement

Damage to Median Nerve	Arm Involved		Total	<i>p</i> -value
	Right Arm	Left Arm		
Yes	20	3	23	0.001
No	76	72	148	
Total	96	75	171	

p ≤ 0.05

Table-4: Cross tabulation of damage to median nerve and age of study participants

Damage to Median Nerve	Age (yrs)		Total	<i>p</i> -value
	Upto 6 yr	>6		
Yes	7	16	23	0.071
No	75	73	148	
Total	82	89	171	

p ≤ 0.05

DISCUSSION

Median nerve is frequently damaged in supracondylar fractures of humerus in children and the frequency of damage to median nerve was 13.4% in our study while the overall incidence of neurological damage following supracondylar fractures was 21.05%.

Similar incidence rates have been reported in literature. A recently published report by Kwok and colleagues mentioned the frequency of neurological damage supracondylar fractures of humerus was 15.7%.¹⁰ In that study, the Ulnar nerve was the most commonly affected nerve (43.4%). The frequency of damage to median and radial nerves was 36.7% and 19.9% respectively.¹⁰

In contrast, the commonest nerve injury in our study was damage to the median nerve while the ulnar nerve damage was the least common occurrence. While the study cohorts were almost similar in terms of age and sex distribution, this difference in damage to ulnar nerve could be explained on the basis of social or geographical factors, though it is yet to be ascertained if this really is the cause. We didn't also follow the children till complete recovery to document the nature of clinical outcome.

On the other hand, a study published fairly recently reported a fairly high (62%) frequency of damage to median nerve following supracondylar fractures of humerus.¹¹ The sample size of that study was larger than ours, (244 vs 171) while the age distribution was similar to ours. Majority of patients (89%) had a single nerve injury with about a third of patients presenting with concomitant vascular injury as well. Of the neurological damage, majority of injuries (62%) were to the median nerve.¹¹ In another recently published study neurological injury was noted in 29 (6.5%) out of 448 children with a supracondylar fracture of humerus. Of the 29 children with neurological damage, radial nerve injury was most common, present in 14 children, followed by median nerve injury in 13 children and ulnar nerve in 9 children. The study cohort was elder (7.5±1.9 years) than our study population.¹²

In a study from India, the 5–8 yrs age group was associated with most of supracondylar fractures and the mean age of the children was 7.9 years.¹³ Median nerve injury was the commonest nerve involved, being present in 7 (53.85%) out of 13 children who had neurological damage following supracondylar humeral fractures with an overall frequency of neurological injury to be 13 (4.94%).¹²⁹ The study cohort was larger than this study the study participants were also older than those enrolled in this study.

In our study, median nerve injury was found to be significantly associated with sex, type of fracture and arm involvement ($p < 0.05$) (Tables-1–3). No statistically significant association was noted between median nerve involvement and age of study participants (Table-4) ($p > 0.05$), though some studies have mentioned advanced age as a risk factor for

neurological damage in supracondylar fractures of humerus.¹⁴

Our study records interesting observations regarding association of median nerve injury with the sex, type of fracture and arm involvement as discussed above. These could be a result of cultural issues since it has been observed that sex or body mass index did not affect severity of fracture or the frequency of complications associated with a particular fracture.^{15,8} However, a British study did report an increased incidence of childhood fractures in boys compared to girls with forearm fractures being the most common fractures in both boys and girls.¹⁶ In view of such conflicting observations, we feel that more research is required before associating such factors with median nerve injury in supracondylar fractures of humerus in children.

Most of the supracondylar fractures of humerus result from fall on the outstretched hands, though a small number of fractures do result from high-energy trauma to the arms. Falls can be preventable in most, if not all, cases and hence, education can play a role in reducing the complications of falls and therefore, the complications associated with the fractures resulting from the falls.

Our study is not without limitations. We feel that a small sample size was inadequate and hence we couldn't generalize our results onto the general population. Additionally, we did not determine the time taken to complete recovery in our study population, an obvious limitation of the study design. The overall clinical outcome in terms of recovery from neurological damage was not also determined in this study.

CONCLUSION

Neurological damage is a common complication of supracondylar humeral fractures with median nerve being the most commonly affected nerve in these fractures.

AUTHORS' CONTRIBUTION

AK: Performed the data collection and study design and wrote initial manuscript. SZ: patient recruitment, data entry and reviewed final manuscript. MA Facilitated data collection, data analysis and interpretation. JI: writeup and proof reading.

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Address for Correspondence:

Alam Zeb Khan, Department of Orthopaedics, Ayub Medical Institution, Abbottabad-Pakistan

Cell: +92 321 980 2108

Email: alamzebdr70@gmail.com