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Prevalence of Nerve Injuries in Supracondylar Fracture of Humerus in a Tertiary Care Hospital

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ABSTRACT

Background: Supracondylar fracture is a common childhood injury. These fractures are often associated with neural and vascular injuries. There is discrepancy in literature about the most common nerve injured in such fractures. This study aims to study the nerve injury patterns in supracondylar fractures of humerus in Nepalese children.

Methods: This descriptive cross sectional study was conducted in 152 children (aged 2 to 14 years) with supracondylar fractures of humerus attending in Bharatpur Hospital during the period of one year. All eligible patients were assessed clinically and radiologically. Neurological assessment was done for nerve injury.

Results: Out of 152 children, 18(11.8%) had nerve injuries. The mean age was 7.41 ± 2.91 years. Boys were more injured (68.4%) than girls (31.6%). It was more common on non-dominant side (57.9%). Out of 18 nerve injuries, most commonly injured nerve was median nerve 10(55.5%) followed by radial nerve 7(38.9%). Median nerve injury was common in posterolateral displacement and radial nerve injury was common in posteromedial displacement type of fracture.

Conclusions: Displaced supracondylar fractures have relatively higher prevalence of nerve injuries. Most commonly involved nerve is median nerve followed by radial nerve. So, every displaced fracture should be routinely screened for nerve injuries.

Keywords: Humeral fractures; median nerve; peripheral nerve injuries; prevalence; radial nerve

INTRODUCTION

Supracondylar fracture of humerus is a very common elbow injury in children. Among all childhood injuries, 7-10% are elbow injuries, of them supracondylar fracture comprises the majority 50-80%. Thus 4.5-6.5% of all pediatric fracture is supracondylar fracture.^{1,2} These fractures are often associated with neurovascular injuries because of swelling and their vulnerable anatomical relation with the fracture fragments. It is reported that 5-30% of supracondylar fracture comprises neurovascular injuries.³

Nerve injury is reported to be the most common complication associated with displaced supracondylar fracture of humerus. Most of the older studies mention radial nerve, while recent studies mention anterior interosseous nerve to be commonly affected.¹ Variation in the type of nerve involved in supracondylar fracture and very few studies done in our part of the world on pattern and type of nerve injuries in supracondylar fracture warrants the need of this study.

This study aims to find nerve injury patterns associated with supracondylar fracture of humerus.

METHODS

This is a descriptive cross sectional study conducted at Bharatpur Hospital, Bharatpur from 1st Jan, 2020 to 30th December, 2020. Ethical clearance was taken from IRC, Bharatpur Hospital. Children from 2 to 14 years with supracondylar fracture of humerus attending at emergency or outpatient department were included in this study. Children with history of attempted closed reduction, associated ipsilateral injuries around the elbow and children with polytrauma were excluded from the study. We have excluded those children who were not able to follow our commands during nerve examination. This eliminated the potential bias.

Sample size was 138, derived using the formula $N = Z^2 \times p \times (1-p) / C^2$ where

N= Minimum sample size, Z= Confidence interval (95%)

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=1.96, P= Prevalence (10% =0.1)(Prevalence of nerve injury)⁴ C= Margin of error (<5%=0.05)

Allowing non-response rate of 10%, the adjusted sample size was 152. Total of 152 children visiting OPD and emergency were included in the study. Informed written consent was taken from the accompanying guardian. Structured questionnaire was filled up following detail history, clinical examination and x ray. Age, sex, side of injury, side of dominance, mode of injury, time to presentation to hospital, type of fracture and neurological status were documented.

Neurological status was documented by screening clinical examinations. Motor examinations were elicited by asking patient to raise or extend the thumb for radial nerve, “OK” sign or “Pointing index” sign for median nerve and finger abduction and adduction for ulnar nerve respectively. Sensory examinations elicited by light touch sensation over autonomous zones: dorsum of first web space, palmer aspect of tip of index finger and palmer aspect of little finger for radial, median and ulnar nerves respectively.

Fracture classified and documented on the basis of x ray findings: Extension type and flexion type. Extension type further classified as Gartland I for undisplaced type, Gartland II for posterior angulation with periosteal hinge intact and Gartland III for completely displaced fracture. Type III further classified into IIIA to posteromedial displacement and IIIB for posterolateral displacement.⁵

Statistical analysis was done with Statistical Package for Social Science 20.0 version software.

RESULTS

One hundred and fifty-two children from 2 years to 14 years were enrolled in this study. Mean age was 7.41±2.91 years. Most common age group was 7-8 years (40, 26.3%) (Figure 1). Majority of them were boys with boy to girl ratio 2.1:1. Fracture occurred predominantly on left side and non-dominant side was injured mostly. Most of the fractures were extension type, type III with posterolateral displacement was the most common type among all (Table 1).

Only 18 cases (11.8%) were associated with nerve injury (Figure 2). Out of 18 cases, median nerve was most common 10(55.5%), radial nerve was 7(38.9%) and ulnar nerve was 1(5.5%). Among median nerve injuries, 8 were

isolated anterior interosseous nerve injuries.

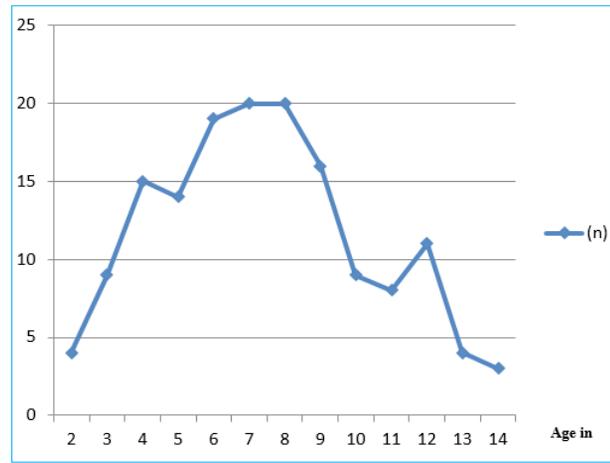


Figure 1. Age distribution.

Table 1. Clinical and fracture patterns.

SN	Variables	(n=152)	Percentage
1	Sex	Boy	104 68.4
		Girl	48 31.6
2	Side of injury	Right	66 43.4
		Left	86 56.6
3	Side of dominance	Dominant	64 42.1
		Non-dominant	88 57.9
4	Type of fracture	Gartland I	23 15.1
		Gartland II	28 18.4
		Gartland IIIA	45 29.6
		Gartland IIIB	54 35.5
		Flexion	2 1.3

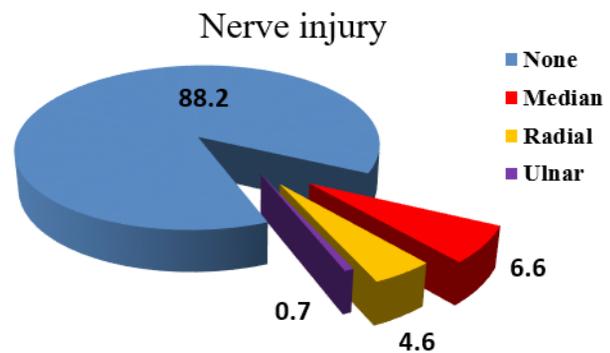


Figure 2. Pattern of nerve injuries.

Nerve injuries pattern vary with types of fracture (Table 2). No nerve injury was seen in type I and II.

Table 2. Nerve injuries according to fracture type.

Nerve	Type					Total
	I	II	IIIA	IIIB	Flexion	
None	23	28	38	44	1	135
Median	0	0	1	9	0	10
Radial	0	0	6	1	0	7
Ulnar	0	0	0	0	1	1
Total	23	28	45	54	2	152

Most common mode of injury was fall from height followed by ground level fall and others. Nerve injuries occurred more in supracondylar fractures due to fall from height (14/113) as compared to ground level falls (3/19) or RTA (1/12). Most of the children presented within 24 hours from the time of injury (Table 3). Most of the nerve injury cases presented in 8-24 hours of injury and none after 48 hours of injury. There was a case of open fracture along with nerve injury.

Table 3. Mode of injuries and delay in presentation.

SN	Variables	(n=152)	Percent
1	Mode of injury	Fall from height	113 74.3
		Ground level fall	19 12.5
		Road traffic accident	12 7.9
		Unknown	8 5.3
2	Delay in attending hospital	<8 hours	16 10.5
		8-24 hours	83 54.6
		24-48 hours	43 28.3
	>48 hours	10 6.6	

DISCUSSION

Nerve injury is the most common complication associated with displaced supracondylar fracture of the humerus. This study was conducted to find the prevalence of nerve injuries in supracondylar fracture of humerus in children.

Among 152 children ranging from 2 to 14 years, mean age was 7.41±2.91 years. It was similar to other studies that mention 5-8 years age as the common as group for the fracture.^{1,2,4,6} Studies show boys have higher incidence than girls.^{3,4,7} There are very few studies showing equal or higher incidence in girls.⁸ In our study boys are twice more injured than girls.

Left and non-dominant side is involved in majority of cases.^{1,4,9} It may be because the dominant upper extremity is in use, and the non-dominant assumes the protective role during injury. However, in study done

by Mangwani et al³ majority of injuries was seen on dominant side.

Most of the children (98.7%) sustained extension type of injury and only 1.3% had flexion type of injury as seen in other studies.^{1,5,10} Among the extension type, majority of them were completely displaced types as in study by Mangwani et al.³ 35.5% were posterolateral displacement type (Gartland IIIB) and 29.6% were posteromedial displacement type (Gartland IIIA). Study done by Lyons et al¹¹ also had comparable occurrence of posteromedial and posterolateral displacement types. Unlike, most of previous studies mention posteromedial displacement type to be more common than posterolateral displacement type.^{2,8} As this study was done at tertiary hospital, minimally displaced and undisplaced type of fracture might have been managed at other hospitals. This may be the possible explanation for low incidence of Gartland type I and type II fracture in our study.

Most common complication of supracondylar fracture of humerus in children is nerve injury. Frequency of nerve injuries is not consistent in different studies. It ranges from 5%-20%.^{2,4,6,11,12} It is documented upto 31% in a study done by Campbell CC et al, 1995.¹³ It is rare in Gartland I and II fractures, but 43% of Gartland III are associated with nerve injury in a study done by Houshian et al.⁸ Our study showed 18 cases (11.8%) of nerve injuries. The incidence of particular nerve injury is not consistent among different studies. However, most studies report median or anterior interosseous nerve lesion to be most commonly involved.^{5,6,7,11,12} Similar to these results, our study revealed median nerve injury is most common (55.5%) followed by radial nerve injury (38.9%). There is some pattern of nerve injuries according to their type of displacement. Most of the studies mention median nerve to be more affected in posterolateral type of displacement, whereas radial nerve is more involved in posteromedial displacement.^{5,8,11} Similar finding is seen in our study, 9 out of 10 nerve injuries in posterolateral type were median nerve injury and 6 out of 7 nerve injuries in posteromedial type were radial nerve injury. But in a study by Otsuka et al⁶ median nerve injury was seen more in posteromedial displacement as well. In posteromedial displacement, lateral structures are stretched over the proximal fragment. Similarly, in posterolateral displacement, medial structures are stretched over the proximal fragment.² This may be the possible explanation for high incidence of median nerve injury in posterolateral displacement and radial nerve injury in posteromedial displacement. Recent studies mention anterior interosseous nerve to be

most commonly injured rather than median nerve itself.^{1,4} In our study, 8 out of 10 median nerve injuries were isolated anterior interosseous nerve injuries. The fibers of anterior interosseous nerve are located in posterior part of the median nerve itself making it more vulnerable for stretch.^{12,14} Though rare, flexion type of supracondylar fractures have higher incidence of neurovascular injury compared to extension type. The incidence of ulnar nerve injury ranges from 14%-26% of all type of flexion injuries.^{10,11} In our study, there were only 2 cases of flexion type of injury. One of them had ulnar nerve injury, 5.5% among total nerve injuries.

Most of the injuries (74.3%) occurred due to fall from height. Ground level falls and road traffic accidents were rare causes of injury in our study. Fall from height is the common mode of injury in other studies as well.^{3,7,15,16} Displaced supracondylar fracture of humerus in children is considered as surgical urgency.⁵ Most of the children were brought to hospital within 8 to 24 hours. Few children presented within 8 hours and beyond 48 hours.

As this study is done at tertiary hospital only, it may not reflect the true prevalence of supracondylar fractures along wider geographical area. This study is single center study, multicenter studies with bigger sample size is needed to validate the prevalence of nerve injuries in supracondylar fractures. Only single motor examination was done as a screening test to assess the nerve injury status for each nerve. More than one motor examination for a single nerve would better interpret the nerve injury. Some of the children were not able to follow our commands of nerve examination, though we have excluded such children from the study, could otherwise have influenced the prevalence of nerve injuries.

CONCLUSIONS

Displaced supracondylar fractures have relatively higher prevalence of nerve injuries. Most commonly involved nerve is median nerve followed by radial nerve. The type of nerve involvement usually depends on the displacement of distal fragment. So, every displaced fracture should be routinely screened for nerve injuries.

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