Epidemiological Evaluation of Pediatric Elbow Injuries: A Retrospective Observational Single Center

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Abstract

Introduction Elbow fractures are the commonest fractures in the pediatric age group. The aim of this study is to evaluate the epidemiology of fresh and neglected pediatric elbow fractures in a hilly state of India with a limited health care facility.

Materials and Methods This was a retrospective observational single-center study conducted between January 2019 and January 2021.

Results Supracondylar was the most common fracture in 58.7% of patients followed by lateral condyle and proximal radius fracture. The highest number of fractures were reported in the age group of 5 to 8 years. In addition, 19% of patients presented with associated complications, 8% of patients had combination injuries of the ipsilateral upper limb, 16% of patients presented to the hospital 1 week after the trauma, 48% of patients had the first contact with a bonesetter/native practitioner.

Conclusion Supracondylar fracture was the most common elbow fracture followed by lateral condyle. The most common involved age group was 5 to 8 years. A significant number of elbow fractures are mismanaged by native practitioners in rural India.

Keywords

- elbow
- pediatric
- fracture
- supracondylar

Introduction

With 32.8% of 1.3 billion people in the pediatric age group in India, pediatric injuries constitute a major part of patients in trauma centers.¹ Among the pediatric musculoskeletal injuries, elbow fractures are the most common.² The exact incidence of pediatric elbow fractures is not known in India. Pediatric elbow injuries are usually caused by low-energy trauma such as tumble and fall, fall from a height on an outstretched hand, or during contact supports. However, elbow injuries are prone to complications such as compartment syndrome, neurovascular injury, malunion, stiffness, and myositis ossificans. Pediatric

elbow fractures also have a small window period for surgery to get good functional outcome.³ In rural India, a significant number of low-energy elbow fractures get mismanaged or neglected due to lack of specialist orthopaedic facilities.

Materials and Methods

Complete epidemiological data on age at the time of injury, gender, the calendar month of injury, type of fracture (open/closed, single/combined, and unilateral/bilateral), fracture mechanism, combination injury of ipsilateral or contralateral upper limbs, and injury associated with acute

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complications such as neurovascular injury or compartment syndrome were obtained and recorded.

We classified the patients into four age groups 1 to 4 years (including up to 1 year old), 5 to 8 years, 9 to 12 years, and 12 to 15 years. To understand the mode of trauma we used the following categories.

1. Fall on plane/level ground on an outstretched hand.
2. Fall from a height on an outstretched hand.
3. Direct trauma/hit.
4. Twisting injury during sports/sports injury.
5. Road traffic accident (RTA).

On the basis of presentation, we classified the patients into three groups: (1) Within 48 hours; (2) between 48 hours to 7 days; (3) after 7 days.

Results

Out of 211 patients, 135 were boys and 76 were girls, resulting in elbow fractures 1.7 times more in boys.

In total, 129 fractures were on the left side and 82 were on the right side, resulting in a right/left ratio of 0.6. No patient had a bilateral injury. Eleven patients (5.2%) had open fractures.

Forty (19%) patients presented with associated complications such as gross swelling with blister formation, cellulitis, compartment syndrome, or neurovascular injury. The management of such cases was decided on the basis of presentation. Patients with gross swelling, blister formation, and cellulitis needed prolonged observation in the hospital. All patients with associated complications had a history of manipulation by a bonesetter. Fourteen (6.6%) patients had a combination injury of the ipsilateral side. Most of the patients, (102 [48%]) presented more than 48 hours after the trauma, and 37 (16%) patients with elbow fractures presented more than 7 days after the trauma. In addition, 102 (48%) patients had first contacted a bonesetter before coming to the hospital (►Table 1).

A significant seasonal variation was observed in our study with the most number of cases in the summer season (between April to September). The highest number of cases (40) was seen in June and the least in January (►Fig. 1).

The most common age group was between 5 and 8 years and the most frequent year was the fifth year of age (►Fig. 2A,B).

The most common mechanism of injury (49%) was a fall from a height on an outstretched hand followed by a fall on outreached hand on level ground. In the age group of 1 to 4 years, fall on level ground was the most common mode of injury. Sports injuries and road traffic accidents as the mode of trauma were reported (►Table 2).

Supracondylar (SC) fractures constituted 58.7% of all elbow fractures. Gartland type III was the most common fracture,⁴ and 4.8% of patients had open SC fractures. Sixteen supracondylar fractures presented with gross swelling around the elbow with a pink pulseless warm hand. Three patients presented with cold pulseless limbs and were referred for vascular surgery intervention. Eleven patients had associated bony injury of ipsilateral limb, and 1 patient

Table 1 Parameters of pediatric elbow fractures

Parameter	Number, n (%)
Total no of patients	211
Gender	
Male	135 (64)
Female	76 (36)
Laterality	
Right	82 (38)
Left	129 (62)
Bilateral	0
Open fractures	11 (5.2)
Closed fractures	200 (94.8)
Fractures with complications	40 (19)
Combination fractures	14 (6.6)
Presentation	
Within 48 h	82 (34)
48 h to 7 d	102 (48)
After 7 d	37 (18)
Patients having the first contact with bonesetter	102 (48)

Abbreviations: n, number of patients.

Fig. 1 Age in years.

presented with compartment syndrome and needed immediate fasciotomy. All the patients with type III SC fractures, open SC fractures, and patients with combination injuries reported fall from significant heights as the cause of trauma. Thirteen (9%) patients had associated nerve injury involving the median nerve in 11, radial nerve in 1, and iatrogenic ulnar nerve in 1. All patients with pink pulse-less hands did well and nobody needed vascular surgeon intervention. Twenty-three patients presented with neglected SC fractures (more than 1 week old) and were managed conservatively. Among these 23 patients, 13 patients presented 3 weeks after the trauma with a complete union in an unacceptable position. All patients with the union in the unacceptable position were planned for corrective osteotomy in the future (►Table 3).

Fig. 2 (A) Age distribution of fractures. (B) Number of patients in different age groups.

The lateral condyle was the second most common fracture in our study. Two patients presented more than 3 weeks late, one with associated injury ulnar nerve palsy and the second patient with an open fracture. Proximal radius fracture was the third most common fracture in our study.

Monteggia fracture was the fourth most common fracture observed. One patient had an open Monteggia fracture. Another patient with a Monteggia fracture presented with compartment syndrome and needed fasciotomy. One patient had posterior interosseous nerve palsy. Two patients with medial epicondyle had ulnar nerve paresthesia. Intercondylar fracture and elbow dislocation were the least common in our study. Distal forearm fracture of the ipsilateral side was the most associated fracture in 7 patients (► **Table 4**).

Table 2 Mechanism of injury in different age groups

		Mechanism of trauma					
Age group (years) n		Fall on plane ground (%)	Fall from height (%)	Direct hit/trauma (%)	Sports injury n (%)	RTA* n (%)	Unknown (%)
1–4	50	32 (64)	11 (22)	3 (6)	2 (4)	2 (4)	0
5–8	100	22 (22)	64 (64)	6 (6)	5 (5)	2 (2)	1 (1)
9–12	42	5 (12)	21 (50)	2 (5)	3 (7)	3 (7)	1 (2)
> 12	19	2 (10)	8 (42)	7 (37)	5 (26)	4 (21)	0
No. of patients (n/%)		61 (29)	104 (49)	18 (6)	15 (7)	11 (5)	2 (1)

Abbreviations: n, number of patients.

Table 3 Parameters of supracondylar fractures

Parameter	Number of patients/percentage
Total no of patients	124/(58.7)
Gender	
Male	70 (56)
Female	54 (44)
Laterality	
Right	52 (42)
Left	73 (58)
Soft tissue injury	
Open fractures	11 (5.2)
Closed fractures	200 (94.8)
Displacement	
Extension	119 (96)
Flexion	5 (4)
Gartland classification	
Type-1	20 (16)
Type-2	48 (39)
Type-3	56 (45)
Presentation	
Within 48 h	43 (37)
48 h to 1 wk	58 (46)
More than 1 wk	23 (17)
Combination fractures	11 (9)
Pink pulseless warm hand	16 (7)
With pale/cold limb	3 (2.4)
With compartment syndrome	2 (1.6)
With nerve injury	13 (10)

Discussion

This is the first epidemiological study on pediatric elbow fractures from the hilly state of Himachal Pradesh, India, with hilly topography where health care facilities are limited and

Table 4 Features of elbow

Fracture type	N (%)	Gender ratio	Laterality	Presentation			Complications	Combination injury
		M/F	R/L	Early (within 48 h)	Delayed (48 h to 7 d)	Late (after 7 d)		
Supracondylar	124 (58.7)	1.81	0.7	23	58	43	34	11
Lateralcondylar	29 (13.7)	1.7	0.4	9	9	11	2	1
Proximal radius	15 (7.2)	1.9	0.9	7	4	4	0	0
Monteggia	13 (6.1)	1.9	0.6	7	4	2	2	1
Olecranon	11 (5.1)	1.7	0.4	7	3	1	0	0
Medial epicondylar	9 (2.3)	1.5	0.8	3	4	2	1	1
Intercondylar	5 (2.2)	1.8	0.7	3	2	0	0	0
Dislocation	2 (0.1)	2	0.5	1	0	0	0	0

Abbreviations: E, early (within 48 h); Delayed (48 h to 7 d); L, late (after 7 d); Lt., left; n, number of patients; Rt., right.

bad road connectivity (roads remain blocked for months during winter).

Fall from a height on an outstretched hand was the most common cause of trauma (in 49%) in our study, consistent with the findings of Behdad et al.⁵ Only 15% of the pediatric elbow injuries in our study occurred while playing sports. This could be because of the unavailability of sports grounds in the region because of mountainous topography. Many urban center studies have shown sports as a significant cause of elbow fractures.⁶

A significant seasonal variation was observed in the pattern of pediatric elbow fractures. We observed that 75% of the fractures were reported in the summer season (April to September) with the maximum number of cases in June. The high number of cases during summer could be because of more outdoor activity during this period. Prolonged winters with very low temperatures and snowfall in this region keep the people limited to their houses and decrease their outdoor activity. Seasonal variations in our study were consistent with the observations by Houshian et al.⁷ Male to female ratio, laterality, and pattern of fractures in different age groups were

consistent with the observations of most of the other studies. However, Houshian et al observed elbow fractures more in girls than boys with a boy:girl ratio of 0.8^{7,8} (► **Table 5**).

The supracondylar fracture was the most common and constituted 58% of all elbow injuries, followed by lateral condyle and proximal radius fracture. The pattern was similar to the findings by Khoshbin et al.⁹ However, the frequency of medial epicondyle, olecranon, and Monteggia fractures was not consistent with this and other studies.¹⁰ Several studies have shown that the incidence of SC fractures varies from 48% to 58%.^{11–14} Okubo et al attributed different trauma mechanisms (varus/valgus impacted force) and different elbow axes in different ethnicities as the cause of varied incidence of elbow fractures.¹⁵

We observed a higher number of open elbow fractures (5.3%), a higher number of Gartland type III fractures (45%), and a higher number of patients (7%) with combination injuries of ipsilateral upper limb compared with other studies. One of the reasons for this could be that a significant number of low-energy elbow injuries end up with bone practitioners and patients do not visit the hospital. Also,

Table 5 Comparison of findings with other studies

Study	No	Right/left ratio	Male/female ratio	Age group with max involvement	Month with maximum cases	Month with minimum cases
Okubo et al ¹⁵	488	0.7	1.7	6	July	Jan
Houshian et al ⁷	355	0.7	0.8	5	August	December
Landin et al ⁶	589	0.8	1.9		July	august
Behdad et al ⁵	300	0.7	2.6	4–8	–	–
Present study	211	0.6	1.8	5	June	January

the hilly topography of the region with the mode of trauma from significant heights contributes to it. All patients with open fractures, Gartland type III SC fractures, and all patients with combination injuries had a history of falls from significant heights.

Roposch et al reported 5.3% of patients with associated injuries in SC fractures in their study.¹⁶

One of the characteristic features in our study was a high number of patients (19%) with associated complications at the time of presentation. This was primarily because a significant number of patients (48%) consulted local bone setters before coming to the hospital. All patients with associated complications had their first contact with bone setters. Vigorous manipulation, forceful massaging after applying some form of oil or herbal products, and tight bandages around the elbow by bone setters cause massive swelling and at times blisters around the elbow. Similar to other developing countries, the culture of native practitioners and bonesetters is still prevalent in rural India.^{6,12} Little literature is available on the impact of the culture of native practitioners on orthopaedic injuries in India. It is prevalent in both rural and urban setups, though more common in rural areas.

Native practitioners are almost always from the local community and people usually feel more comfortable visiting them. They charge a minimal amount for services. The orthopaedic services usually are available at higher centers. People have to travel long distances and spend a lot of money to visit the hospitals. Lack of education, poor socioeconomic status, poor health care facilities, and inadequate orthopaedic facilities contribute to the culture of bonesetters in rural India. Being low-energy injuries, a large number of elbow fractures end up with bone setters. In our study, 48% of patients had first contacted a native practitioner/bone setter and ended up late in hospital, which affected the treatment and outcome.

Novel Insight

This study highlights the importance of understanding the association of difficult topography with difficult pediatric elbow injuries. We as surgeons should be well versed with these complications and should be ready with correct approaches to treat them. In developing countries such as India, efforts should be made to educate people regarding early reporting to hospitals. This is a pioneer study characterizing the pattern of pediatric trauma presenting in one of the most backward and hilly districts of Chamba, Himachal Pradesh, India.

Already Known Facts

It is already known that supracondylar and lateral condyle fractures are two of the most common fractures in the pediatric age group

This is one of the first studies on pediatric elbow fractures in India. Fall from height was the most common mechanism of injury and is preventable by simple measures such as sidebars along small link roads around houses and schools, stairs, and rooftops. Being low-energy trauma, a significant number of pediatric elbow injuries get neglected and mis-

managed by bonesetters in rural India. People in rural India need to be educated about this.

Informed Consent

Written informed consent was obtained from all patients and/or families.

Funding

None.

Conflict of Interest

None declared.

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