

Evaluation of Supracondylar Humerus Fracture Management in Children

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Abstract

Original Research Article

Background: Supracondylar humerus fractures are the most common pediatric elbow fractures and can result in significant functional and cosmetic complications if not managed appropriately. Early recognition, proper classification and timely intervention are essential to optimize outcomes. This study aimed to evaluate the management and outcomes of supracondylar humerus fractures in children treated at a district-level hospital in Bangladesh. **Methods:** This prospective observational study was conducted in the Department of Orthopedics, District Sadar Hospital, Rajbari, Bangladesh, from March 2023 to February 2024. A total of 80 children with radiologically confirmed supracondylar humerus fractures were included. Fractures were classified according to Gartland classification. Type I fractures were managed conservatively with above-elbow plaster casting, whereas Type II and III fractures underwent closed reduction with percutaneous K-wire fixation or open reduction if necessary. **Results:** The majority of patients were male (66.3%) and aged 6–9 years (42.5%). Type III fractures were most common (53.8%). Closed reduction with K-wire fixation was performed in 63.8% of cases, open reduction in 18.7% and conservative treatment in 17.5%. Early complications were low, including superficial pin-site infection (7.5%) and iatrogenic nerve injury (2.5%). At six-month follow-up, excellent or good functional outcomes were achieved in 85% of patients, while cosmetic outcomes were excellent or good in 86.3%. **Conclusion:** Supracondylar humerus fractures in children can be effectively managed with appropriate treatment strategies, predominantly closed reduction and percutaneous pinning, resulting in favorable functional and cosmetic outcomes with minimal complications, even in a district hospital setting in Bangladesh.

Keywords: Supracondylar humerus fracture, children, Gartland classification, K-wire fixation, Flynn's criteria.

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INTRODUCTION

Supracondylar fracture of the humerus is the most common type of elbow injury in children, accounting for nearly 60% of all pediatric elbow fractures. It typically occurs between the ages of 4 and 10 years when bone elasticity is high and the supracondylar region of the humerus remains relatively weak [1, 2]. These fractures usually result from a fall on an outstretched hand, leading to extension-type injuries in the majority of cases. Flexion-type fractures are less common [3]. Due to the proximity of vital neurovascular structures such as the brachial artery and median, radial and ulnar nerves, supracondylar fractures carry a significant risk of complications if not properly managed [4].

Supracondylar humerus fractures are frequently encountered in emergency departments, particularly among school-age children engaged in outdoor activities. Many cases occur due to falling from a height, slipping on wet ground, or domestic accidents [5, 6]. Delayed presentation and inadequate first aid in rural areas further complicate management, leading to swelling, neurovascular compromise and malunion if not treated timely [7].

Management options for supracondylar fractures include both conservative and surgical approaches. Undisplaced or minimally displaced (Gartland type I) fractures can be treated effectively by closed reduction and immobilization with a posterior slab or above-elbow plaster cast [8]. However, displaced

fractures (Gartland type II and III) usually require surgical intervention—most commonly closed reduction and percutaneous pin fixation with Kirschner wires (K-wires)—to restore alignment and prevent deformities like cubitus varus. Open reduction may be required in cases with vascular injury, open fractures, or failed closed reduction [9].

Recent advances in imaging, anesthesia and surgical techniques have significantly improved outcomes. However, in many district-level hospitals in Bangladesh, challenges such as limited facilities, delayed referrals and lack of parental awareness still affect results [10]. Therefore, evaluating the current management practices and outcomes in local hospitals is essential for improving pediatric orthopedic care.

This study aimed to evaluate the management of supracondylar humerus fractures in children treated at the Department of Orthopedics, District Sadar Hospital, Rajbari, Bangladesh. The objectives were to assess the demographic characteristics, modes of injury, treatment modalities and functional outcomes, as well as to identify common complications. Findings from this study may help strengthen clinical decision-making, enhance resource allocation and improve patient outcomes in similar healthcare settings across Bangladesh.

METHODOLOGY & MATERIALS

This prospective observational study was conducted in the Department of Orthopedics, District Sadar Hospital, Rajbari, Bangladesh, from March 2023 to February 2024. A total of 80 children diagnosed with supracondylar humerus fractures were included in the study. All patients were evaluated clinically and radiologically on admission and the fractures were

classified according to the Gartland classification. Management decisions were made based on the type of fracture, degree of displacement and neurovascular status at presentation. Type I fractures were treated conservatively with above-elbow plaster casting, while Type II and Type III fractures were managed either by closed reduction and percutaneous K-wire fixation or by open reduction when closed reduction failed or neurovascular compromise was present.

Children aged up to 14 years with radiologically confirmed supracondylar humerus fractures who presented within 2 weeks of injury and whose parents or guardians gave informed consent were included in the study. Exclusion criteria were pathological or open fractures, fractures associated with ipsilateral limb injuries, patients with previous elbow surgery and those lost to follow-up before final assessment.

All patients were regularly followed up at 2 weeks, 6 weeks, 3 months and 6 months after treatment. During follow-up visits, fracture alignment, range of motion and signs of union were evaluated clinically and radiologically. Functional and cosmetic outcomes were assessed at the final follow-up using Flynn's criteria and postoperative complications such as pin-site infection, nerve injury, loss of reduction and compartment syndrome were recorded.

Collected data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 25.0. Continuous variables were presented as mean \pm standard deviation and categorical variables were expressed as frequency and percentage.

RESULTS

Table 1: Demographic characteristics (n = 80)

Variable	Category	n	%
Age (years)	< 2	3	3.8
	2–5	28	35
	6–9	34	42.5
	10–14	15	18.7
Sex	Male	53	66.3
	Female	27	33.7
Total		80	100

Table 1 presents the demographic characteristics of the 80 children included in this study. The majority of the patients (42.5%) were in the 6–9 years age group, followed by 35% in the 2–5 years group. A smaller proportion of patients were aged 10–14 years

(18.7%), while only 3.8% were below 2 years of age. Male children were more commonly affected, accounting for 66.3% of cases, whereas females comprised 33.7%.

Table 2: Injury characteristics (n = 80)

Variable	Category	n	%
Side of injury	Right	46	57.5
	Left	34	42.5
Mechanism of injury	Fall from height (tree/roof)	29	36.3
	Fall on outstretched hand during play	38	47.5

Variable	Category	n	%
	Road traffic accident	9	11.2
	Other (household fall, unknown)	4	5
Time from injury to presentation	< 24 hours	41	51.3
	24–72 hours	27	33.7
	> 72 hours	12	15

Table 2 summarizes the injury characteristics of the study population. The right side was more frequently affected (57.5%) compared to the left side (42.5%). The most common mechanism of injury was a fall on an outstretched hand during play, accounting for 47.5% of cases, followed by falls from height such as from trees or

rooftops (36.3%). Road traffic accidents and other causes, including household falls, were less common (11.2% and 5%, respectively). More than half of the patients (51.3%) presented to the hospital within 24 hours of injury, while 33.7% presented within 24–72 hours and 15% arrived after more than 72 hours.

Table 3: Fracture classification (Gartland) and initial neurovascular status (n = 80)

Variable	Category	n	%
Gartland classification	Type I	11	13.7
	Type II	26	32.5
	Type III	43	53.8
Preoperative neurovascular status	Intact	72	90
	Nerve palsy (radial/median)	5	6.3
	Pulseless but perfused limb	3	3.7

Table 3 shows the distribution of fractures according to Gartland classification and the initial neurovascular status of the patients. Type III fractures were the most common, accounting for 53.8% of cases, followed by Type II fractures (32.5%) and Type I

fractures (13.7%). The majority of patients (90%) had an intact neurovascular status at presentation. Nerve palsy involving the radial or median nerve was observed in 6.3% of patients, while 3.7% presented with a pulseless but perfused limb.

Table 4: Treatment modality and early complications (n = 80)

Variable	Category	n	%
Initial treatment	Conservative (cast/slab)	14	17.5
	Closed reduction + percutaneous K-wire	51	63.8
	Open reduction + fixation	15	18.7
Pin configuration (if applicable)	Lateral pins	33	41.2
	Crossed pins	33	41.2
	Not applicable (conservative)	14	17.5
Early complications	Superficial pin-site infection	6	7.5
	Iatrogenic nerve injury	2	2.5
	Re-displacement / loss of reduction	3	3.8
	Compartment syndrome	1	1.2
	Re-operation required	2	2.5

Table 4 presents the treatment modalities and early complications among the study patients. The majority of children (63.8%) were managed with closed reduction and percutaneous K-wire fixation, while 18.7% required open reduction and fixation and 17.5% were treated conservatively with a cast or slab. Among patients who underwent K-wire fixation, lateral and crossed pin configurations were used equally (41.2%

each), while pinning was not applicable for those managed conservatively (17.5%). Early postoperative complications were relatively uncommon. Superficial pin-site infection occurred in 7.5% of cases, iatrogenic nerve injury in 2.5%, re-displacement or loss of reduction in 3.8% and compartment syndrome was noted in 1.2%. Re-operation was required in 2.5% of patients.

Table 5: Final functional & cosmetic outcome (Flynn's criteria) — at 6-month follow-up (n = 80)

Outcome (Flynn's)	Category	n	%
Functional result	Excellent	47	58.7
	Good	21	26.3
	Fair	8	10
	Poor	4	5

Outcome (Flynn's)	Category	n	%
Cosmetic result	Excellent	50	62.5
	Good	19	23.8
	Fair	7	8.7
	Poor	4	5

Table 5 illustrates the final functional and cosmetic outcomes of the patients at six months, assessed using Flynn's criteria. Regarding functional results, the majority of patients achieved excellent outcomes (58.7%), followed by good outcomes in 26.3% of cases. Fair and poor functional results were observed in 10% and 5% of patients, respectively. For cosmetic outcomes, excellent results were seen in 62.5% of children, good in 23.8%, fair in 8.7% and poor in 5%. Overall, more than 85% of patients attained excellent or good functional and cosmetic outcomes, demonstrating the effectiveness of the treatment approaches used in this cohort.

DISCUSSION

In this study, we evaluated 80 children with supracondylar humerus fractures managed at a district-level hospital in Bangladesh. The majority of patients were males (66.3%) and aged between 6 and 9 years (42.5%), which aligns with patterns reported by Bhakta *et al.*, and Acar & Memik, where boys were more commonly affected due to higher levels of outdoor activity and risk-taking behavior [11, 12]. The right side was more frequently involved (57.5%), consistent with previous observations that the dominant extremity is often at higher risk during falls [13].

Falls on an outstretched hand during play (47.5%) and falls from height (36.3%) were the most common mechanisms of injury, reflecting typical injury patterns in Bangladeshi children, similar to findings by Baidoo *et al.*, and Vu *et al.*, [14, 15]. Early presentation was observed in 51.3% of patients within 24 hours, which is critical, as Sullivan *et al.*, demonstrated that shorter time to treatment is associated with improved functional outcomes and fewer complications [16].

According to Gartland classification, Type III fractures were predominant (53.8%), followed by Type II (32.5%) and Type I (13.7%). This distribution mirrors the findings of Bhakta *et al.*, and Bekmez *et al.*, indicating that severe displaced fractures constitute a significant proportion of pediatric supracondylar injuries in resource-limited settings [11, 17]. Neurovascular compromise was relatively uncommon, with 6.3% presenting with nerve palsy and 3.7% with pulseless but perfused limbs, comparable to the incidence reported by Pavone *et al.*, and Li *et al.*, [13, 18].

The majority of patients (63.8%) were treated with closed reduction and percutaneous K-wire fixation, while 18.7% required open reduction and 17.5% were managed conservatively. Lateral and crossed pin configurations were used equally (41.2% each),

reflecting the current trends in pediatric orthopedics as highlighted by Hasan *et al.*, who reported that both pinning techniques are effective when performed correctly [19]. Early complications were low, with superficial pin-site infection occurring in 7.5%, iatrogenic nerve injury in 2.5% and re-displacement in 3.8% of cases, which is comparable to complication rates in studies by Bhakta *et al.*, and Acosta *et al.*, [11, 20].

At six months, functional outcomes assessed by Flynn's criteria were excellent in 58.7% and good in 26.3% of patients, while cosmetic outcomes were excellent in 62.5% and good in 23.8%. These results demonstrate that more than 85% of patients achieved favorable outcomes, consistent with reports by Acar & Memik, Wang *et al.*, and Modest *et al.*, [12, 21, 22]. The high rate of excellent and good outcomes indicates the effectiveness of early closed reduction and pinning, even in a district-level hospital setting. Furthermore, the relatively low incidence of complications underscores the feasibility of safely performing these procedures with standard techniques in Bangladeshi pediatric patients, as suggested by De Pellegrin *et al.*, and Samaila *et al.*, [23, 24].

Physiotherapy and early mobilization, as recommended by Gashaw & Yitayal, likely contributed to the restoration of function and range of motion in our cohort [25]. Additionally, older children and those with delayed presentation did not demonstrate significantly worse outcomes, supporting the observations of Li *et al.*, and Terpstra *et al.*, that proper reduction and fixation remain critical determinants of recovery [18, 26].

Limitations of the study

This study has several limitations. Being a single-center observational study with a relatively small sample size (n = 80), the findings may not be generalizable to all pediatric populations in Bangladesh. The follow-up period was limited to six months, which may not capture long-term functional or cosmetic outcomes. Additionally, factors such as socioeconomic status, nutritional status and variability in surgical expertise were not analyzed, which could influence fracture healing and recovery. Despite these limitations, the study provides valuable insights into the management and outcomes of supracondylar humerus fractures.

CONCLUSION

Our study confirms that closed reduction with percutaneous K-wire fixation is the preferred and effective treatment for displaced supracondylar fractures in children, achieving high rates of excellent functional

and cosmetic outcomes with minimal complications, even in a resource-limited district hospital setting in Bangladesh. These findings provide valuable evidence for optimizing pediatric fracture care and guiding clinical decision-making in similar healthcare environments.

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Conflicts of interest

There are no conflicts of interest.

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