

## A Retrospective Study on the Management and Outcomes of Supracondylar Humerus Fractures in Children

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### Abstract:

**Background:** Supracondylar humerus fractures are among the most common pediatric elbow injuries, often associated with significant morbidity if not managed appropriately.

**Aim:** To evaluate the management strategies and clinical outcomes of supracondylar humerus fractures in children.

**Methodology:** This retrospective observational study included 90 pediatric patients ( $\leq 14$  years) treated at Department of Orthopaedics, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar, India. Data on demographics, injury mechanism, fracture type (Gartland classification), management approach, and outcomes were analyzed using SPSS.

**Results:** The majority of patients were aged 6–10 years (46.7%) with male predominance (64.4%). Falls during play were the most common cause (60%). Type III fractures were most frequent (46.7%), followed by Type II (35.6%) and Type I (17.8%). Overall, 62.2% cases required surgical management, particularly displaced fractures. Most patients (64.4%) had no complications; however, nerve injury (11.1%), infection (8.9%), malunion (7.8%), and elbow stiffness (7.8%) were observed.

**Conclusion:** Supracondylar fractures are common in school-aged children, with management largely dependent on fracture severity. Early diagnosis and appropriate treatment yield favorable outcomes, though careful monitoring is essential to minimize complications.

**Keywords:** Supracondylar fracture, pediatric, Gartland classification, surgical management, complications, elbow injury.

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### Introduction

Humeral supracondylar fractures are one of the most frequent and clinically important injuries in the paediatric population [1]. These fractures are usually in the distal humerus, just above the elbow joint, and are most commonly observed in children because of the anatomical and physiological nature of their developing bones. The supracondylar area is vulnerable, and the high physical activity of children increases the occurrence of such injuries. Out of all the fractures of the elbow region in children, supracondylar fractures are almost 70 percent of the total, which underscores their prevalence and clinical significance [2]. Consequently, they constitute a significant percentage of paediatric orthopaedic

emergencies and must be assessed and managed promptly to achieve the best results.

Most supracondylar fractures occur when people experience a fall that causes them to land on their outstretched hand, which results in their elbow joint moving into a hyperextended position. The medical community identifies extension-type fractures as more common injuries than flexion-type injuries. The location of critical neurovascular components, which include the brachial artery and median nerve, creates a hazardous situation because these fractures have a high chance of producing complications [3]. The process of assessing an injury requires both clinical evaluation and radiological analysis to establish

its severity, which subsequently informs treatment selection. The Gartland classification system is widely used to categorize these fractures into type I (undisplaced), type II (partially displaced), and type III (completely displaced), which aids in determining the appropriate management strategy.

Supracondylar fractures generally have an excellent prognosis when doctors identify the fracture early and provide proper treatment. Doctors typically use conservative treatment methods which include cast immobilization to treat type I fractures and certain type II fractures. The treatment of displaced fractures especially type III injuries need surgical intervention through closed reduction and percutaneous pinning which establishes and maintains correct bone alignment [4]. The treatment of these fractures remains difficult to manage because surgical methods and postoperative treatment have advanced while medical staff face difficulties when treating patients with vascular problems or patients who come to the hospital after a long time.

The assessment of vascular status in the affected limb constitutes an essential element for managing supracondylar fractures according to [5]. The clinical presentation of upper limb blood flow disturbance shows a "pulseless pale hand" which indicates a serious vascular injury that requires immediate surgical exploration and treatment. The "pulseless pink hand" shows that doctors cannot feel the pulse yet blood continues to flow through the limb which means they do not need to perform emergency surgery. The medical staff needs to identify the different clinical situations because their choice makes a direct impact on the treatment process and results.

Most supracondylar fractures achieve successful healing but improper management through delayed treatment creates serious medical problems. Volkmann's ischemic contracture represents the most dangerous complication which results from extended periods of reduced blood flow and elevated compartment pressure in the forearm [6]. This medical condition causes lasting damage which results in permanent loss of limb functionality and physical deformity. The development of better methods for diagnosing conditions at an early stage together with advanced surgical procedures and improved methods for monitoring patients after surgery has led to a significant reduction in Volkmann's contracture which now occurs as an uncommon medical condition.

The potential adverse outcomes of the procedure include vascular complications and nerve injuries and malunion which results in deformities that include cubitus varus (gunstock deformity) and the development of joint stiffness and infection. The complications interfere with the child's ability to recover from their condition while they create psychological and social problems that will last for an extended period

of time [7]. The management team has two objectives which they need to accomplish because they want to achieve both fracture union and the restoration of normal anatomical alignment and body function while they decrease the chances of complications.

Multiple research studies throughout history have investigated three main areas which include better diagnostic methods and improved treatment techniques and the study of epidemiological patterns linked to supracondylar fractures observed in children. The research has established standardized treatment protocols which improve the treatment outcomes for pediatric patients. The medical field still displays different treatment patterns because doctors select their preferred approaches to handle patient conditions and related health issues.

In this regard, retrospective studies are crucial in assessing the actual clinical outcomes in the real world and determining the factors that affect the effectiveness of various management strategies. Such studies can be useful in refining the methods and enhancing the care of patients by examining previous cases, which can give a clear understanding of the effectiveness of treatment, the rate of complications, and the long-term outcomes of the treatment.

Therefore, the present study titled "A Retrospective Study on the Management and Outcomes of Supracondylar Humerus Fractures in Children" aims to assess the patterns of presentation, treatment modalities employed, and the clinical outcomes associated with these fractures. It also seeks to evaluate the incidence of complications and their correlation with different management strategies. Through this analysis, the study intends to contribute to the existing body of knowledge and provide evidence-based recommendations for optimizing the management of supracondylar humerus fractures in the paediatric population.

### Methodology

**Study Design:** The present study was designed as a retrospective observational study aimed at evaluating the management strategies and clinical outcomes of supracondylar humerus fractures in children.

**Study Area:** The study was conducted in the Department of Orthopaedics, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar, India.

**Study Duration:** The duration of the study was one year from April 2025 to March 2026.

### Study Participants

#### Inclusion Criteria

- Pediatric patients aged  $\leq 14$  years diagnosed with supracondylar humerus fractures

- Patients who received treatment (conservative or surgical) at the study center
- Cases with complete medical records, including clinical, radiological, and follow-up data
- Both male and female patients

#### Exclusion Criteria

- Patients aged >14 years
- Fractures other than supracondylar humerus fractures
- Cases with incomplete or missing medical records
- Patients with pathological fractures or associated systemic bone disorders
- Patients lost to follow-up before outcome assessment

**Sample Size:** A total of 90 pediatric patients fulfilling the inclusion criteria were included in the study.

**Procedure:** Data for this retrospective study were obtained from hospital medical records, case sheets, radiographic archives, and operative notes of pediatric patients diagnosed with supracondylar fractures of the humerus. Relevant demographic details such as age, sex, and mechanism of injury (e.g., fall during play, road traffic accidents) were recorded. Clinical evaluation findings, including swelling, deformity, neurovascular status, and associated injuries, were also noted. Fractures were classified based on standard classification systems (such as Gartland classification) using available radiographic images. Details regarding the type of management were documented, including conservative treatment (closed reduction and casting) and surgical interventions (closed reduction with percutaneous pinning or open reduction and internal fixation). The choice of treatment modality was based on fracture type, displacement, and surgeon preference.

Post-treatment records were reviewed to assess outcomes such as fracture union, range of motion at the elbow joint, and presence of complications including nerve injury, vascular compromise, infection, malunion, or stiffness. Follow-up data were analyzed to evaluate functional and radiological outcomes. Functional outcomes were assessed using standard clinical parameters such as range of motion and carrying angle. All collected data were systematically entered into a structured data collection sheet to ensure uniformity and accuracy. Ethical considerations were maintained by ensuring confidentiality of patient information and using the data strictly for research purposes.

**Statistical Analysis:** The collected data were compiled and analyzed using Statistical Package for the Social Sciences (SPSS) version 27.0. Descriptive statistics such as mean, standard deviation, frequencies, and percentages were used to summarize demographic and clinical variables. Inferential statistical tests, including the Chi-square test, were applied to determine the association between categorical variables. A p-value of <0.05 was considered statistically significant.

#### Result

Table 1 shows the age-wise distribution of patients included in the study (n = 90). The majority of patients belonged to the 6–10 years age group, accounting for 42 cases (46.70%), indicating that this age range is most commonly affected. This was followed by the 11–14 years age group with 30 patients (33.30%), while the youngest age group (≤5 years) comprised 18 patients (20.00%), representing the least affected category. Overall, the findings suggest that middle childhood (6–10 years) constitutes the peak incidence period among the studied population.

**Table 1: Age-wise Distribution of Patients (n = 90)**

Age Group (years)	Number of Patients	Percentage (%)
≤5	18	20.00%
6–10	42	46.70%
11–14	30	33.30%
<b>Total</b>	<b>90</b>	<b>100%</b>

Table 2 shows the gender distribution of the study participants (n = 90). The majority of patients were male, comprising 58 individuals (64.40%), whereas females accounted for 32 patients (35.60%). This indicates a clear male predominance in the study

population, suggesting that the condition or clinical presentation under investigation was more commonly observed among males compared to females in this sample.

**Table 2: Gender Distribution (n = 90)**

Gender	Number of Patients	Percentage (%)
Male	58	64.40%
Female	32	35.60%
<b>Total</b>	<b>90</b>	<b>100%</b>

Table 3 shows the distribution of patients according to the mode of injury among the study population (n = 90). The majority of injuries occurred due to falls during play, accounting for 54 patients (60.00%), indicating that this is the most common cause of injury in children. Road traffic accidents were the second most frequent cause, observed in 20 patients (22.20%), highlighting their significant contribution

to trauma cases. Falls from height were responsible for 12 cases (13.30%), suggesting a moderate level of risk associated with such incidents. Sports-related injuries were the least common, seen in only 4 patients (4.50%). Overall, the findings suggest that most injuries are related to routine physical activities rather than high-impact or organized sports events.

Mode of Injury	Number of Patients	Percentage (%)
Fall during play	54	60.00%
Road Traffic Accident	20	22.20%
Fall from height	12	13.30%
Sports-related injury	4	4.50%
<b>Total</b>	<b>90</b>	<b>100%</b>

Table 4 shows the distribution of fracture types according to the Gartland classification and their respective management among the study population (n = 90). Type I fractures accounted for 16 cases, all of which were managed conservatively, with no cases requiring surgical intervention, indicating their stable nature. Type II fractures were observed in 32 patients, of which 14 were treated conservatively while a higher proportion, 18 cases, required surgical management, suggesting partial instability in this

group. Type III fractures constituted the largest group with 42 cases, where the majority (38 cases) underwent surgical management and only 4 were managed conservatively, reflecting the severe displacement and instability associated with this type. Overall, out of 90 cases, 34 (37.8%) were managed conservatively, whereas 56 (62.2%) required surgical intervention, demonstrating a higher preference for operative management, particularly in more severe fracture types.

Fracture Type (Gartland)	Conservative Management	Surgical Management	Total
Type I	16	0	16
Type II	14	18	32
Type III	4	38	42
<b>Total</b>	<b>34</b>	<b>56</b>	<b>90</b>

Table 5 presents the distribution of post-treatment complications among the study participants (n = 90). The majority of patients, 58 (64.40%), did not experience any complications, indicating a generally favorable outcome of treatment. However, a notable proportion of patients developed complications, among which nerve injury was the most common, observed in 10 patients (11.10%). This was followed

by infection in 8 patients (8.90%). Malunion and elbow stiffness were reported equally, each affecting 7 patients (7.80%). Overall, while most patients had uneventful recovery, the presence of complications in a considerable minority highlights the need for careful surgical technique, postoperative monitoring, and rehabilitation to minimize adverse outcomes.

Complication Type	Number of Patients	Percentage (%)
No complications	58	64.40%
Nerve injury	10	11.10%
Infection	8	8.90%
Malunion	7	7.80%
Elbow stiffness	7	7.80%
<b>Total</b>	<b>90</b>	<b>100%</b>

**Discussion**

The current research results match the existing literature about how supracondylar humerus fractures in children develop and get treated. The highest occurrence rate in our research appeared in the 6 to 10 years age group which registered 46.70 percent

while the 11 to 14 years group registered 33.30 percent. Otsuka and Kasser (2001) [8] established that children between 5 and 10 years of age represent the majority of supracondylar fractures because they found that this age group shows a 50 to 60 percent occurrence rate. Cheng et al. (1993) [9] reported

that school-aged children experience their highest incidence rate because their research found that 55 percent of cases involved children aged 6 to 12 years which matches our results. The lower proportion in children  $\leq 5$  years (20.00%) in our study is also supported by Hasler (2002) [10], who indicated that younger children are less frequently affected due to closer parental supervision and lower exposure to high-risk activities.

The study found that 64.40% of participants were male which matches the results of previous studies. The study of Skaggs et al. (2004) [11] showed that males made up between 60% and 70% of cases which matches our research results. The study by Holt (2018) [12] showed that males participated in about 65% of pediatric supracondylar fractures. Boys show more outdoor activity together with higher risk-taking behavior which results in a permanent gender difference between boys and girls. The study results support the common belief that male children experience a greater risk of sustaining such injuries.

Our research found that 60.00% of cases occurred because of falls during play which represented the primary cause of injuries while road traffic accidents followed with a 22.20% share. The findings of Houshian et al. (2001) [13] show that approximately 70% of supracondylar fractures happen because people fall onto their outstretched hands while they play. Wilkins (1998) [14] showed that around 65 to 75 percent of all injuries occur because people fall down which matches our research results. Our study found that sports-related injuries made up 4.50% of all cases which matches earlier research that shows children get injured more often from informal play than from organized sports. The study found that our research recorded 22.20% of road traffic accidents which shows higher results than some Western studies because it demonstrates different regional patterns of environmental safety and supervision.

The study results showed that Gartland Type III fractures occurred most frequently at 46.70% while Type II fractures accounted for 35.60% and Type I fractures made up 17.80% of cases. The results show similar outcomes to those reported by Pirone et al. (1988) [15] who found that Type III fractures occurred in 45 to 50 percent of cases while Type II fractures appeared in 30 to 35 percent of cases. Leitch et al. (2006) [16] discovered that Type II and III displaced fractures together formed approximately 75 to 80 percent of all cases which matched our total of 82.30 percent. The higher occurrence of severe fracture types in hospital-based studies including our research results from referral bias which sends severe cases to tertiary centers while primary care facilities treat mild cases.

The management pattern which we observed in our research study shows the same pattern which

modern orthopedic medical techniques use in their practices. All Type I fractures in our series received conservative treatment while Type II fractures and all Type III fractures needed surgical treatment which created an overall surgical rate of 62.20%. The research of Skaggs et al. (2004) showed that they recommended closed reduction with percutaneous pinning as treatment for displaced fractures and their study found that approximately 60-70% of patients needed surgical treatment. Otsuka and Kasser (1997) [17] demonstrated that Type III fractures need surgical treatment to achieve proper bone alignment which helps to prevent medical complications. The current medical consensus about fracture treatment shows that doctors use different treatment methods based on the severity of a patient's fracture.

The results of our research showed positive results after treatment because 64.40% of patients showed no signs of any complications. Leitch et al. (2006) found that 70 to 80 percent of patients achieved good to excellent results after receiving proper treatment. Our study found that 35.60% of cases experienced complications which included nerve injuries as the most frequent issue occurring in 11.10% of cases. The incidence rate exceeds 6 to 10 percent which Pirone et al. (1998) reported yet it remains within the acceptable boundaries established in scientific research. Our study found that 8.90% of cases resulted in infection which exceeds the 2 to 5 percent range that Skaggs et al. (2004) reported because of differences in surgical environments and postoperative treatment methods. Our study found that malunion and elbow stiffness occurred in 7.80% of cases which matches the findings of Houshian et al. (2001) who discovered residual deformities and stiffness in about 5 to 10 percent of their cases.

The present study results show strong agreement with existing research because they demonstrate that school-aged boys experience the highest rate of supracondylar humerus fractures, which mainly result from falls that occur during playtime. The established treatment protocols show that hospitals follow the same pattern of fracture types and they prefer to treat displaced fractures through surgical methods. The majority of patients reach positive treatment results because the medical team needs to identify their condition early and choose correct treatments and use precise surgical methods. The comparisons demonstrate that our results are trustworthy while showing that we must keep working to decrease complications and enhance functional recovery for our young patients.

### Conclusion

The present retrospective study highlights that supracondylar humerus fractures are a common pediatric injury, predominantly affecting children aged 6–10 years with a higher incidence in males. Falls during play emerged as the leading cause,

emphasizing the role of routine activities in injury occurrence. The study demonstrated that fracture severity significantly influences management, with conservative treatment effective for Type I fractures, while most Type II and III fractures required surgical intervention. Overall outcomes were favorable, with the majority of patients showing no complications. However, the presence of nerve injury, infection, malunion, and stiffness in a subset of patients underscores the importance of early diagnosis, appropriate treatment selection, and careful postoperative care to ensure optimal functional recovery and minimize complications.

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