

A Study on Complications of Supracondylar Fractures of Humerus in Children

Amit Rahangdale¹, Anita Harinkhede², Ajay Singh³, Surendra Kumar Padarya^{4*}

¹Assistant Professor, Department of Orthopedics, CIMS, Chhindwara, MP, India

²Assistant Professor, Department of Pediatrics, CIMS, Chhindwara, MP, India

³Assistant Professor, Department of Anaesthesiology, Bundelkhand Medical College, Sagar, MP, India

⁴Assistant Professor, Department of Orthopedics, Bundelkhand Medical College, Sagar, MP, India

Received: 01-01-2024 / Revised: 10-01-2024 / Accepted: 14-01-2024

Corresponding Author: Dr. Surendra Kumar Padarya

Conflict of interest: Nil

Abstract:

Background: Supracondylar fractures are the most common kind of elbow injury in children under eight years old, accounting for 64% of cases. These fractures may lead to problems such as: A) Pre-existing complications: 1) neurological, 2) vascular, & 3) compartment syndrome. Post-treatment complications: 1) shortly after treatment: possible issues include loss of alignment, neurological complications, vascular problems, compartment syndrome, and infection related to Kirschner wires. Late consequences in therapy may include angular deformity, reduced mobility, ossifying myositis, avascular necrosis of the trochlea, and other potential issues.

Objectives: To assess the prevalence of complications in children with humeral supracondylar fractures.

Material and methods: The research included fifty children aged three to fourteen with a supracondylar fracture of the humerus. The results were evaluated by measuring the carrying angle and range of motion at the elbow, and any issues were documented.

Results: The majority of fractures were displaced fractures (Gartland type III) at 58%, with the remaining 42% being Gartland type I & II fractures. 4% of the patients experienced vascular injuries, 6% developed compartment syndrome, and 2 individuals suffered nerve lesions out of a total of 50 patients. The long-term consequences included cubitus varus, cubitus valgus, elbow stiffness, and myositis ossificans.

Conclusion: The main consequence of a supracondylar humerus fracture is compartment syndrome, which is a serious condition. However, if treated promptly, children often respond well. Brachial artery damage is a surgical emergency that requires immediate examination to save the limb. Nerve injuries, particularly involving the median nerve, are uncommon. Late consequences may involve malunion resulting in either cubitus varus (gunstock deformity) or cubitus valgus, elbow joint stiffness, and myositis ossificans. These problems have a substantial impact on the patient's functional result. Supracondylar humerus fractures in children should be treated promptly and with consideration of potential consequences.

Keywords: Children; Complications; Cubitus; K wire; Supracondylar humerus fracture; Valgus; Varus.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Between 40% and 50% of all fractures in children occur in the upper extremities, with supracondylar humeral fractures being the most common paediatric elbow fractures. [1,2] Children older than five years old are most commonly affected by this fracture [3]. Roughly 70% of occurrences of supracondylar fractures are caused by falls onto an outstretched arm.

When a child falls from a height of little more than three feet, as from a bed or couch, they frequently suffer a supracondylar fracture. This kind of fracture is common in children over three who fall from a height of more than three feet.[4] Suh S. et al.'s research [5] shown that although

supracondylar fractures are more prevalent in men, they affect women and men equally. It is thought that left elbow fractures are more prevalent. [6]

The Gartland Classification [7] provides three fundamental types into which supracondylar fractures can be divided. A non-displaced fracture of the humerus' distal portion is known as type I. Angulated fracture of the distal humerus with an intact posterior cortex is called type II. A displaced fracture with no cortical contact is known as type III. [First Figure] Options for treatment include reduction, either closed or open, with or without percutaneous Kirschner-wire (K-Wire) fixation, or immobilisation in an above-elbow cast. Treatment

choices are frequently influenced by the particular kind of fracture. While Type II and Type III supracondylar fractures are treated with closed and open reduction techniques, Type I fractures are

usually treated with a cast for around three weeks [8]. Numerous side effects from surgical treatments include neurovascular damage, elbow deformity, and infections. [9]

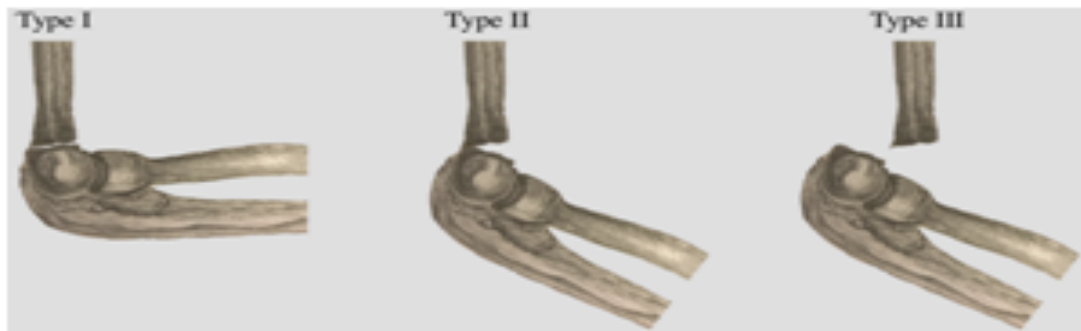


Figure 1: Gartland classification of supracondylar humerus fracture

Aim and Objectives:

The purpose of the study was to determine if different types of supracondylar fracture and its consequences are related.

Material and method:

This study was carried out at the NSCB Medical College in Jabalpur using a retrospective cohort methodology. The study was approved by the research ethics commission before it started.

All paediatric patients with supracondylar humeral fractures who came to the OPD and casualty departments between the ages of 3 and 14 were included in the research. Every case was examined, evaluated, and monitored for a minimum of three to a maximum of twelve months. Every pathological fracture was not included in the research. Categorization of supracondylar humerus fracture:

- Type I fracture: Undisplaced fracture.
- Type II fracture: An intact posterior cortex is displaced with angulation.
- Type III fracture: Complete displacement.

The information contained information on the mechanism of injury, pre- and post-operative

exams, fracture type, amount of time between injury and operation, kind of care, length of immobilization, and existence of complications. Preoperative, intraoperative, and postoperative X-rays were obtained and evaluated. Children treated with an above-elbow splint at 90° of flexion for three weeks had fractures that were either undisplaced (Gartland Type I) or mildly displaced. Close reduction was performed for Gartland Type II and III fractures. If the fracture was found to be stable following closed reduction casting at 90° of flexion, but more than 90° of flexion is required to maintain reduction, percutaneous pinning (K wires) was used to stabilize the fracture in order to reduce the risk of complications from the increased elbow flexion. Open reduction and internal fixation were performed for fractures that did not respond to closed manipulation [Figure 2]. Patients had radiological and clinical evaluations during follow-up. When a patient first presented to the centre, immediate problems were noted; late complications were noted over the follow-up period [Figure 3]. Flynn's grade was used to measure elbow function functionally. Change in carrying angle (degrees) and functional loss of extension - flexion (degrees) Good from 6 to 10, Fair from 11 to 15, and Poor above 15.



Figure 2: Type III supracondylar fracture humerus treated with cross K-wire fixation following closed reduction



Figure 3: Malunion as cubitus varus (Gun Stock Deformity)

Observation and results:

Of the 50 patients, 32 (64%) are in the 5–10 age range. Male to female ratio was 7:3, with 35 patients being male and 15 female. 38 occurrences (76%) affected the left elbow, indicating a left-sided preponderance over a right-sided one. One instance had anterior (flexion) damage, one had significant communicative damage, and 48 cases (96%) had posterior (extension type) injuries. 28 out of 48 (60.4%) of the 48 instances with extension type injury were found to have displaced fractures (Gartland type III), with the remaining

39.6% having Gartland types I and II. Three out of fifty patients (3%) had compartment syndrome, which required emergent fasciotomy treatment. Acute vascular damage, with no radial pulse, affected 4% (2 of 50) of the patients and was treated with surgery.

Both instances, which resulted from brachial artery kinking, recovered well following investigation. In both cases, 4% of the patients (2 out of 50) experienced a nerve lesion affecting the median nerve, which largely healed with conservative treatment over time. [Table 1]

Table 1: Demographic variables

Variables		N	%	
Age groups	3-5 years	03	06	
	5-10 years	32	64	
	10-14 years	15	30	
Gender	Male	35	70	
	Female	15	30	
Laterality	Left elbow	38	76	
	Right elbow	12	24	
Type of injury	Posterior (Extension type)	Total	48	96
		Gartland type III	28	60.4
		Gartland type I & II	20	39.6
	Anterior (Flexion type)	01	02	
Comminuted	01	02		

Cubitus varus, cubitus valgus, elbow stiffness, and myositis ossificans were among the long-term consequences. Out of 50 patients, 16 (32%) had cubitus varus (gun stock deformity) due to malunion, whereas 7 instances (14%) had cubitus valgus. Fifteen patients (30%) complained elbow joint stiffness. stiffness in the joint in both flexion (10 of 50), extension (4 of 50), and both (1 of 50).

Every patient who had progressive joint stiffness was recommended physical therapy. Out of fifty patients, five had a report of myositis ossificans (10%). Each patient was provided a single daily dosage of 75 mg of oral Indomethacin. Surgery was not necessary for any of the myositis ossificans patients. Volkmann's ischemic contracture did not affect any of the patients in the future. [Table 2]

Table 2: Associated complications

Complications		N (%)
1.	Malunion- Cubitus varus	16 (32)
2.	Malunion- Cubitus valgus	07 (14)
3.	Joint stiffness in flexion	10 (20)
4.	Joint stiffness in extension	04 (08)
5.	Joint stiffness in flexion/extension both	01 (02)
6.	Myositis ossificans	05 (10)

In terms of overall recovery and functional improvement, 25% of patients (or 50%) had outstanding outcomes, 36% had good results (18 of 50), 10% had acceptable results (5 of 50), and 4% had bad results (2 of 50). [Table 3]

Table 3: Recovery and functional improvement

Recovery and functional improvement		N (%)
1.	Excellent	25 (50)
2.	Good	18 (36)
3.	Fair	05 (10)
4.	Poor	02 (04)

Discussion:

Childhood injuries involving humeral supracondylar fractures are not uncommon. [1-3] It is responsible for almost 60% of paediatric elbow fractures and around 16% of all paediatric fractures. [10] For any fracture with displacement, routine surgical therapy is the best course of action since complications are usually avoidable with early treatment.

A retrospective analysis of 752 individuals who had their supracondylar humerus fractures surgically fixed between January 2006 & December 2010 was carried out by Oetgen et al. [11]. Considering a statistically significant p-value of less than 0.0001, the study discovered that the complication rate in type III fractures (19.8%) was substantially greater than in type II fractures (5.7%).

When it comes to children with supracondylar fractures, the incidence of Cubitus Varus has dropped from 58% to around 3% thanks to advanced surgical techniques such Closed Reduction with Percutaneous Pinning [13]. One typical outcome of supracondylar fractures is reduced range of motion or stiffness. Restoring the elbow joint's normal range of motion is an important goal in treatment. According to the 2008 article, the range of motion of the elbow joint gets better with time. [14] Their findings, which indicated that 94% of their patients recovered a normal range of motion after 6 months, closely matched our results, which showed that 93% did so within 7 months. Additionally, they stated that after a year-long follow-up, there was still improvement in range of motion, reaching 98%.

Conclusion:

Male children are more likely than female children to sustain a supracondylar fracture of the humerus

in children between the ages of 5 and 10. The most frequent cause of injury is falls on the outstretched hand, with the left side elbow being the most usually afflicted. Injuries of the extension type occur more frequently than those of the flexion type. When reduction is undertaken within 3–4 days of trauma after edoema subsides, closed reduction can produce good outcomes; for this reason, closed reduction should be the preferred course of therapy. Nonetheless, the functional result of a comminuted type fracture is not adequate.

The most common primary consequence of supracondylar fracture of the humerus is compartment syndrome, which is a feared condition that, in children, responds well to early treatment. Additionally, brachial artery damage requires immediate surgical attention in order to save limbs. Although very uncommon, nerve damage is also reported, particularly in the form of a median nerve lesion. Myositis ossificans, elbow joint stiffness, and malunion as either cubitus varus (gun stock deformity) or cubitus varus are examples of late or secondary consequences. The functional outcome of the patient is greatly impacted by these problems. Therefore, children's supracondylar humerus fractures should be treated critically and promptly, along with any associated sequelae.

References:

1. Morrissey RT and Weinstein SL (2006) Lovell and winter's pediatric orthopedics. In: 6th ed. Philadelphia, PA: Lippincott.
2. Omid R, Choi PD, Skaggs DL (2008) Supracondylar humeral fractures in children. J Bone Joint Surg Am 90:1121-1132.
3. Rodríguez-merchán EC (2005) Pediatric fractures of the forearm. ClinOrthopRelat Res 432:65-72.

4. Fletcher N, Schiller JR, Garg S, Weller A, Larson AN, et al. (2012) Increased severity of type III supracondylar humerus fractures in the preteen population. *J Pediatr Orthop* 32:567-572.
5. Suh SW, Oh CW, Shingade VU, Swapnil MK, Park BC, et al. (2005) minimally invasive surgical techniques for irreducible supracondylar fractures of the humerus in children. *Acta Orthop* 76:862-866.
6. Mehlman CT, Strub WM, Roy DR, Wall EJ, Crawford AH (2001) The effect of surgical timing on the perioperative complications of treatment of supracondylar humeral fractures in children. *J Bone Joint Surg Am* 83:323-327.
7. Miller MD, Thompson SR, Hart J (2012) Review of Orthopedics. In: 6thed Philadelphia, PA: Saunders.
8. Mulpuri K, Hosalkar H, Howard A (2012) AAOS clinical practice guideline: the treatment of pediatric supracondylar humerus fractures. *JAAOS* 20:328-330.
9. Souder C. Supracondylar Fracture - Pediatric - orthobullets.com.
10. Omid R, Choi PD, Skaggs DL (2008) "Supracondylar humeral fractures in children," *e Journal of Bone & Joint Surgery-American* Volume 90: 1121-1132.
11. Oetgen M, Mirick G, Atwater L, Lovejoy J (2015) Complications and Predictors of Need for Return to the Operating Room in the Treatment of Supracondylar Humerus Fractures in Children. *The Open Orthopaedics Journal* 9:139-142.
12. Zamzam MM and Bakarman KA (2008) Treatment of displaced supracondylar humeral fractures among children: crossed versus lateral pinning. *Injury* 40:625-630.
13. Kumar V (2016) Fracture Supracondylar Humerus: a review. *Journal of clinical and diagnostic research* 10: RE01-RE06.
14. Zions L, Woodson C, Manjra N, Zalavras C (2009) Time of Return of Elbow Motion after Percutaneous Pinning of Pediatric Supracondylar Humerus Fractures. *Clinical Orthopaedics and Related Research* 467:2007-2010.