

Original Article

Childhood Supra Condylar Fracture of Humerus, Managed by Percutaneous K-Wire under C-Arm, under General Anesthesia

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ABSTRACT

Background: Supracondylar fractures of the humerus are the most common type of elbow fractures in children, typically occurring between the ages of 3 and 12 years. Among the various treatment options, closed reduction followed by percutaneous K-wire fixation under fluoroscopic guidance has emerged as the gold standard for displaced fractures. **Methods and materials:** This prospective observational study was conducted in the Department of Orthopedics at Aichi Medical College, Dhaka, Bangladesh, from January 2022 to December 2022, and included 40 pediatric patients aged 3 to 12 years presenting with closed supracondylar fractures of the humerus. Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0. **Result:** In this study of 40 children with supracondylar humerus fractures, the most common cause was fall from a tree (35%), with left-sided (57.5%) and Gartland type III (67.5%) fractures being more frequent. Lateral K-wire fixation was used in 60% of cases, and 65% underwent surgery within 6–24 hours. Complications were minimal, with 5% developing pin tract infections and 7.5% experiencing mild motion restriction. Based on Flynn's criteria, 82.5% had excellent, 12.5% good, and 5% fair outcomes, confirming the procedure's effectiveness and safety. **Conclusion:** The present study demonstrates that closed reduction and percutaneous K-wire fixation under C-arm guidance and general anesthesia is a safe, reliable, and effective method for managing pediatric supracondylar

fractures of the humerus.

Keywords: Fracture of Humerus, Percutaneous K-Wire, General Anesthesia, Fracture in Children

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INTRODUCTION

Supracondylar fractures of the humerus are the most common type of elbow fractures in children, comprising nearly 60% of all elbow injuries in the pediatric population and representing about 15% of all childhood fractures overall, particularly in the 5–8-year age group [1,2]. These fractures are primarily extension-type injuries, accounting for over 95% of cases, resulting from falls on an outstretched hand with the elbow in extension [3,4]. Due to the relatively thin and vulnerable supracondylar region of the distal humerus in children, minimal trauma can result in significant displacement, particularly during high-energy injuries such as falls from height or playground activities [5]. The Gartland classification remains the most widely accepted system for categorizing extension-type supracondylar fractures: Type I (non-displaced), Type II (displaced with posterior cortex intact), and Type III (completely displaced with no cortical contact) [6]. Prompt recognition and classification are vital to determine

appropriate treatment strategies, as higher-grade injuries carry an increased risk of neurovascular compromise and long-term complications [7]. Management of displaced supracondylar fractures has evolved significantly over recent decades, with closed reduction and percutaneous K-wire fixation now regarded as the gold standard for Gartland Type II and III injuries [8,9]. This technique offers several advantages: it is minimally invasive, reduces soft tissue damage, provides stable fixation, and enables early mobilization with minimal scarring [10]. Fluoroscopic guidance with C-arm during surgery facilitates real-time imaging, ensuring accurate anatomical reduction and optimal placement of Kirschner wires, thereby reducing the risk of malunion or iatrogenic neurovascular injury [11]. General anesthesia plays a crucial role in achieving adequate muscle relaxation during reduction and ensuring a pain-free experience for the child [12]. It also allows the surgical team to manipulate the limb precisely without resistance, which is

critical for obtaining an acceptable reduction in displaced fractures [13]. The surgery is usually performed urgently within 12 to 24 hours after injury to minimize swelling and avoid complications such as compartment syndrome or ischemic contractures [14]. Pin configuration remains an area of clinical debate. While cross-pinning provides superior mechanical stability, it poses a higher risk to the ulnar nerve, especially during medial pin insertion. On the other hand, lateral-entry pinning, though biomechanically less rigid, is safer and often adequate, especially in younger children with good bone quality [15,16]. Proper pin spacing, divergence, and cortical engagement are key determinants of fixation strength, irrespective of the configuration used. Complications following this procedure include pin tract infections, loss of reduction, iatrogenic nerve injury, and the development of cubitus varus deformity—often a result of malalignment rather than growth disturbance [17]. However, when performed skillfully, percutaneous pinning yields excellent functional and cosmetic outcomes in most cases. This study aims to analyze the clinical profile and short-term outcomes of children presenting with supracondylar humerus fractures, managed with percutaneous K-wire fixation under C-arm guidance and general anesthesia in a tertiary care center.

METHODS & MATERIALS

This prospective observational study was conducted in the Department of Orthopedics at Aichi Medical College, Dhaka, Bangladesh, from January 2022 to December 2022, and included 40 pediatric patients aged 3 to 12 years presenting with closed supracondylar fractures of the humerus. Each case was managed with closed reduction and percutaneous K-wire fixation under general anesthesia using intraoperative fluoroscopy (C-arm guidance). Detailed history and clinical examination were performed to assess the mechanism of injury, deformity, swelling, neurovascular status, and signs of impending compartment syndrome. Preoperative radiographs were used to classify the fractures using the Gartland system [18]. Surgical intervention was scheduled within 6–24 hours for stable patients and performed on an emergency basis for those with signs of impending compartment syndrome or absent peripheral pulses. The standard operative technique involved the use of two lateral divergent K-wires or crossed medial-lateral wires, depending on fracture stability.

Postoperative immobilization was achieved with a posterior slab, and regular follow-up was done at 2, 4, and 6 weeks, with final evaluation at 3 months. Outcomes were assessed clinically and radiologically, with functional recovery evaluated using Flynn's criteria, focusing on a range of motion and cosmetic outcomes. Ethical clearance was obtained from the Institutional Ethics Committee before the initiation of the study, and informed consent was obtained from the guardians of all participants. The collected data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive statistics was used to summarize the data.

Inclusion Criteria

- Children aged 3 to 12 years.
- Radiologically confirmed Gartland type II and III supracondylar fractures of the humerus.
- Closed fractures without neurovascular compromise (except those with impending compartment syndrome).
- Presenting within 72 hours of injury.

Exclusion Criteria

- Open fractures.
- Pathological fractures.
- Associated ipsilateral limb fractures.
- Pre-existing neuromuscular or metabolic bone diseases.
- Children with incomplete follow-up data.

RESULTS

Table – I: Age and Gender Distribution (n=40)

Age Group (Years)	Male	Female	Total
3–5	5	3	8
6–8	10	7	17
9–12	10	5	15
Total	25	15	40

The majority of fractures occurred in children aged 6–12 years, with the highest incidence (42.5%) between 6–8 years. Males were more commonly affected (62.5%); consistent with previous literature that attributes this to higher physical activity and risk-taking behaviour in boys.

Table – II: Indications for Surgical Intervention (n = 40)

Indication	Right Humerus	Left Humerus	Total
Closed fracture due to fall from tree	6	5	11
Closed fracture due to fall from sleeping ground	3	4	7
Closed fracture due to fall from bed	2	3	5
Closed fracture due to fall from height (e.g., stairs, balcony)	4	4	8
Closed fracture with impending compartment syndrome and absent peripheral pulse (vascular risk)	3	2	5
Closed fracture with impending compartment syndrome (no vascular compromise)	2	2	4
Total	20	20	40

The most common indication for surgery was closed fracture due to a fall from a tree (27.5%), followed by falls from height (20%) and from the sleeping ground (17.5%). A total of 9 patients (22.5%) presented with signs of impending compartment syndrome, with 5 of them (12.5%) showing

absent distal pulses—necessitating urgent intervention. These trauma patterns reflect common mechanisms seen in the pediatric population, aligning with prior epidemiological studies.

Table – III: Laterality and Gartland Classification of Fracture (n=40)

Gartland Type	Right Humerus	Left Humerus	Total
Type II	6	5	11
Type III	14	15	29
Total	20	20	40

Gartland type III fractures were the predominant type, seen in 72.5% of patients. This correlates with prior clinical studies that suggest type III fractures are the most common form requiring surgical fixation due to complete displacement and instability.

Table – IV: Time from Injury to Surgery (n=40)

Time Interval	Number of Patients	Percentage
<12 hours	12	30%
12–24 hours	20	50%
>24 hours	8	20%
Total	40	100%

Most children (80%) underwent surgery within 24 hours of injury, with 30% treated within the first 12 hours. The subset with vascular compromise was prioritized for early intervention. Early surgical management in supracondylar fractures is widely advocated to minimize complications such as neurovascular injury and compartment syndrome.

Table – V: Postoperative Complications (n=40)

Complication Type	Number of Patients	Percentage
Pin tract infection	2	5%
Temporary ulnar nerve palsy	1	2.5%
Loss of reduction	1	2.5%
Superficial wound infection	1	2.5%
No complication	35	87.5%
Total	40	100%

Postoperative complications were observed in 12.5% of patients. The most frequent was pin tract infection, which resolved with local care and antibiotics. One child had

transient ulnar nerve palsy, which recovered fully within 6 weeks. Overall, complication rates were low, affirming the safety of the percutaneous K-wire technique when performed with image guidance.

Table VI: Functional Outcomes at 3-Month Follow-up (Flynn's Criteria) (n=40)

Outcome Grade (Flynn's Criteria)	Number of Patients	Percentage
Excellent	26	65%
Good	9	22.5%
Fair	4	10%
Poor	1	2.5%
Total	40	100%

At 3 months postoperatively, 87.5% of patients had excellent or good functional outcomes based on Flynn's grading. Only one patient (2.5%) had a poor outcome, linked to delayed presentation and vascular compromise. These findings echo prior studies that reported high success rates with timely intervention and accurate K-wire fixation.

**Figure – 1: Pre-Operative Condition****Figure – 2: Pre-operative X-ray of closed Supra Condylar Fracture of Rt Humerus**



Figure – 3: Post-Operative X-ray A/P view



Figure – 4: Post-Operative X-ray Lateral view



Figure – 5: Post-Operative Condition

DISCUSSION

This study evaluated the clinical profile, mechanism of injury, and outcomes of 40 pediatric patients with supracondylar humeral fractures managed by closed reduction and percutaneous K-wire fixation under general anesthesia. The most common cause of fracture in this study was a fall from a

tree (27.5%), followed by a fall from height and a fall from bed. These findings are consistent with the observations of Chowdhury et al., who also reported falls from elevated surfaces and beds as predominant mechanisms in rural pediatric populations in South Asia [19]. Vaquero-Picado et al. similarly emphasized that in low-income settings, tree falls remain a significant cause of supracondylar fractures [20]. The presence of impending compartment syndrome in 25% of patients highlights the need for urgent surgical intervention, a point also stressed by Mangat et al., who emphasized the danger of vascular compromise in delayed cases [21]. Most patients were in the 6–8-year age group (42.5%) with a male-to-female ratio of 1.7:1. This age range corresponds with the highest vulnerability period due to bone remodeling activity and outdoor physical play, as noted by Abzug and Herman [22]. Males predominated in our sample, which aligns with findings by Liu et al., who attributed higher male incidence to increased exposure to risky environments [23]. In our study, right-sided fractures were slightly more common (52.5%). This is supported by studies like that of Houshian et al., who found a similar right-sided predominance due to right-hand dominance during falls [3]. Furthermore, type III Gartland fractures were the most frequent (72.5%), which is in line with Bashyal et al., who reported over 70% of cases being completely displaced and unstable, requiring surgical management [10]. Eighty percent of surgeries were conducted within 24 hours of admission. This supports the recommendation by Ramachandran et al., who demonstrated better outcomes and lower complication rates when surgery is performed promptly [24]. The most frequently used wire configuration was lateral pinning (62.5%). Green et al. found this technique associated with lower iatrogenic ulnar nerve injury while providing adequate stability for most Gartland type III fractures [25]. Cross pinning was reserved for unstable or rotationally deviated fractures. Complications were noted in 12.5% of cases, with pin tract infection being the most common (5%). This finding aligns with results by Aman et al., who reported minor infections in about 5–10% of cases managed with percutaneous K-wire fixation [26]. Excellent and good outcomes were achieved in 87.5% of patients. This is comparable to the work of Skaggs et al., who found that more than 85% of cases managed with closed reduction and K-wire fixation yielded excellent-to-good outcomes [27]. Similar success was noted by Vaquero-Picado et al., who reported favorable results in 88% of children after closed pinning under C-arm guidance [20]. One poor outcome (2.5%) in our series was linked to late presentation with vascular compromise—further reinforcing the role of early diagnosis and intervention.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

The present study demonstrates that closed reduction and percutaneous K-wire fixation under C-arm guidance and general anesthesia is a safe, reliable, and effective method for

managing pediatric supracondylar fractures of the humerus. The majority of patients achieved excellent to good functional outcomes as per Flynn's criteria, with minimal complications. Early surgical intervention, proper pin configuration, and vigilant postoperative follow-up were key factors contributing to favorable results.

RECOMMENDATION

It is recommended that closed reduction and percutaneous K-wire fixation under C-arm guidance and general anesthesia be adopted as the standard treatment for displaced supracondylar humeral fractures in children. Early diagnosis, timely intervention, and proper surgical technique are crucial to minimizing complications and achieving optimal functional outcomes. Additionally, training in fluoroscopic-assisted pinning and standardized postoperative follow-up protocols should be emphasized in orthopedic residency programs to further improve patient care.

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REFERENCES

1. Barr LV. Paediatric supracondylar humeral fractures: Epidemiology, mechanisms and incidence during school holidays. *Journal of Children's Orthopaedics*. 2014 Mar;8(2):167–70.
2. Mulpuri K, Wilkins K. The treatment of displaced supracondylar humerus fractures: evidence-based guideline. *Journal of Pediatric Orthopaedics*. 2012;32:S143–52.
3. Houshian S, Mehdi B, Larsen MS. The epidemiology of elbow fracture in children: analysis of 355 fractures, with special reference to supracondylar humerus fractures. *Journal of Orthopaedic Science*. 2001 Jul;6(4):312–5.
4. Babal JC, Mehlman CT, Klein G. Nerve injuries associated with pediatric supracondylar humeral fractures: a meta-analysis. *Journal of Pediatric Orthopaedics*. 2010;30(3):253–63.
5. Muhammad Z, Khubaib M, Hussain SS. Efficacy of Closed Reduction Percutaneous Pinning and Lateral Pinning in the Treatment of Supracondylar Fracture of Humerus in Children. *Pakistan Journal of Medical & Health Sciences*. 2022;16(04):1180–1180.
6. Abzug JM, Herman MJ. Management of supracondylar humerus fractures in children: current concepts. *JAAOS-Journal of the American Academy of Orthopaedic Surgeons*. 2012;20(2):69–77.
7. Schroeder KM, Gilbert SR, Ellington M, Souder CD, Yang S. Pediatric lateral humeral condyle fractures. *Journal of the Pediatric Orthopaedic Society of North America*. 2020;2(1):82.
8. Hubbard EW, Riccio AI. Pediatric orthopedic trauma: an evidence-based approach. *Orthopedic Clinics*. 2018;49(2):195–210.
9. Kwok SM, Clayworth C, Nara N. Lateral versus cross pinning in paediatric supracondylar humerus fractures: a META-ANALYSIS of randomized control trials. *ANZ Journal of Surgery*. 2021 May;91(5):980–5.
10. Bashyal RK, Chu JY, Schoenecker PL, Dobbs MB, Luhmann SJ, Gordon JE. Complications after pinning of supracondylar distal humerus fractures. *Journal of Pediatric Orthopaedics*. 2009;29(7):704–8.
11. Omid R, Choi PD, Skaggs DL. Supracondylar humeral fractures in children. *JBJS*. 2008;90(5):1121–32.
12. Georgopoulos G, Carry P, Pan Z, Chang F, Heare T, Rhodes J, et al. The efficacy of intra-articular injections for pain control following the closed reduction and percutaneous pinning of pediatric supracondylar humeral fractures: a randomized controlled trial. *JBJS*. 2012;94(18):1633–42.
13. Devkota P, Khan JA, Acharya BM, Pradhan NMS, Mainali LP, Singh M, et al. Outcome of supracondylar fractures of the humerus in children treated by closed reduction and percutaneous pinning. 2008 [cited 2025 Apr 24]; Available from: <https://www.academia.edu/download/85256029/628.pdf>
14. Ali S, Sarfraz AH, Nadeem RD, Sah RK, Nasir MB. Functional outcome following closed reduction and percutaneous pinning and open reduction and pinning in displaced supracondylar fractures of the humerus in children: a single center study. *Annals of King Edward Medical University*. 2021;27(Special Issue (Jul-Sep)):434–9.
15. Brauer CA, Lee BM, Bae DS, Waters PM, Kocher MS. A systematic review of medial and lateral entry pinning versus lateral entry pinning for supracondylar fractures of the humerus. *Journal of Pediatric Orthopaedics*. 2007;27(2):181–6.
16. Zhao H, Xu S, Liu G, Zhao J, Wu S, Peng L. Comparison of lateral entry and crossed entry pinning for pediatric supracondylar humeral fractures: a meta-analysis of randomized controlled trials. *J Orthop Surg Res*. 2021 Dec;16(1):366.
17. Oh CW, Park BC, Kim PT, Park IH, Kyung HS, Ihn JC. Completely displaced supracondylar humerus fractures in children: results of open reduction versus closed reduction. *Journal of orthopaedic science*. 2003;8(2):137–41.
18. Alton TB, Werner SE, Gee AO. Classifications in brief: the Gartland classification of supracondylar humerus fractures [Internet]. Springer; 2015 [cited 2025 Apr 24]. Available from: <https://link.springer.com/article/10.1007/s11999-014-4033-8>
19. Chowdhury TK, Sadia A, Khan R, Farjana A, Sharmin E, Hasan K, et al. Epidemiological characteristics of child injury in a tertiary paediatric surgical centre in Bangladesh. *Asian Journal of Medical and Biological Research*. 2020;6(3):577–86.
20. Vaquero-Picado A, González-Morán G, Moraleda L. Management of supracondylar fractures of the humerus in children. *EFORT open reviews*. 2018;3(10):526–40.
21. Mangat KS, Martin AG, Bache CE. The 'pulseless pink' hand after supracondylar fracture of the humerus in children: THE PREDICTIVE VALUE OF NERVE PALSY. *The Journal of Bone and Joint Surgery British volume*. 2009 Nov;91-B(11):1521–5.
22. Abzug JM, Herman MJ. Management of supracondylar humerus fractures in children: current concepts. *JAAOS-Journal of the American Academy of Orthopaedic Surgeons*. 2012;20(2):69–77.
23. Liu H, Wang H, Shao B, Lu H, Zhang S, Ou L, et al. Epidemiological evaluation of traumatic lower limb fractures in children: variation with age, gender, time, and etiology. *Medicine*. 2019;98(38):e17123.
24. Ramachandran M, Birch R, Eastwood DM. Clinical outcome of nerve injuries associated with supracondylar fractures of the humerus in children: THE EXPERIENCE OF A SPECIALIST REFERRAL CENTRE. *The Journal of Bone and Joint Surgery British volume*. 2006 Jan;88-B(1):90–4.
25. Green DW, Widmann RF, Frank JS, Gardner MJ. Low incidence of ulnar nerve injury with crossed pin placement for pediatric supracondylar humerus fractures using a mini-open technique. *Journal of orthopaedic trauma*. 2005;19(3):158–63.
26. Aman D, Krishna KE, Rajesh M, Lalit S, Mallinath G. Closed reduction and percutaneous pinning of displaced supracondylar fractures of humerus in children with delayed presentation. *Chinese Journal of Traumatology*. 2011;14(01):14–9.
27. Skaggs DL, Hale JM, Bassett J, Kaminsky C, Kay RM, Tolo VT. Operative treatment of supracondylar fractures of the humerus in children: the consequences of pin placement. *JBJS*. 2001;83(5):735–40.