

Pediatric Supracondylar Humerus Fractures with Medial Column Comminution: Case-Based Guidance on Fixation Method and Varus Prevention

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Received: 27 March 2026; Revised: 01 June 2026; Accepted: 03 July 2026

Abstract

Background: Supracondylar humerus fractures are the most common pediatric elbow injuries, and maintaining stable reduction is essential to prevent late complications such as cubitus varus. Medial column comminution is an often underrecognized factor that can compromise stability, even in fractures that appear minimally displaced. This report highlights the clinical importance of medial column comminution in pediatric supracondylar fractures and emphasizes surgical strategies to prevent varus deformity.

Case Report: Two pediatric cases with supracondylar humerus fractures were evaluated. The first case involved a minimally displaced fracture initially treated non-operatively, which subsequently developed cubitus varus due to medial column collapse. The second case presented with medial column comminution and was managed with closed reduction and percutaneous pinning. Stable fixation and maintenance of alignment successfully prevented postoperative collapse and deformity.

Conclusion: Medial column comminution is a key determinant of stability in pediatric supracondylar humerus fractures. Early identification and a tailored surgical approach, including valgus reduction and selective medial pinning when indicated, are critical to prevent collapse, maintain alignment, and avoid late varus deformity.

Keywords: Humerus Fractures; Deformities; Injuries

Citation: Zolghadr H, Najafi Pirasteh M, Shapourgan ME. Pediatric Supracondylar Humerus Fractures with Medial Column Comminution: Case-Based Guidance on Fixation Method and Varus Prevention. *J Orthop Spine Trauma* 2026; 12(4): 212-4.

Background

Supracondylar fractures of the humerus are the most common elbow injuries in children, accounting for a substantial proportion of pediatric orthopedic fractures (1). Displaced fractures are generally managed with closed reduction followed by percutaneous pin fixation, which remains the standard of care for restoring alignment and ensuring stability (2). Despite its widespread use, controversy persists regarding the optimal pin configuration, balancing mechanical stability with the risk of iatrogenic ulnar nerve injury. While medial pin placement enhances torsional and coronal stability, it carries a higher risk of nerve injury, whereas lateral-only pinning is considered safer but may be less effective in certain fracture patterns (3, 4).

A factor that has received increasing attention in recent years is medial column comminution. Fractures with medial comminution, even when appearing minimally displaced on initial radiographs, are prone to collapse of the medial column if not recognized and appropriately addressed. This collapse can compromise lateral pin fixation, reduce bicortical purchase, and ultimately lead to varus malalignment or cubitus varus deformity over time (5). Several studies have emphasized that the presence of medial column comminution is an independent risk factor for loss of reduction, highlighting the need for meticulous reduction techniques and, in some cases, supplemental medial pinning to maintain stability (2, 6).

Although lateral-only pin fixation remains the preferred method in many centers due to its safety profile, recognizing fracture patterns that involve medial column

comminution is critical. Failure to identify these injuries may result in technical under-treatment, medial column collapse, and subsequent deformity (1, 5). Therefore, careful preoperative evaluation and intraoperative assessment of the medial column are essential for optimizing treatment outcomes, preventing varus collapse, and minimizing the need for corrective procedures in the future.

Case Report

Case 1: A six-year-old boy sustained an elbow injury and was initially evaluated at another medical center. At the time of the initial injury, anteroposterior (AP) and lateral radiographs of the elbow were obtained (Figure 1). The patient was managed non-operatively with splint immobilization and subsequently discharged.

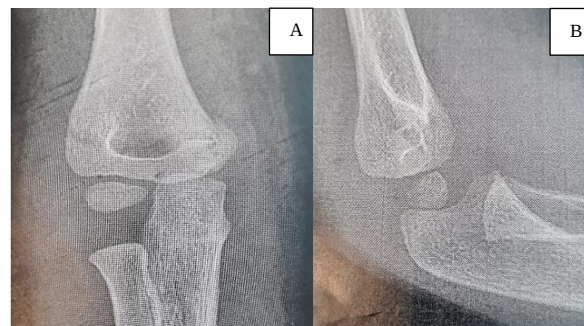


Figure 1. Anteroposterior (AP) (A) and lateral (B) views of the elbow radiographs before initial treatment

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Three years after the initial trauma, the patient presented to our institution because of an elbow deformity (Figure 2). Clinical examination revealed a distinct cubitus varus deformity. Radiographic evaluation demonstrated varus malalignment of the distal humerus, consistent with malunion of a previous supracondylar humeral fracture.



Figure 2. Clinical photograph showing a cubitus varus deformity of the elbow three years after the initial injury

Case 2: A pediatric patient presented to our center following a fall resulting in elbow trauma. Radiographic evaluation, including AP and lateral views, demonstrated a supracondylar fracture of the distal humerus (Figure 3).



Figure 3. Anteroposterior (AP) (A) and lateral (B) radiographs obtained preoperatively

The radiographs revealed medial column comminution of the distal humerus. Given the fracture configuration and concerns regarding stability, the patient underwent closed reduction followed by percutaneous pin fixation. Post-procedural radiographs confirmed acceptable alignment and stable fixation of the fracture (Figure 4).

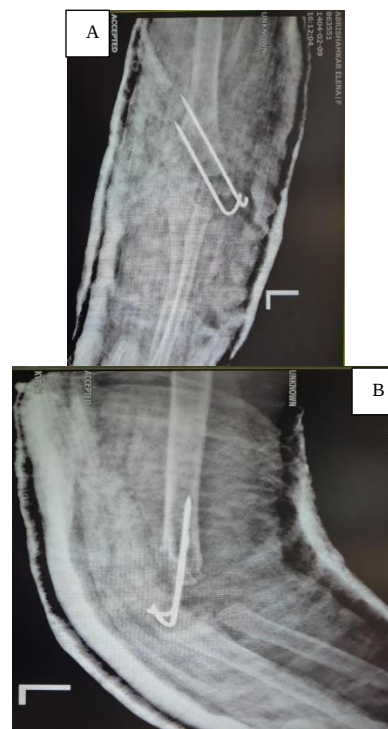


Figure 4. Anteroposterior (AP) (A) and lateral (B) radiographs of the elbow obtained postoperatively

Discussion

Supracondylar fractures of the humerus represent the most common elbow fractures in the pediatric population and remain associated with a spectrum of complications despite appropriate management, among which cubitus varus deformity is one of the most concerning late sequelae (1, 2). Although coronal plane malalignment is often attributed to inadequate reduction or fixation failure, increasing evidence suggests that medial column comminution or impaction plays a critical and frequently underrecognized role in the development of postoperative instability and subsequent cubitus varus deformity (7).

A common misconception in the initial evaluation of supracondylar fractures is the classification of certain injuries as minimally displaced based solely on standard radiographic appearance, without careful assessment of the medial column integrity. As described by Skaggs and Mirzayan, fractures with medial column impaction may masquerade as simple supracondylar fractures and are, therefore, prone to insufficient treatment, ultimately leading to medial column collapse, loss of Baumann angle, and varus deformity (7). This mechanism was clearly illustrated in the first case of the present report.

In our first case, the fracture corresponded to a Gartland type II supracondylar fracture, in which the anterior humeral line failed to intersect the capitellum, indicating the need for reduction. The presence of medial column comminution was overlooked, and the fracture was treated non-operatively. Over time, collapse of the medial column occurred, resulting in progressive loss of the Baumann angle and development of cubitus varus, necessitating corrective osteotomy several years later. These findings are consistent with prior studies demonstrating that changes in the Baumann angle reliably reflect coronal plane deformity and are predictive of long-term varus malalignment (8).

In contrast, the second case highlights the importance of early recognition of medial column comminution. Identification of this fracture characteristic prompted closed reduction with a valgus corrective maneuver, followed by stable fixation. This approach successfully restored coronal alignment and prevented medial column collapse, thereby avoiding the cascade that leads to cubitus varus deformity. This case underscores the clinical significance of recognizing medial comminution at the time of initial management.

Lateral-only pin fixation has become a widely accepted technique for the treatment of displaced supracondylar humerus fractures due to its ability to minimize the risk of iatrogenic ulnar nerve injury (3-6).

Several clinical trials and meta-analyses have demonstrated comparable rates of loss of reduction between lateral-only pinning and crossed pin configurations (4, 6, 9). However, fracture stability following lateral-only pinning is highly dependent on achieving adequate pin spread and bicortical fixation, both of which may be compromised in the presence of medial column comminution.

Medial column integrity is particularly important for maintaining bicortical purchase of lateral pins. When comminution is present, the effective pin spread at the fracture site is diminished, significantly reducing construct stability and increasing the risk of loss of reduction (6). This biomechanical disadvantage explains why fractures with medial comminution are more susceptible to varus collapse when treated with lateral-only fixation.

Although avoidance of ulnar nerve injury has traditionally driven the preference for lateral-only pinning, recent studies have demonstrated that medial pin insertion can be performed safely when appropriate techniques are employed, such as a small medial incision and pin placement with the elbow in extension (10, 11). In selected cases, particularly those with medial column comminution, the addition of a medial pin may be necessary to achieve sufficient stability and prevent varus deformity.

Importantly, attention to the medial column should not be limited to Gartland type I or II fractures. Even in Gartland type III fractures, medial comminution may preclude adequate bicortical fixation with lateral pins alone. In such scenarios, reliance on lateral-only constructs may be insufficient, and supplemental medial pinning should be strongly considered to prevent medial collapse and subsequent cubitus varus (3, 6, 10).

Conclusion

Fractures with medial column comminution, even when appearing minimally displaced on initial imaging, represent a distinct subset of supracondylar humerus fractures that require careful attention to reduction and fixation. Proper closed reduction and percutaneous pinning are essential to restore alignment and prevent collapse of the medial column. In Gartland type III fractures with medial comminution, standard lateral-only pinning may not provide adequate stability, and the addition of a medial pin should be considered to maintain coronal alignment and prevent varus deformity. Early recognition and appropriate surgical strategy tailored to the presence of medial comminution are critical to

achieving optimal long-term outcomes and minimizing the risk of late deformity.

Conflict of Interest

The authors declare no conflict of interest in this study.

Acknowledgements

The authors sincerely thank Dr. Mohammad Hossein Nabian, founder of the Center for Orthopedic Trans-Disciplinary Applied Research, Tehran University of Medical Sciences, Iran, for his invaluable support and guidance throughout this study. We are also grateful to the Center for Orthopedic Trans-Disciplinary Applied Research for providing an enriching academic environment that greatly contributed to this study.

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