

<https://doi.org/10.46344/JBINO.2026.v15i02.02>

## **SURGICAL MANAGEMENT OF PEDIATRIC SUPRACONDYLAR HUMERAL FRACTURES: DO BURNEI X AND DOUBLE X CONSTRUCTIONS OFFER AN ADVANTAGE?ANALYTICAL STUDY**

**<sup>1</sup>Alexandru Cînea, MD., <sup>2</sup> Mioara Georgescu, MD, PhD., <sup>3</sup> Mihaela Banculescu, MD, PhD., <sup>4</sup> Vlad Zamfirescu, MD, PhD & <sup>5</sup> Anca Burnei, MD, PhD**

Paediatric Surgeon Resident, 'Sf. Apostol Andrei 'County Emergency Hospital in Constanța, Romania

Paediatric Surgeon and Orthopaedist, 'Sf. Apostol Andrei 'County Emergency Hospital in Constanța, Romania

Anaesthesiology-Intensive Care, 'Sf. Apostol Andrei 'County Emergency Hospital in Constanța, Romania

Assistant UMF "Carol Davila" Bucharest, Department of Obstetrics & Gynecology & Neonatology, Elias Emergency University Hospital Romania

Lecturer UMF "Carol Davila" Bucharest, Department of Obstetrics & Gynecology & Neonatology, Elias Emergency University Hospital Romania

### **Abstract**

Supracondylar fractures of the humerus in children are commonly treated with closed reduction and percutaneous fixation, although the optimal fixator configuration remains controversial. Lateral and cross fixation provide comparable results with different risk profiles. The Burnei X and double X techniques provide improved three-dimensional stability, especially in highly unstable fractures, while eliminating neurovascular risk. These configurations may improve fixation strength, but require careful surgical execution and appropriate case selection

### **Keywords**

Supracondylar humerus fracture in a child, total biodynamic control of the distal fragment, X and double X fixation

## Introduction

Supracondylar humerus fractures represent the most common elbow injuries in children and account for a significant proportion of pediatric orthopedic emergencies. Closed reduction and percutaneous pinning (CRPP) has become the standard of care for displaced fractures due to its reliability in achieving stable fixation with minimal soft tissue trauma.<sup>1</sup> Despite this, controversy persists regarding optimal pin configuration to balance mechanical stability and neurovascular safety.

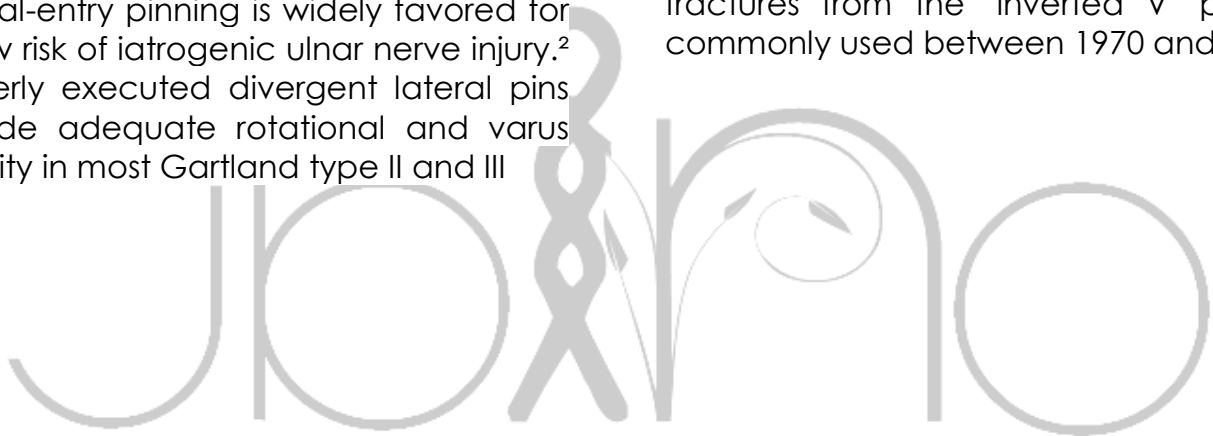
## Classical Pin Configurations

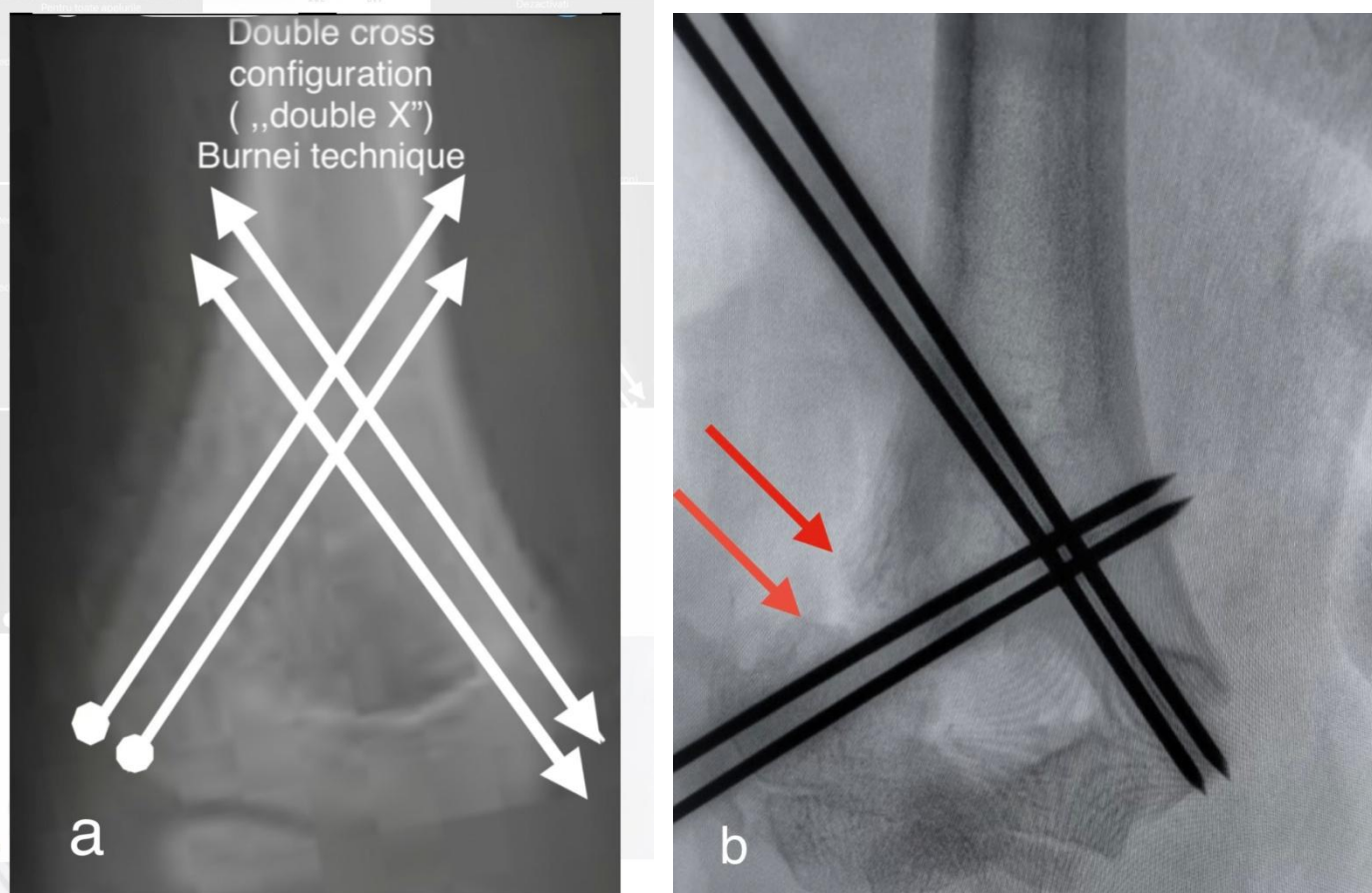
Lateral-entry pinning is widely favored for its low risk of iatrogenic ulnar nerve injury.<sup>2</sup> Properly executed divergent lateral pins provide adequate rotational and varus stability in most Gartland type II and III

fractures.<sup>3</sup> Crossed medial-lateral pinning has been considered biomechanically superior, offering enhanced rotational control in displaced fractures, but is associated with increased risk of ulnar nerve injury.<sup>4-6</sup> Contemporary meta-analyses show similar functional outcomes between well-performed lateral and crossed techniques, emphasizing technical precision over configuration dogma.<sup>6</sup>

## Burnei X and Double X Osteosynthesis

The pursuit of improved stability has gradually transformed fixation techniques for pediatric supracondylar humeral fractures from the "inverted V" pattern commonly used between 1970 and 1985





### Figure 1. Double X Configuration in a supracondylar fracture with multiple comminuted lateral pillar and high instability after X-fixation.

(a) In the medial column, the bidirectional arrows indicate oblique insertion of K-wires into the proximal pillar segment, penetrating the outer cortex. The wires are subsequently advanced in the same oblique trajectory but in the opposite direction, traversing the distal segment of the medial column toward the epitrochlea.

(b) In the lateral column, the unidirectional arrows with a stopper denote insertion of the K-wires from the epicondyle toward the inner cortex under fluoroscopic guidance.

to the X configuration and, in more complex situations, to the double X construct.

Gheorghe Burnei have described X- and double X-structured osteosynthesis techniques to address highly unstable fractures.<sup>7-9</sup> The X configuration uses two obliquely crossed K-pins and provides improved torsional and varus/valgus stability without medial exposure. It is the most biomechanically stable configuration, especially for unstable Gartland type III fractures. The double X configuration uses two intersecting cross-pin pairs, increasing multiplanar stiffness, especially in Gartland type III and IV fractures. These two configurations provide three-dimensional biomechanical stability.

Clinical studies show that both X and double X constructs maintain reduction effectively while minimizing soft tissue trauma.<sup>7-9</sup> Biomechanical analyses suggest improved stability compared with lateral-only constructs and possibly even traditional cross-pin fixation. The main considerations include careful insertion of the pins to ensure cortical perforation opposite the epitrochlea and epicondyle, multiplanar control of the distal fragment by pins passed through the humeral pillars. The Burnei technique excludes iatrogenic nerve injury and its application in severely unstable, comminuted, and oblique fractures will clarify the indication and beneficial effect of X and double X fixation. In reported series, the double X technique combines the advantages of maximum stability

with an extremely low complication rate.

#### Comparative perspective

A summary of current evidence suggests:

- Lateral fixation: Low risk to the ulnar nerve, appropriate for most displaced fractures.<sup>2,3</sup>
  - Cross fixation: Slightly increased mechanical stiffness, higher nerve risk.<sup>4 – 6</sup>
  - X configuration (Burnei): Improved torsional control, minimal complication rates in unstable fractures.<sup>7, 8</sup>
  - Double X configuration (Burnei): Maximizes multiplanar stability in severely unstable models; requires a relatively simple technique.<sup>7 – 9</sup>
- Burnei techniques offer demonstrated biomechanical advantages.<sup>10 – 12</sup>

#### Conclusion

CRPP remains the cornerstone of treatment for pediatric supracondylar humeral fractures. Burnei X and double X osteosynthesis methods offer innovative options for highly unstable fractures, increasing stability and eliminating neurovascular risk. Optimal outcomes are based on individualized assessment, meticulous surgical technique, and vigilant neurovascular monitoring.

#### References

1. Vaquero-Picado A, González-Morán G, Moraleda L. Management of supracondylar fractures in children: current concepts. *J Child Orthop.* 2018;12(5):433-443.
2. Silva M, Cooper SD. Closed reduction and percutaneous pinning of pediatric supracondylar fractures. *J Pediatr Orthop.* 2019;39(6 Suppl 1):S43-S49.

3. Dekker AE, et al. Pin configuration and complication risk. *Clin Orthop Relat Res.* 2021;479(3):456-465.
4. Zions LE, et al. Torsional strength of pin configurations. *J Bone Joint Surg Am.* 1994;76(2):253-256.
5. Kwok SM, Clayworth C, Nara N. Lateral versus cross pinning in paediatric supracondylar humerus fractures: a meta-analysis of randomized control trials. *ANZ J Surg.* 2021 May;91(5):980-985. doi: 10.1111/ans.16743. Epub 2021 Apr 1. PMID: 33792121.
6. Bashyal RK, et al. Outcomes of lateral-only pinning. *J Pediatr Orthop.* 2020;40(4):e273-e279.
7. Burnei G, et al. X osteosynthesis in pediatric supracondylar humerus fractures. *J Med Life.* 2016;9(1):80-85.
8. Burnei G, et al. Clinical outcomes of X-pin fixation in unstable fractures. *J Med Life.* 2018;11(3):250-256.
9. Burnei G, et al. Multiplanar stability using X and double X fixation in pediatric distal humerus fractures. *Rom J Orthop Surg Traumatol.* 2019;2(2):45-52.
10. Georgescu I, et al. Burnei's "double X" internal fixation technique. *J Med Life.* 2013;6(2):131-139.
11. Burnei G. "Double X" cross fixation: 20-year expertise. *Ann Clin Med Case Rep.* 2020;5(6):1-12.
12. Burnei G, Răducan ID, Enache F, et al. "Double X" fixation for rare fractures. *Med Res Arch.* 2021;9(6):1-22.