COMPARISON OF CONVENTIONAL CROSS-K WIRES VERSUS DORGAN'S TECHNIQUE FOR SUPRACONDYLAR FRACTURES IN CHILDREN

Ahmad Humayun Sarfraz,[1] Muhammad Akram,[2] Rana Muhammad Asghar,[3] Waqas Azam,[4] Abdul Haq,[5] Saif Ullah[6]

ABSTRACT

Background & Objectives: Supracondylar humerus fractures are one of the most common fractures in childhood. The traditional treatment utilizing cross-K-wire fixation is biomechanically stable, it poses a considerable risk of ulnar nerve injury. Dorgan's technique, employing lateral cross K-wires, presents a viable alternative by reducing the complication rate. This study assessed the outcomes of standard cross-K-wire fixation compared to Dorgan's technique in paediatric patients for treatment of type III supracondylar fractures.

Methods: A comparative cross-sectional study was conducted at the Department of Orthopaedics, Mayo Hospital, Lahore. A total of 72 paediatric patients with Gartland type III supracondylar fractures were randomly distributed to two groups: Group A (n=36) received traditional cross K-wire fixation, while Group B (n=36) received Dorgan's technique. Patients were monitored for six weeks, and outcomes were evaluated based on operative time, ulnar nerve injury, union rate, pin track infection, as well as cosmetic and functional outcomes as per Flynn's criteria.

Results: The incidence of ulnar nerve palsy was less in Group B ($p = 0.013$). Fracture healing rate was higher in Group B (88.9% vs 77.8%) ($p = 0.206$). Based on Flynn's criteria, Group B demonstrated significantly superior cosmetic (58.3% vs 47.2% excellent, $p < 0.001$) and functional results (52.8% vs 44.4% excellent, $p < 0.001$) than Group A.

Conclusion: Dorgan's technique had less incidence of ulnar nerve injury and better cosmetic and functional results than traditional cross K-wire fixation. Furthermore, it provides a safer and similarly effective option for addressing type III supracondylar humeral fractures in children.

Keywords: Gartland type III fracture, K-wire fixation, Supracondylar humerus fracture, Dorgan's technique, ulnar nerve injury.

How to cite: Sarfraz AH, Akram M. Asghar RM, Azam W, Hq A, Ullah S. Comparison of Conventional Cross-K Wires Versus Dorgan's Technique for Supracondylar Fractures in Children. JAIMC. 2025; 23(3): 89-93

Supracondylar fractures of the humerus are one of the most common types of humerus fractures in children. Around 55% to 80% of all elbow fractures in children are supracondylar, accounting for almost 2/3rd of elbow injuries in children requiring operative management. Supracondylar fractures usually result from a fall from a height, participation in sports, or recreational activities. It is usually treated as an emergency in children.[1,2]

1-6. Department of Orthopedics, Mayo Hospital, Lahore

Correspondence:
Ahmad Humayun Sarfraz, Assistant Professor, Department of Orthopedics, Mayo Hospital, Lahore.

Submission Date: 27-07-2025
1st Revision Date: 05-08-2025
Acceptance Date: 10-09-2025

In 1959, Gartland classified the supracondylar fractures on the basis of displacement. Type I, are the non-displaced fractures and are generally managed with immobilization through the collar-and-cuff. Type II fractures mostly require closed reduction and are a displaced type of fracture. All type III fractures are ideally treated through closed reduction and are stabilized through percutaneous wiring.[3]

There is a persistent debate concerning the optimal configuration of the K-wires for the stabilization of type II and type III supracondylar fractures. Swenson and Flynn, indicate the use of two pins in a cross-wire technique. This technique uses two K-wires, with one being placed into the lateral condyle and the other into the medial condyle. However, this method carries a hazard of injury to the ulnar nerve from the medial

wire as it traverses through the medial condyle, with a reported rate of up to 6%.[4,5] According to Dučić et al., the ulnar nerve injury could be prevented by insertion of wires through the lateral epicondyle.[6] The avoidance of a medial K-wire placement serves to protect the ulnar nerve. Nevertheless, it is considered to have less biomechanical stability compared to the configuration through cross-K-wires.[7]

From a biomechanical perspective, the stability offered by two lateral pins in the parallel direction is inferior.[8] Dorgan's technique, which involves the usage of two crossed wires in the lateral direction, ensures a fixation with high biomechanical stability and mitigates the hazard of injury to the ulnar nerve.[9] This technique is named in honor of Dr. John Dorgan, a consultant orthopaedic surgeon at Alder Hey Children's Hospital in Liverpool, who developed this lateral cross-pinning method.[6]

This study aimed to analyze and compare the effectiveness of standard percutaneous cross-K-wires versus lateral cross-K-wires methods in addressing type III unstable supracondylar fractures in pediatric patients in terms of union time and iatrogenic ulnar nerve injury.

METHODS

A comparative cross-sectional study was conducted at the Department of Orthopaedics, Mayo Hospital, Lahore, from 15th February 2025 to 15th August 2025. The patients aged below 12 years of both genders presenting with the Gartland Type III supracondylar fracture of the distal humerus within 24 hours of injury were included. Patients with open fractures, multiple fractures, and associated neurovascular injury were excluded.

A total sample size of 72 patients, divided into two groups of 36 each, was calculated based on a 95% confidence level and an absolute precision of 9%. The anticipated percentage of pin track infection for Dorgan's technique was estimated at 3.3%, while for the cross K technique was 4.4%.[10]

Written informed consent was obtained from all participants, and their personal information was not recorded to maintain anonymity. The institutional review board of the King Edward Medical University approved the study with the IRB no.414/ARA/KEMU/25 dated 14-2 2025.

Non-probability consecutive sampling technique was used for the recruitment of the participants. Demographic information as age, gender, side of fracture, and duration of injury, was recorded. Before surgery, an X-ray was performed to check and classify the fracture according to the Gartland classification. Patients were randomly assigned to two groups using a lottery method, with 36 individuals in each group. Patients in Group A and Group B undergo conventional cross K-wires and Dorgan's technique for supracondylar fracture.

All surgeries were performed under general anesthesia on a radiolucent table along with an image intensifier. The affected upper limb was prepared and draped. The surgeon reduced the fracture by traction and manipulation through a closed technique, countertraction provided by an assistant, and the reduction was verified using the image intensifier. The hand was positioned in pronation, with the elbow fully flexed to sustain the reduction. Confirmation of fracture reduction was achieved in anteroposterior and lateral views via an image intensifier.

For the conventional cross K-wire technique, a K-wire, measuring 1.5 - 2 mm in diameter, was inserted in the lateral condyle, passing through the fracture and extending to the medial cortex, while a second wire of the same size was inserted in the medial condyle through the lateral cortex on the opposite side. In Dorgan's technique, a K-wire of 1.5 - 2 mm was inserted from the lateral condyle through the fracture into the medial cortex of the humerus, and a second K-wire was inserted proximally to the fracture from the lateral cortex in an antegrade direction into the medial condyle, without breaching the cortex of the medial condyle.

An above-elbow backslab was applied to all patients for a duration of two to three weeks, and ulnar nerve injury was assessed immediately as the effect of anaesthesia faded. Patients were discharged on the following day of surgery and were followed at intervals of 2, 4, and 6 weeks. With each visit, patients undergo an X-ray to check the union. The time required for union was also recorded for each patient. After two weeks, the backslab was removed, and range of motion exercises began, while still ensuring the fixation was protected with a polysling for an additional two weeks. After six weeks, all patients had their K-wires removed. During the final visit, the assessment of radiological union or malunion was conducted using radiographs in anteroposterior and lateral views. The functional outcome was evaluated according to Flynn's criteria, which categorized the outcome as excellent, good, fair, or poor.

Data was analysed using the Social Package for Statistical Analysis (SPSS) version 27. Quantitative variables such as age, duration of fracture, and operative time were expressed as mean ± standard deviation.

The qualitative variables, as gender, anatomical site, incidence of ulnar nerve palsy, pin track infection, union rate, and Flynn's criteria (Excellent, Good, Fair, Poor), were presented as frequency and percentage. Independent sample t-test was used for comparison of operative time across both groups. Chi-square test was used for comparison of the incidence of ulnar nerve palsy, pin track infection, union of fracture, and Flynn's criteria across both groups. A p-value of less than 0.05 was deemed statistically significant.

RESULTS

The mean age of participants was 6.72 ± 2.75 years. The majority of the participants were male 44 (61.1%), and had a fracture of the left side 49 (68.1%). (Table 1)

The operative time was significantly reduced in Group A (30.41 ± 4.48 vs 33.36 ± 6.24 minutes) (p = 0.004). Additionally, incidence of ulnar nerve palsy was less in Group B (2.8% vs 22.2%) (p = 0.013). Utilizing Flynn's criteria, the cosmetic results were significantly more favourable in Group B, with 58.3% classified as excellent compared to 47.2% in Group A(p < 0.001). Functional outcomes also favoured Group B, where 52.8% achieved excellent results compared to 44.4% in Group A (p < 0.001). (Table 2)

Table 1: Baseline Charateristics of Participants

Variables	Group A	Group B	Total
Age (Years)	6.61±2.70	6.83 ± 2.83	6.72 ± 2.75
Gender			
Male	21 (58.3%)	23 (63.9%)	44 (61.1%)
Female	15 (41.7%)	13 (36.1%)	28 (38.9%)
Side of fracture			
Right	12 (33.3%)	11 (30.6%)	23 (31.9%)
Left	24 (66.7%)	25 (69.4%)	49 (68.1%)
Duration of fracture (Hours)	12.22±6.20	10.91 ± 6.14	11.56±6.16

Table 2: Comparison of operative outcomes of Group A and Group B:

Variable	Group A	Group B	*p*-value
Operative Time (Minutes)	30.41±4.48	33.36±6.24	0.004
Ulnar nerve palsy	8 (22.2%)	1 (2.8%)	0.013
Pintrack infection	6 (16.7%)	5 (13.9%)	0.743
Union of fractures	28 (77.8%)	32 (88.9%)	0.206
Flynn's Criteria			
Cosmetic Factor			
Excellent	17 (47.2%)	21 (58.3%)	
Good	12 (33.3%)	10 (27.8%)	<0.001
Fair	7 (19.4%)	5 (13.9%)	
Functional Factor			
Excellent	16 (44.4%)	19 (52.8%)	
Good	14 (38.9%)	13 (36.1%)	<0.001
Fair	6 (16.7%)	4 (11.1%)	

DISCUSSION

Supracondylar fractures of the humerus are among the most common elbow injuries in children, with surgical stabilization being the preferred treatment for displaced type III fractures. This study indicated that while the traditional cross-K-wire method had a shorter operative time, Dorgan's lateral cross-wiring technique offered enhanced safety against ulnar nerve palsy and resulted in improved cosmetic and functional outcomes.

Following the treatment of supracondylar fractures, ulnar nerve palsy was observed in merely 2.8% of patients utilizing Dorgan's technique, then 22.2% of patients with the traditional K-wiring method, suggesting that Dorgan's technique is associated with a reduced occurrence of ulnar nerve palsy. Dučić et al. indicated that in the comparison between conventional pins and Dorgan's lateral wires for pediatric supracondylar fractures of the humerus, 9.9% of patients with the standard configuration of Kirschner pins had nerve injury, whereas no nerve injury occurred in patients treated using Dorgan's technique.[6] Correspondingly, Afaque et al. also reported that 2 patients from the cross-wire group experienced sensations of tingling and paraesthesia in the region of the ulnar nerve, yet their motor functions were intact, as observed two days post-operatively.[11] The results of these investigations align with our research, suggesting that lateral K-wires play a more effective role in preventing neurological damage.

Regarding Flynn's criteria, Dorgan's technique had better outcomes for both cosmetic and functional factors than the cross K-wire technique. Afaque et.al reported that Flynn's grading was excellent in 26 patients receiving lateral K-wires for supracondylar fractures, and in patients receiving cross K-wires, Flynn's score was excellent in 24 patients.[11] Pavone et al. presented a comparison between Dorgan's technique and cross K-wire for the surgical intervention of supracondylar fractures. As per Flynn's criteria, the cross K-wire group attained excellent cosmetic results in 94.4% of the participants and a good outcome in 5.6% of the

participants. The functional aspect was regarded as satisfactory in 94.4% participants. In Dorgan's technique group, both cosmetic and functional outcomes were deemed satisfactory for 100% patients.[12] Naik et. al had also reported that 22 patients (78.6%) achieved excellent outcomes, 5 patients (17.9%) had satisfactory results, and 1 patient (3.5%) experienced an unsatisfactory cosmetic outcome in the cross-pin group. The functional aspect was also satisfactory for 27 patients (96.4%). In the lateral pin group, the cosmetic factor was rated as excellent for 23 patients (79.3%) and good for 6 patients (20.6%). Furthermore, the functional factor was satisfactory for all patients in the lateral pin group.[13]

The operative time in Group A was 30.41±4.48 minutes, which was less than in Group B, 33.36 ± 6.24 minutes. These results suggested that the duration of time necessary for the fixation of supracondylar fractures via Dorgan's technique exceeded that of the conventional cross K-wire fixation. According to Dučić et al., the procedure's duration was increased (mean 36.54 ± 5.65 min) and the exposure to radiations was elevated (mean 10.19 ± 2.70 exposures) in group that underwent Dorgan's method, as opposed to conventional technique (mean 28.66 ± 3.76 min and 7.54 ± 1.63 exposures).[6] Rizk et al. have also indicated similar observations regarding the procedure's duration, with a difference having a statistical significance (p=0.001). Dorgan's approach took more time (mean, 25.45±5.2 min) compared to the standard cross-pinning method (mean, 16.34±4.5 min).[14]

This study has some limitations. The limited sample size may constrain the generalizability of the results to broader populations. The follow-up duration was adequate to evaluate early outcomes, it may not comprehensively address long-term complications such as growth disturbances or late deformities. Lastly, despite efforts to minimize them, variations in surgical techniques and the experience of the surgeon may have impacted the results. It is advisable to conduct future multi-center studies with a large sample size and prolonged follow-up periods to confirm these outcomes and further evaluate the efficacy and safety of Dorgan's technique.

CONCLUSION

Dorgan's technique using lateral crossing K-wires for Gartland type III supracondylar fractures of the humerus in paediatric age, achieves more favourable clinical outcomes relative to the traditional cross K-wire technique. The significant decrease in ulnar nerve palsy emphasizes its safety advantage. Therefore, Dorgan's technique ought to be considered a preferred fixation method in surgical management of unstable paediatric supracondylar fractures of humerus.

Ethical Approval: Ethical approval was obtained from the King Edward Medical University, Lahore IRB/ERB No.414/ARA/KEMU/25 dated 14-2 2025.

Conflict of interest: None

Funding Source: None

Author's Contribution

Conceptualization study design	AHS, MA, AH, WA
Data Acquisition	AH, WA, AHS, SU
Data Analysis/ interpretation	AH, SU, WA, RMA
Manuscript drafting	RMA, WA, AH, SU
Manuscript review	MA, RMA, AH, WA

All authors read and approved the final draft.

REFERENCES

1. Vaquero-Picado A, González-Morán G, Moraleda L. Management of supracondylar fractures of the humerus in children. EFORT Open Rev. 2018 Oct 1;3(10): 526-540. DOI: 10.1302/2058-5241.3.170049.
2. Zorrilla S de Neira J, Prada-Cañizares A, Marti-Ciruelos R, Pretell-Mazzini J. Supracondylar humeral fractures in children: current concepts for management and prognosis. Int Orthop. 2015 Nov;39(11):2287-96. DOI: 10.1007/s00264-015-2975-4.
3. Shannon FJ, Mohan P, Chacko J, D'Souza LG. "Dorgan's" percutaneous lateral cross-wiring of supracondylar fractures of the humerus in children. J. Pediatr. Orthop. 2004;24(4):376.URL:https://journals.lww.com/pedorthopaedics/abstract/2004/07000/_dorgan_s_percutaneous_lateral_cross_wiring_of.6.aspx
4. Zaidman M, Eidelman M, Abu-Dalu K, Kotlarsky P. Pediatric Supracondylar fracture of the humerus with sideward displacement. Surg Tech Dev. 2023; 12(3): 107-18. DOI: 10.3390/std12030010
5. Claireaux H, Goodall R, Hill J, Wilson E, Coull P, Green S, et al. Multicentre collaborative cohort study of the use of Kirschner wires for the management of supracondylar fractures in children. Chin J Traumatol. 2019;22(05):249-54. DOI: 10.1016/j.cjtee.2019.06.002

6. Dučić S, Radlović V, Bukva B, Radojičić Z, Vrgoč G, Brkić I, et al. A prospective randomised non-blinded comparison of conventional and Dorgan's crossed pins for paediatric supracondylar humeral fractures. Injury. 2016;47(11):2479-83. DOI:10.1016/ j.injury. 2016.09.011
7. Lee KM, Chung CY, Gwon DK, Sung KH, Kim TW, Choi IH, et al. Medial and lateral crossed pinning versus lateral pinning for supracondylar fractures of the humerus in children: decision analysis. J Pediatr Orthop. 2012;32(2):131-8. DOI: 10.1097/ BPO. 0b0 13e3182471931
8. Rupp M, Schäfer C, Heiss C, Alt V. Pinning of supracondylar fractures in children–Strategies to avoid complications. Injury. 2019;50:S2-S9. DOI: 0.1016/ j.injury.2019.03.042.
9. Flynn K, Shah AS, Brusalis CM, Leddy K, Flynn JM. Flexion-type supracondylar humeral fractures: ulnar nerve injury increases risk of open reduction. J Bone Joint Surg Am.2017;99(17):1485-7. DOI: 10.2106/ JBJS.17.00068
10. Patel Ravindrakumar Gopalbhai AK, Prabhanjan Kumar. Outcome analysis of cross pinning in supracondylar fractures of humerus in children. Int J Orthop. Sci2021;7(4):626-32. DOI: 10.22271/ortho.2021.v7. i4i.2943
11. Afaque SF, Singh A, Maharjan R, Ranjan R, Panda AK, Mishra A. Comparison of clinic-radiological outcome of cross pinning versus lateral pinning for displaced supracondylar fracture of humerus in children: A randomized controlled trial. J Clin Orthop Trauma 2020;11(2):259-63. DOI: 10.1016/j.jcot.2019.01.013
12. Pavone V, Vescio A, Accadbled F, Andreacchio A, Wirth T, Testa G, Canavese F. Current trends in the treatment of supracondylar fractures of the humerus in children: Results of a survey of the members of European Paediatric Orthopaedic Society. J Child Orthop.2022;16(3):208-19. DOI: 10.1177/ 1863252 12 21106379
13. Naik LG, Sharma GM, Badgire KS, Qureshi F, Waghchoure C, Jain V. Cross pinning versus lateral pinning in the management of type III supracondylar humerus fractures in children. Journal of clinical and diagnostic research: J Clin Diagn Res.2017;11(8):RC01. DOI: 10.7860/JCDR/2017/28481.10351.
14. Rizk AS, Kandil MI. Conventional versus lateral cross-pinning (Dorgan's technique) for fixation of displaced pediatric supracondylar humeral fractures: a randomized comparative study. Egypt Orthod J. 2018; 53(4): 348-58. DOI: 10.4103/eoj.eoj_72_18