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Original article

Crossed *versus* Lateral K-Wire Fixation for Supracondylar Humeral Fractures in Children: Comparative Outcomes at Tripoli Central Hospital (2023–2025)

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Abstract
Supracondylar fractures of the humerus (SFH) account for about 3 to 15% of all bone lesions affecting the immature skeleton, especially in children under seven years of age. In general, these lesions are treated with closed reduction and percutaneous fixation using Kirschner wires (KW). This study aimed to assess crossed versus lateral K-wire fixation for supracondylar fractures of the Humerus in children (outcome comparison) at Tripoli Central Hospital, 2023-2025. This retrospective randomized control trial study was conducted at the orthopedics department of Tripoli Central Hospital between January 2023 and October 2025. This study included children who suffered from supracondylar fractures of the Humerus. It was managed by crossed versus lateral K-wire fixation, and the data were collected via simple random techniques through a standardized, predesigned structural questionnaire during that time interval. The collected data were entered, encoded, and analyzed via the specialized statistical program of SPSS version 24. Sixty (60) children with supracondylar humerus fractures were treated with crossed K-wires (30 cases) or lateral K-wire fixation (30 cases). The mean age was 4.716 years ± 1.132 SD, with a minimum age of three and a maximum age of seven years. 58.3% (35) of the cases were males, while 41.7% (25) were females. Only 6.7% (4) of the cases had a previous history of trauma. All cases had closed fractures, with 51.7% (31) at the right supracondylar and 48.3% (29) at the left supracondylar. The mean duration of fracture was 6.63 hours ± 4.971 SD. The majority of cases had Gartland's type 3 fracture, accounting for 70.0% (42), while 30.0% (18) had Gartland's type 2 fracture. Only 8.3% (5) experienced wound infection, and 3.3% (2) experienced weakness. Significant statistical differences were found between crossed and lateral K-wires regarding complications, with a P-value of 0.021. The study revealed that crossed K-wires had more complications, including weakness (neuropraxia) in 4 cases and wound infection in 2 cases, compared to lateral K-wires, which had only 1 case of wound infection. About 56.7% (34) of the cases experienced swelling, and 3.3% (2) had other associated fractures, but all cases had favorable functional and operative outcomes. In summary, this study concluded that lateral K-wire management of supracondylar fracture among the pediatric age group had better functional and operational outcomes with a lower rate of postoperative complications compared to crossed K-wire, which was found to have more complications, such as weakness (neuropraxia) and wound infection. Therefore, proper assessment of supracondylar fracture cases is an essential approach to achieve optimal management outcomes.
Keywords. *K-Wire Fixation, Supracondylar Humeral Fractures, Children: Tripoli Central Hospital.*

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Introduction

Supracondylar fractures of the humerus (SFH) account for about 3 to 15% of all bone lesions affecting the immature skeleton, especially in children under seven years of age [1]. It is the fracture that most requires surgical treatment in the pediatric population, with an estimated incidence of 1.7 per 1,000 individuals [2-3]. In general, these lesions are treated with closed reduction and percutaneous fixation using Kirschner wires (KW). This osteosynthesis method offers several configurations that can arrange implants in various ways, typically by cross (two lateral and one medial or one medial and one lateral wires) or lateral entries (three or two divergent or two parallel wires) [4]. Successfully treating pediatric SFH depends on achieving and maintaining an acceptable reduction until the fracture consolidates, avoiding potential complications [5]. Therapeutic advances and improvements in the care of SFH have undoubtedly contributed to the success of the treatment (which depends on obtaining and maintaining an adequate and stable reduction until the fracture consolidates [6]. The possible complications of these fractures especially include nerve and vascular

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injuries, compartment syndrome, malunion, and functional impairment (including reduced range of motion and angular deformities) [1,5]. Controversy persists regarding the choice of the ideal fixation technique for these fractures. Although the literature describes many pin configurations with KW, the two most common refer to cross-fixation and osteosynthesis with a lateral entry. However, despite its many articles, this review acknowledges the persisting controversies on this topic [7].

Figure (1A, B). X-ray views of preoperative anteroposterior (A) and lateral (B) from our case showing a displaced supracondylar fracture of the distal humerus

Methods and materials

Study design and setting

This study was a retrospective cohort analysis conducted at the orthopedics department of Tripoli Central Hospital between January 2023 and October 2025.

Study population

This study included children who suffered from supracondylar fractures of the Humerus and were managed by crossed versus lateral K-wire fixation. The data were collected via simple random techniques through a standardized, predesigned structural questionnaire during that period.

Data analysis

The questionnaire tool used contains relevant data of demographic and special data for crossed versus lateral K-wire fixation of supracondylar fractures of the Humerus in children.

Statistical analysis

Collected data were entered, encoded, and analyzed via the specialized statistical program of SPSS version 24. Descriptive statistics such as frequency, percentage, and mean ± SD were summarized in a graphical and tabular manner, and inferential statistics were used to determine the P-value of less than 0.05, considered statistically significant.

Ethical considerations

Permission was obtained from the health authorization and orthopedics department of Tripoli Central Hospital. The objectives of the study were to assess the benefits, and the data collection tools were anonymous with maintained confidentiality throughout the study.

Results

Out of 60 children with supracondylar fracture of the humerus, 30 cases were treated by crossed K-wires versus 30 cases were treated by lateral K-wires fixation at Tripoli Central Hospital during 2023 – 2025. Demographic and patient characteristics. Based on age distribution, the mean age was 4.716 years ± 1.132 SD, with the minimum age being three years, while the maximum age was seven years (Table 1).

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Table (1). Age distribution of children, TCH, Tripoli, Libya, 2023-2025

Statistic	Value
Mean	4.716
Median	5.00
Mode	6.00
Standard Deviation	1.132
Minimum	3.00
Maximum	7.00

Based on gender distribution, 58.3% (35) of cases were males, while 41.7% (25) of them were females. (Figure 2).

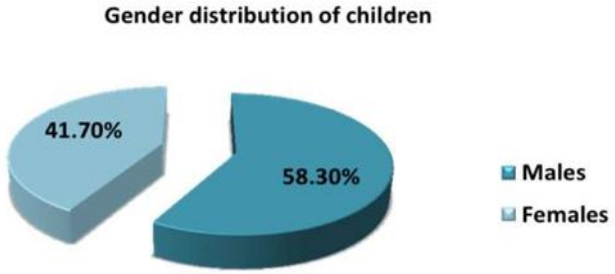

Figure (2). Gender distribution of children, TCH, Tripoli, Libya, 2023-2025

Based on previous trauma distribution, only 6.7% (4) of cases had a previous history of trauma. (Figure 3).

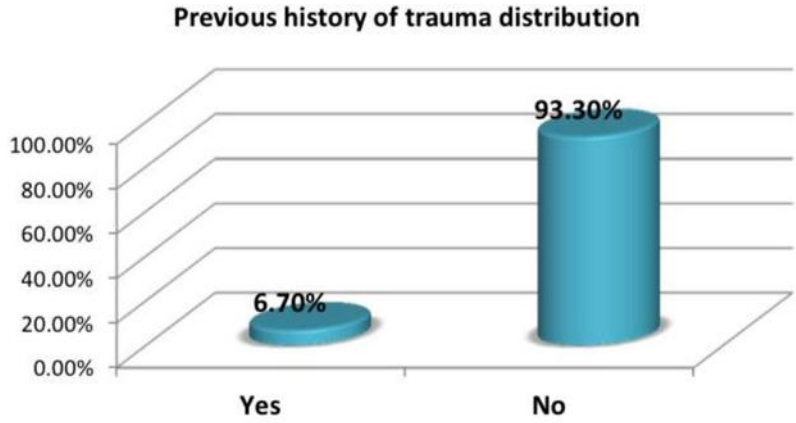

Figure (3). Previous history of trauma distribution, TCH, Tripoli, Libya, 2023-2025

Supracondylar fracture outcomes characteristics

Based on the distribution of supracondylar fracture outcomes, all cases had closed fractures, with 51.7% (31) of cases at the right supracondylar, while 48.3% (29) of them at the left supracondylar. And the mean duration of fracture was 6.63 hours ± 4.971 SD (Figure 4).

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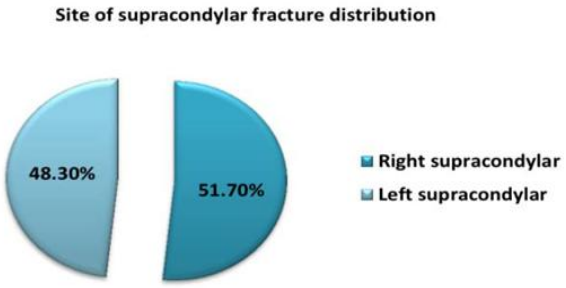

Figure (4). Site of supracondylar fracture distribution, TCH, Tripoli, Libya, 2023-2025

Based on Gartland's classification system distribution, the majority of cases had Gartland's type 3 fracture, which accounted for 70.0% (42), while 30.0% (18) of them had Gartland's type 2 fracture. (Figure 5)

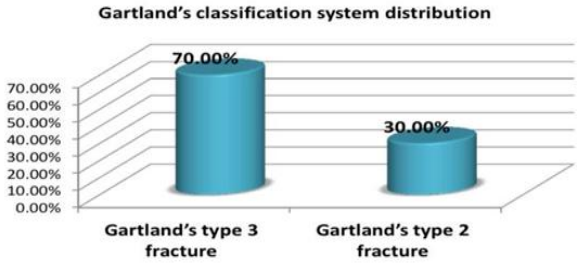

Figure (5). Gartland's classification system distribution, TCH, Tripoli, Libya, 2023-2025

Based on complications distribution, just five cases (8.3%) had expressed wound infection, and two cases (3.3%) had expressed weakness (Table 2).

Table (2). Complications distribution of children, TCH, Tripoli, Libya, 2023-2025

Variable	Frequency (N)	Percentage (%)
None	53	88.3
Weakness (Neuropraxia)	2	3.3
Wound infection	5	8.3

Statistically significant differences were identified in the relationship between crossed versus lateral K-wires and complications outcomes, with a P-value of 0.021. This study reported that the crossed K-wires had more complications in terms of weakness (neuropraxia) (four cases) and wound infection (two cases) compared to lateral K-wires (only one case of wound infection) (Table 3).

Table (3). Relationship between crossed versus lateral K-wires and complications outcomes distribution of children, TCH, Tripoli, Libya, 2023-2025

Complication	Crossed K-wire	Lateral K-wire	Total
No complication	24	29	53
Weakness (Neuropraxia)	2	0	2
Wound infection	4	1	5
Total (P-value = 0.021)	30	30	60

About 56.7% (34) of cases had suffered from swelling, and 3.3% (2) of them had other associated fractures, but all cases had good functional and operational outcomes (Figure 6).

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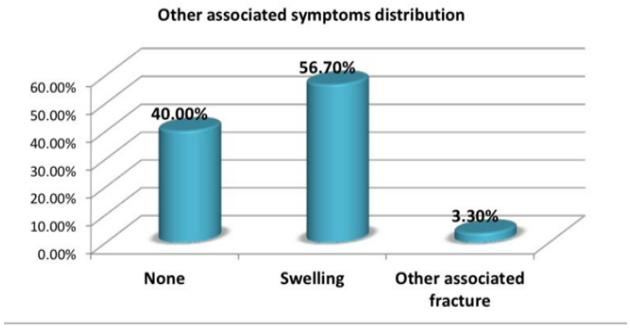

Figure (6). Other associated symptoms distribution, TCH, Tripoli, Libya, 2023-2025

Discussion

Supracondylar fractures are the most common form of elbow fracture in children, with an annual incidence between 60 and 177 per 100,000. Children between five and six years of age. For this context, we studied 60 children's cases with supracondylar fracture of the humerus, which were treated by crossed K-wires (30 cases) versus lateral K-wires fixation (30 cases) at Tripoli Central Hospital during 2023 - 2025. The present study reported that the lateral K-wires had good functional outcomes and a lower complication rate compared to crossed K-wire fixation in supracondylar fracture, which had more weakness (neuropraxia) and wound infection. Several epidemiological studies have reported little gender difference in the incidence of these injuries. However, a study of children in Hong Kong reported a higher incidence in boys, equating to a ratio of 17 boys to 10 girls; our study was consistent with this study, which showed that the rate of males was higher. Is more prevalent compared to females [8-12]. The typical mechanism of injury is a fall onto an outstretched hand or a direct fall onto a flexed (bent) elbow. Only 1% of supracondylar fractures are open, with an associated wound providing a direct route for contamination of the bone ends; the remaining 99% are closed (with no open wound). Open fractures require urgent surgical treatment to reduce the risk of serious. Infection [8,11]. Successful treatment of a supracondylar elbow fracture in a child leads to normal function with no lasting symptoms. However, complications of this injury can occur as a result of the initial injury or as a result of problems during surgery. The major blood vessels and nerves in the arm can be damaged during the injury, the operation, or as a result of compartment syndrome [8-12].

A prospective comparative interventional study was undertaken by Sharma, D. K et al study (2024) to compare the stability of fixation, functional outcome, and neurovascular complications between crossed pinning and lateral pinning in Gartland's type 2 and type 3 fractures. About 60 patients of the age group 2 to 12 years with Gartland's type 2 and 3 fractures were randomized into 2 groups- lateral pinning (n=30) and crossed pin fixation (n=30). Intraoperative parameters were compared, and postoperative ulnar nerve palsy and serial range of motion were assessed. At the 3-month follow-up, the outcome was assessed using. Flynn criteria. There were 2 cases (3.3%) of iatrogenic ulnar nerve injury in the crossed pinning group and none in the lateral pinning group. This finding was parallel to our study. The lateral group had more cases with an excellent Flynn rating. The mean loss of range of motion and the mean loss of carrying angle were significantly lower for the lateral method. This study concluded that the lateral pinning provides a better functional outcome along with comparable stability without the risk of iatrogenic ulnar nerve injury. [13].

On Carrazzone OL et al.'s study (2021) of twelve randomized control trials on meta-analysis, with a total of 930 patients, met the inclusion criteria. Both groups (crossed-wire and lateral-wire fixation) presented satisfactory functional results, with no difference between them (RR, 0.99; 95% confidence interval [CI], 0.96-1.02; P = .44). Patients undergoing crossed-wire fixation had a higher risk of iatrogenic neurologic injury (RR, 0.45; 95% CI, 0.21-0.99; P = .05), like our study. The crossed group showed greater fixation stability, with a lower incidence of loss of fracture reduction (RR, 1.39; 95% CI, 1.04-1.85; P = .03). The GRADEpro GDT (Guideline Development Tool) showed that the quality of evidence of the evaluated outcomes was low or very low. There is evidence of very low quality that fixation with lateral wires is safer regarding iatrogenic nerve lesions, whereas fixation with crossed wires is more effective at maintaining fracture reduction [14].

In general, the surgeons' personal experience determines how and in which configuration K-wires are used. Carter et al. found that of the 309 pediatric orthopedic surgeons, 33% preferred two lateral pins, 33% preferred three lateral pins,

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and 30% preferred cross-pins. Lee et al. reported that hand surgeons preferred a more stable pinning technique by using a triple pin, while pediatric orthopedic surgeons and general orthopedic surgeons were more inclined to use two pins on the lateral side. They prefer cross-pinning, which is often shown to be a more stable fixation in experimental studies. They think that other approaches in clinical applications have similar functional results with cross-pinning due to the fact that the plaster splint, which is used up to one month postoperatively, provides the restriction of rotational movements by reducing elbow movements. For this purpose, they think that it is beneficial to use cross-pinning, which is a more stable method in patients who do not have good cooperation or require constant dressing. Therefore, each supracondylar humerus fracture should be considered separately, and the type of fixation should be determined according to the type of fracture, the location of disintegration, and the direction of displacement [15-19]. The limitation of the study was a retrospective single-center study, while the strength of the study was a good sample size with comparable groups during the assessment of the study.

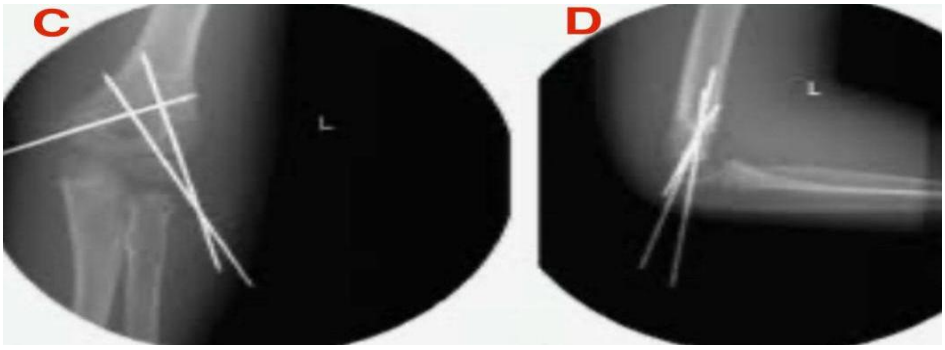

Figure (7C, D). X-ray of intraoperative AP and lateral views showing 2 lateral K-wires with medial crossed K-wire fixation

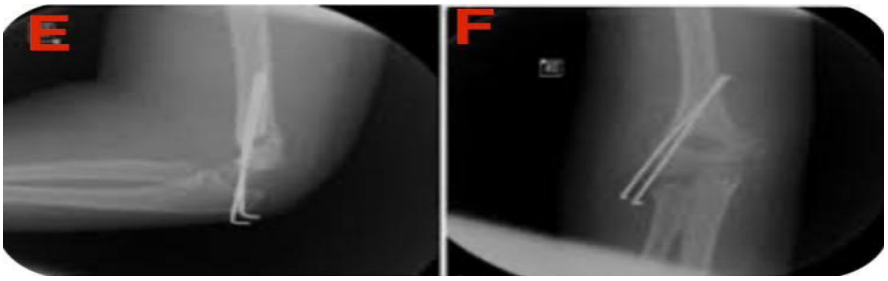

Figure (8E, F). X-ray of intraoperative AP and lateral views showing maintained alignment and bicortical purchase of the pins

Conclusion

In summary, this study concluded that lateral K-wire management of supracondylar fracture among the pediatric age group had better functional and operational outcomes with a lower rate of postoperative complications compared to crossed K-wire, which was found to have more complications, such as weakness (neuropraxia) and wound infection. Therefore, proper assessment of supracondylar fracture cases is an essential approach to achieve optimal management outcomes.

Recommendation

Further prospective large-scale multicenter studies all over Libya are recommended to assess surgical outcomes and different modalities of approach for supracondylar fractures among the pediatric age group.

Conflict of interest. Nil

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