

Original Research Article

Functional outcome of crossed Kirschner wire fixation in pediatric supracondylar humerus fracture

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Received: 26 May 2019

Revised: 06 July 2019

Accepted: 11 July 2019

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ABSTRACT

Background: Distal humeral fractures are one of the most common types of fractures in children, most of them being supracondylar. Supracondylar fractures are usually caused by trauma, most likely falls. It is an emergency, requiring rapid diagnosis and management to avoid serious complications. Recommended treatment modalities vary from no reduction and immobilization to open reduction and internal fixation. Kirschner wire (K-wire) fixation of displaced supracondylar fractures after closed reduction is a preferred method and is being performed for over 50 years now. This study was conducted to determine the functional outcome of crossed K-wire fixation in pediatric supracondylar fracture.

Methods: This prospective study was conducted from May-November 2018 at the department of Orthopedics, Abbasi Shaheed Hospital, Karachi, Pakistan. It was inferred that functional outcome of pediatric displaced supracondylar humeral fractures is satisfactory when managed with percutaneous crossed K-wire fixation. It included 83 children with supracondylar fractures. They were treated with percutaneous crossed K-wire fixation. Patients were then followed up to determine satisfactory functional outcome according to Flynn's criteria. Data entry and analysis was done using SPSS 21.0.

Results: Eighty-three patients were included. The mean±standard deviation age of this study population was 7.03±3.39 years. Out of the study participants, 47 (56.6%) were males and 36 (43.4%) were females. 71.1% of the patients were of Gartland class II fractures and 28.9% were of Gartland class III. 43.4% had an injury due to fall while playing while 19.3% had fallen from height. 80.7% were found to have a satisfactory functional outcome.

Conclusions: It was inferred that the functional outcome of pediatric displaced supracondylar humeral fractures is satisfactory when managed with percutaneous crossed K-wire fixation.

Keywords: Flynn's criteria, Gartland classification, Children, Supracondylar fractures, Humeral fractures, Pediatric fractures

INTRODUCTION

Elbow joint is the second most common part of upper limb involved in pediatric fractures, 85% of which occur

in the distal humerus and these distal humeral fractures are usually supracondylar. These supracondylar humeral fractures are one of the most important but difficult to treat fractures in the pediatric population, accounting for 3% of all fractures in children.¹⁻³ Most of the time,

mechanism of injury is direct or indirect traumas like falls, leading to comminution or open fractures.⁴

This type of fracture requires immediate diagnosis and management since it can easily complicate into severe neurovascular injuries, malunion, and contractures.^{5,6} The main objective of timely management is anatomical reduction (since remodelling of malunion and cubitus varus does not occur with growth) and restoration of function. Initial assessment includes proper examination of patient's neurological and vascular system. An ideal method of treatment of this type of fracture has always been a topic of debate. Many procedures have been put forward like closed reduction and immobilization in a plaster cast, ulnar traction with elbow flexed, Dunlop's skin traction, closed reduction with percutaneous Kirschner (K-wire), and finally open reduction and internal fixation.⁷⁻¹² Current recommendations vary from no reduction to open reduction and internal fixation. Stabilization with pins strengthen the fractures already reduced by cast immobilization which is why it is preferred.^{13,14} Percutaneous pinning involves insertion of metallic pins K-wire into the disrupted fracture fragments to provide stability. K-wire fixation of displaced supracondylar fractures of humerus in children is being performed for over 50 years now due to its high efficacy, reduced cost, easy use, decreased postoperative hospitalization, and minimum risk of complications.^{3,8,15}

This study was conducted to determine the functional outcome of percutaneous crossed K-wire fixation in pediatric supracondylar humeral fracture. Hence results of our study may provide justification of using k-wires as a preferred method of treatment in our population.

METHODS

This was a prospective observational study conducted in the department of Orthopedics unit I, Abbasi Shaheed Hospital, Karachi, Pakistan, from May-November 2018. Ethical approval was obtained by the hospital's ethical review board and well informed consent was obtained from the parent/guardian of participant. All the fractures were clinically and radiographically assessed and classified according to Gartland's classification.¹⁶ During this period of six months, all children with supracondylar humeral fractures (Gartland type II and III), in the age range of 2-12 years, irrespective of gender were included in the study. Those children whose parents/guardians did not give informed consent were excluded. Multiple or open fractures, Gartland type I fractures, fractures older than four days, and those with accompanying neurovascular injury were also excluded. A total number of 83 patients were selected for the study. Information regarding basic demographics, mechanism of injury, and Gartland classification was noted. All patients received preoperative prophylactic antibiotics. Manual reduction preoperatively was done after giving general anesthesia. Patients then underwent percutaneous crossed K-wire fixation within seven days of hospital admission.

The patients were discharged on the third postoperative day and kept on regular follow-ups. A clinical and radiological assessment was performed at 1st and 3rd week. Patients were asked for another follow-up on the 6th postoperative week for wires removal. Information regarding union, loss of range of elbow motion, and carrying angles of both sides was recorded. Pin tract site was checked for any signs of infection. On the same day, final outcome i.e. satisfactory functional outcome was assessed. This outcome was measured according to Flynn's criteria according to which these fractures are assessed on the basis of functional and cosmetic component (both further divided into good, moderate, and poor which we did not assess). Functional component measures the motion arc in sagittal plane including flexion and extension whereas the cosmetic one measures the carrying angle. Motion loss of <15 degrees and carrying angle loss of <15 (assessed on clinical examination with goniometer) was considered as satisfactory while greater loss in both was considered unsatisfactory.¹⁷

The data from all participants was entered and analysed using IBM Statistical Package for the Social Sciences (SPSS) Statistics for Windows, version 21.0. (IBM Corp., Armonk, NY, US). Mean and standard deviation was calculated for quantitative variables like age, surgery duration, elbow motion, and carrying angles. Frequencies with percentages were computed for qualitative variables like gender, side of upper limb involved, Gartland class, mechanism of injury, and outcome variable according to Flynn's scoring. Effect modifiers were controlled through stratification of age, gender, Gartland class, and mechanism of injury to see effect of these on the outcome, applying Chi square test taking p-value <0.05 as significant.

RESULTS

Eighty three patients fulfilling the inclusion and exclusion criteria were included in this study. The mean±standard deviation age of study population was 7.036±3.390 years. On analysis of demographics data it was observed that 41 children were below six years of age and 42 were of age six years and above. Most of the children were males.

Most of the children (n=61, 73.4%) came with left sided fractures, and majority of the study population were in the supracondylar fracture category of Gartland class II (n=59, 71.1%) while 28.9% (n=24) were of Gartland class III. A great number of included children had injury due to fall while playing (43.4%), while 16 (19.3%) had fall from height. The surgery duration was also noted, average of which came out to be around 29 minutes. Postoperative complication like superficial pin tract infection (treated with antibiotics) was found in three cases (3.6%) while five patients had ulnar nerve injury (6.02%). On clinical and radiological assessment in the final follow-up, union was achieved in all cases (Figure

1-3). On the analysis of frequency of outcome variable at the final follow-up, 67 (80.7%) children had satisfactory functional outcome (Table 1).

Table 1: Patient characteristics (n=83).

Characteristics	Frequency	%
Gender		
Male	47	56.6
Female	36	43.4
Age (in years)		
<6 years	41	49.4
≥6 years	42	50.6
Mean age	7.036 ± 3.390	
Fracture classification		
Gartland class II	59	71.1
Gartland class III	24	28.9
Mechanism of injury		
Fall while playing	36	43.4
Fall from height	16	19.3
Road traffic accident	14	16.8
Blunt trauma	17	20.5

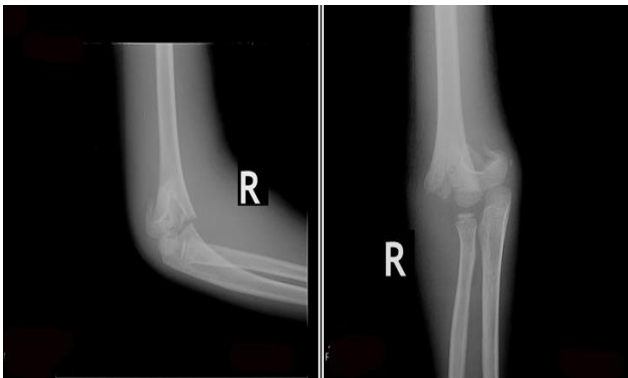


Figure 1: Pre-operative lateral and antero-posterior view X-ray of a 12-year-old female showing dislocated supracondylar humeral fracture.



Figure 2: Post-operative lateral and antero-posterior view X-ray of a 12-year-old female showing dislocated supracondylar humeral fracture fixed with crossed K-wires.

No significant association was found when the outcome was compared with other characteristics of patients as shown in Table 2.



Figure 3: Lateral and anteroposterior view X-ray of a 12-year-old female after K-wires removal at six weeks follow-up.

Table 2: Association of outcome with different variables.

Variable	Satisfactory functional outcome		P value
	Yes	No	
Age			
<6 years	34	7	0.412
≥6 years	33	9	
Gender			
Males	37	10	0.406
Females	30	06	
Fracture classification			
Class II	49	10	0.290
Class III	18	06	
Mechanism of injury			
Fall while playing	31	5	0.211
Fall from height	12	4	0.196
Road traffic accident	12	2	0.463
Blunt trauma	12	5	0.369

DISCUSSION

In the present study, adequate results were obtained when the functional outcome was measured. Major portion of the collected sample (80.7%, n=67) showed a satisfactory functional outcome according to Flynn’s criteria.

The epidemiological data in this series is consistent with earlier publications. There are more boys (57%) than girls.^{3,4,18} A possible explanation may be the involvement of boys in more vigorous sports and physical activities which makes them more prone to these fractures. Left-sided predominance was seen in this study which is comparable to works done by Barr et al and Naik et al.^{3,19}

The mean age of the patients in this study is almost comparable with other studies on the same topic i.e. around seven years. In the age group of five to eleven years, level of activity is higher than the preschool children; this might be one reason why most of the children in the current study were of that age. Average age in other studies was also between six to eight years.²⁰

The K-wire fixation may be employed by a crossed or parallel method. We applied the crossed method. There is no concluding evidence as to which one is the best method. A medial and lateral wire is used in the crossed method while two lateral wires are used in the parallel method. While the crossed method provides greater stability, parallel method has lesser chance of iatrogenic nerve injury.²¹⁻²⁵ Post-operatively, in this study, iatrogenic ulnar nerve injury was noticed on examination in five patients (6.02%) but at the last follow-up, hand functioning was adequate. Ulnar nerve injury is a common occurrence in this type of surgery and also seen in prior studies.^{3,26}

Reduction of supracondylar fractures by a closed method including percutaneous pinning has almost always given good results in comparison to other modes of treatment. Similar to our study, Tiwari et al observed 88% satisfactory results in which 42% were excellent, 30% were good and 6% were fair.⁸ Another study showed good to excellent outcome in more than 90% of the participants. Similar findings were observed when literature was extensively reviewed. This confirms crossed wire fixation to be equally accurate and a safe treatment option for Gartland type II and III fractures.^{3,27-31} We excluded Gartland type I since it is usually treated conservatively.²⁵

Our study was limited owing to the fact that it was conducted in a single tertiary care setup, with a small sample size.

CONCLUSION

As the existing literature suggested, we found satisfactory outcome according to Flynn's scoring system when supracondylar humeral fractures of Gartland type II and III were managed by closed reduction followed by application of percutaneous K-wires. Larger studies are required in our population.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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Cite this article as: Moton RZ, Siddiqui AA, Naseem M, Yaqoob U, Jalil SA, Nawaz Z. Functional outcome of crossed Kirschner wire fixation in pediatric supracondylar humerus fracture. *Int J Res Orthop* 2019;5:772-6.