

Outcome of Closed Reduction and Percutaneous Fixation with Crossed K-Wires in Displaced Supracondylar Fractures of Humerus

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Crossed K-Wires; Humerus; Percutaneous Cross
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1. Abstract

1.1. Introduction: Supracondylar fracture of humerus is one of the most common fractures amongst children. Supracondylar area is the weakest bony region of the upper limb and is most commonly injured by a fall on an outstretched hand⁴. There are two types of supracondylar fractures of humerus in children i.e. extension type (97%) and flexion type (3%). Mechanism of injury commonly is a fall on dorsi-flexed hand with flexed elbow resulting in hyperextension along with abduction or adduction of elbow.

1.2. Objective: To evaluate the functional and anatomical outcomes of closed reduction and percutaneous pinning in displaced supracondylar fractures of humerus.

1.3. Material And Methods: This Descriptive case series study was conducted in the Department of Orthopedic and Trauma, Medical Teaching Institute Lady Reading Hospital Peshawar from Feb, 2019 to Aug, 2019.

Patients meeting inclusion criteria underwent standard percutaneous fixation with cross K wiring under image intensifier by Orthopedic Surgeon with five years' post fellowship experience. Under general anesthesia and supine position closed reduction of the fracture was carried out by gentle traction, side to side elbow deformity correction, hyper-flexion of elbow and pushing the distal fragment with opposite hand thumb, keeping the forearm in pronation to prevent displacement. This position was maintained by applying sterile roll gauze to wrist and upper arm. After confirming closed anatomic reduction on Jones and lateral view, the

image-intensifier was used as platform. Stainless steel k-wires of 1.5 mm diameter was used. The lateral pin was inserted first. The insertion site was selected so that the pin would traverse the lateral portion of the ossified capitellum, cross the physis, proceed up the lateral column, and always engaged the opposite medial cortex proximally. Using a Kirschner wire (K-wire) or a radio dense object, the position for inserting the pin was documented on AP and lateral views.

1.4. Results: Ninety-four (75.2%) patients had excellent outcomes, 14 (11.2%) patients got good outcomes, 07 (5.6%) patients have satisfactory outcomes whereas 10 (8%) got poor outcomes.

1.5. Conclusion: Management of displaced supracondylar fractures of humerus through percutaneous fixation with crossed k-wires yield excellent results.

2. Introduction

Supracondylar fracture of humerus is one of the most common fractures amongst children [1]. This is the weakest bony in upper extremity and is fractured by a fall on an outstretched hand [2]. Supracondylar fractures of humerus in children are either extension or flexion type, but most of them are extension type (97%) [3]. Mechanism of injury commonly is a fall on dorsi-flexed hand with flexed elbow resulting in hyperextension along with abduction or adduction of elbow [4]. There are many classifications that has been used by orthopeditain but the commonly used is Gartland classification [5]. Type II and III fractures in this classification usually needs intervention. There are various management options

comprising of closed reduction and cast splintage, skeletal traction, closed reduction with percutaneous pinning and open reduction and fixation[2,3,5]. Closed reduction and cast splintage may lead to loss of reduction and gunstock deformity. Open reduction and internal fixation can reduce the fracture anatomically but there may be elbow stiffness and chances of loss of range of motion[6]. The complications associated with operative intervention consist of infection, vascular or neurological injury, myositis ossificans, decreased range of motion and cosmetic disfigurement [5,6,7]. Keeping in view the common presentation, a detailed and thorough knowledge of surgical anatomy is required followed by the best treatment option which should be tailored according to the type of injury. The inherent constraints of percutaneous k-wire fixation technique require that the procedure be done under optimal conditions. This would include morning theatre lists when trained orthopaedic surgeon, assistant and technician for image intensifier are available [8,9]. It has been shown that over-night delays have not significantly altered the results [10]. The aim of this study is to evaluate the functional and anatomical results of closed reduction and percutaneous pinning with crossed k-wires in displaced supracondylar fractures of humerus in children. This study will help in giving local fresh evidence based guidelines for supracondylar fracture management in children which will surely help local health researchers in lowering complication rates associate with it as being challenging and stressful. Moreover, a considered medical judgment and a patient's clinical circumstances coupled with preferences will help us guiding patient care and treatment in a much better manner.

3. Materials and Methods

This Descriptive case series study was conducted in the Department of Orthopedic and trauma, Medical Teaching Institute Lady Reading Hospital Peshawar from Feb, 2019 to Aug, 2019 on total 125 patient, keeping 80% [10] proportion of excellent results according to according to Flynn's criteria with 95% confidence Interval, 5% level of significance and 7% margin of error. Patients having age between 5 to 10 Years of either gender with Type III fracture according to Gartland classification were included in the study while patient having open fractures of the distal humerus or patients with multiple bone injuries that required multidisciplinary treatment were excluded from the study.

After taking approval from Hospital Ethical Committee, all the patients admitted as emergency patients meeting inclusion criteria were included in the study. Prior to the conduct of the study, written informed consent was also obtained from all patients. Patients meeting inclusion criteria underwent standard percutaneous fixation with cross K wiring under image intensifier by Orthopedic Surgeon with five years' post fellowship experience. Under general anesthesia and supine position closed reduction of the fracture was done by gentle traction, side to side elbow deformity correc-

tion, hyper-flexion of elbow and pushing the distal fragment with opposite hand thumb, keeping the forearm in pronation to prevent displacement. This position was maintained by applying sterile roll gauze to wrist and upper arm. After confirming closed anatomic reduction on Jones and lateral view, the image-intensifier was used as platform. Stainless steel k-wires of 1.5 mm diameter was used. The lateral pin was inserted first. The insertion site was selected so that the pin would traverse the lateral portion of the ossified capitellum, cross the physis, proceed up the lateral column, and always engaged the opposite medial cortex proximally. Using a Kirschner wire (K-wire) or a radio dense object, the position for inserting the pin was documented on AP and lateral views.

A small incision was made in the skin. The pins were angulated superiorly approximately 40° superiorly and 10° posteriorly ensuring that they continued into the opposite cortex to provide solid fixation. The pin was placed using a power drill and a sharp K-wire. Provisional stability was achieved with the first pin. The elbow was then externally rotated and a lateral image was obtained with fluoroscopy. A second pin was then placed medially. Ulnar nerve was protected by milking with thumb posteriorly. In case of swelling a small incision was made through the skin over the medial epicondyle and then medial pin was inserted. At the end of the procedure the stability and carrying angle was checked by extending the elbow. above elbow back slab was given post-operatively and forearm was hanged in collar and sling. The patients were discharged next day, advised to follow up after two weeks for clinical and radiological evaluation, removal of back slab and the patient was instructed for elbow exercises. Patients were called at 4 weeks after surgery for removal of k-wires. Patients were followed up on monthly basis for up to three months and was evaluated clinically and radiologically for healing of fracture, joint deformity and range of motion (i.e. functional and cosmetic) according to Flynn's criteria. All the information pertaining to pre and post op carrying angle, pre and post op loss of motion, side of injury, dynamics of injury and outcomes i.e. excellent, good, satisfactory and poor was recorded on a pre-designed proforma. Data was then entered and analyzed in SPSS version 20. Mean + SD was calculated for numerical variables like age, pre and post op carrying angel, pre and post op loss of motion and duration of hospital stay. Frequencies and percentages were calculated for categorical variables like side of injury, dynamics of injury and outcomes (excellent, good, satisfactory, poor). Outcomes (excellent, good, satisfactory, poor) were stratified with age, gender, side of injury, dynamics of injury and duration of hospital stay in order to see effect modifiers. Post stratification chi square test was carried out keeping P Value < 0.05 as significant. All results were presented in the form of tables and graphs.

Loss of Carrying Angle: It was carrying angle > 15° away from the body measured on goniometer as per Flynn's criteria.

Loss of Motion: It was the limited range of motion due to a joint that has a reduction in its ability to move ($> 15^\circ$) measured through goniometer as per Flynn's criteria [11].

4. Results

Total number of patients that were included in my study were 125. Out of this, 71 (56.8%) patients were recorded in 5-7 years age group while 54 (43.2%) patients were recorded in 8-10 years of age. Ninety-six (76.8%) patients were male patients while 29 (23.2%) patients were female. Mean and SDs for age was 6.5 ± 1.58 . Mean and SDs for Pre Op Carrying Angle was 16 ± 0.92 . Mean and SDs for Post Op Carrying Angle was 2 ± 4.0 . Mean and SDs for Pre Op loss of motion was 16 ± 0.90 . Mean and SDs for Post Op loss of motion was 2 ± 4.0 . Mean and SDs for duration of hospital stay was 2 ± 0.66 (Table 1). Forty-three (34.4%) patients injured while playing whereas 82 (65.6%) had motor vehicle accidents (Table 2). Left limb was involved in 36 (28.8%) patients while the right limb in 89 (71.2%) patients. Ninety-four (75.2%) patients had excellent outcomes, 14 (11.2%) patients got good outcomes, 7 (5.6%) patients have satisfactory outcomes whereas 10 (8%) got poor outcomes (Table 3). Gender, Age, Dynamics of Injury, Side of Injury and Hospital Stay were controlled through stratification and computed at (Table 4-8) respectively.

5. Discussion

In one study, a total of 30 patients completed the study. The mean age was 6.1 years with a gender distribution of 23 males and 7 females. The involved elbow was right in 17(56.6%) patients and 13(43.3%) patients had left sided injury. There were 18(60%) Gartland type II fractures and 12(40%) Gartland III fractures. All of the fractures were extension type. Three patients (10%) had pin tract infections, whereas none had osteomyelitis, neurovascular damage or compartment syndrome. Twenty-four patients (80%)¹⁰ had excellent results among patients with Type III fracture according to Flynn's criteria whereas four patients (13.3%) had poor results. In my study, 71 (56.8%) patients were recorded in 5-7 years age group. 54 (43.2%) patients were recorded in 8-10 years. (Table 1). 96 (76.8%) patients were male patients. 29 (23.2%) patients were female patients. (Table 2). Mean and SDs for age was 6.5 ± 1.58 . Mean and SDs for Pre Op Carrying Angle was 16 ± 0.92 . Mean and SDs for Post Op Carrying Angle was 2 ± 4.0 . Mean and SDs for Pre Op loss of motion was 16 ± 0.90 . Mean and SDs for Post Op loss of motion was 2 ± 4.0 . Mean and SDs for duration of hospital stay was 2 ± 0.66 . (Table 3). 43 (34.4%) patients have injuries from childish games whereas 82 (65.6%) got injuries from motor accidents. (Table 4). 36 (28.8%) patients got injuries to their left limb while 89 (71.2%) patients got injuries to their right limb. (Table 5). 94 (75.2%) patients had excellent outcomes, 14 (11.2%) patients got good outcomes, 07 (5.6%) patients has

satisfactory outcomes whereas 10 (8%) got poor outcomes. (Table 6). The complications associated with operative intervention consist of infection, vascular or neurological injury, myositis ossificans, decreased range of motion and cosmetic disfigurement [5-7]. Keeping in view the common presentation, a detailed and thorough knowledge of surgical anatomy is required followed by the best treatment option which should be tailored according to the type of injury. The inherent constraints of percutaneous k-wire fixation technique require that the procedure be done under optimal conditions. This would include morning theatre lists when trained orthopaedic surgeon, assistant and technician for image intensifier are available [8-10] It has been shown that over-night delays have not significantly altered the results [7,9]

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Results	Cosmetic Factor-Loss of Carrying Angle	Functional Factor-Loss of Motion
Excellent	0-5o	0-5 o
Good	6-10 o	6-10 o
Satisfactory	11-15 o	11-15 o
Poor	>15 o	>15 o

Flynn’s criteria for assessment of reduction

Table 1: Descriptive Statistics (N = 125)

Numerical Variables	Mean	SDs
Age	6.5	1.58
Pre Op Carrying Angle	16	0.9
Post Op Carrying Angle	2	4
Pre Op Loss Of Motion	16	0.9
Post Op Loss of Motion	2	4
Duration of Hospital Stay	2	0.66

Table 2: Dynamics of Injury (N=125)

Dynamics of Injury	Frequency	Percentage
Playing	43	34.40%
Motor Vehicle Accidents	82	65.60%
Total	125	100%

Table 3: Outcomes (N=125)

Outcomes	Frequency	Percentage
Excellent	94	75.20%
Good	14	11.20%
Satisfactory	7	5.60%
Poor	10	8%
Total	125	100%

Table 4: Stratification Of Outcomes With Respect To Gender (N=125)

Outcomes		Gender Groups		P Value
		Male	Female	
Excellent	Yes	71	23	0.558
	No	25	6	
Good	Yes	10	4	0.613
	No	86	25	
Satisfactory	Yes	10	7	0.058
	No	86	22	
Poor	Yes	5	2	0.728
	No	91	27	

Table 5: Stratification of Outcomes With Respect To Age (N=125)

Outcomes		Age Groups		P Value
		5-7 Years	8-10 Years	
Excellent	Yes	54	40	0.799
	No	17	14	
Good	Yes	3	11	0.004
	No	68	43	
Satisfactory	Yes	8	2	0.122
	No	63	52	
Poor	Yes	6	1	0.111
	No	65	53	

Table 6: Stratification of Outcomes with Respect To Dynamics Of Injury (N=125)

Outcomes		Dynamics of Injury		P Value
		Childish Games	Motor Acctds	
Excellent	Yes	30	64	0.308
	No	13	18	
Good	Yes	4	10	0.626
	No	39	72	
Satisfactory	Yes	4	6	0.697
	No	39	76	
Poor	Yes	5	2	0.033
	No	38	80	

Table 7: Stratification of Outcomes with Respect to Side of Injury (N=125)

Outcomes		Side of Injury		P Value
		Left Limb	Right Limb	
Excellent	Yes	29	65	0.377
	No	7	24	
Good	Yes	4	10	0.984
	No	32	79	
Satisfactory	Yes	1	9	0.171
	No	35	80	
Poor	Yes	2	5	0.989
	No	34	84	

Table 8: Stratification of Outcomes with Respect to Duration of Hospital Stay (N=125)

Outcomes		Duration of Hospital Stay		P Value
		< 3 days	> 3 days	
Excellent	Yes	76	18	0.979
	No	25	6	
Good	Yes	10	4	0.344
	No	91	20	
Satisfactory	Yes	9	1	0.441
	No	92	23	
Poor	Yes	6	1	0.734
	No	95	23	

6. Conclusion

Management of displaced supracondylar fractures of humerus through percutaneous fixation with crossed k-wires yield excellent results.

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