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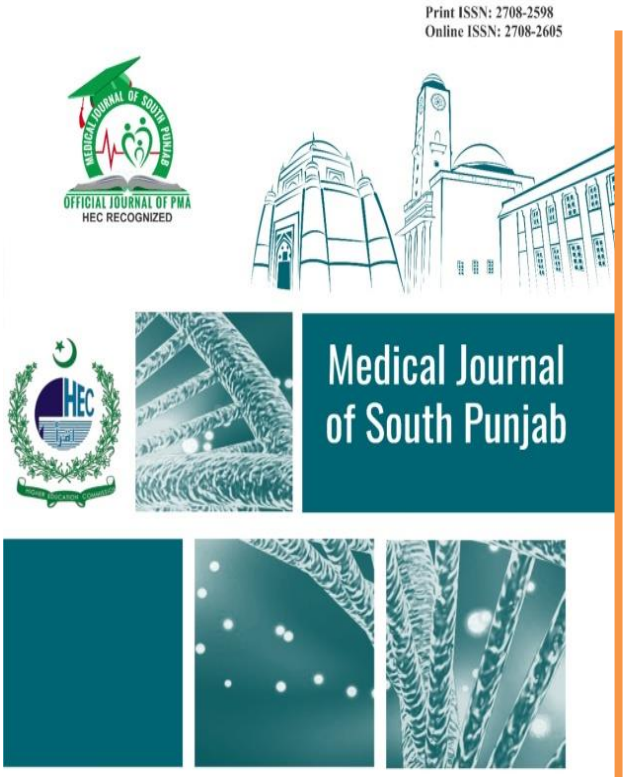

Outcomes of closed reduction and percutaneous k wire fixation of supracondylar humerus fractures

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Original Article

Outcomesof closed reduction and percutaneous k wire fixation of supracondylar humerus fractures

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ABSTRACT

Objective: To determine the outcomes of closed reduction and percutaneous k-wire fixation in supracondylar hummers fracture.

Methods: Retrospective study. Data included in this study was obtained from hospital record ofSligo University hospital, Ireland. Cases of supracondylar humerus fracture that were operated in the year of 2021 with closed reduction and percutaneous K wire fixation technique were taken. Study was conducted on 34patients presented with supracondylar fractures of humerus. Main variables of study were hospital stay, k-wire removal time, duration of operation, side of fracture, mode of injury and outcomes assessed by Flynn criteria. SPSS version 23 was used for data analysis.

Results: According to grading Flynn's Criteria, (58.9%) patients had excellent result, (29.4%) had good, (8.8%) had fair and only one patient had poor result.There was no difference between functional results and gender (p=0.872),age (p=0.072), duration of operation (p=0.073) and length of hospital stay (p=0.366).

Conclusion: Normal range of movements and anatomy of limb can be restored better with closed reduction percutaneous k-wire fixation.

Keywords: Supracondylar hummers fracture, K-wire, closed reduction, Flynn criteria

1. INTRODUCTION

Pediatric supracondylar humerus fractures are one of the most occurring fractures in children, comprising 16.6%[1] of all reported fractures in children, most of which are between 5 to 8 years of age. If not treated effectively, problems may arise even in simple fractures[2].

There are many treatment measures for supracondylar humerus fractures such as closedreduction accompanying above elbow cast, traction method and open reduction and internal fixation. However, many studies have associated the increased chances of complexities with these methods. These include difficulty in anatomical reduction due to inflammation of soft tissues which causes unnecessary delayed union.

For early movement of the joint and to retain the reduction, it is imperative to use k-wires for primary fixation[3] [4]. As this fracture is regarded as orthopedic emergency, normally it is treated within 72hrs after an incident to avoid any further complications like ulnar nerve palsy, wrist drop, brachial artery damages and cubitus Varus deformity. Currently closed reduction and K-wire fixation is extensively used treatment for pediatric supracondylar humerus fractures[5]. Also, various methods for percutaneous pinning with k wires are in practice, generally twok-wires are applied forming cross, one from lateral epicondyle and other from medial epicondyle[6] [7].

However, there is an associated risk of iatrogenic ulnar nerve palsy when the pins are being inserted [8]. As medial pin insertion is riskier than lateral pin insertion, it is imperative to apply optimal pinning technique which should offer sufficient stability while avoiding iatrogenic nerve damage[9] [10]. The primary objective of such treatment is to restore the anatomy of distal humerus to flawless alignment and to avoid any complexities with stability, so early pain free elbow joint movement can be made possible. Our study will be helpful to choose the right technique for management of supracondylar humerus fracture and to stream line the patient referral towards specialized surgical care.

2. METHODOLOGY

Data included in this study was obtained from hospital record of orthopedic department of Sligo University hospital, Ireland.Cases of supracondylar humerus fracture that were operated in the year of 2021 with closed reduction and percutaneous K wire fixation technique were taken.The ethical approval for this study was approved by hospital ethical board and was carried out in accordance with the principles of the declaration of ethical board.Our study includes only children between 2-6years of age which were diagnosed and operated for treatment of supracondylar fracture humerus.

Only supracondylar fracture humerus patients were taken and included in this study. Pre-operative data was collected including history, findings of clinical assessmentand anteroposterior and lateral radiographic record, for proper evaluation.

Patients were assessed with GARTLANDs Classification[11] criterion;as supracondylar humerus fracturesType 1: non-displaced supracondylar humerus. Type 2: Displaced supracondylar humerus, with intact posterior cortex.Type 3: Displaced supracondylar humerus, with no cortical contact, subdivided in (a) Postero-medial, (b) Postero-lateral was taken.

According to record preliminary treatment was provided by temporary closed reduction, for stability above elbow plaster of paris(POP) slab was used with proper limb elevation to control the swelling. General anesthesia was given during closed reduction. Patients were laid down in dorsal decubitus position with homolateral shoulder at the edge of operating table. Arm was sterilized and draped. Traction was applied alongside longitudinal axis while the elbow was kept in extension with supination orientation; Assistant holding the proximal arm provided the counter traction.

Varus and valgus forces were applied to correct the lateral and medial displacements respectively. After that angulation, posterior displacement was adjusted by flexing elbow and force was applied posteriorly from the anterior aspect of proximal fragment and anterior force from posterior aspect of distal fragment. AP and lateral views were observed under image intensifier and reduction was confirmed.

After attaining the adequate alignment, reduction was retained by percutaneous k wire fixation and then above elbow cast was applied with elbow in 90 degrees of flexion. Normally k-wires of around 1.2 to 2mm diameter were used and were inserted by following two methods.

a) 2 crossed k-wires one from medial and one from lateral epicondyle

b) 2 lateral k-wires

Once an adequate reduction was achieved, under the guidance of c-arm the k-wires were introduced with the assistance of drill machine. The medial pin was admitted through the tip of medial epicondyle and lateral pin through the tip of lateral epicondyle respectively. Both of these pins were directed at 40 degree to the shaft of humerus and 10 degree posteriorly in a sagittal plane.

It was made sure that both cortices above the fracture site were included while taking safety measures to avoid the olecranon fossa. In light of postoperative protocol patient were given above elbow cast and sufficient limb elevation was provided with collar and cuff for stability.Distal neurovascular bundle was examined post operatively. Majority of patients were discharged on next day. After 14 days patients were called for follow up and suture were removed. After 4-6 weeksK-wires were removed. To observe callus formation radiography was done in in AP and lateral views; slab was removed and physiotherapy for movements at elbow joint were suggested as part of rehabilitation; it was advised to avoid all kind contact supports for 12 weeks to avoid re-fracture.

SPSS version 23 was used for analysis of data. Mean and standard deviation were calculated for numerical data like age, length of hospital stay, duration of operation and k-wire removal time. Frequencies and percentages were calculated for categorical data like gender. Test of significance was applied to see the association among variables and p-value $\leq$ 0.05 was taken as significant.

3. RESULTS

Thirty-fourpatients werencludedin this study with age range (2-6) years of both genders. The mean age of the patients was 3.24±1.02years. Majority of the patients (79.4%)between age group 2-4 years. Most of the patients (85.3%) stayed in hospital for 1 days. Majority of the patients (76.5%) had duration of operation ≥30 minutes. (Table. I).

Fall from height was the most common mode of injury i.e. (55.9%) patients. Fracture displacement was posteromedial in (94.1%) patients.The presence of neurological involvement pre-operatively,ulnar and radial nerve, good capillary refill and normal color and temperature and radial pulse were shown in table. II.

According to grading Flynn's Criteria, 20 (58.9%) patients had excellent result, 10 (29.4%) had good, 3 (8.8%) had fair and only one patient had poor result. (Table. III). (Figure. I). There was no difference between functional results and gender (p=0.872),age (p=0.072), duration of operation (p=0.073) and length of hospital stay (p=0.366) (Table. IV).

Table I: Demographic and baseline characteristics among the patients

Variable	Mean±S.D	N (%)
Gender		
Male		15 (44.1)
Female		19 (55.9)
Age distribution (years)	3.24±1.02	
2-3		27 (79.4)
4-6		7 (20.6)
Length of hospital stay (days)	1.20±0.43	
1		29 (85.3)
2		5 (14.7)
Duration of operation (minutes)	56.21±7.88	
<30		8 (23.5)
≥30		26 (76.5)
K-wire removal time (week)	5.66±1.17	

Table II: Mode and side of injury

Variable	N (%)
Mode of injury	
Fall while playing	6 (17.6)
Fall from height	19 (55.9)
Road accident	5 (14.7)
Other	4 (11.8)
Fracture displacement	
Posteromedial	32 (94.1)
Posterolateral	2 (5.9)
Neurological involvement pre- operatively	4 (11.8)

Table III: Grading According to Flynn's Criteria of the patients

Grading	Grading According to Flynn's Criteria		N (%)
	Cosmetic factor (Degrees)	Functional factor (Degrees)	
Excellent	0-5	0-5	20 (58.9)
Good	6-9	6-9	10 (29.4)
Fair	10-15	10-15	3 (8.8)
Poor	>15	>15	1 (2.9)

Fig-1

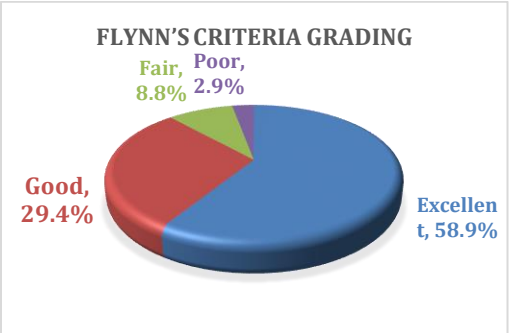

Table-IV: Cross-tabulation of Flynn's Criteria with effect modifiers

Effect modifier	Variable	Grading				P
		Excellent	Good	Fair	Poor	
Gender	Male	10	4	1	1	0.87
	Female	10	6	2	0	
Age (years)	2-3	15	8	3	0	0.07
	4-6	5	0	0	1	
Duration of operation (minutes)	< 30	6	0	0	0	0.07
	≥30	14	8	3	1	
Length of hospital stay (days)	1	18	9	2	0	0.36
	2	2	1	1	1	

4. DISCUSSION

Supracondylar humerus fractures are one of the most common injuries in children between 2-13 years of age. The major challenge is precise reduction and preservation of a fracture and restoration of anatomy while sustaining sufficient blood circulation in the arm. Early and precise treatment of fracture is of utmost importance.

Posteromedial displacement in fracture fragments was most common occurrence; it was treated effectively with closed reduction and percutaneous pining. Percutaneous k-wire fixation of displaced pediatric supracondylar humerus fractures has shown promising results and fewer complications. Majority of patients 88.3% reported excellent and good results according to Flynn's criteria, which is close to study done byAcar E et al[12]. 80.84% of their patients with closed reduction and percutaneous fixation reported excellent and good results in cosmetic and functional evaluation.

After treatment most of patients were discharged on 1st day after the procedure with above elbow (POP)slab for around six weeks; full recovery of elbow movement was allowed after removal of the slab. Elbow ROM restored to 70% of contralateral elbow motion by 6 weeks after treatment and gradually increased these results are comparable to Zionts LE et al.[13]Majority of patients recovered full range of extension and flexion with loss of below 10 degrees in flexion. Dissimilarity between carrying angles of both arms was marginal. All of the patients had decent cosmetic results within 4 weeks (average) of recovery.

Literature in biomechanical studies has validated the necessity of cross k-wire to obtain stabilization in pediatric supracondylar humerus fractures. Eralpet al.[14]compared the outcomes ofk-wire fixation with an addition of third wire and a orthodoxcross fixation. Theystated more stability with 3 wire configurations. Also, it was established in biomechanical studies that although cross k-wire fixation is stable, additional k-wire from lateral side increased the stability.[15, 16,17,18]Furthermore, Zionts et al.[19]concluded two crossed K-wires performed medially and laterally is best configuration. In the current study, cross K-wires were applied in all fixations, resulting stabilization was adequate.

Precise reduction of pediatric supracondylar humerus fractures with percutaneous k-wire fixation is cost effectiveand convenient

procedure. it was also concluded by Su AW et al.[20]It is better in respect of early movement, fracture fixation, hospital staying time, lower chances of deformity in Varus in late stages of rehabilitation and lower risk of neurovascular complexities.

5. CONCLUSION

Normal range of movements and anatomy of limb can be restored better with closed reduction percutaneous k-wire fixation.

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