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Clinical and Radiological outcome of Gartland Type-III closed supercondylar fracture of humerus in Children treatment by percutaneous K-wires fixation

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Abstract

Introduction: Supracondylar fracture of the humerus is the most common fracture of the elbow in children and displacement is common. Main problem regarding management of early supracondylar fracture are obtaining and maintaining reduction as they commonly present in the emergency department with varying degrees of soft tissue swelling. ***Objective*:** To assess the Clinical and Radiological Outcome Type III Closed Supracondylar Fracture Of Humerus in Children treatment by percutaneous K-wires fixation. ***Methods:*** This study was carried out at the NITOR, over a period of 24 months between January 2015 to December 2016. The total number of patients were 30. All patients suffering from closed supracondylar fracture of humerus in children. Each Gartland type-III closed Supracondylar Fracture of humerus among supracondylar Fracture in children attended at emergency, outpatient department and admitted in NITOR. ***Results:*** A total number of 30 patients were enrolled in this study as per inclusion and exclusion criteria. Diagnosis of the supracondylar fracture of humerus was made by history, clinical examination and radiological evidence. The youngest patient in our series is 3 years old and the oldest is 12 years. Majority were in 5-8years. Among 30 patients mean age was 6.85 years with SD = ± 2.37 years. In the present series, maximum patients were male 22 (73.3%) and 8 (26.7%) patients were female. Male female ratio 2.75:1. Male patients were predominant in this study. The results are shown in table-I. In the present series, 19 (63.3%) with left sided supracondylar fracture of humerus and 11(36.7%) presented with right sided supacondylar fracture of humerus. The results are shown in Table-II. Out of 30 cases 15 (50%) cases gave history of fall from tree, 6(20%) cases gave history of fall from bed, 4(13.3%) cases gave history of fall during playing, 5(16.7%) cases gave history of RTA due to fall from bicycle. In the present series, postero-medial fracture was found in 18(60.0%) cases and postero-lateral fracture in 12 (40.0%) cases. Out of 30 patient's about 16 (53.3%) of the patient's was operated between (13-18) hours of receiving injury, 11 (36.7%) with in (7-12) hours and 1 (3.3%) within (0-6) hours of injury and 2(6.7%) with in (19-24) hours of injury, mean interval between injury and Operation was 8.06 ± 5.52 hours. Out of 30 patient's, 22 (73.3%) of the patients stayed in the hospital for 1 day and 8 (26.7%) of the patients stayed in the hospital for 2 days. The mean duration of hospital stay was 1.26 ± 0.45 days. In this series, among 30 Patients, 27(90.0%) had radiologically sufficient callus formation and 3(10.0%) patients had no sufficient callus formation. Functional outcome was satisfactory result (Excellent, Good and Fair) were 27(90.0%) and unsatisfactory result (poor) was 3 (10.0%). ***Conclusion:*** Finally, the result shows that in Gartland type-III closed supracondylar fracture of the humerus, closed reduction and stabilization by two lateral parallel percutaneous 'K'-wires is the good method for treatment.

Keywords: Radiological Outcome, Supracondylar Fracture, Humerus, Children.

INTRODUCTION

Supracondylar fracture of the humerus is the most common fracture of the elbow in children and displacement is common. Main problem regarding management of early supracondylar fracture are obtaining and maintaining reduction as they commonly present in the emergency department with varying

degrees of soft tissue swelling. Supracondylar fracture of the humerus in children is one of the most common fracture seen all over the world accounting for 50% to 70% of all elbow fracture in children in the first decade of life. Traditionally this type of fracture is associated with high rate of mal-union, nerve injury and vacular complications. Current method of treatment of supracondylar fracture of humerus in children is based on Gartland classification [1]. Reported the incidence of cubitus varus deformity after treatment was 5% whereas [2] reported that it was almost 21%, ulnar nerve deficit was found in 15% of patients who were treated with medial and lateral pin [3]. There are several methods of treatment of this fracture, such as one method is open reduction and internal fixation, If open reduction and internal fixation are to be carried out, they should be performed after the swelling has decreased but not later than 5 days after injury, since the possibility of myositis ossificans apparently increases after that time. There are various modalities of treatment adviced for the management of Gartland type III closed supracondylar fracture of humerus. At present closed reduction and percutaneous pin fixation is most widely accepted treatment method for displaced supracondylar fracture but controversy persists regarding the optimal pin fixation technique. The purpose of the study was to compare the stability and risk of ulnar nerve injury treated by lateral entry pin fixation with that of medial and lateral pin fixation for Gartland type III supracondylar fracture [4]. A satisfactory closed reduction may not possible, but this open reduction and Internal fixation has disadvantage of possible complications such as infection, vascular injury, myositis ossificans, excessive callus formation with residual stiffness and decrease range of movement. The treatment of supracondylar fractures of humerus in children has been the subject of much discussion and dispute for many years. Historically, these fractures were associated with complications resulted in cosmetically and functionally inferior results. Results have been improved and the frequency of these complications dramatically decreased with more modern techniques of treatment. Controversies about the treatment of supracondylar fractures of humerus in children, however, still exist. Operative treatment can be done safely and effectively. To fully appreciate the complexity of these problems, we must understand and learn from the historical foundation laid down by our predecessors. It is also only fitting that as we look towards the future, we acknowledge the work of these pioneers. In the management of Gartland type-III closed supracondylar fracture of humerus in children, the key to the success depends on the accuracy of reduction. Immobilization procedure can be selected upon the type of injury and surgeon's choice. A swollen elbow compromises the vascularity and it is difficult to keep the elbow at 90 degree/less because this position will definitely redisplaced the fracture, this called supracondylar dilemma, percutaneous K-wire fixation can solve the problem. Here the elbow can be splinted at 90 degree/lesser degree of flexion without any chance of vascular compromise or re-displacement, it requires general anaesthesia, minor surgical instruments, asepsis, higher surgical skill in pinning under the help of C-arm. Two lateral pins fixation avoids pin penetration over the medial aspect of the elbow and no chance of ulnar nerve injury. Closed supracondylar fracture can be stabilized by placing two lateral parallel percutaneous K-wires. This method provides good stability of fixation and it has low risk of iatrogenic nerve injury. So closed reduction and stabilization by two lateral parallel percutaneous k-wires for the treatment of Gartland type III closed supracondylar fracture of humerus in children may be a better option. This study designed to evaluate how much effective the procedure that is closed reduction and stabilization by two lateral parallel percutaneous 'K'-wires for treatment of Gartland type-III closed supracondylar fracture of humerus in children treatment by percutaneous K-wires fixation.

METHODS

Study design: A prospective quasi experimental study.

Place of the study: National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka, Bangladesh.

Duration of the study: January 2015 to December 2016 (24months).

Study Population: All patients suffering from closed supracondylar fracture of humerus in children.

Sample Unit: Each Gartland type-III closed Supracondylar Fracture of humerus among supracondylar Fracture in children attended at emergency, outpatient department and admitted in NITOR from January 2015 to December 2016.

Sample size calculation: Due to time limitation 30 cases were selected during the study period.

Inclusion Criteria:

i. Age: between 3 to 12 years.
ii. Sex: Both sexes.
iii. Type III supracodylar fracture of humerus in children.
iv. Those presented within 5 days after injury.
v. Closed fracture.
vi. Extention type.

Exclusion criteria:

i. Open fractures.
ii. Pathological fractures.
iii. Age before 3 and after 12 years.
iv. Flexion type.
v. Type III fracture with compartment syndrome.
vi. Late presentation after 5 days.

Data Collection tools: Data was collected with a pre-tested structured questionnaire included history, physical examination, radiological assessment; per-operative & post-operative follow up.

Data Collection Procedure: From January 2015 to December 2016, 186 patients of supracondylar fracture of humerus are admitted in NITOR. Among them, 110 patients were supracondylar fracture of humerus and rest of them were open type of supracondylar fracture and undisplaced type of fracture of humerus. Among 110 patients of supracondylar fracture of humerus, 20 cases were flexion type, 50 cases were more than 12 years of age. Rest of the 40 patients of supracondylar fracture of humerus was treated by closed reduction and percutaneous pinning at NITOR. Among them 30 patients were attended to regular follow up visit at NITOR. All 30 patients were treated by closed reduction and percutaneous lateral parallel K-wire fixation through lateral condyle. At least 12 week follow up was targeted to evaluate final functional outcome. The functional outcome was assessed by Flynn's criteria [1]. The function of the injured limb after treatment is assessed by the comparison between the elbow flexion and loss of carrying angle of the injured limb and healthy limb. The elbow flexion and loss of carrying angle were measured by Gonoiometer. The unit of the measurement was degree.

Data processing: Data will be collected by using a structured data collection containing the variables of interest. All recorded data will be processed and analyzed by using computer software SPSS (Statistical Package for Social Science), Version-22.

RESULTS

Table-I: Age distribution of the participants (N=30)

Age in year	No of Patient	Percentage (%)	Mean± SD
0-4	6	20.0	6.85± 2.37 Years
5-8	18	60.0	
9-12	6	20.0	
Total	30	100.0	
Sex			
Male	22	73.3	
Female	8	27.7	
Total	30	100.0	

A total number of 30 patients were enrolled in this study as per inclusion and exclusion criteria. Diagnosis of the supracondylar fracture of humerus was made by history, clinical examination and radiological evidence. The youngest patient in our series is 3 years old and the oldest is 12 years. Majority were in 5-8years. Among 30 patients mean age was 6.85 years with SD = ± 2.37 years. In the present series, maximum patients were male 22 (73.3%) and 8 (26.7%) patients were female. Male female ratio 2.75:1. Male patients were predominant in this study. The results are shown in Table-I.

Table-II: Side involved (n=30)

Side	Number of patient	Percentage (%)
Left	19	63.3
Right	11	36.7
Total	30	100.0

In the present series, 19 (63.3%) with left sided supracondylar fracture of humerus and 11(36.7%) presented with right sided supacondylar fracture of humerus. The results are shown in Table-II.

Table-III: Causes of injury (n=30)

Causes of injury	Number of patient	Percentage (%)
Fall from tree	15	50.0
Fall from bed	6	20.0
Road traffic injury	5	16.7
Fall during playing	4	13.3
Total	30	100.0

Out of 30 cases 15 (50%) cases gave history of fall from tree, 6(20%) cases gave history of fall from bed, 4(13.3%) cases gave history of fall during playing, 5(16.7%) cases gave history of RTA due to fall from bicycle.

Table-IV: Pie diagram showing the type of fracture

	Number of patient	Percentage (%)
Postero-Medial	18	60.0
Postero-Lateral	12	40.0

In the present series, postero-medial fracture was found in 18(60.0%) cases and postero-lateral fracture in 12 (40.0%) cases.

Table-V: Time interval between injury and operation (N=30)

Time in interval in hours	Number of patient	Percentage (%)	Mean(±SD)
(0-6) hours	1	3.3	8.06± 5.52 Hours
(7-12) hours	11	36.7	
(13-18) hours	16	53.3	
(19-24) hours	2	6.7	
Total	30	100.0	

Out of 30 patient's about 16 (53.3%) of the patient's was operated between (13-18) hours of receiving injury, 11 (36.7%) with in (7-12) hours and 1 (3.3%) within (0-6) hours of injury and 2(6.7%) with in (19-24) hours of injury, mean interval between injury and Operation was 8.06 ± 5.52 hours.

Table-VI: Show's Post-operative hospital stay (n=30)

Duration of Hospital Stay(days)	Number of Patient	Percentage (%)	Mean (±SD)
0-1	22	73.3	1.26± 0.45 Days
2	8	26.7	

Out of 30 patient's, 22 (73.3%) of the patients stayed in the hospital for 1 day and 8 (26.7%) of the patients stayed in the hospital for 2 days. The mean duration of hospital stay was 1.26 ± 0.45 days.

Table-VII: Distribution of the patients by loss of elbow flexion according to Flynn's criteria (n=30)

Loss of range of motion in degrees	Number of Patient	Percentage (%)	Mean (±SD)
No Loss of flexion	3	10.0	9.53± 5.048 Degrees
1-5	3	10.0	
5-10	18	60.0	
10-15	3	10.0	
>15	3	10.0	

Among 30 Patient, mean loss of motion of elbow was 9.53 ± 5.048 degrees.

Table-VIII: Distribution of the patients by loss of carrying angle according to Flynn's criteria (n=30)

Loss of carrying angle in degrees	Number of Patient	Percentage (%)	Mean (±SD)
No Loss	3	10.0	8.5± 5.61 Degrees
1-5	4	13.3	
5-10	17	56.7	
10-15	3	10.0	
> 15	3	10.0	

Among 30 Patient, mean loss of carrying angle was 8.5 ± 5.61 degrees.

Table-IX: Distribution of the patients by radiological outcome and functional outcome (n=30)

	Results	No. of Patients	Percentage (%)
Radiological Outcome	Sufficient callus formation	27	90
	No sufficient callus formation	03	10
	Total	**30**	**100**
Functional Outcome	Satisfactory	27	90
	Unsatisfactory	03	10
	Total	**30**	**100**

In this series, among 30 Patients, 27(90.0%) had radiologically sufficient callus formation and 3(10.0%) patients had no sufficient callus formation. Functional outcome was satisfactory result (Excellent,

Good and Fair) were 27(90.0%) and unsatisfactory result (poor) was 3 (10.0%).

DISCUSSION

Supracondylar fractures of humerus are extra-articular and occur following a fall on out stretched hand. Ligamentous laxity allows for hyperextensibility of the elbow joint, which significantly increase in the incidence of these fractures in children. Displaced extension type of supracondylar fracture always present problem in the management like swelling, Volkmann's ischaemia, neurovascular impairment, cubitusvarus and loss of function. Actually avoidance of complications and achievement of excellent functional and cosmetic result are goal of treatment. Treatment of displacement supracondylar fractures are continues to be controversial. In this series, sample sizes were 30 the fracture was found more common in boys 22(73.3%) than girls 8(27.7%). In other series of supracondylar fracture, there was a higher frequency in male patients 70%, female 30%, sample size was 20 [5] and 66.67% male, 33.34% female [6]. No author, however have mentioned the reason behind that higher male prevalence. Supracondylar fractures of humerus occur commonly in the first decade, peaks at 5 to 8 years of age and decrease in incidence until age 15 years. In this study mean age of the patients were 6.85±2.37 years. In other series of supracondylar fracture, mean age of 5.8 years [7] and mean age of patient was 7.46 years [6] and mean age of 6.1±3.07 years [8]. The high incidence rate of supracondylar fracture in children is due to relative weakness of bone than combined strength of anterior capsule and collateral ligaments in a hyperextension elbow. In this study the older children were associated with greater displacement. In this study, left side was more involved in 19 (63.3%) of patients. While right side fracture was 11(36.7%). According to Sarwar et al [6] left side were more frequently involved (76.7%). In other series of super condylar fracture, left side (75%), right (25%) [5] and left side (60.24%), right side (39.76%) [9]. The cause of this increased susceptibility of left side is probably the children often extend their left elbow to break the force of a fall. In this study most common cause of supracondylar fracture was due to fall from tree 50%, fall from bed 20%, road traffic injury 16.7%, fall during playing 13%. Other series of super condylar fracture most common cause fall from height 46.66%, fall from bed 6.66%, fall during playing 20%, fall due to RTA 26.68% [6]. In this series, Gartland type III fractures were included, with no open fracture. The relative frequency postero-medial was 18(60.0%) and postero-lateral 12(40.0%). In other series of supercondylar fracture Gartland type – III fracture posterior-medial are more common 58% out of 88% posterior displacement [10]. In another study posteromedial displacement was 80% and posterolateral displacement was 20% [6]. In this series patient usually presented with a range of 2 hours to 24 hours, average delay at presentation was 8.06 hours. In other series of super condylar fracture patient usually presented with a range of ½ an hour to 72 hours, average delay at presentation was 4.9 hours [6]. A delay of more than 12 hours in presentation [11]. In current study, 22 (73.3%) of the patients stayed in the hospital for 1 day and 8 (26.7%) of the patients stayed in the hospital for 2 days. The mean duration of hospital stay was 1.26 ± 0.45 days. In other study done by Lal *et al* [12] reported average stay in hospital was 7±1 days. In another study average hospital stay was=2.4 days [1]. In this study, the loss of flexion of elbow, 10% no loss of flexion, 10% show's loss of flexion of elbow was (1-5) degrees, 60% shows loss of flexion of elbow was (6-10) degrees and 20% shows loss of flexion of elbow was (11-15) degrees, mean loss of flexion of elbow was 9.53± 5.048 degrees. In other series; Anowar *et al*., 2011 [13], the mean loss of elbow flexion were 8.38^0 ± 3.10 degrees, Foead *et al*., the loss of elbow flexion were 8.68^0 in medial-lateral pin fixation, the loss of elbow flexion were 11.26^0 in two lateral pin fixations. In other series Shoaib et al.[5], 2(10%) patient got cubitas varus, 1(5%) elbow stiffness, 2(10%) pin tract infection and 1(5%) transient ulnar nerve palsy, vascular compromise was reported in none of the patient. In this study, the loss of carrying angle, 10% no loss of carrying angle, 13.33% shows loss of carrying angle was 4(1-5) degrees, 56.66% shows loss of carrying angle was (6-10) degrees and 20% shows loss of carrying angle was (11-15) degrees, mean loss of carrying angle was 8.5 ±5.61 degrees. Carrying angle loss was 3.70°, excellent result in 25 patients, good in 3 and fair in 1 patient. In group B (both side pin fixation) three iatrogenic ulnar nerve injuries was found. Carrying angle loss was 3.57°, excellent result in 24 patients, good in 5 and fair in 2 patients. Shoaib et al. [5] 13(65%) patients were found to have excellent outcome (if both loss of elbow motion and loss of carrying angle = (0-5) degrees, Four (20%) patients turned out with good outcome (if both loss of elbow motion and loss of carrying angle = (6-10) degrees, Three (15%) patients turned out with poor outcome (if both loss of elbow motion and loss of carrying angle (>15%) degrees. None of the 20 patients turned out with fair results (i e both loss of elbow motion and loss of carrying angle (I 1- 15%) degrees. In this study, among 30 Patient, there are 27(90.0%) radiologically sufficient callus formation and 3(10.0%) patients had no sufficient callus formation. In radiological union- 3 out of 4 cortices with bridging callus [14-20].

CONCLUSION

Finally, the result shows that in Gartland type-III closed supracondylar fracture of the humerus, closed reduction and stabilization by two lateral parallel percutaneous 'K'-wires is the good method for treatment.

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