

Evaluation of Gartland Type-III Closed Supracondylar Fracture of Humerus in Children Treated by Lateral Percutaneous K-Wires under C-Arm Guidance

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Abstract

Introduction: This study has been designed to evaluate the success rate of closed reduction and stabilization by two lateral parallel percutaneous K-wires with the help of C-arm in the management of Gartland type-III closed supracondylar fracture of humerus in children. **Materials and Methods:** A prospective quasi experimental study was conducted from January 2015 to December 2016 in NITOR. A total of 30 patients of Gartland type-III closed supracondylar fracture of humerus in children presenting between ages 3-12 years. Informed written consent was taken from patient's guardian. Regular follow up was targeted for at least 6 month's. Result was evaluated according to Flynn's grading. **Results:** Mean age was 6.85 ± 2.37 years, number of patients were 30, Male patients were more affected 22 (73.33%) than female 8(26.67%), left side patients were more affected. Mean loss of elbow flexion was 9.53 degrees, mean loss of carrying angle was 8.5 degrees. Complications included four (13.33%) cases of pin tract infection, four (13.33%) cases of fracture blister, one (3.33%) case of median nerve palsy, two (6.66%) cases of inadequate pin fixation at first attempt. There were six excellent (20%), eighteen good (60%), three (10%) fair and three (10%) poor results according to Flynn's grading. The overall 90% satisfactory result and rest 10% unsatisfactory result. **Conclusion:** Closed reduction and stabilization by two lateral parallel percutaneous K-wires is a better method for treatment of Gartland type-III closed supracondylar fracture in children.

Key words: Evaluation of Gartland Type-III, Supracondylar Fracture of Humerus.

Number of Tables: 08; **Number of References:** 20; **Number of Correspondence:** 07.

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Introduction:

In children supracondylar fracture of humerus is the commonest fracture. This fracture is common in the 1st decade of life due to ligament laxity. The fracture line is generally transverse; results from a fall on the outstretched hand, and should always be suspected, if child complains of pain in the elbow after such an injury. These injuries can also occur due to fall from height and assault by any mean¹. The most popular method of treating the severely displaced unstable supracondylar fracture was described by Dunlop. Other methods are modifications of Dunlop's, employing skeletal traction through the olecranon, pulling horizontally or vertically. Traction methods need approximately three weeks of hospitalization. Treatment in traction usually loss of carrying angle. Treatment by open reduction and internal fixation is not popular because the method has some complications such as limitation of motion². The extension type of supracondylar fracture of the humerus is the most common, occurring in 95% of cases. About one-third show little or no displacement and in these treatment is simple. The remainder is associated with varying degrees of major displacement which is difficult to treat. For most cases, manipulative reduction and immobilisation in a plaster slab is the procedure of choice, but early and late complications can occur. Cubitus varus is the commonest of the late complications. When the elbow is in extension, both the extensor and the flexor muscles are mechanically neutralized and the carrying angle can be judged accurately, clinically and radiologically. In recent study it is postulated that a method of manipulative

reduction, immobilization and fixation using a U-shaped plaster slab with the elbow in full extension would allow the displaced fragment to be easily reduced and retained after reduction³. There are various modalities of treatment advised 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 fracture⁴. In third and fourth century, Hippocrates described supracondylar fractures (SCF) of the humerus in children⁵. In 1826, Astley Cooper and in 1921, Robert Jones recommended treating these fractures using the collar and cuff technique cited in English-language literature⁶. In 1965, El-Sharkawi and Fattah described the treatment of supracondylar fractures in extension: in one of these a plaster cast was used⁷. Devkota et al. 2008, studied 102 displaced supracondylar fractures of humerus, aged between one and half to 13 years. They were treated closed reduction percutaneous Kirschner wire fixation under C-arm fluoroscopy. Seventy nine patients were treated by cross K-wires and in twenty three cases lateral two K-wires were put. All patients were followed upto 14th week postoperatively⁸. At the lower end, four secondary centres appear. There is one for capitulum and lateral ridge of the trochlea at 2nd year, one for medial epicondyle at 5th year, the remainder of the trochlea at the 12th year and the lateral epicondyle at the 13th year. The medial epicondyle remains as a separate centre, separated by a downward projection of the shaft from the other three which fuse together. Union with the shaft occurs at about 16th year. (Skaggs and Flynn, 2015)⁹.

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.

Materials and Methods:

This prospective quasi experimental study was conducted from January 2015 to December 2016 (24months) at National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka. 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 from January 2015 to December 2016. Purposive sampling (non-randomized) according to availability of the patient and strictly considering the inclusion and exclusion criteria.

Inclusion criteria: Age: between 3 to 12 years, Sex: Both sexes, Type III supracondylar fracture of humerus in children, Those presented within 5 days after injury, Closed fracture, Extension type. Exclusion criteria: Open fractures, Pathological fractures, Age before 3 and after 12 years. Flexion type, Type III fracture with compartment syndrome,

late presentation after 5 days. 1.8mm or 2mm K wires selected according to the age. First wire started from the tip of lateral epicondyle directed across the fracture towards the medial cortex in 50° to 60° angle. K wire position in lateral view confirmed. 2nd wire passed 1 cm below the first K wire and passed exactly parallel to it, crossing the olecranon fossa and having 4 cortical purchase. Elbow extended and rotated, stability of fracture assessed under C-Arm. If we feel like cortical purchases are inadequate, remove wire and again we can put 2nd wire in similar fashion, between the parallel wires. All wires cut after bending, outside the skin and supported by LABS.

Results:

The results were assessed on the basis of Flynn's criteria (Flynn, et al., 1974). Table-1 shows that are The youngest patient in our series is 3 years old and the oldest is 12 years. Majority were in 5-8 years. 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-II. In the present series, 19 (63.3%) with left sided supracondylar fracture of humerus and 11(36.7%) presented with right sided supracondylar fracture of humerus. The results are shown in Table-III. 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-I: Age, Sex, Side and Causes distribution of the participants (n=30).

	Group of variable	No of Patient	Percentage (%)	Mean±SD
Age	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	
Side	Left	19	63.3	
	Right	11	36.7	
	Total	30	100.0	
Causes	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	

Table-II: Time interval between injury and operation.

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-III: 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(\pm SD)
No Loss	3	10.0	8.5 \pm 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 \pm 5.61 degrees.

Table-IV: Distribution of the patients by loss of elbow flexion and carrying angle according to Flynn's criteria.

		No of Patient	Percentage (%)	Mean \pm SD
Loss of range of motion in degrees	No Loss of flexion	3	10.0	9.53 \pm 5.048 Degrees
	1-5	3	10.0	
	5-10	18	60.0	
	10-15	3	10.0	
	>15	3	10.0	
	Total:	30	100%	
Loss of carrying angle in degrees	No Loss	3	10.0	8.5 \pm 5.61 Degrees
	1-5	4	13.3	
	5-10	17	56.7	
	10-15	3	10.0	
	> 15	3	10.0	
	Total:	30	100%	

Table-V: Distribution of complications (n=30).

Complication	No. of Patients	Percentage (%)
Pin tract infection	4	13.3
Fracture blister	4	13.3
Median nerve palsy	1	3.3
Failure of fixation	2	6.7
Volkman's Ischemia	0	0
Radial nerve palsy	0	0
Ulnar nerve palsy	0	0
No complications	19	63.3

In this series 4 (13.3%) patients out of 30 cases developed pin tract infection, 4(13.3%) patients out of 30 cases were developed fracture blister. All are superficial infection and culture shown staphylococcal infection, according to sensitivity, antibiotic was given and cured. In this series 1% (3.3%) patient's median nerve palsy and 2(6.7%) patients had inadequate pin fixation first attempt. The pins had to removed and refixed after second reduction.

Table-VI: Shows loss of motion and carrying angle in different groups of functional outcome.

Loss of motion in degree	Loss of carrying angle in degree	Grading	Percent (%)
0-5	0-5	Excellent (6)	20.0
5-10	5-10	Good (18)	60.0
10-15	10-15	Fair (3)	10.0
> 15	> 15	Poor (3)	10.0

Functional outcome was analyzed by Flynn's grading. In this study, all 30 patients were treated by closed reduction and percutaneous K-wire fixation. 6 (20%) out of 30 were provided excellent results, 18 (60%) out of 30 cases shown good results and 3 (10%) out of 30 fair outcome and 3 (10%) out of 30 cases poor outcome.

Table-VII: Final outcome according to Flynn Criteria.

No. of Cases	Grading			
	Excellent Number (%)	Good Number (%)	Fair Number (%)	Poor Number (%)
30	6(20.0)	18 (60.0)	3 (10.0)	3 (10.0)

Final Outcome was analyzed by Flynn's grading. In this study there were 6(20.0%) cases with excellent, 18(60.0%) were good and 3 (10.0%) were fair and 3(10.0%) were poor functional outcome.

Table-VIII: 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 outcomewassatisfactory result (Excellent, Good and Fair) were 27(90.0%) and unsatisfactory result (poor) was 3(10.0%).

Discussion:

In this series, sample sizes was 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 20⁹.

In this study mean age of the patients were 6.85 \pm 2.37 years. In other series of supracondylar fracture, mean age of 6.1 \pm 3.07 years¹⁰.

In this study, left side was more involved in 19 (63.3%) of patients. While right side fracture was 11(36.7%). In other series of supercondylar fracture, left side (60.24%), right side (39.76%)¹¹.

In this studies 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 supracondylar fracture most common cause fall from height 46.66%, fall from bed 6.66%, fall during playing 20%, fall due to RTA 26.68%¹². 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 callus¹³. 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, the mean loss of elbow flexion were 8.38 ± 3.10 degrees, Foad et al. the loss of elbow flexion were 8.68° in medial-lateral pin fixation, the loss of elbow flexion were 11.26° in two lateral pin fixation¹⁴. Percutaneous lateral parallel K-wire fixation can solve the problem. It requires general anaesthesia, aseptic precaution, C-arm followed by antibiotic therapy. Percutaneous pin can be fixed through lateral condyle. Though stability of fixation incase of medial-lateral pin fixation is biomechanically more than lateral pin fixation but there is more chance of ulnar nerve injury in medial K-wire fixation. This problem can be solved by only lateral pin fixation. We think that the treatment of Gartland type-III closed supracondylar fracture of the humerus in children with only a lateral K-wire would be safer and more convenient¹⁵. 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 supracondylar fracture patient usually presented with a range of ½ an hour to 72 hours, average delay of more than 12 hours in presentation¹⁶. 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 supracondylar fracture a delay of more than 12 hours in presentation¹⁷. In this study, mean loss of carrying angle was 8.5 ± 5.61 degrees. Vaidya (2009) showed in group A (Lateral pin fixation) mean loss of carrying angle was 3.70° and In group B (both side pin fixation) mean loss of carrying angle was 3.57° ¹⁸. 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 years¹⁹. 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; Foad et al. the loss of elbow flexion were 8.68° in medial-lateral pin fixation, the loss of elbow flexion were 11.26° in two lateral pin fixation²⁰. In this study, 1(3.33%) patient had medial nerve palsy, pin tract infection 4(13.33%), fracture blister 4(13.34%), failure of fixation 2(6.67%), 2 patients had inadequate pin fixation at first attempt, which did not get contact with the proximal fragment. In other series, cited an incidence of 18% vascular and 8% neural complications in his 72

displaced supracondylar fracture study². In this study, Final outcome of our study, 6(20.0%) cases were excellent, 18(60%) were good and 3(10%) were fair and 3(10%) had poor result among 30 cases. The overall satisfactory result (including the excellent, good and fair) was 90%. In other series of supracondylar fracture, Flynn et al. (1974) achieved 98% satisfactory results. Good functional and cosmetic outcome is our goal. For this closed reduction and stabilization by two lateral parallel percutaneous K-wire is a better option.

Conclusion:

There are several methods of treatment of this fracture, closed reduction and percutaneous lateral K wire pinning through lateral epicondyle provides good stabilization with less chance of iatrogenic nerve injury, less complications, no fracture re-displacement, no post-operative deformity and almost quite normal functional outcome.

Conflict of Interest: None.

Acknowledgement:

Thanks and all praise to Almighty Allah, the beneficent, the merciful for providing us enough energy and patience to complete this article. Our special thanks and gratitude to Prof. Dr. Md. Shah Alam, National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka, Bangladesh. Prof. Dr. Shaymol Chandra Dabnath, National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka, Bangladesh for providing instructions, encouragement and valuable advice from beginning of this study. We should like express our sincere gratitude and grateful to all Teachers, Doctors and Employee in the department of Orthopedics National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka, Bangladesh for valuable suggestion and advice to complete this study.

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