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Outcome of Percutaneus K Wire Fixation for Paediatric Supracondylar Humerus Fracture

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Abstract **Original Research Article**

Introduction: Elbow joint is the most common part of upper limb involved in pediatric fractures and 85% of which occur in the distal humerus. In distal humeral fractures, supracondylar humeral fractures are very difficult to treat in the pediatric population.-3Frequently, the mechanism of injury is direct or indirect traumas like falls ,on out stretched hand .This type of fracture requires instant diagnosis and proper management, because any undue delay may complicate the condition and treatment. ***Methodology:*** This prospective cross-sectional study was carried out at the department of Orthopaedics Surgery in Dhaka Orthopaedics Hospital, Dhaka, Bangladesh from January 2018 to December, 2019. The Ethical clearance of this study was obtained from the ethics committee of the hospital. A written informed consent was obtained from all the patients (by their parents) and a total of, 18 children aged (5-15) years ,with Grade II and III closed supracondylar fractures of humerus were included in this study. The collected data were analyzed using Statistical Package for Social Sciences (SPSS) software, version-23.0. Chi-square tests were performed to compare the results of the follow up, where $p<0.05$ considered as the level of significance. ***Results:*** A total of 18 children were enrolled in this study. According to sex distribution, 12(67%) children were male and 6(33%) children were female. According to age distribution, 12(67%) children were aged (5-10) years and 6(33%) children were aged (11-15) years. The mean age of the children was 9.16 years. The mode age was 7 years and the median age was 9 years. According to fracture classification, 12 (67%) had Gartland class II and 6(33%) children had Gartland class III. According to mechanism of injury distribution,10(55%) children fall while playing, and followed by 5(28%) fall from the height, 2(11%) children met road traffic accident and 1(6%) children had blunt trauma. On an average, the children aged (5-10) years started elbow movement within 11. 66 days and the children aged (11-15) years started elbow movement within 12 days. The children aged (5-10) years achieved full range of movement within 7.8 weeks and the children aged (11-15) years achieved full range of movement within 8.66 weeks. The children aged (5-10) years got radiological union within 6.5 weeks and the children aged (11-15) years got radiological union within 8.66 weeks. The K-wires of the children aged (5-10) years were removed by 12.91 months and the K-wires of the children aged (11-15) years were removed by 14.15 months. According to final visit at 8 months, in cross K wire group, excellent were observed 7(78%) and 2(22%) were observed good whereas in lateral K wire group, excellent were observed 9(100%) which was statistically non-significant (p=0.092).According to post- operative complications, 2(11%) children got ulnar nerve injury and only 1(5.5%) children got pin tract infection.***Conclusion:***This study suggest that the lateral percutaneous pinning technique of displaced Supracondylar fractures of the humerus offers a viable alternative to the crossed pinning group as it offers the same stability without the incipient risk of iatrogenic ulnar nerve injury.

Keywords*:* K Wire Fixation, Close Reduction, Chi Square Test, Humerus, Percutaneous Pinning, Supracondylar Fracture.

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INTRODUCTION

Elbow joint is the most common part of upper limb involved in pediatric fractures and 85% of which occur in the distal humerus. These distal humeral fractures are usually supracondylar and these supracondylar humeral fractures are very difficult to treat in the pediatric population [1, 3] Frequently, the mechanism of injury is direct or indirect traumas like falls, leading to comminution or open fractures [4]. This

type of fracture requires instant 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 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 [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 [15]. This study was conducted to determine the functional outcome of percutaneous K-wire fixation in pediatric supracondylar humeral fracture. The findings of our study may provide justification of using k-wires as a preferred method of treatment in the Paediatric population of Bangladesh

OBJECTIVES

General objective: To determine the outcome of percutaneus K wire fixation for paediatric supracondylar humerus fracture

Specific objectives:

- To determine the demographic characteristics of the study patients.
- To know the fracture classification of the study patients.
- To find out the mechanism of injury among the study patients.
- To determine the functional outcome of percutaneous K wire fixation.

METHODOLOGY

This prospective cross-sectional study was carried out at the department of Orthopaedics Surgery in Dhaka Orthopaedics Hospital, Dhaka, Bangladesh from January 2018 to December, 2019. The Ethical clearance of this study was obtained from the ethics committee of the hospital A written informed consent was obtained from all the patients (by their parents) and a total of, 18 children aged (5-15) years, with Grade II and III close Supracondylar fractures of humerus were included in this study. They were treated either with medial-lateral pin fixation (n = 9) or with 2-lateral pin fixation (n = 9). The time of operation ranges from the 1st day of injury to the 8th day of injury with the mean time of operation being 4.7 days. The patients were evaluated as described by Flynn and the results compared with the contra lateral normal elbow.2 Under general anaesthesia, using c-arm fluoroscopy closed reductions were done.21 When satisfactory reduction had been achieved, then fixations were done by -wires of 1.5 or 2.0 mm size and well-padded above-elbow posterior back-slabs were applied. The patients were carefully observed for 12-72 hours (average 58 hours) and then discharged. The above-elbow plaster of paris (POP) back slabs were kept for two to three weeks and the pins and slab were removed in the outpatient (OPD) clinic. Elbow Range of motion (ROMS) was started after removing the POP back slab. The follow-ups were arranged as follows: The first follow-up on the 7th day to inspect the wound; the second follow-up on the second week for wound inspection or suture removal and to see the pin configuration. Within 2-3 weeks, x-rays were taken to see the callus formation; if callus is formed, then we remove the pop and pins and to start physiotherapy; the first follow up was observed on the 2nd month and the second follow-up was on the 4th month post-operatively to see the ROM and carrying angle of the elbow, and the final follow-up was on the 8 months post-operatively to see the final result of the study. The data were collected using a case record form. The collected data were analyzed using Statistical Package for Social Sciences (SPSS) software, version-23.0. Chi-square tests were performed to compare the results of the follow up, where $p<0.05$ considered as the level of significance.

RESULTS

Table 1: Demographic characteristics of the study patients (n=18).

Characteristics	Frequency	Percentage (%)
Age (in years)		
5-10	12	67
11-15	6	33
Gender		
Male	12	67
Female	6	33
Mean age:	9.16	
Mode:	7	
Median:	9	

Table 1 shows the demographic characteristics of the study patients. According to demographic characteristics distribution, 12(67%) children were aged (5-10) years and 6(33%) children were aged (11-15) years. 12(67%) children were male and 6(33%) study children were female. The mean age of the children was 9.16 years. The mode age was 7 years and the median age was 9 years.

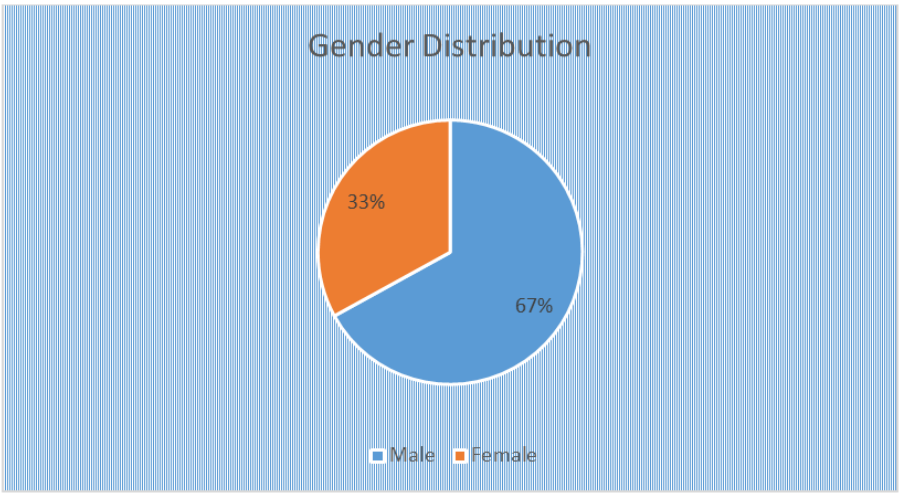

Fig. 1: Shows gender distribution of the study children

Table 2: Fracture classification of the study patients (n=18).

Types of Fracture	Frequency	Percentage (%)
Gartland class II	12	67
Gartland class III	6	33
Total	18	100

Table 2 shows the fracture classification of the study patients. According to fracture classification, Gartland class II were 12 (67%) and Gartland class II were 6(33%).

Table 3: Mechanism of injury observed among the study patients (n=18).

Mechanism of injury	Frequency	Percentage (%)
Fall while playing	10	55
Fall from height	5	28
Road traffic accident	2	11
Blunt trauma	1	6
Total	18	100

Table 3 shows the mechanism of injury among the study patients. According to mechanism of injury distribution, fall while playing were 10(55%) and followed by fall from height 5(28%), road traffic accident 2(11%), blunt trauma was 1(6%).

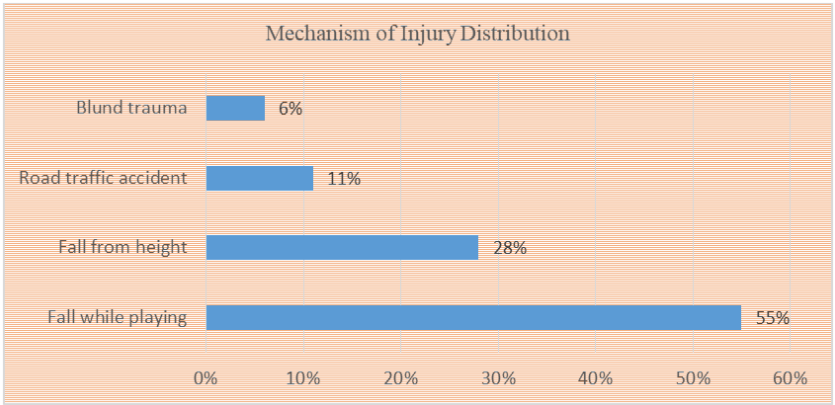

Fig. 2: Shows the mechanism of injury distribution

Table 4: Mean time of elbow movement of the study patients (n=18).

Age group (in years)	Mean time of elbow movement (in days)
5-10	11.66
11-15	12

Table 4 shows the mean time of elbow movement of the study children. On an average, the children aged (5-10) years started elbow movement within 11, 66 days and the children aged (11-15) years started elbow movement within 12 days.

Table 5: Mean time of achievement of full range of movement of the study patients (n=18).

Age group (in years)	Mean time of achievement of full range of movement (weeks)
5-10	7.8
11-15	8.66

Table 5 shows the mean time of achievement of full range of movement of the study patients. On an average, the children aged (5-10) years achieved full range of movement within 7.8 weeks and the children aged (11-15) years achieved full range of movement within 8.66 weeks.

Table 6: Mean time of radiological union of the study patients (n=18).

Age group (in years)	Mean time of radiological union (weeks)
5-10	6,5
11-15	8.66

Table 6 shows the mean time of radiological union of the study children. On an average, the children aged (5-10) years got radiological union within 6.5 weeks and the children aged (11-15) years got radiological union within 8.66 weeks.

Table 7: Mean time of removal of K-wires of the study patients (n=18).

Age group (in years)	Mean time of removal of K-wires (months)
5-10	12.91
11-15	14.15

Table 7 shows the mean time of removal of K-wires of the study children. On an average, the K-wires of the children aged (5-10) years were removed by 12.91 months and the K-wires of the children aged (11-15) years were removed by 14.15 months.

Table 8: Outcome of percutaneous K wire fixation at 8th month according to Flynn Criteria (n=18).

Grading	At 2months		At 4 months		At 8months	
	Cross	Lateral	Cross	Lateral	Cross	Lateral
Excellent	6	3	7	8	7	9
Good	2	3	1	1	2	0
Fair	1	2	1	0	0	0
Poor	0	1	0	0	0	0
P-value	0.238^{NS}		0.287^{NS}		0.092^{NS}	

Table 8 shows the functional outcome of percutaneous K wire fixation at 8th month according to Flynn Criteria. First follow up at 2 months, in cross K wire group, excellent were observed 6 and followed by 2 good, 1 fair, and no poor while in lateral K wire group, excellent were observed 3 and followed by 3 good, 2 fair, and 1 poor(p=0.238). During second follow at 4 months, in cross K wire group, excellent were observed 7 and followed by 1 good, 1 fair, and no poor while in lateral K wire group, excellent were observed 8 and followed by 1 good, 0 fair, and 0 poor(p=0.287). Final visit at 8 months, in cross K wire group, excellent were observed 7 and 2 were observed good whereas in lateral K wire group, excellent were observed 9 and 0 was observed good which was statistically non-significant(p=0.092).

Table 9: Postoperative complications observed among the study patients (n=18).

Complications	Frequency	Percentage (%)
Ulnar Nerve injury	2	11
Pin tract infection	1	5.5

Table 9 shows the postoperative complications observed among the study patients. Among 18 children, 2(11%) got ulnar nerve injury and only 1(5.5%) children got pin tract infection.

DISCUSSION

Management of displaced extension type II and III Supracondylar fracture of humerus treated by close reduction and percutaneous pin fixation has consistently given satisfactory result compared to other method of treatment. However, controversy persists regarding the adequate pin fixation technique comparing medio-lateral and lateral pin fixation. In this study, not much difference between both fixation methods in terms of stability was found but there is an evidence of iatrogenic ulnar nerve injury (11%) in cross K wire pin fixation group, while pin tract infection was observed in lateral K wire group. Complete transaction of the nerve or neurotmesis was not seen in this study. The total strength of this construct is not only related to pin entry but mainly to divergence of the pins in different column and number of pins. The greater strength seen with the divergence of the pins was related to the location of the interaction of the two pins and the fact that the greater amount of divergence between the two pins allow for some purchase in the medial and lateral column [16]. Some studies suggested for the use of the third wire to prevent the displacement of the distal fragment [17]. The use of a third pin requires the medial pin to enter the joint and thus increases the risk of joint penetration and infection. The use of two pins laterally was preferred to decrease the risk of infection [18]. The most common complication in the treatment of closed reduction and percutaneous pinning of displaced Supracondylar fractures of the humerus is iatrogenic ulnar nerve palsy with the use of medial pin [19]. In this study, the results of both lateral and cross pin insertion groups at 4th post-operative month showed excellent results in around 84% of patients. At the final follow-up at 8th month, these excellent results were seen in around 90% of the cases. In post-operative period, physiotherapy plays a significant role in increasing the ROM of the elbow joint. Those patients who had good or fair results were having severe soft tissue injuries or repeated closed reduction. Khan obtained 88% excellent, 4% good and 4% poor results in his study [20]. Tiwari observed 88% satisfactory results, among which 42% were excellent, in his series of late presenting Supracondylar fractures of humerus in children [21]. These two studies are comparable to our study. In our study, 5.5% patients developed pin-tract infections, which were superficial and healed after removing pins and administration of oral antibiotics. No deep infection or septic arthritis was found. Pirone found superficial pin-tract infection in 2% of cases with no deep infection and septic arthritis [22]. In the present series, the distal pin migration was seen in five (2.94%) patients and loss of reduction in six (3.52%), which were not significant and so required no re-reduction and re-pinning. Gordon observed pin-tract migration in 6% of cases and Lee noticed the loss of reduction in 7%. Lee *et al.,* stated that the lateral pinning technique was found to be more beneficial than the medial and lateral crossed pinning technique for Supracondylar fractures of the humerus in children, on the basis of current evidences [23]. However, avoiding the worst clinical scenario might be more important and affordable than obtaining favorable clinical results at the potential cost of disastrous complications. Dua *et al.,* proposed that closed reduction and crossed pinning of displaced Supracondylar fractures of humerus in children is a safe and effective method even with delayed presentation. Erpelding *et al.,* stated that Open treatment of distal humeral fractures with an extensor mechanism-on approach results in excellent healing, a mean elbow flexionextension arc exceeding 100°, and maintenance of 90% of elbow extension strength compared with that of the contra lateral, normal elbow. Woratanara *et al.,* stated that lateral pinning is preferable to cross pinning for fixation of pediatric Supracondylar humerus fractures as a result of decreased risk of ulnar nerve injury [22- 24]. The main goal of the treatment of displaced paediatric Supracondylar humerus fractures is to achieve an anatomic reduction. This reduction should be supported by a fixation with a good stability and less morbidity. When all these are taken into consideration, the percutaneus K wire fixation method will be the best procedure for paediatric supracondylar humerus fracture treatment in Bangladesh.

CONCLUSION

This study suggest that the lateral percutaneous pinning technique of displaced Supracondylar fractures of the humerus offers a viable alternative to the crossed pinning group as it offers the same stability without the incipient risk of iatrogenic ulnar nerve injury.

Limitations of the Study

This study was conducted with a purposive small sample size for a very short period. Therefore, a further study may be recommended with a large sample size for a long study period.

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