Comparison of Open reduction and internal fixation by Stabilization with cross K-wires in early versus late presentation of Supracondylar Humeral Fractures in Children

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ABSTRACT

Objective: To compare open reduction and internal fixation by stabilization with cross k-wires in early (within 6 days of injury) versus late (2 to 4 weeks) presentation of supracondylar humeral fractures in children.

Study Design: A quasi experimental study

Place and Duration: Department of Orthopedic, Lahore General Hospital, Lahore from 1st January 2021 to 30th June 2021.

Methodology: A total of 42 cases (21 children in Group-A with early presentation and 21 in Group-B with late presentation) of Gartland's type II and III humeral supracondylar fracture were included. All open reduction and internal fixation procedures were done by a single surgical team while post-surgical follow up consisted of 3-months. Functional and cosmetic outcome of surgery were observed in terms of decrease in carrying angle and elbow movements as per Flynn's criteria.

Results: Out of a total of 42 cases, there were 71.4% male and 28.6% female. The mean age of children in Group-A was 8.29±1.85 years while it was 7.43±2.06 years in Group-B. Mean procedure time was noted to be 0.91±0.35 hours in Group-A and 1.38±0.25 hours in Group-B ($p<0.001$). All cases were found to have satisfactory wound condition and bony union. Decrease in range of motion of elbow as $0\text{-}5^0$, $6\text{-}10^0$, and $11\text{-}15^0$ in 10, 9 and 2 cases in Group-A respectively in comparison to 4, 14 and 3 cases in Group-B respectively ($p=0.145$). Functional outcome in 33.3% cases was excellent, good in 54.8% and fair in 11.9% cases while there was no difference in between both study groups ($p=0.145$).

Conclusion: There is no significant difference in functional outcomes of early or late presentation in children undergoing open reduction and internal fixation for supracondylar fractures.

Keywords: Supracondylar fracture, Humerus, Children, Early presentation, Late presentation, Open reduction, Internal fixation, K-wire stablization, Functional outcome.

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INTRODUCTION

Pediatric supracondylar fracture is a common occurrence during 1st 10 years of life with peak incidence in 6-9 years of life.[1] Epidemiological data analyzing pediatric elbow fractures calculated incidence of supracondylar fractures to be around 58%.[2] The supracondylar area of humerus in children in composed of thin and weak bone. Its anterior border is coronoid fossa while posterior is olecranon fossa. These fractures presenting within 6 days of trauma are considered early presentation whereas those presenting after 7 or more days of injury are termed as late presentation.[3] The supracondylar fracture occurs usually after falls. Force is transmitted to weak supracondylar region via olecranon, resulting in a proximal fracture fragment may displace anteriorly while the distal fragment posteriorly leading to a transverse fracture line just above the growth plate.[4]

Un-displaced supracondylar fractures are treated conservatively but treatment of displaced fractures remains controversial. In past years, skeletal traction and immobilization were thought to be the customary measures for managing the supracondylar fractures.[5] The disadvantages of continuous traction are

prolonged hospitalization, exposure to frequent radiographic analysis, and improper reduction. Malunited supracondylar fractures usually result in cubitus varus deformity which is the cause of cosmetic dissatisfaction and functional impairment and need various corrective procedures.[6]

The standard mode of treatment is open reduction and internal fixation (ORIF) in supracondylar fractures of humerus.[7] A good cosmetic and functional result can also be achieved by K-wiring in supracondylar fractures of humerus.[8] The ORIF of late presenting supracondylar fractures provides satisfactory results and minimize hospital stay when compared to non-operative cases. Surgical treatment gives satisfactory but not excellent outcomes.[9] Wamsley et al studied the results of open osteoclasis and K-wiring for all supracondylar fractures presenting between 2-4 weeks after injury.[10] It was recommended that for functional, social and psychological satisfaction of the patients, it is better to go for ORIF in such fractures with late presentation (2-4 weeks) rather than to wait for deformity to occur and plan subsequent corrective osteotomy. In the present study, we hypothesized that for functional outcome, it is better to go for ORIF in patients with late presentation within 2-4 weeks rather than to wait for deformity to occur and plan for subsequent corrective osteotomy. This study was done to compare ORIF by stabilization with cross k-wires in early (within 6 days of injury) versus late (2 to 4 weeks) presentation of supracondylar humeral fractures in children. This study was done with an objective to compare open reduction and internal fixation by stabilization with cross k-wires in early (within 6 days of injury) versus late (2 to 4 weeks) presentation of supracondylar humeral fractures in children.

METHODOLOGY

This quasi experimental study was conducted at the Department of Orthopaedics, Lahore General Hospital, Lahore from 1st January 2021 to 30th June 2021. Inclusion criteria were children of both genders aged 3 to 12 years with Gartland type II and III fractures. Exclusion criteria were children with vascular injuries or those whose parents/guardians did not want to be part of this study were excluded. Informed and written consent was sought from parents/guardians of all study cases. Approval from institutional ethical review committee was acquired for this study.

Using purposive, non-probability sampling technique, we enrolled 21 children in Group-A (early presentation as within 6 days of injury) and 21 in Group-B (late presentation as 2-4 weeks after injury). At the time of enrollment, demographic information like gender, age and area of residence were noted. All cases underwent general anesthesia for surgical procedure. Pre-anesthesia check-up was done in all cases. All cases were kept nil by mouth for 6 hours prior to surgery. In Operation Theater, antibiotic (injection ceftriaxone 500 mg) was given intravenously for surgical prophylaxis following skin sensitivity test half an hour before the start of surgery. Surgery was performed under general anaesthesia, following strict sterilization techniques and under torniquet control. Patient was placed lateral on operation table with injured limb up, elbow in flexed position and forearm hanging down over resting side post of table. A 4 to 6cm posterior skin incision given, ulnar nerve identified and protected with a sling, triceps muscle splitted, fracture exposed, hematoma was drained. Gentle manipulation with slight traction done to get reduction, once satisfactory reduction achieved, 1.5mm to 2mm medial k-wire from anterior half of medial condyle to posterior cortex of humerus passed, reduction checked under C-arm, lateral wire passed from lateral condyle to medial cortex of humerus. Wires were left little proud and out of skin to facilitate removal at follow up. Torniquet released and hemostasis secured, capillary refill checked and wound closed. A back slab applied with elbow flexed at 90-100 flexion and supination. Patient discharged from hospital on 3rd day of surgery and follow up visit advised at 10-12 days for stitch removal, back slab removed and poly-sling applied to facilitate active flexion and extension advised to involve patient in gentle play therapy consisting of hand grasp and release and elbow flexion and extension. At four weeks, wires were removed under local anaesthesia and sedation. Parents and child were encouraged to use operated limb during play activity. At 10-12 weeks, if range of motion was still limited, then patient was referred to physical therapy department.

All patients were followed up until 3-months period. Post-surgery, infections, union time, heterotropic ossificans and time required to achieve pre-injury level of function were recorded. Outcome was evaluated as per Flynn's criteria (Table I).[11] All study information was noted on a pre-designed proforma.

For data analysis, SPSS version 26.0 was used. Frequency and percentages were used to represent qualitative data while mean and standard deviation (SD) were calculated for quantitative variables. Between both study groups, student t-test was used to compare quantitative data while chi-square test was employed to compare qualitative data. P-value $\leq$ 0.05 was considered as significant.

Table – I: Outcomes as per Flynn's Criteria (N=42)[11]

Parameter	Excellent	Satisfactory	Poor
Limb Length Inquality	<1 cm	<2 cm	>2 cm
Malalignment	Up to 5^0	$5\text{-}10^0$	$>10^0$
Pain	Non	Non	Present
Complications	None	Minor	Major Complications and/or lasting morbidity

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RESULTS

In a total of 42 children, there were 30 (71.4%) male and 12 (28.6%) female while male to female ratio was 2.5:1. Overall, mean age was found to be 7.86±1.98 years (ranging between 4 to 11 years). Mean age in Group-A was 8.29±1.85 years and 7.43±2.06 years in Group-B (p=0.162). Table II is showing characteristics of cases in both study groups.

Overall, the mean time required for surgery was 1.15±0.38 hours (ranging between 40 minutes to 2 hours). The mean time of surgery was significantly low in Group-A in comparison to Group-B (0.91±0.35 hours vs. 1.38±0.25 hours, p=<0.001). In the 1st

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post-operative week, there were 3 (7.1%) cases with superficial infection out of which, 1 belonged to Group-A and 2 to Group-B which were resolved later.

Table – II: Characteristics of Patients in Both Study Groups (N=42)

Characteristics		Group-A (n=21)	Group-B (n=21)	P-Value
Gender	Male	16 (76.2%)	14 (66.7%)	0.495
	Female	5 (23.8%)	7 (33.3%)	
Area of Residence	Urban	7 (33.3%)	9 (42.9%)	0.525
	Rural	14 (66.7%)	12 (57.1%)	
Age in Years (Mean±SD)		8.29±1.85	7.43±2.06	0.162*

Group-A: Early presentation as within 6 days of injury; Group-B: Late presentation as 2-4 weeks after injury
* Independent sample student t-test used

No other post-surgical complications were noted in the 3-months follow up period. At the time of final follow up (3-months), satisfactory wound condition was noted among all cases. Decrease in range of motion of elbow as $0\text{-}5^0$, $6\text{-}10^0$, and $11\text{-}15^0$ in 10, 9 and 2 cases in Group-A respectively in comparison to 4 (19.0%), 14 (66.7%) and 3 (14.3%) cases in Group-B respectively (p=0.145). Functional outcome in 14 (33.3%) cases was excellent, good in 23 (54.8%) and fair in 5 (11.9%) cases while there was no difference in between both study groups (p=0.145). Table III is showing comparison of intra-operative, post-operative and functional outcomes in both study groups.

Table – III: Comparison of Intra-Operative, Post-Operative and Functional Outcomes in both Study Groups (N=42)

Characteristics		Group-A (n=21)	Group-B (n=21)	P-Value
Number of K-Wires Used	2	10 (47.6%)	9 (42.9%)	0.757
	3	11 (52.4%)	12 (57.1%)	
Duration of Surgery		0.91±0.35	1.38±0.25	<0.001*
Wound Examination	Satisfactory	20 (95.2%)	19 (90.5%)	0.549
	Clear/ Haemo-serous Discharge	1 (4.8%0	2 (9.5%)	
Loss of Elbow Range of Motion	$0\text{-}5^0$	10 (47.6%)	4 (19.0%)	0.145
	$6\text{-}10^0$	9 (42.9%0	14 (66.7%)	
	$11\text{-}15^0$	2 (9.5%)	3 (14.3%)	
Loss of Carrying Angle	$0\text{-}5^0$	10 (47.6%)	6 (28.6%0	0.443
	$6\text{-}10^0$	9 (42.9%0	12 (57.1%)	
	$11\text{-}15^0$	2 (9.5%)	3 (14.3%)	
Functional Outcome (Flynn's Criteria)	Excellent	10 (47.6%)	4 (19.0%)	0.145
	Good	9 (42.9%)	14 (66.7%)	
	Fair	2 (9.5%)	3 (14.3%)	
Amount of Elbow Stiffness	Excellent	10 (47.6%)	4 (19.0%)	0.145
	Good	9 (42.9%)	14 (66.7%)	
	Fair	2 (9.5%)	3 (14.3%)	
Bony Union as per X-ray Findings		21 (100%)	21 (100%)	1

Group-A: Early presentation as within 6 days of injury; Group-B: Late presentation as 2-4 weeks after injury
* Independent sample student t-test used.

DISCUSSION

Among children, the most common fractures around the elbow are supracondylar fractures. These fractures are frequently neglected and thus present late, particularly in developing countries.[12] Many researchers have already expressed their opinion in favor of emergent treatment of these fractures in order to resist complications.[13]

In this study, there were a total of 30 (71.4%) male and 12 (28.6%) female. Eren et al and Tiwari et al in their studies also reported almost same mean age and same male to female ration.[14] This shows that male children are more prone of having supracondylar fracture of humerus. But in a study done by Walmsley, the male to female ratio was 1:1.06.[10] This fact meant that female children were at more risk of having supracondylar fracture which is in contrast to the results of this study.

We found that mean operative time was 0.91±0.35 hours in early presentation group while it was 1.38±0.25 hours in late presentation group (p<0.001). These results are very consistent with what Mehlman et al found in their study where cases in late presentation group needed significantly more surgery time in comparison to those with early presentation.[15]

We noted that superficial infections were reported in 7.1% patients in 1st post-surgery week which were resolved by antibiotics utilization while satisfactory wound condition was observed in 100% cases at final outcome along with complete bony union in all cases (100%) in both study groups. These findings are similar to Wlmsley et al and Mehlman et al where they noted almost same rates of post-surgery infections.[10,15] A study by Devkota et al reported 7.8% patients to have superficial pin tract infection following surgical management of supracondylar fractures of the humerus in children which is quite similar to what was reported by us.[16] A study by Waikhom et al reported mean delay in presentation of supracondylar fractures of humerus in children to be 7.5 days (ranging between 2 to 14 days) while 100% patients undergoing ORIF with K-wire had satisfactory functional outcomes as per Flynn's criteria which is quite similar to present findings.[9] Khan et al in a local study employing ORIF with K-wire also reported 97.5% satisfactory outcomes among children with supracondylar fractures of humerus.[17]

The most important issue among patients presenting late is stiffness. The factors adding up to severity of this issue are setback in treatment time of elbow joint and repetitive manipulations that result in hard swelling. The ORIF have been found to result in satisfactory range of motion in patients with late presentation. In this study, functional outcomes were statistically similar between early and late presentation groups. Tiwari et al in their study had fewer patients with unsatisfactory outcomes while others have also reported similar findings.[14]

Relatively small sample size and non-randomized study design were some of the limitations of this study. We couldn't report long term follow up among studied cases.

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CONCLUSION

There is no significant difference in functional outcomes of early or late presentation in children undergoing open reduction and internal fixation for supracondylar fractures.

AUTHOR'S CONTRIBUTION

Khan MZ: Conceived Idea, Designed Research Methodology, Literature Review
Basit MA: Literature Search, Manuscript writing
Shakeel M: Date Collection, Data interpretation
Akram MN: Statistical analysis
Hanif MM: Manuscript final reading and approval

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