Comparison of Outcome of three Different Approaches for Supracondylar Humerus Fractures in Children.

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ABSTRACT

Objectives: To compare the radiological and functional outcomes of lateral, medial and posterior approaches for open reduction and k wire fixation in children with type III supracondylar fractures of the humerus.

Methods: We conducted this retrospective Cohort study in Orthopedic department Dr. Ruth K M Pfau Civil Hospital Karachi. All children with type III supracondylar fracture of the humerus fulfilling the inclusion criteria operated in time period extending from 3rd January 2018 to 3rd December 2020 and with minimum one year follow up were included. The clinical records were reviewed for surgical approaches and children with lateral approach(LA),medial approach(MA) and posterior approach(PA) were asked for follow up visit. Radiological outcome was assessed by measuring Shaft Condylar Angle(SCA) and Baumann angle. Flynn's criteria was used for functional outcome in all children and results were categorized into Excellent, Good, Fair(satisfactory) and Poor(unsatisfactory). Results of lateral, medial and posterior approach were compared and *P* value was calculated with Chi-Square test and Kruskal-Wallis test (*P* value <0.05 significant).

Results: The total number of children in our study were 90. Each LA, MA and PA had 30 children each. Mean age of children in LA was 8.54 ± 4.5 years, MA 7.21 ± 3.5 years and PA 8.1 ± 6.1 years. Mean Shaft Condylar Angle was 42.2±7.1°, 42.5±3.2° and 41.3±2.7° in LA,MA and PA respectively(P> 0.05). Mean Bauman angle was 19.4±4.0° in LA, 20.3±6.3° in MA and 21.6±3.1° in PA (P> 0.05). Excellent outcome was noted in 22(73.33%),17(56.66%) and 15(50%) in LA,MA and PA respectively. (P> 0.05)Good outcome was noted in 8(26.66%) children in LA, 13(43.33%) in MA and 15(50%) in PA.(P >0.05)

Conclusion: Lateral approach for supracondylar fracture yielded better radiological and functional outcome than medial and posterior approach in our patients. The difference was however not statistically significant.

Keywords: Flynn's criteria, Functional outcome, Open reduction, Supracondylar fractures.

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INTRODUCTION

Paediatric supracondylar fractures accounts for 50 to 70% of upper limb fractures in 3 to 10 years old children.[1] Displaced fractures (Gartland type III) are treated with closed reduction and percutaneous pinning under image intensifier.[2,3] In children with open fractures, associated vascular injury and failure to achieve adequate fracture reduction with closed methods open reduction is mandatory.[1,4,5] No consensus has been achieved regarding the ideal surgical approach for displaced paediatric supracondylar fractures in terms of optimum functional and cosmetic results and with minimum complications.[6] One can find studies utilizing posterior, lateral, medial and anterior approaches for fixation of paediatric supracondylar fractures.[7-9] Each approach has its own merits, demerits and variable results.[10,11]

In our institution no guidelines exist regarding the surgical approach for supracondylar fractures and the approach depends upon individual surgeon's preferences and expertise rather than clinical evidence. The objective of our study was to compare the radiological and functional outcomes of lateral, medial and posterior approaches for open reduction and k wire fixation in children with type III supracondylar fractures of the humerus. The results of our study would be used to formulate guidelines for treating type III supracondylar fractures of the humerus.

METHODS

This retrospective Cohort study was conducted in Orthopedic department Dr. Ruth K M Pfau Civil Hospital Karachi. All children with type III supracondylar fracture of the humerus who were operated in time period extending from 3rd January 2018 to 3rd December 2020 and with minimum one year follow up were enrolled in this study. The study was approved by the Ethical Committte of our hospital. We included all those children who had Gartland type III fractures operated within a week of sustaining the factures with 2 crossed k wires one from lateral and other from medial epicondyle through identical lateral(LA), medial(MA) and Posterior(PA) approach. Children with open fractures, neurovascular injuries, compartment syndrome, poly trauma and resurgery were excluded. The radiographs and demographic details were collected from clinical records.

Surgical Techniques

The clinical notes were examined for detail operative notes. It was noted that lateral approach(LA) to the supracondylar fracture was executed with the patient supine and elbow across the chest. Under tourniquet control a 5 cm incision was given which extended from lateral epicondyle proximally to the distal humerus shaft . The lateral edge of fascia and triceps was dissected for fracture exposure and reduction. Manual reduction of fracture was ensured and fracture was stabilized with a k wire from lateral epicondyle. Another k wire was passed from medial epicondyle through a stab incision crossing the first k wire above the fracture. The k wires were cut, bent and buried under the skin.

The medial approach(MA) was executed in the supine position under tourniquet control with elbow across the chest. A 5cm medial incision at distal humerus was used for dissection and protection of ulnar nerve followed by fracture reduction and crossed k wires one from medial epicondyle and other from lateral through a stab incision. The k wires were cut, bent and buried under the skin.

The posterior approach(PA) was utilized with the patient in supine position with a tourniquet and limb across the chest. A 5 cm posterior midline incision was made over the elbow. The ulnar nerve was identified and protected. The triceps was elevated from both sides to facilitate fracture reduction. Two k wires one from medial and one from lateral epicondyles were used to stabilize fracture. The k wires were cut, bent and buried under the skin.

The clinical notes indicated identical post operative protocol for all approaches. Post operatively above elbow plaster slab was applied for 3 weeks. Stitches were removed at 2 weeks. Elbow range of motion exercises were started at 3 week. The k wires were removed at 6 weeks under short general anaesthesia and elbow manipulated for any stiffness. Post k wire removal all the children had minimum of two physiotherapy session to enhanced the elbow range of motion.

Parents of all the children with minimum of one year post operative duration were contacted for follow up visit of their children. In the follow up visit radiological assessment of alignment in coronal plane was done by measuring Baumann angle on AP radiograph whereas sagittal plane alignment was determined by measuring Shaft Condylar Angle (SCA) on lateral elbow radiograph.

Baumann angle was calculated on AP xray of elbow. One line was drawn along the humerus shaft and the other line along the lateral condyle physeal line. The intersection angle is the Baumann angle(normal 9 to 26 degrees).[12] Shaft Condylar Angle(SCA) was calculated on lateral xray elbow by drawing one straight line along the humerus shaft and the other line along the axis of capitellium dividing it into two equal parts. The anterior part of intersection of these two lines in the metaphysis of hmerus is the SCAS angle .(normal >40 degree).[13] Flynn's criteria(Table I)[14]was used for assessment of functional outcome in all children and results were categorized into Excellent, Good, Fair(satisfactory) and Poor(unsatisfactory) category.

We analyzed our data with SPSS version 23. Qualitative variables were represented with frequencies and percentages while for quantitative variables mean and standard deviation was calculated. Inferential statistics were used to calculate *P* value with Chi-Square test and Kruskal-Wallis test(*P* value <0.05 was considered significant). Data presented in tables where necessary.

Table I: Flynn's Criteria of functional outcome

Result	Rating	Loss of carrying angle	Loss of range of motion
Satisfactory	Excellent	0° to 5°	0° to 5°
	Good	6° to 10°	6° to 10°
	Fair	11° to 15°	11° to 15°
Unsatisfactory	Poor	11° to 15°	11° to 1°

RESULTS

We collected the record of 96 eligible children for our study but 06 children could not come to our hospital for follow up when we contacted their parents. Therefore the data of 90 children were analyzed. Each LA, MA and PA had 30 patients each. The demographic variables of children in all the three approaches were identical(Table II). Mean age of children in LA was 8.54 ± 4.5 years, MA 7.21 ± 3.5 years and PA 8.1 ± 6.1 years. Majority of children in each approach were male and right supracondylar fracture was the predominant fracture in each approach. The mean operative time of the lateral approach was (39±4.7 minutes) less than the other two but not statistically significant (*P* 0.31). Mean Shaft Condylar Angle was 42.2±7.1°, 42.5±3.2° and 41.3±2.7° in LA, MA and PA respectively (P> 0.05). Mean Bauman angle was 19.4±4.0° in LA, 20.3±6.3° in MA and 21.6±3.1° in PA (P> 0.05). Excellent outcome was noted in 22(73.33%), 17(56.66%) and 15(50%) in LA, MA and PA respectively. (P> 0.05) Good outcome was noted in 8(26.66%) in LA 13(43.33%) in MA and 15(50%) in PA. (P >0.05). No fair and poor outcome was noted in any approach. Ulnar nerve injury (neuropraxia) was documented in 1(3.33%) patient in MA and 1(3.33%) in PA while no nerve injury was noted in LA. Pin tract infection of k wires was noted in 3(10%) children in LA, 07 (23.33%) in MA and 4(13.33%) in PA. All the complications were resolved with conservative treatment.

Table II: Comparison of demographic and outcome variables of three approaches for supracondylar fracture humerus.

S. No	Demographic & clinical variables	Surgical Approaches			P value
		Lateral approach (n=30)	Medial approach (n=30)	Posterior approach (n=30)	
1	Age(years)	8.54 ± 4.5	7.21 ± 3.5	8.1 ± 6.1	0.71
2	Gender				
	Male	18	17	19	0.40
	Female	12	13	11	0.31
3	Side of surgery				
	Right	20	19	18	0.11
	Left	10	11	12	0.21
	Operative time(min)	39±4.7	44±6.1	45±3.2	0.31
4	Radiological Outcome				
	Mean Shaft Condylar Angle(degrees)	42.2±7.1°	42.5±3.2°	41.3±2.7°	0.60
	Mean Baumann angle(degrees)	19.4±4.0°	20.3±6.3°	21.6±3.1°	0.81
5	Complications				
	Nerve injury	--	01	01	0.70
	Pin tract infection	03	07	04	0.89
6	Functional outcome as per Flynn,s criteria				
	Excellent	22	17	15	0.10
	Good	08	13	15	0.30
	Fair	--	--	--	
	Poor	--	--	--	

DISCUSSION

In our study excellent functional outcome as per Flynn's criteria was documented in 22(73.33%) children in lateral approach, 17(56.66%) in medial and 15(50%) in posterior approach. Good outcome was noted in 8(26.66%) children in lateral, 13(43.33%) in medial and 15(50%) in posterior

approach. This difference was however not statistically significant (P>0.05). Similarly lateral approach had better radiological outcome but the difference was not statistically significant. (P>0.05). Hagebusch and Koch[15] treated 41 children of supracondylar fractures with three different approaches. At 46 months follow up functional outcome was assessed with Mayo Elbow Performance Score (MEPS) and Quick Disabilities of Arm, Shoulder and Hand (qDASH). Radiological assessment was done by measuring Baumann's Angle and Anterior Humeral Line. No significant difference in functional and radiological outcome of the three approaches was noted. Bamrungthin[16] treated 30 children with lateral approach and 52 with posterior. Good and excellent functional outcome (Flynn's criteria) was noted in 80% children in lateral approach and 80.7% in posterior approach. No significant difference in the complication rate was found. The operative time however was significantly less in posterior approach than in lateral approach.(P<0.05). In our study lateral approach had less operative time than medial or posterior approach. Kizilay *et al*[17] treated 11 children each with lateral, medial and posterior approach. They noted excellent functional outcome in 100% children in lateral and medial group while posterior approach had excellent results in 72.72% and good results in 27.27%.These authors advocated that if closed reduction fails then either lateral or medial approach can be used for open reduction. Sahi and Zehir[18] treated 33 patients with medial approach and 34 with posterior approach. The radiological and functional outcome of the two approaches were similar except that the operative time of medial approach was significantly shorter than posterior approach. In our study lateral approach had the shortest surgical time than the other two approaches. However the difference was not statistically significant.

Uludag[3] treated 25 patients with medial approach and 13 with lateral approach. The radiological and functional outcome was similar in both approaches. Among the children operated with medial approach three had pin tract infection and one had compartment syndrome for which fasciotomy was done. Eren and Ozkut[19] treated 20 children with lateral approach and 20 with medial approach. Post operative assessment was done at 19.8 months. Excellent functional outcome was observed in 90%,good in 5% and fair 5% children treated with lateral approach. Those treated with medial approach had excellent outcome in 95% and good in 5%. Medial approach had no complication while lateral approach had ulnar nerve neuropraxia in one patient and cubitus varus in another patient. These authors concluded that although no significant difference in functional outcome between the two approaches existed the medial approach should be used for fixation as it had low risk of ulnar nerve damage and acceptable medial scar. In our study both medial and lateral approach had ulnar nerve injury while lateral approach had no neurological injury.

Rokaya[20] treated 30 children with medial approach and 40 with posterior triceps splitting approach. The radiological outcome was same in both groups. The functional outcome was better in medial approach than in posterior approach. In one local study Orfi and Ahmad[21] treated 54 patients with posterior approach and 50 with lateral approach. At 6th months follow up posterior approach had excellent outcome in 65%,good in 15% fair in 13% and poor in 7%.The functional outcome in lateral group had excellent result in 70%,good in 20%,fair in 8% and poor in 2%. The lateral approach had significantly less operation time than the posterior approach. This study however had short follow up while we had one year follow up.

Our study had few limitations. The design of our study was retrospective. Our sample size was small and follow up was short. The operating surgeons for the surgical approaches were different. We recommend further studies to verify our results.

CONCLUSION

Lateral approach for supracondylar fracture yielded better radiological and functional outcome than medial and posterior approach in our patients. The difference was however not statistically significant. Surgeon can prefer lateral approach because of less operative time and less complication rate.

Conflict of Interest: None
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