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ORIGINAL ARTICLE

A Comparative Study on Outcome of Three Dissimilar Approaches for Supracondylar Humerus Fractures in Children

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ABSTRACT

Aim: To compare the radiological and functional results of lateral, medial and posterior access for K-wire fixation and open reduction among children with type III supracondylar fractures of the humerus.

Study Design: A retrospective cohort study.

Place and Duration: In the Orthopedic department of PIMS hospital, Islamabad for three-year duration from October 2018 to September 2021.

Methods: All children with type-3 supracondylar fractures of the humerus who were operated and followed for at least one year who met the criteria of inclusion were involved in the research. There were 105 total children in this study. Lateral approach, Medial approach and posterior approach was used in 35 children each. Medical records were reviewed for surgical access, and children with lateral (LA), medial (MA), and posterior (PA) access were screened. The radiological result was evaluated by measuring the Baumann angle and Shaft Condylar Angle (SCA). All children were applied with Flynn's criteria for functional results, which were classified as excellent, good, poor (unsatisfactory) and Fair (satisfactory). The results from medial, lateral and posterior approaches were compared and the P value was determined using the Kruskal-Wallis and Chi-square test (significant P value <0.05).

Results: There were 105 total children in this study. Lateral approach, Medial approach and posterior approach was used in 35 children each. The mean age of children with Lateral approach was 8.60 ± 4.2 years, Medial approach 7.15 ± 4.1 years and with posterior approach 7.9 ± 5.9 years. The mean angle of the condylar axis was 41.9±7.4°, 42.5 ± 3.2 ° and 42.1±2.1 º in lateral approach, Medial approach and posterior approach respectively (p> 0.05). The mean Bauman angle was 20.1±3.9 º, 21.1±6.1 º and 22.2±3.4 º in lateral approach, Medial approach and posterior approach (P> 0.05). Excellent results were obtained in 25 (71.4%), 19 (54.3%) and 17 (48.6%) patients in lateral approach, Medial approach and posterior approach respectively. (P> 0.05) Good results were obtained in 10 (28.6%) children in LA, 16 (45.7%) children in MA and 18 (51.4%) children in PA (P> 0.05).

Conclusions: The lateral approach for the supracondylar fracture gave better functional and radiological results in our patients in comparison to the medial and posterior approach. Though, the difference was not statistically significant.

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

INTRODUCTION

Supracondylar fractures in Childs account for 50 to 75% of upper limb fractures in children aged 3 to 10 years[1-2]. Displaced fractures (Gartland type III) are treated with percutaneous pinning and closed reduction with image intensification[3-4]. Open reduction is mandatory in children with open fractures, concomitant vascular injuries and those who cannot sufficiently reduce the fracture by closed methods. There is disagreement over the ideal surgical approach for optimal functional and cosmetic outcomes and minimal complications in pediatric displaced supracondylar fractures[5]. In the detection of supracondylar fractures in children, tests can be found using posterior, lateral, afferent and anterior approaches[6-7]. Each approach has its own advantages, disadvantages, and different outcomes. There are no guidelines in various facilities for the surgical management of supracondylar fractures, and the approach is grounded on the preferences and skills of the surgeon, not on clinical evidence[8-9]. The goal of this research was to compare the functional and radiological results of lateral, medial and posterior access for K-wire fixation and open reduction among children with type III supracondylar fractures of the humerus. The results of our analysis will be used to articulate guidelines for the management of type-3 supracondylar fractures of the humerus.

MATERIAL AND METHODS

This study was held in the orthopedic department of PIMS hospital, Islamabad for three-year duration from October 2018 to September 2021. There were 105 total children in this study. Lateral approach, Medial approach and posterior approach was used in 35 children each. All children with type-3 supracondylar fractures of the humerus who were operated and followed for at least one year who met the criteria of inclusion were involved in the research. Medical records were reviewed for surgical access, and children with lateral (LA), medial (MA), and posterior (PA) access were screened. The Ethical Committee of the hospital approved the study. All of these children were operated on for Gart-land type III fractures within one week of suffering the fracture with two crossed k-wires, one from the lateral and the other from the medial epicondyle and applied with lateral (LA), medial (MA) and Posterior (PA) approach. Children with open fractures, neurovascular injuries, multiple injuries, compartment syndrome and repeated surgical procedures were excluded from the study. Radiographs and demographic data were collected from the medical records.

Surgical Techniques: Clinical notes were reviewed for detailed surgical notes. It was found that the lateral approach (LA) of the supracondylar fracture was performed in the supine position with the elbow crossed over the chest. A 5 cm incision was made under tourniquet band control from the lateral epicondyle to the distal shaft of the humerus proximally. In direction to reduce and expose the fracture, the fascia and the lateral border of the triceps were dissected. Manual fracture reduction and fracture stabilization with K wire from the lateral epicondyle were achieved. Another k-wire was passed through the medial epicondyle through the stab incision, passing through the first k-wire over the fracture. The K-wires were cut, twisted and buried beneath the skin. Medial approach (MA) was performed in the supine position, with the elbows crossed over the chest, under the control of a tourniquet. In command to preserve and dissect the ulnar nerve, a five-cm long medial incision was given in the distal part of the humerus, and then the fracture reduced and crossed wires were directed with a stab incision, one from the medial epicondyle and the other from the lateral. The K-wires were cut, twisted and suppressed beneath the skin. The posterior approach (PA) was used in the patient in

the supine position with a tourniquet and the limb crossed through the chest. A 5 cm posterior midline incision is made above the elbow. The ulnar nerve was identified and preserved. The triceps has been raised on both sides to help reduce fractures. Two k-wires were used to stabilize the fracture, one from the medial and the other from the lateral epicondyle. The K-wires were cut, twisted and bury beneath the skin.

Clinical notes showed the same postoperative protocol for all approaches. A plaster slab was placed on the elbow for 3 weeks after the operation. The sutures were removed after 2 weeks. Elbow movement exercises were started at week 3. K-wires were removed under short general anesthesia at week 6 and the elbow was manipulated for stiffness. After the K wire was removed, all children received at least two sessions of physical therapy to improve elbow range of motion. The parents of all children who have had at least one year after surgery were contacted for their child's follow-up visit. At the follow-up visit, the Baumann angle was measured on the AP radiograph, and the sagittal plane alignment was assessed by measuring the Shaft Condylar Angle on the lateral radiograph of the elbow. The Baumann angle was assessed from the AP X-ray of the elbow. One line runs along the shaft of the humerus and the other along the epiphyseal line of the lateral condyle. The intersection angle is the Baumann angle (normally 9 to 26 degrees). The Shaft Condylar Angle was calculated by drawing a straight line along the shaft of the humerus and another along the axis of the capitellium on the lateral radiograph of the elbow, dividing it into two equal parts. The anterior intersection of these two lines at the epiphysis of the humerus is the SCAS angle (Normal> 40 degrees). The Flynn criteria (Table I) were used to assess the functional outcomes in all children, and the results were divided into excellent, good, fair (adequate), and poor (unsatisfactory).

Table 1: Flynn's Criteria of functional outcome

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

We analyzed our data with SPSS version 23. Qualitative variables were represented by percentages and frequencies, while mean and standard deviation were calculated for quantitative variables. For the calculation of the P-value by the Kruskal Wallis and Chi-square test, the P value <0.05 was considered significant.

RESULTS

There were 105 total children in this study. Lateral approach, Medial approach and posterior approach was used in 35 children each. The demographic variables of children in the three approaches were the same (Table II).

Table 2: Comparison of outcome variables and demographics of 3 methods for supracondylar fracture humerus

S. No	Demographic & clinical variables	Surgical Approach		es	P value
		Lateral approach (n=35)	Medial approach (n=35)	Posterior approach (n=35)	
1	Age(years)	8.60 ± 4.2	7.15 ± 4.1	7.9 ± 5.9	0.69
2	Gender				
	Male	22	19	25	0.39
	Female	13	16	10	0.28
3	Side of surgery				
	Right	24	21	20	0.13
	Left	11	14	15	0.19
	Operative time(min)	40±5.1	43±5.9	46±3.1	0.30
4	Radiological Outcome				
	Mean Shaft Condylar Angle(degrees)	41.9±7.4 º	43.1±3.5 º	42.1±2.1 º	0.59
	Mean Baumann angle(degrees)	20.1±3.9 º	21.1±6.1 º	22.2±3.4 º	0.79
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	25	19	17	0.11
	Good	10	16	18	0.32
	Fair	--	--	--	
	Poor	--	--	--	

The mean age of children with Lateral approach was 8.60 ± 4.2 years, Medial approach 7.15 ± 4.1 years and with posterior approach 7.9 ± 5.9 years. The mean angle of the condylar axis was 41.9±7.4°, 42.5 ± 3.2 ° and 42.1±2.1 º in lateral approach, Medial approach and posterior approach respectively (p> 0.05). The mean Bauman angle was 20.1±3.9 º, 21.1±6.1 º and 22.2±3.4 º in lateral approach, Medial approach and posterior approach (P> 0.05). Excellent results were obtained in 25 (71.4%), 19 (54.3%) and 17 (48.6%) patients in lateral approach, Medial approach and posterior approach respectively. (P> 0.05). Good results were obtained in 10 (28.6%) children in LA, 16 (45.7%) children in MA and 18 (51.4%) children in PA (P> 0.05).

Neither of the approaches showed fair or bad results. While damage to the ulnar nerve (neuropraxia) was detected in 1 (2.9%) patient in MA and 1 (2.9%) patient in PA, no nerve damage was observed in LA. K-wire infection was observed in 4 (11.4%) children in LA, 08 (22.9%) children in MA and 5 (14.3%) children in PA. All complications resolved after conservative treatment.

DISCUSSION

In our study, an excellent functional outcome according to Flynn criteria was documented in 25 (71.4%), 19 (54.3%) and 17 (48.6%) patients in lateral approach, Medial approach and posterior approach respectively. (P> 0.05). Good results were obtained among 10 (28.6%) children in LA, 16 (45.7%) children in MA and 18 (51.4%) children in PA (P> 0.05). However, this change was not statistically important (P> 0.05). Likewise, the LA had improved radiographic outcomes, but the change was not statistically significant. (P> 0.05). Hagebusch and Koch treated 41 children with supracondylar fractures using three different methods[9-10]. During the 46-month follow-up, the functional score was measured using the Quick Disabilities of Arm, Shoulder and Hand (qDASH) and Mayo Elbow Performance Score (MEPS)[11-12]. Radiological evaluation was performed by measuring the Baumann angle and the anterior line of humerus. There were no substantial alterations in functional and radiological outcomes for these three approaches. Bamrungthin treated 30 lateral and 52 posterior

children. Good and perfect functional results (Flynn criteria) were observed in 80% of children from lateral approach and 80.7% from posterior approach[13-14]. There was no substantial change in the complication percentage. However, the operative time was significantly shorter in the posterior approach than in the LA ($p < 0.05$). In our study, the lateral approach had a shorter operative time than the middle or posterior approach. Kızılay et al exhibited that children were treated with lateral, medial and posterior access[15-16]. They observed excellent functional results in 100% of the children in the lateral and medial groups, excellent in 72.72% and good in 27.27% in the posterior approach. These authors argued that if closed reduction fails, a lateral or medial approach can be used for open reduction. Şahi and Zehir treated 33 patients from a medial approach and 34 from a posterior approach[17-18]. The radiological and functional results of both approaches were similar, except that the operative time for the middle approach was significantly shorter than that for the posterior approach. Uludag treated 25 patients with medial approach and 13 patients with lateral approach. Radiological and functional results were similar in both approaches[19-20]. Three children who underwent medial access had a pin tract infection, and one had fasciotomy due to compartment syndrome. Eren and Özkut treated 20 children's with lateral approach and 20 children's with medial approach. Postoperative evaluation was performed after 19.8 months[21-22]. Excellent outcomes in 90%, 5% good, and 5% moderate functional score was observed in children treated by lateral approach. 95% excellent and 5% good results were obtained in those treated with medial access[23-24]. While no complications in the medial access were observed, one patient had ulnar neuropraxia and the other had ulnar varus in the lateral approach. Although there was no substantial variance in functional results between the two approaches, these authors concluded that a medial approach should be used for fixation as there is a low risk of ulnar nerve damage and an acceptable medial scar.

Our study had several limitations. Our study design was retrospective. Our trial was small and our observation was short-lived. Surgeons who practiced surgical methods differed. We recommend further research to confirm our results.

CONCLUSION

The lateral approach of the supracondylar fracture gave better radiological and functional results in our patients in comparison to the medial and posterior approach. Though, the difference was not statistically significant. The surgeon may prefer lateral approach because of the shorter operation time and complication rate.

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