DOI: https://doi.org/10.53350/pjmhs20221611830

ORIGINAL ARTICLE

Comparative Outcome of Three Different Approaches for Supracondylar Humeral Fractures in Children in Khyber Pakhtunkhwa, Pakistan

MUHAMMAD SHAKEEL[1], MOHIB ULLAH KHAN[2], ZIA ULLAH[3], MUHAMMAD AFRASIYAB JAVED KHAN[4], MUHAMMAD ASGHAR ESSA[5], AFIFA TAHIR[6]

[1]*Resident Orthopedic Unit, Lady Reading Hospital, Peshawar*
[2]*District Orthopedic Surgeon, District Headquarter Hospital, Miranshah, North Waziristan*
[3]*Assistant Professor Khalifa Gul Nawaz Hospital , Bannu*
[4]*Senior Registrar Orthopedic and Trauma Unit, Khyber Teaching Hospital Peshawar*
[5]*Specialist Registrar Orthopedic and Trauma Unit, Mufti Mehmood Teaching Hospital Dera Ismail Khan*
[6]*Physiotherapist, University of Lahore*
Correspondence to: Muhammad Shakeel

ABSTRACT

Background: The closed reduction and percutaneous pinning are the min treatment approaches tested in pediatric humerus supracondylar fractures but the treatment approach preferred in fractures without closed reduction is remains unclear.

Objectives: The purpose of this study was to compare three common orthopaedic procedures for treating children with supracondylar humerus fractures of the displaced extension type.

Methods: The current retrospective analytical study was started in the Department of Orthopedic at Khyber Teaching Medical College from 2015 to 2020, with the approval of the clinical research ethics committee. This analysis was conducted on 64 patients between the ages of 1 and 12 years who underwent hospital surgery for Gartland IIb, Gartland IIb, and Gartland III supracondylar humerus fracture.

Results: A total of 64, 22 patients were from group A, in which 18 (81.81%) were male and only 4 (18.18%) were female, while in group B and C were 21 (80.76%), 5 (19.23%) and 14 (87.5%), 2 (12.50%) male and female, respectively. The injury on left elbow and right elbow in group A was recorded 68.18 and 31.81%, respectively. Among the total injured children, the left elbow was fractured in 47 (73.43%) case and the right one in 7 (10.93%). Approximately the duration of injury to therapeutic procedure was recorded 7.53±3.03 hours in the study. When compared to the group of displaced supracondylar humeral fractures that were conservatively handled, the functional and aesthetic treatment outcomes between the closed and open reduction with K-wire fixation groups were significantly different. According to this system, excellent, fair, good and poor functional outcomes were recorded in 10 (45.45%), 6 (27.27%), 4 (18.18%) and 2 (9.09%) patients of A group, respectively, while 13 (50%), 5 (19.23%), 5 (19.235), and 3 (11.50%) patients in group B, respectively. The poor and fair functional outcome was noted in 1 (6.25%) and 3 (18.75%) patients, respectively in group C.

Practical implication: This is a critical surgical condition in children and they should be provided with the appropriate treatment to acquire the child's ability of movement. According to our findings among three management techniques, the most favorable was open reduction with K-wire fixation, and therefore was recommended with good success rate.

Conclusion: It was thus concluded that open reduction with K-wire fixation is a good alternative to closed reduction with percutaneous pinning for treating displaced pediatric supracondylar humeral fracture.

Keywords: Children; Supracondylar humerus fracture; Surgical treatment; Pediatric fractures; Pakistan

INTRODUCTION

Supracondylar fractures, which are believed to occur in 55 to 75% of patients with elbow fractures, are among the most common types of bone injuries in children. It is fairly uncommon for adjacent soft tissue to sustain neurological and vascular damage that are related to the displacement of the metaphyseal bone fragment. The fractures were categorized using the modified Gartland classification method in accordance with radiological results [1-3]. Non-displaced fractures are those of type I. Type II fractures, which include an intact posterior hinge, were further classified into the following categories by Wilkins: Subtype IIb- posterior dislocation distal fragment with rotation, and subtype IIa - posterior dislocation distal fragment without rotation are two subtypes of posterior dislocation [4-6].

Complete displacement is a feature of Type III fractures. Usually, a fracture of the humerus above the condyles, with or without displacement, is caused by an injury to the arm's extension. Displacement and treatment of these fractures are strongly connected. Non-displaced fractures are typically conservatively treated with plaster [7-9]. Before being immobilized in plaster, displaced fractures should be minimized and, if necessary, repaired with wires. Both cross pinning and parallel pinning have been recommended. The success of the fracture reduction has a direct impact on the functional and cosmetic outcome [10-12]. To choose the best method of treatment, a precise first assessment is crucial. Additionally, a lot of studies that conducted to determine the treatment outcome and clinical course of displaced supracondylar humeral fractures in children, making them potentially susceptible to selection and outcome misclassification bias.

In children, most of the fractures of the upper limb occur in age of 3-10 years, out of which supracondylar fractures is the most prevalent. Using image intensification, (Gartland type III) fractures are treated with percutaneous pinning and closed reduction. Children with open fractures, accompanying vascular damage, or fractures that cannot be properly reduced with closed methods must have open reduction. The ideal surgical approach for optimal functional and cosmetic outcomes with minimal complications in children with displaced supracondylar fractures is a source of debate. Available tests for diagnosing supracondylar fractures in children include posterior, lateral, afferent, and anterior. Each technique has its own pros, disadvantages, and results [2].

There are no guidelines for the surgical treatment of supracondylar fractures in different facilities, and the approach is based on the surgeon's preferences and abilities rather than clinical evidence. Therefore, in order to establish a clinical evidence based guideline, this comparative study was conducted for the functional outcomes of lateral, medial, and posterior K-wire fixation and open reduction in children with type III supracondylar humerus fractures.

MATERIAL AND METHODS

The current study began with the approval of the clinical research ethics committee and was carried out in the Department of Orthopedic at Khyber Teaching Medical College from 2015 to 2020. Retrospective analysis was conducted on 64 patients between the ages of 1 and 12 years who underwent hospital surgery for Gartland IIb, Gartland IIb, and Gartland III supracondylar humerus fracture between the years 2015 and 2020. Total 64 patients were included in this study. Three groups

were made i.e. Group A consists of 22 patients which underwent closed reduction and percutaneous pinning; Group B consists of 26 patients which underwent open reduction with medial intervention and percutaneous pinning while Group C consists of 16 patients which underwent open reduction and percutaneous pinning with lateral intervention. Notes and electronic medical records were used to obtain demographic, clinical, and radiological data. Data on kind of therapy, time from show to conclusive therapy, procedural subtleties, confusions and result, were recorded and explored from patients' clinical outlines.

RESULTS

Criteria for grading cosmetic and functional outcomes is given in table 1. A total of 64, 22 patients were from group A, in which 18 (81.81%) were male and only 4 (18.18%) were female, while in group B and C were 21 (80.76%), 5 (19.23%) and 14 (87.5%), 2 (12.50%) male and female, respectively. The injury on left elbow and right elbow in group A was recorded 68.18 and 31.81%, respectively. Among the total injured children, the left elbow was fractured in 47 (73.43%) case and the right one in 7 (10.93%). Approximately the duration of injury to therapeutic procedure was recorded 7.53±3.03 hours in the study. Based on the type of treatment, there was no significant difference between the three groups of patients in terms of clinical and demographic variables (Table 2).

Table 1: Grading results Criteria for cosmetic and functional factor.

Resulting	Cosmetic factor	Functional factor
Poor	>15	>15
Good	5-10	5-10
Fair	10-15	10-15
Excellent	0-5	0-5

Table 2: The clinical characteristics of children with displaced supracondylar fractures depending on the type of treatment.

Characteristic		A		B		C		p-value
		No. patients	%	No. patients	%	No. patients	%	
Age in years, mean ± SD		6.4±1.8		6.8±1.9		6.6±1.8		0.398
Gender	Male	18	81.81	21	80.76	14	87.5	0.432
	Female	4	18.18	5	19.23	2	12.5	
Arm	Left	15	68.18	20	76.92	12	75	0.97
	Right	7	31.81	6	23.07	4	25	
Fracture type	Gartland IIa	3	13.63	4	15.38	2	12.5	NS
	Gartland IIb	6	27.27	7	26.92	5	31.25	NS
	Gartland III	13	59.09	15	57.69	9	56.25	NS

Note: A= Patients which underwent closed reduction and percutaneous pinning
B= Patients which underwent open reduction with medial intervention and percutaneous pinning
C= Patients which underwent open reduction and percutaneous pinning with lateral intervention

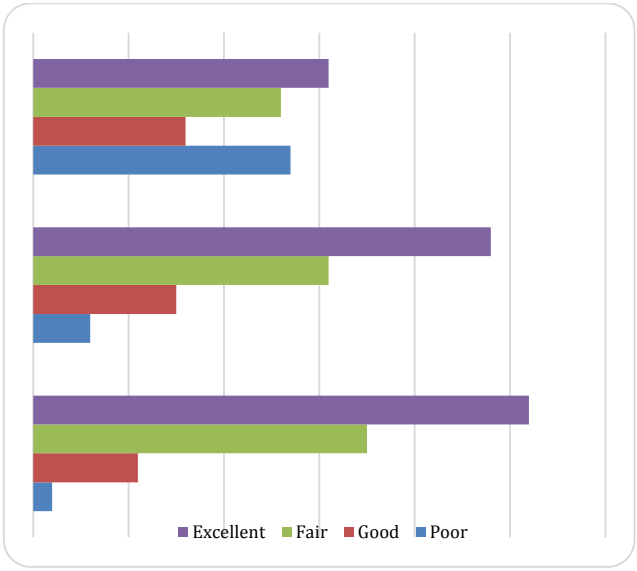

Figure 1: Outcomes of treatment based on applied approaches.

Table 3: Comparison between outcomes of open reduction with K-wire fixation, closed reduction with casting techniques, and closed reduction with percutaneous pinning.

P	Group A/Group C	Group B/Group C	Group A/Group B
Cosmetic/difference in carrying angle	0.051	0.044	NS
Functional/loss of range of motion	0.01	0.052	NS
Treatment outcome	0.007	0.028	NS
Flexion (degrees)			
Effected arm	0.004	0.02	NS
Opposite arm	0.011	NS	NS

Table 3 shows the comparison between outcomes of open reduction with K-wire fixation, closed reduction with casting techniques, and closed reduction with percutaneous pinning. When compared to the group of displaced supracondylar humeral fractures that were conservatively handled, the functional and aesthetic treatment outcomes between the closed and open reduction with K-wire fixation groups were significantly different. In the treatment of supracondylar humeral fractures, there was no statistically significant difference between the two non-conservative treatment groups, closed and open reduction with K-wire fixation. Both closed and open reduction with K-wire fixation have been shown to have excellent clinical results, and patients who underwent both procedures fared much better than those who just received cast immobilization.

Table 4: Flynn's criteria for functional and cosmetic outcomes among three tested approaches.

Treatment outcome		A		B		C	
		No. patients	%	No. patients	%	No. patients	%
Functional, loss of range of motion	Poor	2	9.09	3	11.5	1	6.25
	Good	4	18.18	5	19.2	3	18.75
	Fair	6	27.27	5	19.2	3	18.75
	Excellent	10	45.45	13	50	9	56.25
Cosmetic, difference in carrying angle	Poor	1	4.54	4	15.4	1	6.25
	Good	3	13.63	2	7.69	3	18.75
	Fair	5	22.72	6	23.1	4	25
	Excellent	13	59.09	14	53.8	8	50

The functional and cosmetic outcomes among three tested approaches were determined by using Flynn's modified classification system. According to this system, excellent, fair, good and poor functional outcomes were recorded in 10 (45.45%), 6 (27.27%), 4 (18.18%) and 2 (9.09%) patients of A group, respectively, while 13 (50%), 5 (19.23%), 5 (19.235), and 3 (11.50%) patients in group B, respectively. The poor and fair functional outcome was noted in 1 (6.25%) and 3 (18.75%) patients, respectively in group C (Table 4). The cosmetic result was excellent and good in 13 (59.09%) and 3 patients (13.63%), respectively belonged to group A, while excellent cosmetic result was recorded in 8 patients (50%) of group C.

DISCUSSION

The ratio of supracondylar humerus fractures is 60-71/100000. About 16% of these fractures require surgical intervention, however the majority are managed conservatively. Gartland type 3 fractures make up about 17% of supracondylar humerus fractures. Following closed reduction of the fracture, percutaneous fixation with cross-pinning is used to treat these sorts of fractures. Using only the lateral k-wire to provide biomechanical stability and the significant risk of ulnar nerve damage produced by the medial-applied k-wire during percutaneous cross-pinning have raised questions about pinning [13-14.] Supracondylar fractures of the humerus account for 12–17% of all pediatric fractures, which is a significant burden of injuries in children. Ninety-five percent of supracondylar fractures are caused by extensions [15-17].

The functional and cosmetic outcomes among three tested approaches were determined by using Flynn's modified classification system. According to this classification system, excellent was recorded in 10 patients, fair in 6 patients, good in 4 patients and poor functional outcomes recorded in 2 patients in group A. The current study findings are almost similar to the previous study findings as reported by many scientist working in medical departments [18-22]. The majority of authors concur that children with dislocated supracondylar fractures do not respond well to closed reduction and cast immobilization alone. The exception to this rule is the type-IIa dislocated fracture, which can be treated by closed reduction and cast immobilization. However, the distal fragment should be stabilized by percutaneous fixation with K-wires if there are even the tiniest doubts about the stability of reposition or the position of the fragments. A study reported excellent clinical outcome in 70.3% of patients treated with closed reduction with percutaneous pinning approach. Open reduction pinning method was recorded best than closed whose outcomes were significantly worse in children [1].

CONCLUSION

The conclusion is that closed reduction should always be tried first. Open reposition should be used if the fragment is not positioned correctly after two closed reduction attempts. However, orthopaedic surgeons still need more research and clinical experience to agree on the best course of treatment for children with displaced supracondylar humeral fractures. According to our findings, plaster manipulation and immobilization is the least effective treatment option and should only be used for children with uncomplicated extension humeral fractures (Gartland type IIa).It is critical that children with displaced supracondylar extension-type fractures receive the appropriate treatment because the child's ability to acquire or perform skilled movements with the injured arm may be significantly hindered by the appropriate choice of initial management.

Acknowledgement: Authors are highly thankful to the concern institute.

Conflict of interest: Authors declare no conflict of interest.

REFERENCES

1. Dučić S, Bumbaširević M, Radlović V, Nikić P, Bukumirić Z, Brdar R, Radojičić Z, Bukva B, Abramović D, Dučić JT. Displaced supracondylar humeral fractures in children: Comparison of three treatment approaches. Srp Arh Celok Lek. 2016;144(1-2): 46-51.
2. Holt JB, Glass NA, Shah AS. Understanding the epidemiology of pediatric supracondylar humeral fractures in the United States: identifying opportunities for intervention. J Paed Ortho. 2018;38: 245-251.
3. Reisoglu A, Reisoglu A, Kazimoglu C, Hanay E, Agus H. Is pin configuration the only factor causing loss of reduction in the management of pediatric type III supracondylar fractures? Acta Orthopaedic Traumatol Turc. 2017;51: 34-38.
4. Abbott MD, Buchler L, Loder RT, Caltoum CB. Gartland type III supracondylar humerus fractures: outcome and complications as related to operative timing and pin configuration. J Child Orthopaed. 2014;8(6): 473-7
5. Dodds SD, Grey MA, Bohl DD, Mahoney EM, DeLuca PA. Clinical and radiographic outcomes of supracondylar humerus fractures treated surgically by pediatric and non-pediatric orthopedic surgeons. J Child Orthopaed. 2015;9(1): 45-53.
6. Waikhom S, Mukherjee S, Ibomcha I, Digendra A, Sohkhlet HR. Delayed open reduction and K-wire fixation of widely displaced supracondylar fractures of humerus in children using medial approach. J Clinic Diag Res. 2016;10: 6-10.
7. Dabis J, Daly K, Gelfer Y. Supracondylar Fractures of the Humerus in Children- Review of Management and Controversies. Orthop Muscul Sys. 2016;5: 206.
8. Erçin E, Bilgili MG, Baca E, Başaran SH, Bayrak A, Kural C, Avkan MC: Medial mini-open versus percutaneous pin fixation for type III supracondylar fractures in children. Ulus Travma Acil Cerrahi Derg. 2016;22: 350-354.
9. Or O, Weil Y, Simanovsky N, Panski A, Goldman V. He Outcome Of Early Revision Of Malaligned Pediatric Supracondylar Humerus Fractures. Injury. 2015;46: 1585-1590
10. Mohammed R, Bhogadi P, Metikala S. A study of biplanar crossed pin construct in the management of displaced pediatric supracondylar humeral fractures. J Child Orthopedic. 2014;8(5): 435-41.
11. Uludağ A, Tosun H, Aslan T. Comparison of Three Different Approaches in Pediatric Gartland Type 3 Supracondylar Humerus Fractures Treated With Cross-Pinning. Cureus. 2020;12(6): e8780.
12. Zhao JG, Wang J, Zhang P. Is lateral pin fixation for displaced supracondylar fractures of the humerus better than crossed pins in children? Clinic Orthoped Relatives Res. 2013;471: 2942-53.
13. Dekker AE, Krijnen P, Schipper IB. Results of crossed versus lateral entry K-wire fixation of displaced pediatric supracondylar humeral fractures: a systematic review and meta-analysis. Injury. 2016;47: 2391-2398.
14. Feldman D. Supine Position Is Ideal for Manipulation and Pinning of All Types of Supracondylar Fractures Compared with the Prone Position. J Bone Joint Surg Am. 2015;97: 1372.
15. Carter CT, Bertrand SL, Cearley DM. Management of pediatric type III supracondylar humerus fractures in the United States: results of a national survey of pediatric orthopaedic surgeons. J Pediatr Orthoped. 2013;33: 750-754.
16. Khoshbin A, Leroux T, Wasserstein D, Wolfstadt J, Law PW. He epidemiology of paediatric supracondylar fracture fix Dtiona population-based study. Injury. 2014;45: 701-708.
17. Homson LE, Pagkalos J, Prem H. Splintage following supracondylar fracture in paediatrics. Annals Royal Coll Surg Eng. 2015;97: 317-318.
18. Glenn GR, Devito D, Schmitz M. Medial and lateral pin versus lateral-entry pin fixation for type 3 supracondylar fractures in children: a prospective, surgeon-randomized study. J Pediatr Orthoped. 2010;8: 799-806.
19. Guy SP, Ponnuru RR, Gella S, Tulwa N. Lateral entry fixation using three divergent pins for displaced paediatric supracondylar humeral fractures. ISRN Orthoped. 2011;13: 7372.
20. Memisoglu K, Cevdet Kesemenli C, Atmaca H. Does the technique of lateral cross-wiring (Dorgan's technique) reduce iatrogenic ulnar nerve injury? Int Orthoped 2011;35(3): 375-8.
21. Reisoglu A, Reisoglu A, Kazimoglu C, Hanay E, Agus H. Is pin configuration the only factor causing loss of reduction in the management of pediatric type III supracondylar fractures? Acta Orthopaedic Traumatol Turc. 2017;51: 34-38.
22. Zorrilla S de Neira J, Prada-Cañizares A, Marti-Ciruelos R, Pretell-Mazzini J. Supracondylar humeral fractures in children: current concepts for management and prognosis. Int Orthope. 2015;39: 2287-2296.