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Indian Journal of Orthopaedics Surgery

Journal homepage: <https://www.ijos.co.in/>

Original Research Article

A study of Joystick maneuver as a novel therapeutic approach in supracondylar humerus fracture in pediatric age group

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ARTICLE INFO

Article history:

Received 05-12-2023

Accepted 11-01-2024

Available online 04-03-2024

Keywords:

Joystick maneuver

Closed reduction

Supracondylar humerus fracture

Clinic-pathology

Flynn grading

ABSTRACT

Background: Supracondylar humerus fracture (SCFH) is one of the commonest fractures in the pediatric age group. Joystick maneuver is novel therapeutic approach for closed reduction & fixation in supracondylar humerus fracture, hence we have undertaken this study.

Materials and Methods: Present study was prospective in nature conducted among 68 SCFH pediatric patients. All patients fulfilling inclusion criteria and exclusion criteria were taken up for the study. Study was carried out over a period of 2 years.

Results: Majority of the patients was in the age group of 7-9 years and most of them were male children. Flynn grading has shown that initially at 1 month follow up, most i.e. 59 (86.76%) cases had good outcome followed by 08 (11.76%) cases were having excellent outcome & 1 (1.47%) was having fair outcome which significantly improved over a period of year and at the end of 12 months, most i.e. 56 (82.35%) cases had excellent outcome & 12 (17.65%) was having good outcome ($p < 0.001$).

Conclusion: Joystick maneuver for supracondylar humerus fracture in pediatric age group is a safe & effective procedure for closed reduction associated with excellent functional outcomes in majority & good in rest as per Flynn grading.

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1. Introduction

Supracondylar humerus fracture (SCFH) is one of the commonest fractures in the pediatric age group responsible for 60% of the fracture cases. SCFH is mostly caused by fall on the outstretched hand with elbow joint in hyperextension, which would push the distal fragment posteriorly.¹⁻³ Gartland classification is used to classify and guide the treatment of these fractures. Gartland type III & IV needs operative treatment. The goal of treatment in these cases is to achieve anatomic reduction and stable fixation and good functional outcomes. Surgical treatment consists

options could be open or closed reduction with K-wire fixation. Treatment with cross K-wires is widely accepted and has successful results.⁴⁻⁸ Open reduction may be more associated with complications than the closed reduction like loss of motion, elbow stiffness, myositis ossificans, infection, scar formation and an increased risk of iatrogenic neurovascular injury.⁹ Another novel therapeutic approach for closed reduction & fixation in supracondylar humerus fracture is Joystick maneuver, hence we have undertaken this study to find out functional outcomes in fractures treated with this approach.

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2. Objectives

To evaluate the functional outcomes associated with Joystick maneuver in supracondylar humerus fracture in pediatric age group.

3. Materials and Methods

This was a facility based prospective observational study. Protocol of this study was approved by the Institutional Ethical committee of the medical college. Informed and written consent was taken from the patient's parent/guardian.

Patient of supracondylar humerus fracture (SCFH) presented to our tertiary Care Hospital constituted our study subjects. All consecutive patients fulfilling inclusion and exclusion criteria were taken up for the study until the required sample size was fulfilled. Sampling method used was universal sampling. Study was carried out over a period of two years from January 2021 to December 2022. Patient recruitment was done for one year and followed up for another one year. We have included patients between 2 and 12 years old and a completely displaced SCFH in which movement of the distal fragment into both flexion and extension was detected immediately before surgery (multidirectional instability test). All the routine investigations like complete blood count were done. Patients with compartment syndrome, open fractures and fractures with vascular insufficiency were excluded. All cases were analyzed as regard to the demographic data including age, sex, mechanism of trauma, type of fracture, site of injury, associated fractures, direction of initial deviation of the distal fragment, and time between presentation and surgical intervention. A careful neurological and vascular examination of the involved limb was done. Then we have attempted closed reduction under intravenous (IV) sedation/general anaesthesia with an assistance by a 2.0-2.5 mm K-wire inserted at the outer cortex of both condyles just distal to fracture and at the condyles most outmost cortex at an angle of 40-50 degrees to joint line working as joystick under C-arm imaging. After using the joystick K wires to reduce the distal fracture fragment with stabilised proximal fracture fragment against arm board the wires are proceeded into proximal fragment crossing the opposite side cortex and wires crossing each other proximal to fracture site. Other group was operated with the conventional arm board reduction manuevre as per the fracture displacement followed by check reduction on c-arm and then k wire insertion was done. Check X-ray done to assess reduction. Above elbow slab was applied after satisfactory reduction.

Post operatively K-wires were removed after 3 weeks and active elbow mobilization was started after 4 weeks. Radiological evaluation was done at 1 month, 3 months, 6 months, 9 months and 1 year. Functional evaluation of patients was done at every follow-up using Flynn criteria.

Data was collected in pre-structured proforma which was pilot tested and after ensuring it's validity. The data collected was then analyzed by using SPSS IBM version 20.

68 pediatric SCHF cases presenting during study period were included in the study.

4. Results

In the present prospective study, there was no lost to follow up and we could analyze all 68 patients. Maximum (33.82%) cases were in the age group of 7-9 years followed by 20 (29.41%) were from 10-12 years, 18 (26.47%) from 4-6 years & 07 (10.29%) from <3 years. There was male predominance (52.94%). 34 (50%) fractures were on right side and 34 (50%) on left side. Majority, 49 (72.06%) cases had Gartland type III fracture & rest 19 (27.94%) had type II fracture. Among majority (80.88%) of the cases time interval from fracture to surgery was < 24 hours while in 19.12% it was > 24 hours. Mean duration of surgery was 44.4 + 15.1 minutes. (Table 1)

In this study, to assess functional outcome of Joystick maneuver in supracondylar humerus fracture in pediatric age group, we have completed five follow-ups at 1, 3, 6, 9 & 12 months respectively. Flynn grading has shown that initially at 1 month follow up, most i.e. 59 (86.76%) cases had good outcome followed by 08 (11.76%) cases were having excellent outcome & 1 (1.47%) was having fair outcome which significantly improved over a period of year and at the end of 12 months, most i.e. 56 (82.35%) cases had excellent outcome & 12 (17.65%) was having good outcome ($p < 0.001$). Baumanns angle & carrying angle loss was significantly improved over the period of 12 months ($p < 0.001$). Mayo elbow performance score, ROM flexion & extension also significantly increased over 12 months ($p < 0.001$). (Table 2)

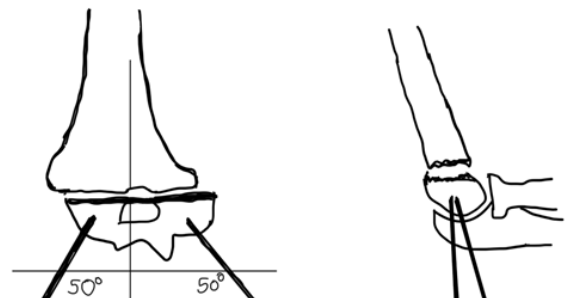


Figure 1: Reduction is achieved with k wires in distal fracture fragment by joystick manoeuvre

Table 1: Distribution of patients according to baseline characteristics.

Baseline characteristic		Frequency (no.)	Percentage (%)
Age groups	<3	07	10.29
	4-6	18	26.47
	7-9	23	33.82
	10-12	20	29.41
Gender	Male	36	52.94
	Female	32	47.06
Laterality	Right	34	50
	Left	34	50
Gartland type of fracture	II	19	27.94
	III	49	72.06
Time from fracture to surgery	<24 hours	55	80.88
	>24 hours	13	19.12
Mean duration of surgery	Mean + SD (min.)	44.4 + 15.1	

Table 2: Functional outcomes among patients

Functional outcome		Follow up (month)					p
		1	3	6	9	12	
Flynn grading	Good	59 (86.76)	49 (72.06)	30 (44.12)	14 (20.59)	12 (17.65)	<0.001
	Excellent	08 (11.76)	18 (26.47)	38 (55.88)	54 (79.41)	56 (82.35)	
	Fair	01 (1.47)	01 (1.47)	00 (00)	00 (00)	00 (00)	
Baumanns angle	Mean + SD	5.9 + 3	4.4 + 2.1	3.8 + 2.3	3.1 + 2.6	3 + 2.4	<0.001
Carrying angle loss	Mean + SD	3.9 + 3	3.3 + 2.6	2.5 + 2.6	2.2 + 2.6	2.2 + 2.5	<0.001
Mayo elbow performance score	Mean + SD	54.3 + 6.7	73.6 + 7.9	77.1 + 5.7	79.5 + 4.5	82.3 + 4.7	<0.001
ROM flexion	Mean + SD	113.6 + 9.9	125.4 + 6.9	128.5 + 5.7	131.2 + 5.2	132.8 + 4.7	<0.001
ROM extension	Mean + SD	0.6 + 1.6	1.7 + 2.4	3.3 + 2.4	3.9 + 2.1	4 + 2	<0.001

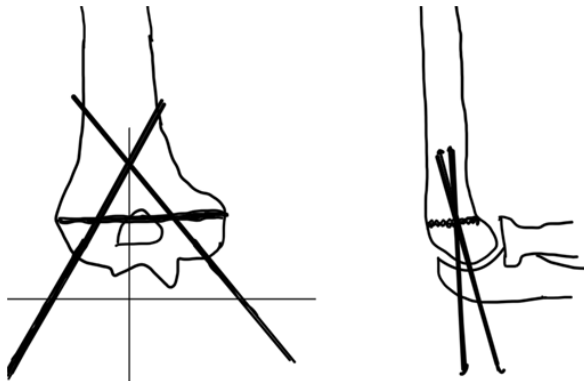


Figure 2: After achieving reduction k wires are proceeded into proximal fragment for bicortical purchase

5. Discussion

SCFH in children are treated based on the modified Gartland classification system using conventionally close reduction approach. This fracture pattern presents with severe instability in both flexion and extension. In this

study, we present the results of a joystick technique of closed reduction and percutaneous pinning fixation of 68 consecutive children. Maximum (33.82%) cases were in the age group of 7-9 years followed by 20 (29.41%) were from 10-12 years, 18 (26.47%) from 4-6 years & 07 (10.29%) from <3 years. There was male predominance (52.94%). 34 (50%) fractures were on right side and 34 (50%) on left side. 72.06% cases had Gartland type III fracture & 27.94% had type II fracture. Among majority (80.88%) of the cases time interval from fracture to surgery was < 24 hours. Mean duration of surgery was 44.4 + 15.1 minutes. This is similar to Kumar B et al.¹⁰ who noted most cases between 4-6 years with male majority & had left elbow predominantly affected & had Gartland type III & IV fractures. Also, consistent observations are noted by H.-C. Shon et al.¹¹

In this study, functional outcomes associated with Joystick maneuver in supracondylar humerus fracture in pediatric age group, assessed with the five follow-ups at 1, 3, 6, 9 & 12 months respectively. Flynn grading significantly improved over a period of year and at the end of 12 months, 82.35% cases had excellent outcome & 17.65% was having good outcome (p<0.001). Baumanns angle & carrying angle loss was significantly decreased while Mayo elbow performance score, ROM flexion & extension

significantly increased over 12 months ($p < 0.001$). There was no complication during follow up period of 12 months such as pin-site infection, loss of fixation, malunion, cubitus varus, iatrogenic nerve injury, or need for further surgical evaluation. These findings are in line with Eduardo N. Novais et al,¹² Kumar B et al.¹⁰ reported that according to Flynn's criteria, 13 children had excellent (54.2%) outcomes, 8 (33.3%) had a good outcome and 3 (12.5%) did not complete follow up. Hai Zhou et al. had¹³ done a comparative study of conventional technique & novel closed reduction and percutaneous pinning (CRPP) technique & found that all cases of MDJ fractures were treated successfully with the novel CRPP technique without the need for open procedures or re-operation. No complications such as pin-site infection or iatrogenic nerve injury were found in this group. In conventional technique group, five of the eight fractures were treated successfully; three fractures needed open reduction, and one of them had further surgery because of the loss of fixation. Serdar Hakan Basaran et al¹⁴ also found the same results & concluded that lateral joystick and K-wire-assisted reduction is a useful way to make and maintain the reduction, functional and radiological results are as good as lateral and posterior open approaches. Short operation time is an advantage. This method reduces the risk of complications due to repeated closed reduction in pediatric supracondylar humeral fractures.

6. Conclusion

Joystick maneuver for supracondylar humerus fracture in pediatric age group is a safe & effective procedure for closed reduction associated with excellent functional outcomes in majority & good in rest as per Flynn grading.

7. Source of Funding

There was no source of funding in our study.

8. Conflict of Interest


None.


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Cite this article: Kumarjuvekar SA, Gathani HJ, Jadhav RM. A study of Joystick maneuver as a novel therapeutic approach in supracondylar humerus fracture in pediatric age group. *Indian J Orthop Surg* 2024;10(1):44–47.