

# International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958  
P-ISSN: 2706-6630  
IJOS 2023; 9(1): 170-174  
© 2023 IJOS

<https://www.orthopaper.com>

Received: 13-11-2022

Accepted: 16-12-2022

## R Rupesh Kanna

Post Graduate, Department of Orthopaedics, Shri Sathya Sai Medical College & Research Institute-Sri Balaji Vidyapeeth, Ammapettai, Chengalpattu, Tamil Nadu, India

## J Mahendhira Varman

Professor, Department of Orthopaedics, Shri Sathya Sai Medical College & Research Institute-Sri Balaji Vidyapeeth, Ammapettai, Chengalpattu, Tamil Nadu, India

## G Gopinath

Assistant Professor, Department of Orthopaedics, Shri Sathya Sai Medical College & Research Institute-Sri Balaji Vidyapeeth, Ammapettai, Chengalpattu, Tamil Nadu, India

## Corresponding Author:

### R Rupesh Kanna

Post Graduate, Department of Orthopaedics, Shri Sathya Sai Medical College & Research Institute-Sri Balaji Vidyapeeth, Ammapettai, Chengalpattu, Tamil Nadu, India

## A comparative study of functional outcome of criss-cross pinning vs parallel pinning for Gartland type III supracondylar humeral fractures in children in tertiary care centre

R Rupesh Kanna, J Mahendhira Varman and G Gopinath

DOI: <https://doi.org/10.22271/ortho.2023.v9.i1c.3292>

### Abstract

**Introduction:** Supracondylar fracture of the humerus is the most frequently encountered elbow injuries among children that occupies around 60% of all elbow injuries in the initial ten years of life. Trouble in reduction and its maintenance, recurrent association of neurovascular structures injury are the common complications of displaced supracondylar fractures.

**Methods:** Around 64 patients with displaced type III supracondylar fractures of humerus were selected who fulfilled our inclusion criteria. The method of patient selection for criss-cross pinning (GROUP-1) or parallel pinning (GROUP-2) be random. All the children with suspected supracondylar fractures of the humerus were assessed for vascular and neurological status. Clinical evaluation was graded according to carrying angle and elbow range of motion using the criteria of Flynn. Radiographic evaluation was performed at 3rd week, 6 week and at 3 and 6 months. In the 3rd week, the pins were removed. At 3- and 6-month follow-up, the children were evaluated for full function, minor limitation of function and major loss of function.

**Result:** All the 64 subjects in our study had full range of motion postoperatively. The carrying angle in group 1 Vs group 2 was  $11.18 \pm 1.99$  Vs  $11.96 \pm 1.92$ . The Baumann's angle in group 1 Vs group 2 was  $71.59 \pm 3.10$  Vs  $71.65 \pm 2.23$ . Flynn *et al.* in group 2 with parallel all the 100% had excellent score whereas in group 1, 94% had excellent

**Conclusion:** From our study, we concluded that the lateral pinning technique provides better functional outcome as cross pinning technique in the management of displaced supracondylar fracture of humerus in children. When compared to crossed wire pinning, lateral pinning avoids the risk of nerve injury, reduces operation time and have Flynn excellent scores.

**Keywords:** Supracondylar fracture of humerus, cross pinning, parallel pinning

### Introduction

Supracondylar fracture of the humerus is the most frequently encountered elbow injuries among children that occupies around 60% of all elbow injuries in the initial ten years of life<sup>[1]</sup>. It is often seen in the first decade of life, which increases steadily during the first 5 years and reaches its peak between 5-8 years<sup>[2, 3]</sup>. Incidence is 2 times more in boys than in girls<sup>(2)</sup>. Trouble in reduction and its maintenance, recurrent association of neurovascular structures injury are the common complications of displaced supracondylar fractures<sup>[4, 5]</sup>.

Past studies have reported the incidence of vascular injury occurs in 0.5%-0.8% of cases, nerve injury in 6-16%, cubitus varus in 30% of cases which doesn't remodel with growth<sup>[6, 7]</sup>. Usually, the fracture occurs due to fall with hyperextended elbow on an outstretched hand. The distal fragment displaces posteriorly in more than 95% of fractures<sup>[8, 9]</sup>. In 1959, Gartland classified supracondylar fractures<sup>[10]</sup>. Type III fractures are displaced fractures with no cortical contact. This can be further subdivided into III a - posteromedial displacement and III b - posterolateral displacement.

Management of undisplaced fractures is usually conservative, but the treatment of choice would be open or closed reduction with Kirschner wire in a entirely displaced fracture. Theses done to prevent to failure of reduction leading to malunion and cubitus varus deformity. Kirschner wires can be applied in various configurations to stabilize the reduced fracture.

Since traditional treatment is accompanied with complications, the preferable choice of treatment will be either medial or a lateral pinning in a cross fashion or two lateral pins<sup>[11]</sup>. Superior stability was observed in cross pinning when compared to pinning with two lateral pins<sup>[12, 13]</sup>. However past studies have reported that cross pinning is associated with 2 to 4 times increased rate of iatrogenic ulnar nerve injury

But closed reduction percutaneous pinning (CRPP) is considered as the gold standard treatment for displaced supracondylar fractures. Even though increased bio mechanical stability is observed in cross pinning, it also carries the risk of iatrogenic ulnar nerve injury IUNI (5%) due to medial pin placement. Meanwhile, lateral pinning gives the dual advantage of stability and prevents IUNI. This study aims at comparing criss-cross pinning vs parallel pinning in displaced supracondylar humeral fractures in children

## Methods

In a tertiary care center Around 64 patients Age less than 12 with displaced TYPE III supracondylar fractures of humerus were selected. GARTLAND TYPE I and TYPE II supracondylar fracture, Compound and comminuted fractures, those who had previous attempt of manipulations, Patient with neurovascular injury were excluded.

It was based on the previous study<sup>(14)</sup>, the proportion of both the criss-cross pinning vs parallel pinning for supracondylar fracture of humerus are 2% and 33.3% using 5% level of significance and 80% power the total sample size 32 in each group including 10% non-response error.

After approval from ethical committee -IEC.NO:2021/652 dated on 29/01/2021.

Total 64 patients with supracondylar fractures of humerus were included in the study from the patients that we admitted in the orthopaedic wards either through the outpatient department or emergency services who fulfilled our inclusion criteria. The method of patient selection for criss-cross pinning or parallel pinning was random. Randomization was done by computer generated random number. This analysis included 64 patients who were followed up for at least 6 months at 3, 6, 10, 14, and 24 weeks. All the children with suspected supracondylar fractures of the humerus were assessed for vascular and neurological status.

Anteroposterior and lateral radiographs were performed. All displaced supracondylar fractures of humerus were admitted and limb immobilized in an above-elbow splint with limb elevation. Surgical techniques were standardized in terms of pin location, pin size (weight < 20 kg size 1.5 mm and weight > 20 kg size 2 mm), stability on the table and the position of the elbow for pin placement. Surgery was performed by a senior orthopaedic surgeon who was well trained in this technique. Anaesthesia was used for all patients, in supine position with the injured upper limb on the side of the table. Closed reduction was performed and confirmed by the image intensifier.

First, longitudinal traction was applied with the elbow in hyperextension and the forearm in supination. While the traction maintained, the medial or lateral displacement was corrected by applying a valgus or Varus force at the fracture site. The posterior displacement of the distal fragment was then corrected by applying a force to the posterior aspect while the elbow was gently hyper flexed and the elbow was secured in hyperflexion, and the reduction was confirmed by the image intensifier.

For the parallel pin fixation technique, two or three pins were inserted as per stability from the lateral aspect of elbow across the lateral cortex to engage the medial cortex keeping the elbow in hyperflexion.

Pins was placed either in parallel or divergent configuration with adequate separation at the fracture site.

For the cross (medial-lateral) fixation technique, first the lateral pin will be inserted from lateral cortex to engage the medial cortex keeping the elbow in hyperflexion. The elbow was then extended to >90 degree and the ulnar nerve rolled back with the opposite thumb and the medial pin was inserted to engage the lateral cortex with the elbow in 45 to 50 degree of flexion. This reduces the incidence of neuropraxia while doing medial to lateral pinning.

The adequacy and stability of the reduction was checked under image intensification. The pins were bent to prevent migration and cut off outside the skin to allow removal in the outpatient clinic.

A single preoperative parenteral dose of antibiotic was given at the time of induction and postoperatively, as per weight. Postoperatively, the extremity was placed in a well-padded posterior splint with the elbow flexed to 90 degrees. For all patients, immediate postoperative radiographs were taken to determine the maintenance of the reduction.

The operated limb was evaluated and carefully observed at regular intervals for any neurovascular deficit.

During follow-up in the outpatient department, clinic-radiological evaluation was performed for maintenance of reduction (at first follow-up) and functional outcome, which included passive range of motion, measurement of carrying angle, neurovascular status, superficial and deep infection.

Clinical evaluation was graded according to carrying angle and elbow range of motion using the criteria of Flynn *et al.* Radiographic evaluation was performed by anteroposterior and true lateral view at 3<sup>rd</sup> week, 6 week and at 3 and 6 months. In the 3<sup>rd</sup> week, the pins were removed. At 3- and 6-month follow-up, the children were evaluated for full function, minor limitation of function and major loss of function. The results were graded as excellent, good, fair and poor, according to the loss of range of motion and loss of carrying angle using the criteria of Flynn *et al.*

Data were entered in MS - EXCEL and statistical analysis done by SPSS 23 software. The results were presented in descriptive statistics and appropriate test of significance was applied with 5% level of significance and 95% confidence interval.

Comparison of outcomes following criss-cross pinning vs parallel pinning for Gartland type III supracondylar humeral fracture was analysed by chi square test

## Result

The frequency distribution of gender of our subjects in the study. Out of 64 subjects, 34 subjects were male (53%) and 30 female (46%).

The frequency distribution of side of humeral fracture among our subjects. 34 subjects had fracture on right humerus and remaining had fracture on left humerus.

The frequency distribution of mode of injury of humeral fracture among our subjects. Majority of the subjects had slip and fall who were around 34 (53%). 45.3% (2 subjects) had fall from height and 1.6% (1 subject) had fall from height while playing.

The frequency distribution of type of fracture among our subjects. All our subjects had Gartland type III supracondylar humeral fracture.

The frequency distribution of associated injuries among our subjects. 63 of our subjects did not have any associated injury and only one subject had associated injuries.

The frequency distribution of age group among our subjects. 16 subjects that is around 25% of them were less than or equal to 5 years and remaining 75% were above 5 years.

The comparison of carrying angle between genders among our subjects. Among 20 subjects, 19 had carrying angle between 11-15 and 1 had the carrying angle between 5-10. In males, 19 had the carrying angle between 5-10 and 15 had the carrying angle between 11-15. Table 1

The comparison of Baumann's angle between genders in our subjects. Among females, 16 had the Baumann's angle between 60-70 and 14 had the angle between 70-80. In males, 18 subjects had the Baumann's angle between 60-70 and 16 had the angle between 70-80. Table 2

The comparison between carrying angles with mode of injury among our subjects. Out of 29 subjects, 22 had the angle between 11-15 and 7 had between 5-10. Only one subject had fall from height while playing and the angle was between 11-15. 34 subjects had slip and fall in which 13 had the angle of 5-10 and 21 had the angle between 11-15.

\* $p < 0.05$ - \*\* $p < 0.001$ - statistically significant, ns- not significant, Group 1 –K – wire fixation cross pinning, Group 2 - K – wire fixation parallel pinning, The comparison of age between the two procedural groups for Gartland Type III Supracondylar humeral fractures in children. The mean age of subjects in group 1 was  $7.50 \pm 2.35$  and in group 2 it was  $7.78 \pm 2.28$ . (Figure 1)

\* $p < 0.05$ - \*\* $p < 0.001$ - statistically significant, ns- not significant, Group 1 –K – wire fixation cross pinning, Group 2 - K – wire fixation parallel pinning, the comparison of gender between the two procedural group for Gartland Type III Supracondylar Humeral fractures in children. In group 1, males were 18 and females were 14 in number and in group 2, 16 were males and 16 were females.

The frequency distribution of distal neurovascular status. All the subjects were normal.

\* $p < 0.05$ - \*\* $p < 0.001$ - statistically significant, ns- not significant, Group 1 –K – wire fixation cross pinning, Group 2 - K – wire fixation parallel pinning, the comparison of number of wires between the two procedural group for Gartland Type III Supracondylar Humeral fractures in children. In group 1 with cross pinning the mean number of wires were  $2.78 \pm .420$  and in group 2, the mean number of wires was 2 and the value was found to be statistically

significant ( $p=0.000$ ). (Figure 2)

\* $p < 0.05$ - \*\* $p < 0.001$ - statistically significant, ns- not significant, Group 1 –K – wire fixation cross pinning, Group 2 - K – wire fixation parallel pinning, the comparison of Operation time between the two procedural group for Gartland Type III Supracondylar Humeral fractures in children. The mean operation time is lesser in group 2 when compared to group 1 and it was  $32.09 \pm 8.16$  Vs  $34.25 \pm 8.76$ .

\* $p < 0.05$ - \*\* $p < 0.001$ - statistically significant, ns- not significant, Group 1 –K – wire fixation cross pinning, Group 2 - K – wire fixation parallel pinning, the comparison of Postoperative neurological status between the two procedural group for Gartland Type III Supracondylar Humeral fractures in children. In group 2, 100% of subjects were normal and in group 1, 9.4% had reduced fracture. (Figure 3)

\* $p < 0.05$ - \*\* $p < 0.001$ - statistically significant, ns- not significant, Group 1 –K – wire fixation cross pinning, Group 2 - K – wire fixation parallel pinning, the comparison of carrying angle between the two procedural group for Gartland Type III Supracondylar Humeral fractures in children. The carrying angle in group 1 Vs group 2 was  $11.18 \pm 1.99$  Vs  $11.96 \pm 1.92$ . Table 3

\* $p < 0.05$ - \*\* $p < 0.001$ - statistically significant, ns- not significant, Group 1 –K – wire fixation cross pinning, Group 2 - K – wire fixation parallel pinning, the comparison of Baumann's angle between the two procedural groups for Gartland Type III Supracondylar Humeral fractures in children. The Baumann's angle in group 1 Vs group 2 was  $71.59 \pm 3.10$  Vs  $71.65 \pm 2.23$ . Table 4

\* $p < 0.05$ - \*\* $p < 0.001$ - statistically significant, ns- not significant, Group 1 –K – wire fixation cross pinning, Group 2 - K – wire fixation parallel pinning, the comparison of Flynn –Etal – Criteria between the two procedural groups for Gartland Type III Supracondylar Humeral fractures in children. In group 2 with parallel all the 100% had excellent score whereas in group 1, 94% had excellent Table 5

The frequency distribution of range of motion in Gartland Type III Supracondylar Humeral fractures in children. All the 64 subjects in our study had full range of motion postoperatively

\* $p < 0.05$ - \*\* $p < 0.001$ - statistically significant, ns- not significant, Group 1 –K – wire fixation cross pinning, Group 2 - K – wire fixation parallel pinning, the comparison of associated injury between the two procedural groups for Gartland Type III Supracondylar Humeral fractures in children. In group 2 with parallel pinning none had associated injuries but in group 1 around 3% had associated injury.

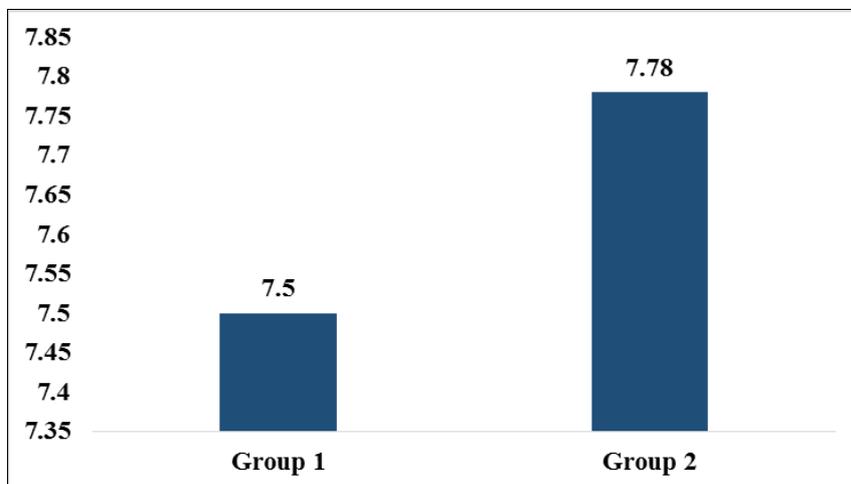
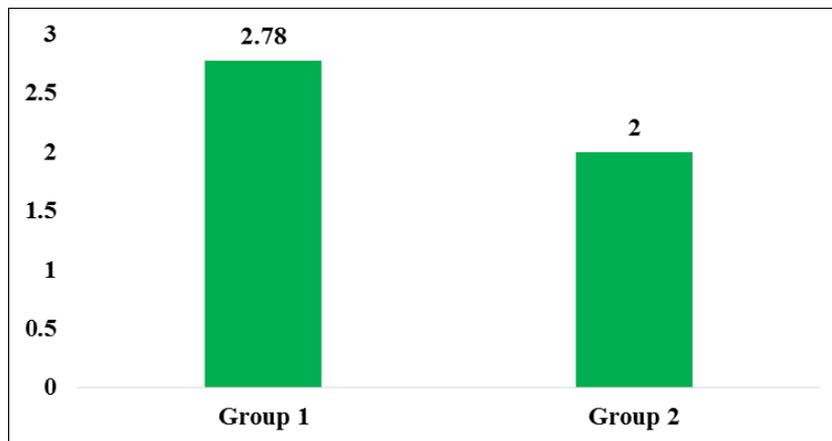
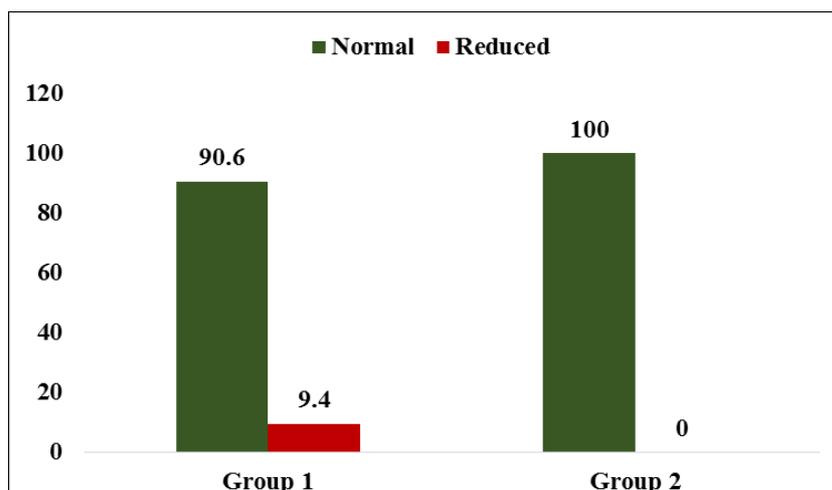


Fig 1: Comparison of Age between the two procedural group for Gartland Type III Supracondylar Humeral fractures in children



**Fig 2:** Comparison of Number of wires between the two procedural group for Gartland Type III Supracondylar Humeral fractures in children



**Fig 3:** Comparison of Postoperative neurological status between the two procedural group for Gartland Type III Supracondylar Humeral fractures in children

**Table 1:** Comparison of carrying angle between gender among our subjects

Gender	Carrying angle		Total	Chi square value	p-value
	5 - 10	11 - 15			
Female	Count	1	29	20.485	0.000*
	% of Total	1.6%	45.3%		
Male	Count	19	15		
	% of Total	29.7%	23.4%		
Total	Count	20	44	64	
	% of Total	31.2%	68.8%	100.0%	

**Table 2:** Comparison of Baumann’s angle between gender in our subjects

Gender	Baumann’s angle		Total	Chi square value	p-value
	60 - 70	70 - 80			
Female	Count	16	14	0.001	1.000
	% of Total	25.0%	21.9%		
Male	Count	18	16		
	% of Total	28.1%	25.0%		
Total	Count	34	30	64	
	% of Total	53.1%	46.9%	100.0%	

**Table 3:** Comparison of Carrying angle between the two procedural group for Gartland Type III Supracondylar Humeral fractures in children

Parameter	Group 1 Mean ± SD N=32	Group 2 Mean ± SD N=32	t - Value	p - Value
Carrying Angle	11.18±1.99	11.96±1.92	-1.596	0.116 (ns)

**Table 4:** Comparison of Baumann’s Angle between the two procedural group for Gartland Type III Supracondylar Humeral fractures in children

Parameter	Group 1 Mean ± SD N=32	Group 2 Mean ± SD N=32	t - Value	p - Value
Baumann’s Angle	71.59±3.10	71.65±2.23	-0.092	0.927 (ns)

**Table 5:** Comparison of Flynn –Etal – Criteria between the two procedural group for Gartland Type III Supracondylar Humeral fractures in children

Flynn –Et al. – Criteria	Group 1 N (%)	Group 2 N (%)	Total N (%)	X <sup>2</sup> - Value	P -Value
Excellent	30 (93.8)	32 (100)	62 (96.8)	2.065	0.151 (ns)
Good	02 (6.2)	0	03 (03.2)		
Total N (%)	32 (100)	32 (100)	64 (100)		

**Discussion**

Supracondylar fracture of the humerus is the most frequently encountered elbow injuries among children that occupies around 60% of all elbow injuries in the initial ten years of life. It is often seen in the first decade of life, which increases steadily during the first 5 years and reaches its peak between 5-8 years.

Incidence is 2 times more in boys than in girls. Trouble in reduction and its maintenance, recurrent association of neurovascular structures are the common complications of displaced supracondylar fractures.

Management of undisplaced fractures is usually conservative, but the treatment of choice would be open or closed reduction with Kirschner wire in a entirely displaced fracture. This is done to prevent to failure of reduction leading to malunion and cubitus varus deformity. Since traditional treatment is accompanied with complications, the preferable choice of treatment will be either medial or a lateral pinning in a cross fashion or two lateral pins. Superior stability was observed in cross pinning when compared to two lateral pinning.

So, this study aims at comparing criss-cross pinning vs parallel pinning in displaced supracondylar humeral fractures in children

All our subjects had Gartland type III supracondylar humeral fracture.

The mean age of subjects in group 1 was 7.50 and in group 2 it was 7.78 which was comparable to past studies: 16 subjects that is around 25% of them were less than or equal to 5 years and remaining 75% were above 5 years.

In our study, 64 subjects were recruited among which 34 subjects were male (53%). We have observed that 34 subjects had fracture on left humerus and remaining had fracture on right humerus. Left sided and male gender predominance was observed in this study as reported by the past researchers<sup>[15, 16]</sup>.

Majority of the subjects had slip and fall who were around 34 (53%). 45.3% (2 subjects) had fall from height and 1.6% (1 subject) had fall from height while playing.

63 of our subjects did not have any associated injury and only one subject had associated injuries.

Among 20 subjects, 19 had carrying angle between 11-15 and 1 had the carrying angle between 5-10. In males, 19 had the carrying angle between 5-10 and 15 had the carrying angle between 11-15.

Among females, 16 had the Baumann's angle between 60-70 and 14 had the angle between 70-80. In males, 18 subjects had the Baumann's angle between 60-70 and 16 had the angle between 70-80.

Out of 29 subjects, 22 had the angle between 11-15 and 7 had between 5-10. Only one subject had fall from height while playing and the angle was between 11-15. 34 subjects had slip and fall in which 13 had the angle of 5-10 and 21 had the angle between 11-15.

The subjects were divided in to two groups, group 1 had cross pinning of K-wire fixation and group 2 subjects were treated with parallel pinning K- wire fixation. In group 1, males were 18 and females were 14 in number and in group 2, 16 were males and 16 were females. All the subjects were normal regarding distal neurovascular status. All the 64 subjects in our study had full range of motion postoperatively.

In group 1 with cross pinning the mean number of wires were 2.78 and in group 2, the mean number of wires was 2 and the value was found to be statistically significant ( $p=0.000$ ).

The mean operation time is lesser in group 2 when compared to group 1 and it was 32.09 mins Vs 34.25 mins.

In group 2 with parallel all the 100% had excellent score whereas in group 1, 94% had excellent score and 6% had good score. Vikram A, et.al, has also reported similar findings that subjects with parallel pinning had 100% excellent scores<sup>[17]</sup>.

In group 2 with parallel pinning none had associated injuries but in group 1 around 3% had associated nerve injury. In group 2, 100% of subjects were normal and in group 1, 9.4% had reduced fracture.

Anwar *et al.* also reported that according to Flynn's criteria the results were excellent in 72% and good in 28% in both

methods but there was one case of iatrogenic ulnar nerve injury in crossing wires<sup>[18]</sup>.

### Conclusion

From our study, we concluded that the lateral pinning technique provides better functional outcome as cross pinning technique in the management of displaced supracondylar fracture of humerus in children. When compared to crossed wire pinning, lateral pinning avoids the risk of nerve injury, reduces operation time and have Flynn –Etal excellent scores.

### Conflict of Interest

Not available

### Financial Support

Not available

### References

- Herring JA. Tachdjian's Pediatric Orthopaedics. 3<sup>rd</sup> ed. Vol; 3. Philadelphia: W.B. Sanders; Fracture about the elbow; 2002. p. 2139-221
- Pirone AM, Graham HK, Krajbich JJ. Management of displaced extension-type supracondylar fractures of the humerus in children. The Journal of bone and joint surgery. American volume. 1988;70(5):641-650.
- Mostafavi HR, Spero C. Crossed pin fixation of displaced supracondylar humerus fractures in children. Clinical Orthopaedics and Related Research (1976-2007). 2000;376:56-61.
- Bachman D, Santora S. Orthopedic trauma. In: Fleisher GR, Ludwig S, Henretig FM (eds.), Textbook of Pediatric Emergency Medicine. Philadelphia: Lippincott Williams and Wilkins 2006, 1538.
- Lins RE, Simovitch RW, Waters PM. Pediatric elbow trauma. Orthop Clin North 1999;30:119.
- John AH. Tachdjian's pediatric orthopaedics. 3rd ed. Philadelphia: Saunders. 2002.
- Jeffrey LN, Malcolm LE, Stanley MK, Paul AL, Marianne D. Supracondylar fractures of humerus in children treated by closed reduction and percutaneous pinning. Clinical Orthopaedics and Related Research. 1983;177:203-9.
- Wilkins KE. Supracondylar fractures. In: Rockwood ChA, Wilkins KE, King RE. Fractures in children. 3rd ed. Philadelphia: J B Lippincott Company; 1991. p. 526-617.
- Devito DP. Supracondylar fracture. In: Morrisy RT, Weinstein SL, editors. Lovell and Winter's pediatric orthopaedics. 4th ed. Philadelphia: Lippincott-Raven publishers; 1996. p. 1242-7.
- Gartland JJ. Management of Supracondylar Fractures of the Humerus. In Children. Surg Gynecol Obstet. 1959;109:145-154.
- Ramachandran M, Skaggs DL, Crawford HA, Eastwood DM, Lanlode FD, Vitale MG, *et al.* Delaying treatment of supracondylar fractures in children: has the pendulum swung too far? J Bone Joint Surg Br. 2008;90(9):1228-33.
- Kruschemandl I, Aldrian S, Kottstorfer J, Seis A, Thalhammer G, Egkher A. Crossed pinning in paediatric supracondylar humerus fractures: a retrospective cohort analysis. Int Orthop. 2012;36(9):1893-98.
- Pellegrin DM, Brivio A, Pescatori E, Tessari L. Supracondylar humerus fractures in children: Closed reduction and cross pin fixation in prone position. GIOT.

2008;34:199–204.

14. Dr. Jairam D Jagiasi, Dr. Tushar V Ubale, Dr. Ganesh B Dole, Dr. Mohit R Upadhyaya. A comparative study of percutaneous pinning techniques (Cross K wire vs lateral K wire) for Gartland type III pediatric supracondylar fracture of the humerus. *Int J Orthop Sci.* 2020;6(3):226-229. DOI: 10.22271/ortho.2020.v6.i3d.2205
15. Naik LG, Sharma GM, Badgire KS, Qureshi F, Waghchoure C, Jain V. Cross pinning versus lateral pinning in the management of type III supracondylar humerus fractures in children. *Journal of Clinical and Diagnostic Research: JCDR.* 2017 Aug;11(8):RC01.
16. Babal JC, Mehlman CT, Klein G. Nerve injuries associated with pediatric supracondylar humeral fractures: A meta-analysis. *J Pediatr Orthop.* 2010;30(3):253-63.
17. Vikram A. Functional outcome of displaced supracondylar fracture humerus in children treated by closed reduction and percutaneous pinning with Kirchner wires: An observational study. *International Journal of Orthopaedics.* 2019;5(4):757-61.
18. W. Anwar, N. Rahman, M.J. Iqbal Comparison of the two methods of Percutaneous K -Wire Fixation in Displaced Supracondylar Fracture of Humerus in children. *J Postgrad Med Inst.* 2011;25(4):356- 61,.

**How to Cite This Article**

Rupesh RK, Mahendhira JV, Gopinath G. A comparative study of functional outcome of criss-cross pinning vs parallel pinning for Gartland type III supracondylar humeral fractures in children in tertiary care centre. *International Journal of Orthopaedics Sciences.* 2023;5(1):170-174.

**Creative Commons (CC) License**

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.