Indian Journal of Orthopaedics Surgery 2022;8(1):53–57

Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Orthopaedics Surgery

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

Original Research Article

Functional and radiological outcome of gartland type 2 and 3 supracondylar fracture humerus in children treated by percutaneous pinning

Shashwat Singh Rajput[1,*], **Jayant Sharma**[1], **S.A Mustafa**[1]

[1] *Dept. of Orthopaedics, Index Medical College and Research Centre, Indore, Madhya Pradesh, India*

ARTICLE INFO

Article history:
Received 28-11-2021
Accepted 29-12-2021
Available online 24-03-2022

Keywords:
Supracondylar humerus fracture
Gartland
Cross pining
Flynn
Carrying angle
Baumann angle

ABSTRACT

Background: Supracondylar fracture of Humerus is the commonest injury around the Elbow in children. It constitutes about 60% of all the fractures about the Elbow in children.
Aim: The aim of the present study is to evaluate the results of percutaneous pinning of unstable or irreducible Type II and III Supracondylar Humeral fractures in children.
Materials and Methods: A prospective study was conducted on 30 children, taking into consideration age, gender, affected side, mode of injury, type of fracture, Gartland classification of fractures, time duration between injury and surgery, postoperative complications and radiographic and clinic variables.
Results: The median loss of motion was 5 degrees and the median change in carrying angle was 4 degrees. All patients had satisfactory results in terms of Loss of Carrying angle, Limitation of Elbow flexion and Flynn's grading. There were 19 patients that had excellent ratings, 9 patients had good ratings and lastly only 2 patients had fair Flynn's ratings. There was only 01 patient suffering from neurological deficit and only 01 patient from pin track infection.
Conclusion: Percutaneous fixation with two crossed Kirschner wires leads to good functional and radiological outcome of Gartland type 2 and 3 supracondylar fracture humerus in children.

1. Introduction

The Supracondylar Humerus fracture is one of the most common fracture encountered in pediatric age group worldwide.[1–3] In age group of 5-7 years (90% cases),[4] the Supracondylar area undergoes remodelling and is typically thinner with a more slender cortex, predisposing this region to fracture. The local anatomy of fracture has made it strenuous to acquire satisfactory reduction and more so maintaining reduction is also very much difficult. Calamitous complications such as Volkmann's ischemic contracture, myositis ossification, stiffness, avascular necrosis, angular deformity, rotational deformity, permanent nerve injuries and malunion will be there if correct management is not opted.[5] It is believed that precise reduction in children is not needed for a good result, because growth may correct a deformity. It is verifiable that functional end results of malalignment are generally great but it is also seen that the cosmetic end results are often below average. Functional outcome and radiological appearance of fracture Supracondylar Humerus should be followed in long term as it may vary from the immediate post-management status. So far in many studies percutaneous pinning has proved its worth in achieving satisfactory results.

Supracondylar fracture of the Humerus shows male preponderance[6,7] and reports for 60% of all pediatric elbow fractures, typically arising as a result of fall on an outstretched hand, either from a height or at ground level. Extension type injury is more frequent than flexion type[4]. It

* *Corresponding author*.
E-mail address: shashwat.rajpoot@gmail.com (S. S. Rajput).

https://doi.org/10.18231/j.ijos.2022.009

is commonly found in the non-dominant limb. The flexion type is common in elderly children.[8]

2. Materials and Methods

In the present series, thirty cases that had unstable, displaced or irreducible type II or type III supracondylar Humeral fractures were included. The prospective study was made in children up to the age of 12 years in between February 2020- July 2021 in Index Medical College Indore, Madhya Pradesh. After achieving satisfactory reduction through percutaneous pinning, functional and radiological outcome was determined by comparing the range of motion and carrying angle with the unaffected arm. The children's with undisplaced, compound or comminuted fractures and those who had undergone attempt of manipulations were excluded in this study.

X-rays were taken in two planes. For initial management, all children with the Supracondylar Humerus fracture were splinted in an above Elbow slab in 20-40 degrees of Elbow flexion to provide pain relief.

Then, fracture was classified according to Gartland's classification[9] for it's appropriate management.

Type I - Nondisplaced

Type II - Displaced (with intact posterior cortex)

Type III - Displaced (no cortical contact)

a) Posteromedial

b) Posterolateral.

2.1. Operative Procedure

Cases were done under Regional or General anesthesia in supine position. Fracture was reduced in tranverse plane by applying traction and in medio lateral plane. The Elbow was flexed and olecranon was pushed anteriorly to correct saggital deformity. Reduction was confirmed by a C-arm fluoroscopy. For Lateral Pining- a 1.8-2mm Kirschner wire passed through the lateral portion of the ossified Capitellum, physis, lateral column and engage the opposite cortex proximally and for Medial Pining- same diameter Kirschner wire passed through medial epicondyle, physis, medial column and engage the opposite cortex proximally. The Kirschner wires were bent and were cut outside the skin and then dressing was done. Finally a posterior above Elbow slab was also given in supine position.

2.2. Post-operative follow up

All patients were examined for distal neurovascular status in immediate post-operative period. The above Elbow slab and Kirschner wires were removed at 3 to 4 weeks when there was no tenderness at fracture site and after check X-Rays. After that patient was allowed to actively mobilize the Elbow to prevent stiffness.

Anterior humeral line, Crescent sign and Baumanns angle were noted in the postoperative X-Rays and the X-Rays before Kirschner wires removal at three to four weeks for assessing adequacy of reduction.

Loss of reduction was determined by change in Baumann's angle. The degree of displacement was graded by Skaggs.

Table 1: Change in Baumanns angle

Displacement	Change in Baumanns angle
No	<6 degree
Mild	6-12 degree
Major	>12 degree

The cosmetic and functional outcomes were assessed using Flynn's criteria at each regular follow up at 2 weeks, 4 weeks and 6 months post operatively.

Table 2: Grading of results according to modified flynn's criteria

Result	Rating	Cosmetic Factor – Loss in Carrying angle (in degrees)	Functional – Limitation of Elbow flexion (in degrees)
Satisfactory	Excellent	0-5	0-5
	Good	6-10	6-10
	Fair	11-15	11-15
Unsatisfactory	Poor	>15	>15

3. Observation & Discussion

There were total 30 displaced Supracondylar Humerus fractures in children who were treated with cross pinning at Index Medical College Hospital & Research Centre between year 2019 and 2021. Patients were randomly selected; the following observations were made from the data collected on age, gender, affected side, mode of injury, type of fracture, Gartland classification of fractures, time duration between injury and surgery, loss of carrying angle limitation of elbow flexion Flynn's grading and post-operative complications.

The success of surgical management of displaced supracondylar fracture of the Humerus in children depends upon initial accurate reduction and maintenance of reduction till union. The most commonly used treatment methods are percutaneous cross pinning or lateral pinning alone. The advantage of cross pinning is its greatest fracture stability over lateral pinning but iatrogenic Ulnar nerve injury can occur while placing the medial pin.

In this context, we undertook the present study to evaluate the radiological and functional outcome of the Supracondylar Humerus fracture in Pediatric population by percutaneous cross pinning. The results were analysed and observations were made in 30 patients who were operated in our hospital. This study was compared to the similar studies by several other authors.

Table 3: Distribution according to age, gender and sides

	No. of Patients	Percentage
Age		
<5	04	13.3
5 -10	18	60
>10	08	26.6
Gender		
Male	18	60
Female	12	40
Sides		
Left	17	56.6
Right	13	43.4

The average age of the patients in our series was 8 years. Age is significant because, by the age of 6-7 years, the Supracondylar area undergoes remodelling and is typically thinner with more slender cortex,[10] predisposing it for fracture. Similarities can also be found in other clinical studies by Mahan ST, May CD, Kocher MS.(2007)[4] and Pirone AM, Graham HK, Krajbich JI (1988).[11]

There is preponderance of/males over female patients. This could be attributed to the increased outdoor activities of male over female children, both in rural and urban population. Similarities can also be found in other clinical studies by Walmsley PJ, Kelly MB, Robb JE, Annan IH, Porter DE (2006)[6] and Flynn JC, Matthews JG, Benoit RL (1974).[7]

Our study showed preponderance of left side (non dominant) over right side . Similarities can also be found in other clinical studies by Spencer HT, Wong M, Fong YJ, Penman A, Silva M (2010)[12] and Flynn JC, Matthews JG, Benoit RL (1974).[7]

All the patients had trauma by falling down fall on an outstretched hand on flat ground and had extension type of fracture injury. Extension type (Gartland type 2 more then type 3) injury is more common because the Elbow is forced into extension and the Olecrenon serves as a fulcrum and focuses the stress on distal Humerus.[10] Similarities can also be found in other clinical studies by Mahan ST, May CD, Kocher MS.(2007)[4] and Campbell CC, Waters PM, Emans JB, Kasser JR, Millis MB(1995).[12]

Table 4: Distribution according to time duration between injury and surgery

Time	Distribution	
	No .of Frequency	Percentage
<48 hours	09	30
48 hrs - 1 week	21	70
>1 week	0	0
Total	30	100

Time duration between injury and surgery is an important factor that strongly determines the outcome as Arabella I Leet et al[13] (2008) reported that thirty patients had unsatisfactory results, defined as a pin infection, more than 15 degrees loss of motion in any plane, loss of normal carrying angle, neuropraxia, or retained hardware due to delayed treatment of type 3 supracondylar Humerus fractures in children.

In our study, all patients had satisfactory results. The Median loss of carrying angle was 4 degrees and the median loss of range of motion was 5 degrees. Loss was not due to loss of reduction but due to inadequate reduction initially. The two patients who had fair (10-15 Degrees) results had an 12 and 14 degree varus deformity; they also had fair results with regard to range of motion despite the fact that they still had a functional range, i.e. 125 degrees and 135 degrees respectively. These results were comparable with the study by Eren A et al. (2005),[14] who conducted a study to evaluate the relationship between the fracture displacement and cubitus deformity in displaced supracondylar Humerus fractures in children. The cause of loss of Carrying angle was attributed to the fact that the medial column compresses more during healing.

Table 5: Distribution according to loss of carrying angle and limitation of elbow flexion in percutaneous pinning

Range	Rating	Loss of carrying angle	Limitation of elbow flexion
0-5 Degrees	Excellent	20	19
5-10 Degrees	Good	8	5
10-15 Degrees	Fair	2	6
>15 Degrees	Poor	0	0
Total		30	30

Table 6: Distribution by Flynn's grading of percutaneous pinned cases

Result	Rating	No. of Frequency	Percentage
Satisfactory	Excellent	19	63.3
	Good	9	30
	Fair	2	6.6
Unsatisfactory	Poor	0	0
Total		30	100

In our study, all patients had satisfactory results. There were 19 patients that had excellent ratings, 9 patients had Good ratings and lastly only 2 patients had Fair ratings. The Flynn's criteria are very 'severe' in that a carrying angle loss of 10 degrees or more is not regarded as a good result. A neutral carrying angle of a few degrees of varus (up to 5°) is generally accepted by patients/parents and is usually not even noticed. Mild varus deformity of the Elbow seems to cause more anxiety to patients and parents and may not be as important as implied by Flynn's criteria. Closed reduction and percutaneous K-wire fixation is considered

the gold standard for treatment of displaced supracondylar fractures and results in 99% satisfactory outcome and only a minor complication rate. Numerous studies on K-wire configuration have been published and even though cross-pin configuration is biomechanically better fixation than lateral only pinning, satisfactory results can be obtained using either technique. These results were comparable with the study by Skaggs et al. (2004),[8] who conducted a study in displaced supracondylar Humerus fractures in children.

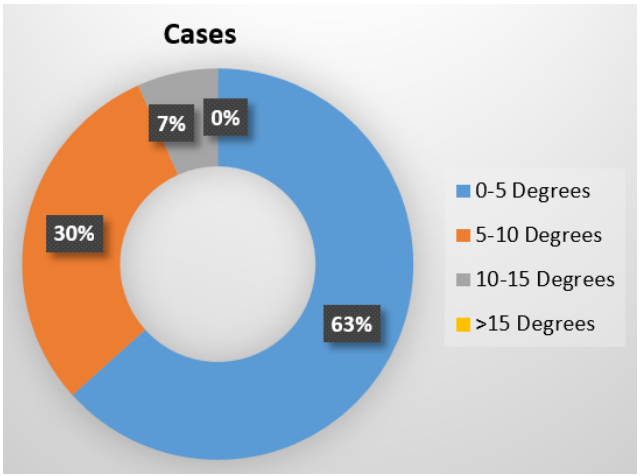

Fig. 1: Distribution by Flynn's grading of percutaneous pinned cases

We had one case of partial Ulnar nerve injury in total of 30 (3.3%) cases of crossed pinning of supracondylar fracture of Humerus in children. Skaggs et al[8] had 8% of Ulnar injury in cross pinning group. We did flexion extension method to avoid Ulnar nerve injury. In our case Ulnar nerve injury recovered completely after 3 weeks duration. We had also 01 patient in total of 30 (3.3%) cases from superficial Pin track infection, rest others showed no postoperative complications. The number in our study was not statistically significant but other studies have reported higher rates of postoperative complications.

4. Conclusion

We have observed the result and found the conclusion those points in our study

1. Fracture supracondylar Humerus is a pediatric disease more so common in less than 12 years age group.
2. Closed reduction and percutaneous Kirschner wire fixation is an excellent treatment of displaced supracondylar fractures and results in 100% satisfactory outcome and only a 6.6% complication rate in our study. Numerous studies on K-wire configuration have been published and even though cross-pin configuration is biomechanically better fixation than lateral only pinning, satisfactory results can be obtained using either technique.
3. Neurological injury associated with Supracondylar fractures of the Humerus in children is a well-known complication. Greater care must be exercised while inserting cross pinning k-wires to avoid risk of iatrogenic ulnar nerve injury.

5. Source of Funding

None.

6. Conflict of Interest

None.

References

1. Cheng JC, Shen WY. Limb fracture pattern in different pediatric age groups: a study of 3,350 children. *J Orthop Trauma*. 1993;7(1):15–22.
2. Canale ST. Fractures and dislocation in children. In: Canale ST, editor. Campbell's Operative Orthopaedics. São Paulo: Manole; 2006. p. 1437–53.
3. Amatuzzi MM, Filho AZ, Montenegro NB. Supracondylar fracture of the humerus in children: study of 90 operated cases. *Rev Bras Ortop*. 1997;32(6):437–42.
4. Mahan ST, May CD, Kocher MS. Operative management of displaced flexion supracondylar humerus fractures in children. *J Pediatr Orthop*. 2007;27(5):551–6.
5. Lal GM, Bhan S. Delayed open reduction for supracondylar fractures of the humerus. *Int Orthop*. 1991;15(3):189–91.
6. Walmsley PJ, Kelly MB, Robb JE, Annan IH, Porter DE. Delay increases the need for open reduction of type-III supracondylar fractures of the humerus. *J Bone Joint Surg Br*. 2006;88(4):528–30.
7. Flynn JC, Matthews JG, Benoit RL. Blind pinning of displaced supracondylar fractures of the humerus in children. Sixteen years' experience with long-term follow-up. *J Bone Joint Surg Am*. 1974;56(2):263–72.
8. Skaggs DL. Elbow fractures in children: diagnosis and management. *J Am Acad Orthop Surg*. 1997;5(6):303–12.
9. Barton KL, Kaminsky CK, Green DW, Shean CJ, Kautz SM, Skaggs DL, et al. Reliability of a modified Gartland classification of supracondylar humerus fractures. *J Pediatr Orthop*. 2001;21(1):27–30.
10. Kasser JR, Beaty JH. Supracondylar fractures of the distal humerus. In: Beaty JH, Kasser JR, editors. Rockwood and Wilkin's fractures in children. Philadelphia: Lippincott Williams & Wilkins; 2001. p. 577.
11. Pirone AM, Graham HK, Krajbich JI. Management of displaced extension-type supracondylar fractures of the humerus in children. *J Bone Joint Surg Am*. 1988;70(5):641–50.
12. Campbell CC, Waters PM, Emans JB, Kasser JR, Millis MB. Neurovascular injury and displacement in type III supracondylar humerus fractures. *J Pediatr Orthop*. 1995;15(1):47–52.
13. Bahk M, Srikumaran U, Ain MC, Erkula G, Leet AI, Sargent MC, et al. Patterns of pediatric supracondylar humerus fractures. *J Pediatr Orthop*. 2008;28(5):493–9.
14. Eren A, Ozkut AT, Altintas F, Güven M. Comparison between the lateral and medial approaches in terms of functional and cosmetic results in the surgical treatment of type III supracondylar humeral fractures in children. *Acta Orthop Traumatol Turc*. 2005;39(3):199–204.

Author biography

Shashwat Singh Rajput, Junior Resident https://orcid.org/0000-0001-6244-449X

Jayant Sharma, Professor https://orcid.org/0000-0003-4755-3318

S.A Mustafa, Professor

Cite this article: Rajput SS, Sharma J, Mustafa SA. Functional and radiological outcome of gartland type 2 and 3 supracondylar fracture humerus in children treated by percutaneous pinning. *Indian J Orthop Surg* 2022;8(1):53-57.