



## MANAGEMENT OF IRREDUCIBLE SUPRACONDYLAR FRACTURE OF HUMERUS IN CHILDREN

<b>Nishant Kashyap</b>	Senior Resident, Department of orthopaedics, IGIMS Patna-14.
<b>Wasim Ahmed</b>	Assistant professor, Department of orthopaedics, IGIMS Patna-14
<b>Indrajeet Kumar</b>	Associate professor, Department of orthopaedics, IGIMS Patna-14
<b>Abhijeet Subhash</b>	Assistant professor, Department of orthopaedics, IGIMS Patna-14
<b>Pawan Kumar</b>	Assistant professor, Department of orthopaedics, IGIMS Patna-14
<b>Santosh Kumar*</b>	Professor and HOD, Department of orthopaedics, IGIMS Patna-14. *Corresponding Author

### ABSTRACT

**Background:** Supracondylar fracture of the humerus is the most common elbow fracture in children. This fracture needs immediate diagnosis and treatment, otherwise, it may lead to significant neurovascular and functional problems. The aim of this study was to assess the short term outcome of displaced supracondylar fracture of the humerus in children by open reduction and pinning from lateral approach.

**Methods:** During a period of 1 year from July 2016 to may 2017, 24 patients less than 10 years old were enrolled in the study. Inclusion criteria were extension type supracondylar fractures of humerus, Gartland type II and III which were irreducible and failed in initial close reduction. The clinical and radiographic results of the treatment using open reduction and internal fixation by lateral K-wire fixation were evaluated. Outcomes were assessed according to the Flynn's criteria.

**Results:** The average age of the patients was 6.3 years. The most prevalent range of age in this study, for both girls and boys 6-8 yrs. In 14 patients (60%), the left extremity was involved while, in the other 10 patients (40%) the right extremity was involved. 09 patients (37.5%) and 15 patients (62.5%) respectively, had involvement of the dominant and non-dominant extremity. According to the Flynn's criteria, the cosmetic results in 21 out of 24 patients that completed their follow-up (87.5%) were excellent, in 2 patients (8.33%) were good and one case (4.16%) was fair ( $P=0.051$ ). The functional results in 22 patients (91.67%) were excellent and in 2 patients (8.33%) were good ( $P=0.047$ ).

**Conclusion:** Treatment of the supracondylar humeral fracture in children by open reduction and internal fixation through lateral pinning is a safe approach with predictable good clinical and radiographical results.

**KEYWORDS :** Humerus supracondylar fracture, Open reduction, Lateral k-wires

### Introduction

Supracondylar fractures of the humerus are the most common elbow fractures in children and adolescents accounting for 50–70% of all elbow fractures.[1,2,3] When a child falls with an outstretched arm, and elbow in hyperextension, the force of the fall is transmitted through the olecranon process to the weak supracondylar region, causing a supracondylar fracture.[2,3] boys are more affected by this fracture in comparison with girls.2,3 This fracture often occurs in left side or the non-dominant side.4,5 About 97-99% of cases are of the extension type.2,6 Several treatment modalities have been recommended including closed reduction and plaster immobilization, open reduction and internal fixation, traction, and closed reduction and percutaneous pinning.[3-7] In extension type fractures, the radial and median nerve and brachial artery are more prone to injury. This is while, in the flexion type fractures, the ulnar nerve injury is more probable.8 The open method is recommended in cases of open fracture, failed or irreducible closed reduction and also when the vascular injury is probable and the supracondylar fracture is in company with the forearm fracture. There are many operative techniques for Open reduction internal fixation (ORIF) in supracondylar fractures of humerus such as cross pin fixation and lateral pin fixation can be done through lateral approach, combined medio-lateral or posterior approach. In Lateral approach there is less soft tissue dissection needed and damage to ulnar nerve will be prevented as compared to posterior approach. Posterior approach is associated with triceps muscle dissection or splitting, and more post operative adhesion.8,9

This study was aimed to assess the outcome of irreducible supracondylar fractures of humerus by open reduction and internal fixation through lateral approach to evaluate both clinical and radiographic results.

### Material and Methods

This prospective study was conducted in a tertiary care hospital in Bihar in a time span of 1-year from 2016 to 2017, after taking written consent from the parents of all patients. 24 Children who presented to during this period in Orthopedic Department with failed or irreducible supracondylar fracture humerus (Gartland's Type II and Type III fractures) were included [Figure 1]. All patients diagnosed as the supracondylar fracture in tertiary care centre of Bihar during July 2016 to may 2017, were considered. Inclusion. The patients were characterized by means of the Gartland's classification method. Among these patients, no case had flexion type fracture. All patients had extension type fracture (type III). 15 patients (62.5%) was operated in 24 hours after injury while, 09 patients (37.5%) was operated after 24 hours. Overall, 23 (98%) patients had closed fracture and only one (2%) had open fracture.

### Inclusion criteria

All children less than 10 years of age with displaced, that is, Type II and Type III supracondylar fracture of the humerus were included in the study whose closed reduction was failed or irreducible and need open reduction & internal fixation, except those who met exclusion criteria.

### Exclusion criteria

Age more than 10 years, Open fracture; late presentations, that is, more than 1-week after the injury; fracture which were associated with neurovascular complications; fracture associated with life-threatening injuries were excluded from this study.

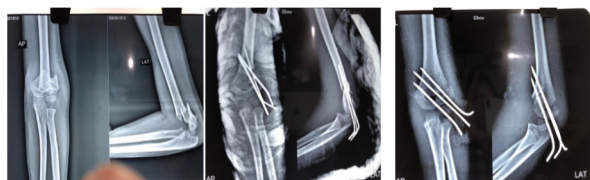
### Management Protocol

All children who presented with a suspected supracondylar fracture humerus were thoroughly evaluated. A detailed history was taken including an enquiry into the mode of injury and the time of injury.

Vascular status of the limb was given special attention. The median, radial, and ulnar nerves were tested. The child was then sent for radiological investigation for the diagnosis and to classify the fracture.

In general, for the patients with the supracondylar fracture, closed reduction method is preferred. However, for the patients used in this study, closed reduction was either irreducible or was tried first but failed. Initial closed reduction was performed in operation room under image guidance. The conversion of closed to open technique was due to inability to gain anatomic reduction in these unstable fractures. We did not use medio-lateral fixation by posterior approach, because it is a major surgery with dissection or splitting of triceps muscle. For all the patients ORIF was performed under general anesthesia, tourniquet inflation, and lateral approach with protection of radial nerve, internal fixation by two (15 cases) or three (09 cases) kirschner's wire( k-wire), which were placed in parallel fashion. Patients were followed up for 6 months. (Fig. 1A and 1B). The X-ray were performed at 1<sup>st</sup> post-operative day, second, and fourth weeks and then, for the third and sixth months after operation.

FIG.1A and 1B



The fracture were fixed by using k-wires from lateral side. First k-wire was introduced through the lateral epicondyle at an angle of 40 degree from the humeral shaft and 10 degree posteriorly and passing proximally to engage the medial cortex. The second k-wire was placed 5-10 mm proximal to the first k-wire ensuring the engagement of medial cortex. The pins were bended and kept outside the skin and the extremities were maintained in a splint with 90° flexion. All patients were hospitalized for 48 hours. Also, the patients were given the oral prophylactic antibiotic for 3-5 days and the sutures were removed after 10 days. For all patients, the splints and k-wires were removed by the end of forth week after operation at which, the union was completed. Criteria for radiographic union were based on disappearance of fracture site and to see callus formation in at least 3 cortices.

**FOLLOW UP**

Afterwards, intermittent active range of motion exercises was started. Passive motion, massage and forceful manipulative motion were strictly avoided. The clinical evaluations were performed for all patients at 2 weekly interval. The flexion, extension, supination and pronation were investigated and the limitation of each was recorded in degree. The clinical evaluation of angular deformity (varus or valgus) was performed and the carrying angle in both sides was measured by goniometer.

The results were evaluated by the Flynn's criteria as presented in Table-I. These criteria are very helpful for investigating the results of the supracondylar fractures. By these criteria, the patients are evaluated by means of the functional and cosmetic factors. Loss of carrying angle in degrees defines the cosmetic factor, and the loss of motion in degrees defines the functional factor. The degree of loss of carrying angle and loss of motion of injured elbow was compared with that of uninjured elbow.

**RESULTS**

The mean age of the patients was 6.3 years old among which, 13 patients (52.1%) were boy and 11 (48%) were girl. The average age of boys and girls was respectively 6.9 and 5.7 years old. The most prevalent range of age in this study, for both girls and boys 6-8 yrs. In 14 patients (60%), the left extremity was involved while, in the other 10 patients (40%) the right extremity was involved. 09 patients (37.5%) and 15 patients (62.5%) respectively, had involvement of the dominant and non-dominant extremity. The frequency of

patients with respect to sex and side of the involvement is presented in Table-I. The mechanism of injury in 09 patients (37.5%) was due to fall while playing, in 13 patients (54.1%) was fall from height and in 2 patients (8.33%) it was due to the motor vehicle accident. The mean operation time was estimated at about 40 minutes ranging from 30 to 55 minutes. The internal fixation was done by using lateral pinning in parallel fashion (2 or 3 pins). No postoperative complication such as vascular injury and infection were seen in all patients. During the first 4-week follow-up, one patient (2%) was identified with the radial nerve injury which, recovered after three months. In three and six months follow-up, one patient (2%) was found with the median nerve injury. Fracture union occurred in all patients in 3- 5 weeks, (mean time of 4.2 weeks). According to the Flynn's criteria (Table-III), the cosmetic results in 21 out of 24 patients that completed their follow-up (87.5%) were excellent, in 2 patients (8.33%) were good and one case (4.16%) was fair (P=0.051). The functional results in 22 patients (91.67%) were excellent and in 2 patients (8.33%) were good (P=0.047). Overall, all cases were graded satisfactory as presented in Table-III.

**Table -I: Frequency of the patients with respect to the involvement side.**

Sexuality extremity	No. of left extremity	No. of right extremity	No. of dominant extremity	No. of non-dominant
Boys	08	06	9	15
Girls	06	04	7	10

**Table-II: Flynn's critical and overall rating.**

Result	Grading	Cosmetic factor Carrying Angle loss (degree)	Functional factor Movement loss (degree)	Overall rating
Satisfactory	Excellent	0 to 5	0 to 5	The lower of the ratings and the two elbow with a varus deformity is automatically graded as poor
Unsatisfactory	Good	6 to 10	6 to 10	
	Fair	11 to 15	11 to 15	
	Poor	>15	>15	

**Table -III: Final results according to the Flynn's criteria.**

Grading	Cosmetic factor: Carrying angle loss (Number of cases)	Functional factors: Movement loss (Number of cases)	Overall result	Percentage (%)
Excellent	21	22	21	87.5
Good	2	2	2	8.3
Fair	1	0	1	4.2
Poor	0	0	0	0

**DISCUSSION**

Humerus supracondylar fracture is the most common injury around elbow in children mostly that occurs in first decade of life, as found in this study. The management of irreducible supracondylar fracture of the elbow is one of the most difficult fractures to treat. According to the Gartland Classification, type II type III humerus supracondylar fracture needs to be treated by closed or open reduction and internal fixation. In treatment of the supracondylar fracture, the main target is to gain anatomic reduction and good functional outcome with no serious complication. In case of fractures without displacement, almost all surgeons agree on the non-operative treatment. However for displaced fractures, several approaches might be chosen. In this context, a common approach for the open reduction is the pinning from lateral side of the elbow. According to the Flynn's criteria, results showed that about 90.9% of the treatments had satisfactory results. However, it is worth noting that while, some surgeons initially chosen the open reduction approach as the treatment modality especially for type III, some others believe that this approach should be applied only if the closed reduction method was failed.8 The later opinion is acknowledged in this

study9,. In an investigation by Weiland et al.10, 11 it was found that short term results of open reduction was similar to the closed reduction method. However, they found that open reduction had less cubitus varus and valgus complications. In the present study, we found that open method has more anatomic reduction and satisfactory outcomes with a low rate of minor varus or valgus deformity. Woratanarat et al.12 did a meta-analysis based on a plenty of articles on pinning methods. They concluded that lateral pinning outperforms the medial-lateral pinning methods since it causes less ulnar nerve injury. Similar findings were also reported in Skaggs et al.13 and Gaston et al.14 The results of this work are also in agreement with the previous studies. In a study by Zamzam et al.15 the patients treated by lateral pinning were prone to failure of fracture stability, complications and more re-operation rates. The previous investigations have shown that outcome of the lateral pinning approach is very satisfactory so that, about 67%-91.8% of treatments were found successful.10,16-19. The outcomes of this study also show that about 87.5% of treatments are excellent and according to the Flynn's criteria all treatment results are satisfactory. In spite of all the excellent results found here and in the previous studies on the use of lateral pinning method, there is no general agreement on the treatment approach for the supracondylar fracture. Indeed, excellent outcomes have also been seen in anterior, posterior and medial approaches. In other words, there is no dramatic statistical differences between the aforementioned approaches.6-8 In the previous studies, various methods have been proposed for pinning.20 However, cross pinning from medial and lateral has been found to be the most stable method in biomechanical standpoint.5,7 In our study, the lateral pinning by using 2 or 3 pins were successfully applied to the patients. Upon the results presented in the previous section, the demographic results, injury mechanism and the morphologic characteristics of the patients are in agreement with the previous studies.

**CONCLUSION** High rates of satisfactory results were found in the treatment of displaced supracondylar fractures of the humerus by lateral pinning method. According to the clinical and radiographical results, we conclude that the lateral pinning method is reliable and safe in terms of elbow function, neurovascular injury and infection issues.

## References

- Omid R, Choi PD, Skaggs DL. Supracondylar humeral fractures in children. *J Bone Joint Surg Am Vol.* 2008;90(5):1121-1132. [PubMed]
- Benedetti Valentini M, Farsetti P, Martinelli O, Laurito A, Ippolito E. The value of ultrasonic diagnosis in the management of vascular complications of supracondylar fractures of the humerus in children. *Bone Joint J* 2013;95-B:694-8.
- Behdad A, Behdad S, Hosseini M. Pediatric Elbow Fractures in a Major Trauma Center in Iran. *Arch Trauma Res.* 2013;1(4):172-175. doi: 10.5812/atr.8098. [PMC free article] [PubMed]
- Shrader MW. Pediatric supracondylar fractures and pediatric physeal elbow fractures. *Orthop Clin North Am.* 2008;39(2):163-171. doi: 10.1016/j.oocl.2007.12.005. [PubMed]
- Cheng JC, Lam TP, Maffulli N. Epidemiological features of supracondylar fractures of the humerus in Chinese children. *J Pediatr Orthoped.* 2001;10(1):63-67. [PubMed]
- Hart ES, Turner A, Albright M, Grottkau BE. Common pediatric elbow fractures. *Orthop Nurs.* 2011;30(1):11-17. quiz 18-19. doi: 10.1097/NOR.0b013e31820574c6. [PubMed]
- David L, Skage, John M, Flynn. Supracondylar fractures of the distal humerus. In: James H. Beaty, James R. Kasser, editors. *Rockwood and Wilkins Fractures in children.* 7th ed. Lippincott; 2010. pp. 488-523.
- S. Terry Canale, James H Beaty. Fractures in children. In: S. Terry Canale, James H. Beaty, editors. *Campbell's Operative Orthopaedics.* 11th ed. Mosby; 2008. pp. 1580-1593.
- Archibeck MJ, Scott SM, Peters CL. Brachialis muscle entrapment in displaced supracondylar humerus fractures: a technique of closed reduction and report of initial results. *J Pediatr Orthoped.* 1997;17(3):298-302. [PubMed]
- Shah RA. Displaced Supracondylar fractures of the Humerus in children, treated by Closed Reduction and percutaneous pin fixation. *Ann Abbasi Shaheed Hosp Karachi Med Dent Coll.* 2004;9:596-600.
- Weiland AJ, Meyer S, Tolo VT, Berg HL, Mueller J. Surgical treatment of displaced supracondylar fractures of the humerus in children. Analysis of fifty-two cases followed for five to fifteen years. *J Bone Joint Surg Am Vol.* 1978;60(5):657-661. [PubMed]
- Ay S, Akinci M, Kamiloglu S. Open reduction of displaced pediatric supracondylar humeral fractures through the anterior cubital approach. *J Pediatr Orthop.* 2005;25:149. [PubMed]
- Woratanarat P, Angsanuntsukh C, Rattanasiri S, Attia J, Woratanarat T, Thakkinstian A. Meta-analysis of pinning in supracondylar fracture of the humerus in children. *J Orthopaed Trauma.* 2012;26(1):48-53. doi: 10.1097/BOT.0b013e3182143de0. [PubMed]
- Skaggs DL, Hale JM, Bassett J, Kaminsky C, Kay RM, Tolo VT. Operative treatment of supracondylar fractures of the humerus in children. The consequences of pin

- placement. *J Bone Joint Surg Am Vol.* 2001;83-A(5):735-740. [PubMed]
- Gaston RG, Cates TB, Devito D, Schmitz M, Schrader T, Busch 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;30(8):799-806. doi: 10.1097/BPO.0b013e3181f73d59. [PubMed]
- Zamzam MM, Bakarman KA. Treatment of displaced supracondylar humeral fractures among children: crossed versus lateral pinning. *Injury.* 2009;40(6):625-630. doi: 10.1016/j.injury.2008.10.029. [PubMed]
- Ramachandran M, Birch R, Eastwood DM. Clinical outcome of nerve injuries associated with supracondylar fractures of the humerus in children: the experience of a specialist referral centre. *J Bone Joint Surg Br.* 2006;88(1):90-94. [PubMed]
- Baratz M, Micucci C, Sangimino M. Pediatric supracondylar humerus fractures. *Hand Clinics.* 2006;22(1):69-75. [PubMed]
- Kazimoglu C, Cetin M, Sener M, Agus H, Kalanderer O. Operative management of type III extension supracondylar fractures in children. *Int Orthopaed.* 2009;33(4):1089-94. doi: 10.1007/s11751-014-0198-7. [PMC free article] [PubMed]
- Ozturkmen Y, Karamehmetoglu M, Azboy I. Closed reduction and percutaneous lateral pin fixation in the treatment of displaced supracondylar fractures of the humerus in children. *Acta Orthopaedica et Traumatologica Turcica.* 2005;39(5):396-403. [PubMed]
- Anwar W, Rahman N, Iqbal MJ, Khan MA. 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):356-361.