Case Series

Comparative study of functional outcome of displaced paediatric supracondylar humerus fracture fixed with two lateral or crossed percuteneous kirschner-wire after closed reduction

Surendra Singh Yadav[1], Vikas Singhal[2], Vivek Dhakad[3], Tarun Naugraiya[4*], Satyam Kumre[5]

[1]Associate Professor, Department of Orthopaedic, Gajraraja Medical College, Gwalior, Madhya Pradesh, India
[2]Assistant Professor, Department of Orthopaedic, Gajraraja Medical College, Gwalior, Madhya Pradesh, India
[3]Senior Resident, Department of Orthopaedic, Gajraraja Medical College, Gwalior, Madhya Pradesh, India
[4]Senior Resident, Department of Orthopaedic, Gajraraja Medical College, Gwalior, Madhya Pradesh, India
[5]Senior Resident, Department of Orthopaedic, Gajraraja Medical College, Gwalior, Madhya Pradesh, India

Received: 04-07-2021 / Revised: 15-08-2021 / Accepted: 23-09-2021

Abstract

Introduction: Supracondylar humerus fractures (SCH) are more common in the pediatric population than in the adult population. Children often utilize an outstretched arm as a protective mechanism when falling, creating a high incidence of fractures about the elbow. Supracondylar fractures of the humerus account for up to 18% of pediatric fractures overall, and up to 60% of elbow fractures. The modified Gartland classification is often used to describe fracture patterns and guide treatment. These injuries can be significant due to the risks of neurological damage, vascular injury, and compartment syndrome. Inadequate reduction and fixation can also lead to malunion and deformity. Some patients who develop a malunion but may have a satisfactory function in the long-term. **Case series:** In this study, we had studied the correlation of supracondylar fracture fixation, 30 cases with cross k wire fixation and 30 cases with 2 lateral k wire fixation . Our study concluded that Cross and lateral k wire pin fixation of Supracondylar fracture humerus result in similar construct stability and functional outcome**. Conclusion:** Our study concluded that Cross and lateral k wire pin fixation of Supracondylar humerus fracture (SCH) result in similar stability and functional Range of motion. Although ulnar nerve injury was 3.33% more likely in the crossed K-wire group, the overall incidence of this complication and other complications was very low.

Keywords: Supracondylar humerus fracture, cross k wire fixation, lateral k wire fixation

Introduction

Fracture of the Supracondylar humerus are the most common fracture in children between 3 to 10 years old and the most common pediatric fracture requiring surgery, supracondylar fracture may have significant complication including nerve injury, vascular injury and compartment injury[1].

Epidemiology

1. Supracondylar fracture of humerus represent 12-17% of all pediatric fractures[4].
2. Extension injuries accounts for 95% of supracondylar fracture of humerus.
3. Flexion injuries result from direct trauma to the posterior aspect.
4. Of the distal humerus or falling on to flexed elbow (accounts 2-5% of cases)[2].
5. The most common mechanism of injury, when patient falls on to a outstretched hand with arm fully extended[3].

*Correspondence
Dr. Tarun Naugraiya
Senior Resident, Department of Orthopaedic, Gajraraja Medical College, Gwalior, Madhya Pradesh, India.
E-mail: tarun_naugraiya@live.com

Classification (Modified Gartland Classification)

Type I :Undisplaced or minimally displaced.
Type II:Displaced but with intact posterior cortex
(a) Stable with posterior angulation
(b) Unstable with posterior angulated and rotated
Type III:Completely displaced
III A : Postero-medial
III B : Postero-lateral

Type IV

Fracture with multidirectional instability

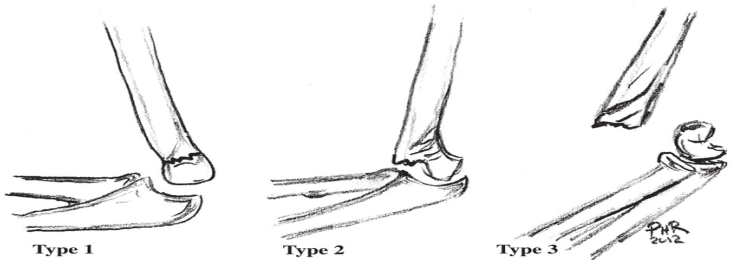


Fig 1: Gartland classification for supracondylar fractures

Case Series

This study was done prospectively in the Department of Orthopaedics and Trauma Centre in J. A. Group of Hospitals, Gwalior (M.P.) from January 2020 to July 2021. The cases being selected on random basis those having displaced pediatric supracondylar humerus fracture. A total number of 60 cases (displaced supracondylar fracture humerus) will be selected on OPD as well as emergency basis. Out of 60 patients, 30 cases with cross k wire fixation and 30 cases with 2 lateral k wire fixation. Patients with Age between 3 to 10 years, Closed supracondylar humerus fracture Gartland type II and III, Duration of injury < 1 week, Compound displaced supracondylar humerus fracture GA type I with no neurological deficit have been included in the study. Patients with Age more than 10 years, Compound fracture with GAII and GAIII ,Duration of injury > 1 week, Polytrauma or with Clinical evidence of inflammatory joint disease, Pathological fracture, old fracture (> 1 week) have been excluded from the study

Methods

Our study is prospective study and study data was collected, complied and analyzed. The different statistical tests as percentage, proportions and chi square was applied. A total number of 60 cases (displaced supracondylar fracture humerus) were admitted in routine as well as emergency basis and operated in routine hours and availability of operation theatre. Most of the cases are operated within 24 hours of admission cases are operated either with two cross K-wire or two lateral k wire fixation. Patients were discharged on postoperative 2nd or 3rd day. Follow-up was done At 7 days than at 21 days, For range of motion/ movement at elbow joint assesed between 6-24 weeks. Follow up was done using Flynn's criteria

Observation

In our study, the age of the patients between 3-10 years and their is no sex preponderance .

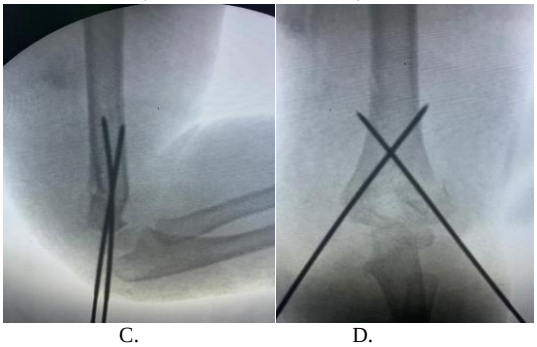
In our study, out of 60 cases , 30 cases were fixed with cross k wire fixation in which their were 2 cases that had ulnar nerve palsy and their was no displacement of fracture fixation and loss of range of motion in 2 patients.

While in 30 cases that were fixed by 2 lateral wire fixation their is no cases reported with nerve palsy and their are only 2 cases with displacement and loss of range of motion in 4 patients.

Table 1: Relationship between lateral and crossed pinning groups in displaced supracondylar fractures of humerus

	Lateral pin fixation	cross pin fixation
No. of Cases	30	30
Age (years)	6 years (mean)	6.7years (mean)
Gender		
a. Males	17	14
b. Females	13	16
Nerve injuries		
Ulnar	0	2
Loss of motion	Mean (38 degree) in 4 pts	Mean (27 degree)in 2 pts
Displacement	2	0
Final result		
Satisfactory	24	26
Unsatisfactory	6	4

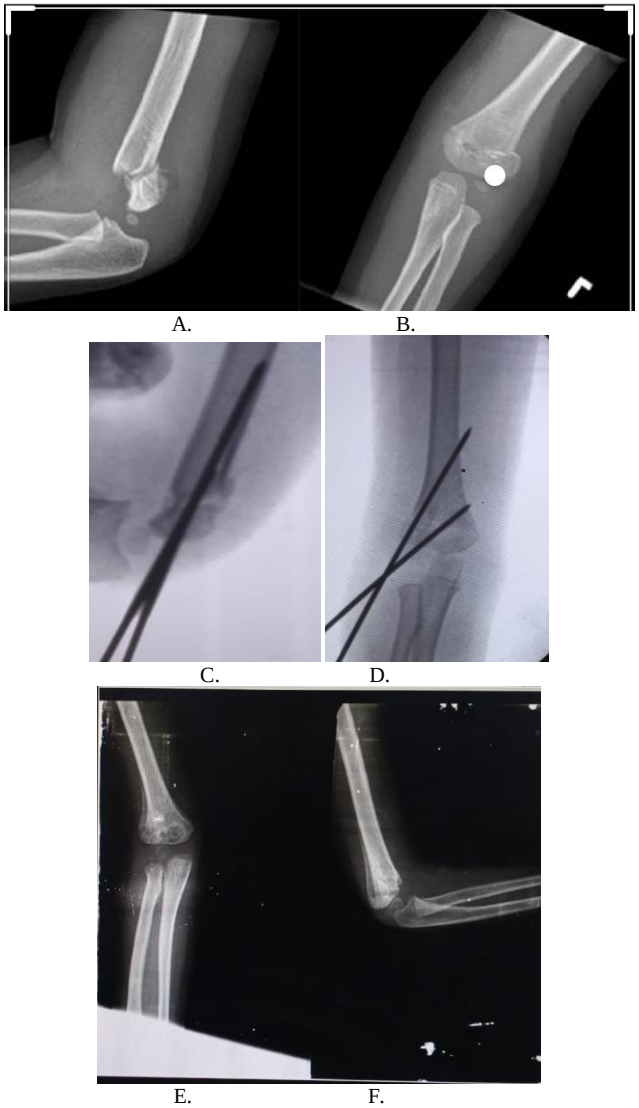
A. B.



C. D.

E. F.

Fig 2 Type IIB supracondylar fracture of humerus in 4-year-old. (A and B) Preoperative radiographs. (C and D) After stabilization with two cross K-wires and Follow up x-rays at 6 weeks(E and F)



A. B.

C. D.

E. F.

Fig 3:Type IIB supracondylar fracture of humerus in 4-year-old. (A and B) Preoperative radiographs. (C and D) After stabilization with two Lateral K-wires and Follow up x-rays at 6 weeks(E and F)

Fig 4: Clinical images of functional range of motion after lateral k wire fixation in fracture supracondylar humerus at 4 weeks.

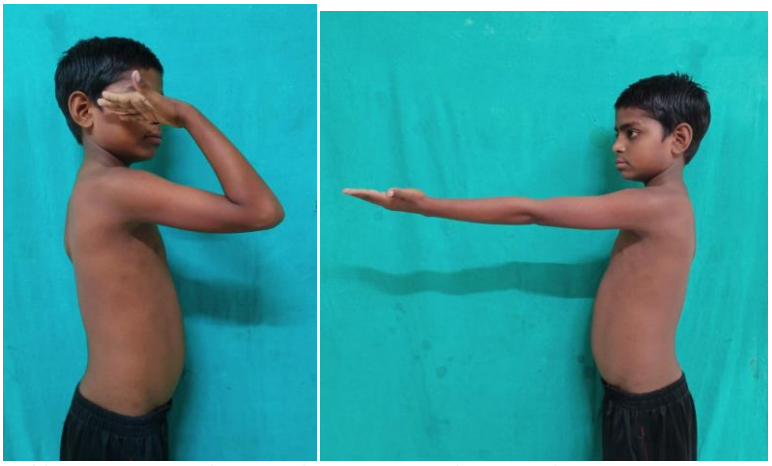


Fig 5: Clinical images of functional range of motion after cross k wire fixation in fracture supracondylar humerus at 4 weeks.

Discussion and conclusion

Our study concluded that crossed pin fixation point out biomechanical studies showing that this configuration gives relative equal stability to lateral pins. Zionts et al[6]. showed on a cadaver model that the torque required to produce 108 of rotation is 40% less for two lateral parallel pins than for wires inserted via the medial and lateral condyles. However, the lateral wires used for this study were parallel and very close to each other in order to avoid the lateral growth plate of the distal humerus. In their biomechanical studies Lee et al. found that a divergent configuration of lateral pins produced similar stability under varus/valgus loading to crossed wires and greater stability than parallel lateral wires[7]. Supporting these findings, Skaggs et al. proposed technical points for lateral entry fixation. These included maximal separation of the pins, engagement of both columns, engagement of sufficient bone of the proximal and distal fragments and use of a third pin if necessary[8]. No laboratory studies have yet been done to check the stability of this configuration.

Despite the laboratory findings of Zionts et al[6] and Herzenberg et al[9]. most publications do not show any significant difference in clinical outcome between the two fixation methods. This has been confirmed by our study which compared the final outcomes in two similar groups of patients. All children treated with closed reduction had cross-wire fixation, however this difference was not statistically significant ($p = 0.06$). Loss of fixation in our series occurred in two cases but was dependent on technical errors rather than the pin configuration. These errors included inadequate pin separation, failure to fix the proximal fragment and failure to engage the opposite cortex.

The main drawback of medial pin placement is the risk of iatrogenic ulnar nerve injury. The risk quoted in the literature ranges from 0 to 6%[10]. This may increase to 15% if the pins are inserted with the elbow in hyperflexion[11]. In our series the incidence was 3.33%. Ulnar nerve palsy occurred only when a medial pin was used to stabilize a closed reduction. A number of strategies have been proposed to avoid ulnar nerve injury. Michael and Stanislas identified the ulnar nerve with a nerve stimulator per-operatively[12]. Others suggest making a small incision over the medial epicondyle or elbow extension during K-wire placement[13]. Neither is foolproof. Palpating the nerve as suggested by Paradis et al. is difficult when the elbow is very swollen[14]. Several authors advise pin insertion from the lateral side only, a view with which we concur[15]. O'Hara et al. reported a high incidence of re-displacement when only lateral pins were used. However, they failed to report how their pins were placed[16].

Clinical Message

Supracondylar fracture humerus fixation either with cross k wire or lateral k wire result in similar construct stability and functional outcome**.**

References

1. Omid R, Choi PD, Skaggs DL. Supracondylar humeral fractures in children. J Bone Joint Surg Am. 2008;90:1121–11
2. Pirone AM, Graham HK, Krajbich JI. Management of displaced extension-type supracondylar fractures of the humerus in children. J Bone Joint Surg Am. 1988;70:641–650; Erratum in: *J Bone Joint Am* 1988;70:1114
3. Battaglia TC, Armstrong DG, Schwend RM. Factors affecting forearm compartment pressures in children with supracondylar fractures of the humerus. J Pediatr Orthop. 2002;22:431–439
4. Cao J, Farmer R, Carry PM, et al. Standardized note templates improve electronic medical record documentation of neurovascular examinations for pediatric supracondylar humeral fractures. JB JS Open Access. 2017;2:e0027
5. Sung K, Chung C, Lee K, et al. Application of clinical pathway using electronic medical record system in pediatric patients with supracondylar fracture of the humerus: a before and after comparative study. BMC Med Inform Decis Mak. 2013;13:8
6. Lyons JP, Ashley E, Hoffer MM. Ulnar nerve palsies after percutaneous cross-pinning of supracondylar fractures in children's elbows. J Pediatr Orthop 1998;18:43—5.

7. Mazda K, Boggione C, Fitoussi F, Pennecot GF. Systematic pinning of displaced extension-type supracondylar fractures of the humerus in children. A prospective study of 116 consecutive patients. J Bone Joint Surg [Br] 2001;83-B:888—93.
8. Mehserle WL, Meehan PL. Treatment of the displaced supracondylar fracture of the humerus (type III) with closed reduction and percutaneous cross-pin fixation. J Pediatr Orthop 1991;11:705—11.
9. Michael SP, Stanislas MJ. Localization of the ulnar nerve during percutaneous wiring of supracondylar fractures in children. Injury 1996;27:301—2.
10. O'Hara LJ, Barlow JW, Clarke NM. Displaced supracondylar fractures of the humerus in children. Audit changes practice. J Bone Joint Surg [Br] 2000;82-B:204—10.
11. Paradis G, Lavallee P, Gagnon N, Lemire L. Supracondylar fractures of the humerus in children. Technique and results of crossed percutaneous K-wire fixation. Clin Orthop Relat Res 1993;297:231—7.
12. PironeAM, Management of displaced extension-type supracondylar fractures of the humerus in children. J Bone Joint Surg [Am] 1988;70-A:641—50.
13. Shim JS, Lee YS. Treatment of completely displaced supracondylar fracture of the humerus in children by cross-fixation with three Kirschner wires. J Pediatr Orthop 2002;22:12—6.
14. Skaggs DL, Cluck MW, Mostofi A, et al. Lateral-entry pin fixation in the management of supracondylar fractures in children. J Bone Joint Surg [Am] 2004;86-A:702—7.
15. Skaggs DL, Hale JM, Bassett J, et al. Operative treatment of supracondylar fractures of the humerus in children. The consequences of pin placement. J Bone Joint Surg Am 2001;83-A:735—40.
16. Topping RE, Blanco JS, Davis TJ. Clinical evaluation of crossed-pin versus lateral-pin fixation in displaced supracondylar humerus fractures. J Pediatr Orthop 1995;15:435—9.
17. Wilkins KE. Fractures and dislocations of the elbow region. In: Rockwood CA, Wilkins KE, King RE, editors. Fractures in children, vol. 3. Philadelphia: JB Lippincott Co.; 1984 . p. 363—575.
18. Zionts LE, McKellop HA, Hathaway R. Torsional strength of pin configurations used to fix supracondylar fractures of the humerus in children. J Bone Joint Surg [Am] 1994;76-A:253—6

Conflict of Interest: Nil Source of support: Nil