



FUNCTIONAL AND RADIOLOGICAL OUTCOME OF SUPRACONDYLAR HUMERUS FRACTURES IN CHILDREN WITH LATERAL PINNING: A RETROSPECTIVE ANALYSIS

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ABSTRACT

Supracondylar humerus fractures being the most common pediatric fracture around the elbow. Closed reduction and percutaneous Kirschner wire (k-wire) fixation is now considered as standard method for surgical management of displaced fractures. The optimal configuration of percutaneous pin fixation is however still debatable. This study was conducted to find out the outcome of percutaneous lateral pinning in the management these fractures. Functional outcome was calculated as per Flynn's criteria. Total of 25 cases were studied, out of which, 20 (80 %) had excellent, 4 (16 %) had good, 1 (4 %) had fair outcome. No poor outcome at the final follow-up of 6 months. No case postoperative of ulnar nerve palsy was seen. We conclude that closed reduction and fixation of Gartland type II and III paediatric supracondylar fractures with lateral pinning is safe and effective without the risk of iatrogenic ulnar nerve injury.

KEYWORDS : Supracondylar humerus, paediatric fracture, Flynn's criteria, lateral pinning

INTRODUCTION

Supracondylar humerus fractures being the most common pediatric fracture around the elbow and are nearly three-fourth of all upper-extremity fractures.¹⁻¹³ Gartland's classification is used to describe this fractures as nondisplaced fractures (Type I), hinged fractures with the posterior cortex intact (Type II), and completely displaced fractures (Type III).⁴ Percutaneous pinning of supracondylar humerus fractures in children after closed reduction is an effective way to maintain an anatomic reduction of a displaced fracture till bony union and was first described by Casiano in 1960.⁵ Closed reduction and percutaneous Kirschner wire (k-wire) fixation is now considered as standard method for surgical management of displaced extension type (Gartland Type II and Type III) supracondylar humerus fractures. Many investigators have used two crossed pins (one introduced medially and one laterally).^{5,7} Others have used two or three lateral pins only and without any medial pin.⁸ The optimal configuration of percutaneous pin fixation is however still debatable.

Biomechanically, a crossed pin configuration (one medial and one lateral) provides increased stability but carries the risk of iatrogenic ulnar nerve injury during insertion of the medial pin.^{9,11} Conversely, lateral pin fixation avoids the danger of iatrogenic ulnar nerve injury but has been proven to be mechanically less stable compared to crossed pin configuration.^{12,16} There are studies which have proven that lateral-only fixation is good enough for maintaining reduction while simultaneously avoiding injury to the ulnar nerve.¹⁷ This retrospective study was conducted to find out the outcome of percutaneous lateral pinning in the management of displaced supracondylar fracture of humerus in children, also to see the associated complications with this method of fixation.

MATERIALS AND METHODS

This retrospective study comprising of 25 cases of displaced fracture supracondylar humerus, treated by lateral and cross pinning was carried out at Orthopedics Department, H. B. T. Medical College and Dr. R. N. Cooper Municipal General

Hospital, Mumbai from July 2018 to June 2019. A written informed consent was obtained from all the patients (by their parents). The inclusion criteria was closed supracondylar fracture of humerus extension Type II and type III in children less than 14 yrs of age. Patients with a) extension Type I of fractures, b) flexion type injuries, c) compound fractures d) patients completed the age of 14 years e) previous history of fractures or nerve injury around elbow, were excluded from the study.

All the necessary preoperative work-up was done in the form of thorough clinical and radiological examination. The fractures were classified as per the Gartland's classification system. All patients were operated under general anesthesia within 48 h after trauma. Under general anesthesia, using c-arm image intensifier, closed reduction was done. The forearm was then pronated and the elbow acutely flexed and held temporarily by adhesive tape. Pronation de-rotates the distal fragment from its frequently medially rotated position and locks it in correct alignment. When satisfactory reduction had been achieved then fixation was done by two divergent lateral K-wires of 1.5 or 2.0 mm size. Adequate reduction was assessed by anterior humeral line passing through the centre of capitulum. Pins were placed in divergent configuration with the adequate separation at the fracture site. If doubt in stability of fixation was there, a third lateral pin was added. Vascularity of distal limb were also checked at this point. The pins were bent and cut off outside the skin and a well-padded, above-elbow, back-slab was applied and vascularity of the distal part of limb checked again. The patient was carefully observed for 48-72 hours with proper limb elevation and then discharged in above elbow POP back slab. The follow-up was done as follows: the first follow-up on the 7th day to inspect pin tract infection and swelling; the second follow-up on the 2nd week to see pin tract infection and the pin configuration; the 3rd follow-up on the 4th week for the removal of plaster slab as well as pins and to start physiotherapy; the 4th follow-up on the 8th week post-operatively to see the progress of rehabilitation and any other complications; and the final follow-up on the 6 months post-operatively to see the final

result of the study. The final results were analyzed using the Flynn criteria. This criteria is divided into two components, the functional and the cosmetic component and both are further sub-divided as excellent, good, moderate and poor at an interval of five degrees.

RESULTS

There were 25 children in this study, 15 children were male and 10 children were females. The children were aged 1.5 years to 13 years with median age of 7.28 years.(Table 1) There were 14 left sided and 11 right-sided fractures. 18 children had injury while playing, 3 children had met with a road traffic accident and 4 had a fall from a height. All were closed fractures. The extension type II were 10 and 15 were of extension type III. 21 cases were treated by two divergent lateral k-wires while 4 cases were treated with three divergent lateral k wires. None of the fractures required open reduction. Pre-operatively, there were no cases of vascular or nerve injuries. During follow-up, none had secondary displacement of wires and loss of reduction. Post-operatively, 2 patients got pin tract infection, which was superficial and healed after removing pins and oral antibiotic administration. Postoperatively, no ulnar nerve injury or vascular injury were noted in any patients. Callus formation was seen in all patients at the 4th week postoperatively follow up before removing the K-wires. No case of nonunion was seen. Results were analyzed using Flynn's criteria (Table 2).⁷

TABLE 1: DISTRIBUTION OF PATIENTS AS PER AGE AND SEX

Age/sex	0-5 years	6-10 years	More than 10 years	Total
Male	4	8	3	15
Female	3	6	1	10

TABLE 2: FLYNN ET AL. CRITERIA FOR GRADING

Results	Rating	Cosmetic factor: carrying angle loss (in degrees)	Functional factor: motion loss (in degrees)
Satisfactory	Excellent	0-5	0-5
	Good	5-10	5-10
	Fair	10-15	10-15
unsatisfactory	Poor	>15	>15

All patients were followed at 8 weeks and 6 month post-operatively. Functional outcome, as per Flynn's criteria, 18 (72 %) had excellent, 4 (16 %) good, 2 (8 %) fair and 1(4 %) poor results at 8 weeks, which was improved to 20 (80 %) excellent, 4 (16 %) good, 1 (4 %) fair and no poor result at the final follow-up of 6 months (Table 3). The average loss of range of movement as well as carrying angle was of 4 degrees.

Table 3: Final results of lateral K-wire fixation of supracondylar fracture humerus

Results	Rating	Cosmetic factor: carrying angle loss (in degrees)	Outcome in patients	Functional factor: motion loss (in degrees)	Outcome in patients
Satisfactory	Excellent	0-5	19	0-5	20
	Good	5-10	5	5-10	4
	Fair	10-15	1	10-15	1
unsatisfactory	Poor	>15	0	>15	0

During this study, complications like vascular injury, compartment syndrome, myositis ossifications, ulnar nerve palsy, significant mal-union and non-union were not seen.

DISCUSSION

Closed reduction and percutaneous pin fixation for the management of pediatric supracondylar humerus fractures is

widely accepted and practiced, but the optimal pin configuration is still controversial.^{1,19-21} Chakraborty *et al.* and Balakumar and Madhuri found crossed (medial/lateral) pinning to be superior than two parallel lateral pin fixations.^{22,23} However, many studies have reinforced the observation that both lateral-entry pin fixation and crossed pin configuration are effective in the management of Type III Gartland supracondylar fractures in children.^{21,24,25}

Sankar *et al.*²⁶ studied the loss of pin fixation in supracondylar humerus fractures. He concluded in all cases, loss of fixation was due to technical errors that were identifiable during intraoperative fluoroscopic images. All these errors could have been prevented with proper reduction and fixation technique. Three types of of pin-fixation errors were identified as: (1) failure to achieve bicortical fixation with two pins or more, (2) failure to engage both fragments with two pins or more, and (3) failure to achieve adequate pin separation (> 2 mm) at the fracture site.

Sapkota *et al.*²⁷ suggested lateral pinning with 2 or 3 K-wires for proper stabilization and ideal configuration to be divergent to hold medial and lateral columns as the treatment of supracondylar fracture without risk of iatrogenic ulnar nerve injury. Pathania *et al.* studied the surgical complications and also compared the functional and radiological result of lateral pinning and crossed pinning in supracondylar fractures in children. They concluded that fixation of supracondylar humerus fracture of Gartland type II and III can be done by both ways either cross or lateral pinning but in view of ulnar nerve injury and extension lag which is more commonly associated with cross pinning, lateral pinning is comparatively safe and reliable for both types of supracondylar fractures of humerus in children.²⁸

Govindasamy *et al.* did a retrospective study on Cross pinning versus lateral pinning in supracondylar fracture in children and concluded that both fixation techniques were good in terms of stability, function and cosmetic outcome. The problem with cross pinning was iatrogenic ulnar nerve injury due to medial pinning which was 11%. So lateral pinning is reliably safe method and provides adequate stability in displaced supracondylar fractures.²⁹

Skaggs *et al.*¹⁷ concluded that lateral-only pins provide adequate stability without endangering the ulnar nerve for fixation of both Type II and III supracondylar humerus fractures. They also advised avoiding the regular use of crossed pins in the treatment of pediatric supracondylar humerus fractures. In our study also, we found that lateral 2-3 pins were enough to provide a stable fixation and give excellent to good functional and radiological outcome without any risk of ulnar nerve injury.

CONCLUSION

As the fixation remained stable with lateral pinning and provided excellent to fair functional as well as cosmetic outcome with no loss of reduction during follow up, it can be concluded that closed reduction and fixation of Gartland type II and III supracondylar fractures with lateral pinning is safe and effective without the risk of iatrogenic ulnar nerve injury.

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