

Operative management of paediatric Supracondylar fractures of Humerus Extension type: The Results of K-wire Placement

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Abstract

Aim: To study the k wire placement Cross Pinning Versus Lateral Pinning technique, in terms of functional outcome and complications in the operative management of paediatric supracondylar fractures of humerus extension type. **Methodology** A total of 50 patients of supracondylar humerus fracture extension type-III were included in the study. 25 patients were operated by closed reduction with Cross K pinning fixation and 25 patients were operated by closed reduction and Lateral 2 K pinning fixation. All patients were followed up to 9 months and assessed for functional outcome and complications. **Results:** The two groups were comparable with respect to age /sex/weight/height and type of fractures. All patients of crosspinning were immobilized for three weeks whereas in lateral pinning 9% patients were immobilized for 4 weeks. The two groups were compared with respect to time till union, range of movement(ROM), carrying angle and function which was done at 3,6 and 9 months. 8.33% of the patients of cross pinning group had ulnar nerve injury. 66.7% had excellent results in cross pinning compared to 70.6% in lateral pinning. **Conclusion:** There is no significant difference in the stability provided by the cross pinning and two lateral pin fixation method. But the medial and lateral pin fixation group shows two cases of iatrogenic ulnar nerve injury. Therefore, lateral pin fixation method for the treatment of type III supra condylar fracture requiring surgery is a reliable and safe method to avoid iatrogenic ulnar nerve injury and provides adequate stability if proper pin fixation principles are used.

Key words: Supracondylar, Pinning, range of movement

Introduction

Supracondylar fractures of the humerus are the most common elbow fracture in children and make up approximately 60 % of all elbow injuries. According to Boyd and Altenberg, these fractures account for 65.4% of upper extremity fractures in children [1]. Peak age of occurrence is in first decade of life and it became progressively more uncommon as the child approaches adolescence the average age group of patient being 7½ years. The main cause for this fracture is fall on outstretched hand and indirect injury to the elbow. It is a fracture of the lower end of the humerus involving thin portion through the metaphysis. Reported cases are higher in males but recent reports indicate equal incidence in males and females. Left non dominant side is most commonly involved [2].

Considering the number of patients injured and the severity of the initial injury that occurs, great diligence is required to secure an excellent result and to avoid or minimize the crippling complications, such as Volkmann's ischemic contracture (VIC), myositis ossificans, and stiffness of elbow, nerve injuries and malunion. Injuries of elbow demand respect because the vascular damage and nerve injury they cause, is seen more often than any other injuries in the body [3]. On the basis of displacement of the distal fragment, supra condylar fractures are divided into extension and flexion types, of which the extension type accounts for 97% to 99%.5 [4]. Surgical management like percutaneous pinning after closed reduction or open reduction and internal fixation with K wires plays an important role in this type of fracture. Closed reduction is done with the help of image intensifier followed by k wire fixation for extension Gartland's type III

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supracondylar fracture of the humerus. The purpose of this study is to compare the results of k wire placement (Cross Pinning Vs. Lateral Pinning) in the operative management of paediatric supracondylar fractures of humerus extension type. There have been numerous pinning techniques described in literature. A crossed k wire configuration is believed to be more stable than two lateral k wires; however there is a risk of ulnar nerve damage during Medial k wire placement. This study is done to evaluate and compare the two pinning techniques in terms of Functional outcome and complications if any, in children with supracondylar fractures of humerus.

Methodology

In this prospective study, 49 patients with Type III Gartland fractures, age 2-12 years were selected. Patients were allotted randomly to one of two groups i.e. Cross Pinning and lateral Pinning based on chit method. On admission the patient was assessed clinically for any neurological injury. Radiographic parameters and patients based outcomes of cases with supracondylar humerus fracture extension type were evaluated. All operated patients followed the same postoperative protocol in the form of post-operative

immobilization and pin removal and radiological assessment. Postoperative assessment was done in term of range of motion, surgical wound healing, cubitus varus deformity, and nerve palsies. All patients were followed up periodically and functional and radiological outcome analysis was done at 2 weeks, 1, 6 and 9 months. Anterior humeral line, Baumann’s angle-suggesting accuracy of reduction, carrying angle, post operative range of motion, post operative complications like – deformity, infection, ulnar nerve injuries were documented. Functional and cosmetic results were graded based on Flynn et al criteria [5].

Inclusion Criteria:

1. Patient aged 2 to 12 years with Type III Gartland Classification Extension type included.
2. Open humeral growth plate.
3. Unilateral extension type fracture

Exclusion criteria:

1. Gartland type 1, II and IV fractures
2. Flexion Type Supracondylar fractures
3. Open fractures
4. Associated Ipsilateral limb fractures

Results

The two groups were comparable with respect to age /sex/weight/height and type of fractures. All patients of crosspinning were immobilized for three weeks whereas in lateral pinning 9% patients were immobilized for 4 weeks. The two groups were also comparable with respect to time for union (3-4 months) range of movement(ROM) and carrying angle (The statistical analysis was done by Student T test and P value was found to be not significant). Functional evaluation which was done at 3,6 and 9 months. Post operative complications were minimal with 8.33% of the patients of cross pinning group having ulnar nerve injury. When looking at overall results we conclude that 66.7% had excellent results in cross pinning compared to 70.6% in lateral pinning. Therefore lateral pinning has a slight upper edge than cross pinning and should be the approach in supra condylar fractures of humerus, extension type.

Table 1: Modified Gartland’s Classification [6].

-TYPE 1	Undisplaced	Fat pad present acutely
-TYPE 2	Hinged posteriorly	Anterior humeral line anterior to capitellum
-TYPE 3	Displaced	No meaningful cortical continuity
TYPE 4	Multi directionally unstable	Diagnosed by manipulation under imaging

Table 2:-Comparison of post op complications.

Post op complications	Cross Pinning (N = 24)	Lateral Pinning (N = 25)
Ulnar nerve Injury	02	--
Infections	01	02

By Chi Square test P > 0.05, Not Significant

Table 3: Comparison of overall results (flynn's score) between the groups

Overall Results (Flynn's score) [5]	Cross Pinning (N = 25)	Lateral Pinning (N = 25)
Fair	04	03
Good	05	04
Excellent	16	18

By Chi Square test $P > 0.05$, Not Significant

Discussion

Treatment of displaced extension type III supracondylar fracture of humerus treated by closed reduction and percutaneous pin fixation has consistently given satisfactory result compared to other method of treatment. But controversy still persists regarding the adequate pin fixation technique comparing lateral pin fixation with medial and lateral pin fixation. In this study we found no significant difference between both fixation methods in terms of stability but there is a evidence of iatrogenic ulnar nerve injury (5%) in medial and lateral pin group.

The lateral and medial pin fixation method supposed to have the advantage of better fracture stability, although iatrogenic ulnar injury can occur with this technique. Conversely, lateral pin entry has the advantage of avoiding ulnar nerve injury but this construct has been thought to be biomechanically less stable. A cadaveric study reported by Lee SS et. al and Ziouts et.al suggested that medial and lateral entry provides greater torsional rigidity than lateral entry pin fixation does [7]. The overall strength of this construct is not only related to pin entry but mainly to divergence of the pins in different column and number of pins. The greater strength seen with the divergence of the pins was related to the location of the interaction of the two pins and the fact that the greater amount of divergence between the two pins allow for some purchase in the medial and the lateral column. Lyons et al. reported that three lateral divergent pins were equivalent to cross pin fixation and both of these constructs were stronger than two lateral divergent pins [8].

The rate of iatrogenic ulnar nerve injury associated with cross medial and lateral pin has been reported to be from 0% to 6%. Others have reported that these injuries occur more commonly [9]. In 1977 Leitch et al. recommended two lateral pins in order to avoid ulnar nerve injury [10]. A recent systemic review of 35 articles comparing lateral pin fixation with lateral and

medial pin fixation revealed that iatrogenic ulnar nerve injury occurred in 40 (3.4%) of 1171 cases of medial and lateral fixation group [11]. Although ulnar nerve injury recovered in most of the cases but there are several reports of permanent ulnar nerve injury [12]. Skaggs et al. reported that even making an incision over the medial epicondyle in an effort to ensure that the ulnar nerve is not directly injured does not guarantee protection of the nerve [13]. In a study by Rasool MN six iatrogenic ulnar nerve injury treated by early operation showed two direct ulnar nerve penetration and three had constriction of cubital tunnel and in one case ulnar nerve was fixed anterior to medial epicondyle [14]. Thus, even if direct injury to the ulnar nerve is avoided, just placing the pin over the medial epicondyle just adjacent to ulnar nerve can cause constriction of cubital tunnel. Therefore, one obvious undeniable conclusion is that, if medial pin is used, the lateral pin(s) should be used first followed by medial pin fixation with elbow in extension. But the best way to avoid ulnar nerve injury is not to place medial pin.

In our study also comparable results were achieved. Mean age of incidence of supracondylar fracture in children being 6.05 and 6.47 in cross pinning and lateral pinning groups respectively which was comparable to the 5 to 6 years mean that was reported in study by Cheng JC et al [15].

Incidence of Supracondylar fractures in males and females we found a higher incidence among females in both the groups with Cross pinning group reporting 52.4 % females and lateral pinning group having an incidence of 58.8 % which was comparable to the studies by Farnsworth CL et al and Houshian S et al [16,17].

The side of the affected extremity with supracondylar fracture humerus in our study was :52.4 % left side affection in the cross pinning group and 47.1 % in the

lateral pinning group was comparable to the studies by Farnsworth CL and Houshian S et al [16,17].with the left or the non dominant extremity being more commonly involved but the difference was insignificant. The type of displacement seen in the supracondylar humerus was Posteromedial 81 % in cross pinning group and 73.5 % in lateral pinning group which was comparable to 75 % of posteromedial displacement seen in studies by Rowell PJW [18].

Immobilization of the treated extremity is done for 3 weeks as per the standard protocol mentioned in Rockwood and Wilkins Fractures in children and we had 3 weeks post operative immobilization using an above elbow slab for all the patients in whom cross pinning was done and about 91.2 % in patients with lateral pinning, rest the slab was kept for 4 weeks according to the radiological evidence of fracture healing [19].

Time for union in the two groups was about 3 months to 4 months with 85.7 % of patients in the cross pinning group showing union at 3 months (12 weeks) as compared to the 88.2 % of patients in the lateral pinning group, which is comparable to the studies by Michael D. McKee et al where time for union was estimated around 3.5 months (14 weeks) [20] .

We had an average loss of reduction of 1 degree in the Baumann’s angle from immediate post-operative to post union time. The observation of ours as regards to the clinical carrying angle and the deformities in terms of

varus and valgus is also in conformity to others like Mehserle [21].

In our study, we observed an average flexion of 135 degrees (125- 145 degrees) and changes in mean ROM being 10-4 degrees over a period of 9 months in the cross pinning group whereas in the lateral pinning group we observed mean change in ROM from 12-6 with differences being insignificant. This observation of ours is similar to the findings of others like Boyd et al and Mehserle [21].

In our study we observed an Iatrogenic Ulnar injury rate of 8.33 % in the cross pinning group which was significantly higher than none ulnar nerve injury in the lateral pinning group. Also, the rate of infections in terms of pin tract infection was 4.8 percent in cross pinning group and 5.9 % in the lateral pinning group with the result being insignificant (P> 0.05)

Incidence of iatrogenic Ulnar nerve injury was almost similar as seen in other studies where 1% -15 % of iatrogenic ulnar nerve injuries were seen following Cross pinning [22]

Incidence of Superficial pin tract infection was comparable to that seen in other studies by Sahu et al [23] where an incidence of 3.55 % was reported.

Comparisons of overall Flynn’s score at 9 months were comparable to other studies as follows:

Table 4 : Final results in comparison with other studies

Study	J.C . Flynn[5] (1974)	A.J. Webb[23] (1989)	W.L.Meh serle[20] (1991)	M S Kocher (2007)[25]		Our Study	
				Cross pinning	Lateral pinning	Cross pinning	Lateral pinning
Number of patients	52	35	33	24	28	24	25
Excellent	42(81%)	20(57%)	23(70%)	78%	60%	16(66.7%)	18(70.6%)
Good	07(13%)	08(23%)	07(21%)	13%	35%	05(19%)	04(17.6%)
Fair	02(04%)	02(6%)	01(04%)	8%	5%	03(14.3%)	03(11.8%)
Poor	01(02%)	05(14%)	02(06%)	1%	0%	0	0

Conclusion

Early closed reduction and fixation is a gold standard treatment for extension type III supracondylar humerus fractures in children, but there is no any statistical significant difference in final functional outcome between closed reduction with fixation by either cross

pinning or lateral pinning. From this prospective study we conclude that there is no significant difference between the stability provided by the medial and lateral pin fixation and two lateral pin fixation methods. But the medial and lateral pin fixation group shows two

cases of iatrogenic ulnar nerve injuries which is also shown by many other studies.

Therefore, lateral pin fixation is a reliable and safe method to avoid iatrogenic ulnar nerve injury which also provides adequate stability if proper pin fixation principles are used.

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