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## Outcome of early versus delayed Kirschner wire fixation of supracondylar fractures of humerus in children

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### Abstract

**Purpose:** Controversy still persists regarding optimum intervention time for late presentations of supracondylar fracture of humerus in children. We compared outcomes in early and late groups of presentation and management.

**Study design:** We conducted prospective study comparing early and late open reduction and Kirschner wire fixation for Gartland type III supracondylar fracture of humerus in children aged less than 16 years. We analyzed results of 27 cases in early group and 19(8 lost) cases in late group. We compared duration of surgery, range of motion, and Flynn's criteria were used to evaluate outcome.

**Results:** Thirty (65%) patients were male and 15(32.60%) had dominant limb involvement. Injury to surgery time was 53.63±41.03 hours in early group and 338.53±134.31 hours in late group (p<0.005). Pre-operative nerve injury was 6(13%) cases in early group. Bauman's angle at 12 weeks in early group was 70.04± 3.240 & in late group had 71.42± 8.329. (p< 0.513). Loss of range of motion between groups was insignificant (p< 0.668). According to Flynn's, results were comparable between groups.

**Conclusion:** We concludes that in cases of Garland type III supracondylar fracture of humerus of children open reduction & k-wire fixation is an effective method of treatment in both groups.

**Keywords:** Supracondylar fracture humerus

### Introduction

Supracondylar fracture of the humerus is the most common fracture around the elbow in children and represents approximately 3% of all fractures in children<sup>[1, 2]</sup>. Gartland type I and type II fracture have good outcome with conservative treatment. The treatment modalities for Gartland type III include side arm traction, overhead skeletal traction, closed reduction and casting with or without percutaneous pinning and open reduction and internal fixation<sup>[3, 4]</sup>. Displaced Gartland type III fractures have been seen as difficult cases by managing with closed reduction and pop cast due to loss of reduction and coronal tilt missed on radiograph resulting to cubitus varus deformity<sup>[5, 6]</sup>. Closed reduction and percutaneous pinning provides the best cosmetic and functional results in early presentation<sup>[7-11]</sup>. Indications for open reduction and internal fixation includes: failed closed reduction, open fractures, brachial injury<sup>[12-15]</sup>. Although some investigator suggests that non-operative treatment with traction and immobilization can be management of choice in case of delayed presentation. Need for corrective osteotomy in significant number of cases had been regarded as failure of such modalities of treatment<sup>[16]</sup>. Literature has variable results regarding early and late treatment. Some studies suggests fracture must treat early to get good results<sup>[17]</sup> where as others had shown comparable results with delayed presentations also. Even after delayed presentation operative management has been shown better outcome than nonoperative treatment<sup>[18-24]</sup>. Early treatment has been regarded as less than 12 hours of injury. But in underdeveloped countries most of the patients presents more than 48 hours after injury due to lack of transportation facilities, monetary constrains, taboos regarding treatment of fracture because of faith healers.

Even if patients present within early days of fracture due to lack of imaging facilities during surgery, adequate reductions may not be possible with remaining varus tilt of distal fragment and also chances of iatrogenic ulnar nerve injury [25]. Hence primary open reduction and k wire fixation may be still an option for displaced supracondylar fracture of humerus in children which has been shown comparable results with CRPP by various studies [26-33]. As controversies still persists regarding how late such fracture should be treated with surgery, our study evaluates early vs late treatment of displaced supracondylar fracture humerus in children.

## Methods

The study was conducted at tertiary care hospital, over a period of twelve months from January 2013 to December 2013. Gartland type III supracondylar fractures of humerus in children less than 16 years of age were included in the study. Patients were allocated into Group A - children receiving operative treatment within 7 days of injury and Group B- Children receiving operative treatment after 7 days of injury and within 21 days. Total 1050 patients of elbow injury presented at our hospital over the study period. Out of which 153 supracondylar fracture and sixty eight patients were having Gartland type III supracondylar humerus. We excluded 14 patients; open fractures (8), associated polytrauma (4), and not given informed consent (2). Hence total 54 patients were undergone open reduction and k wire fixation; 27 patients in each group. Eight of the late cases did not follow up after surgery as they were from remote districts of Nepal. Hence we analyzed results of 27 cases in early group and 19 cases only in late group in the final analysis.

Cases were evaluated at outpatient and emergency department clinically and radiologically and findings were recorded in the Proforma as per the study protocol. All the patients were evaluated preoperatively for fitness for general anesthesia. Preoperative consent was obtained. Preoperative injectable ceftriaxone and amikacin were used. Patients were undergone open reduction and k wire fixation by lateral approach and minimal incision for visualization of ulnar nerve at medial side. Two crossed k wires were used. Above elbow pop slab were used. Intra operatively patients were evaluated for any complications. After the surgery any immediate post operative complications were taken into account. Patients were administered intravenous antibiotics initially (ceftriaxone), oral antibiotics (cefuroxime) along with analgesics for 48 hours. Wound was inspected on 2<sup>nd</sup> day of surgery. They were discharged after 48 hours if there was no complication in the post operative period. Above elbow pop slab was used post operatively for 3 weeks. Patients were reviewed after 2 weeks (pin tract infection, suture removal), 3 weeks (for A/E slab removal & physiotherapy), 6 weeks, 12 weeks since the time of surgery. In each of these visits, the patient were evaluated for pain, range of motion, evidence of union, infection, or for any external malrotation or dorsal and volar angulation and myositic mass. Fresh radiograph were taken in every visit & clinical evaluation of the final follow up based on the arc of flexion extension of both the injured & uninjured elbow. Radiographic assessment of both elbows was done using the Bauman's angle. In the last follow up visit of 12 weeks, patient was evaluated for Flynn's criteria [34].

X<sup>2</sup>- test and t-test were employed to compare the outcome of operative intervention of two groups consisting of early intervention and delayed intervention. Written consent were taken from parents. Ethical approval was obtained from

Institutional Ethical Review Board (IERB).

## Results

As shown in table 1, there are no significant difference between early and late groups with respect to age, intra operative time, hospital stays, postoperative change in Baumann's angle, loss of range of motion at 12 weeks except injury to surgery time which was significant P<0.000.

All of the patients presented with fall injury. Among them playground injury was the commonest presentation (17/46). Total of 15 patients presented with dominant extremity affected out of which 25.9 % (7) patients presented in early group & 42.1 % (8) patients presented in the late group. p-value after analysis was found to be 0.249 which is more than 0.05, so it is not significant. In the early group, 26% (12) patients presented to the hospital within 24 hours of injury, and 33 % (15) patients presented within 1 day to 6<sup>th</sup> day of injury. In the late group, 19% (9) patients presented to the hospital within 7<sup>th</sup> day to 14<sup>th</sup> day of injury and 22 % (10) patients presented within 15<sup>th</sup> day to 21 days of injury. In our study 1 patient in early group had complications like mild fever, swelling, serous discharge. None of the patients in late groups had similar complications. Total 3 patients developed pin tract infection and presented after 1 week of surgery which was managed with pin tract dressing and antibiotics. At the end of 3 weeks no patients had features of pin tract infection. None of the patients in two groups developed surgical site infection at 3, 6 and 12 weeks follow up period. All patients in either group had no pain at 12 weeks. All patients in either group had fracture united at 12 weeks. As shown in table 2, at 12 weeks, 2(11%) patients had arc of motion in the range of 51-100 degrees & 17(89%) patients had arc of motion in the range of 101-150 degrees. On analysis p-value in both the groups at 3 week, 6weeks, 12 weeks was found to be >0.05 so it is not significant. Arc of motion and loss of flexion and extension are not significantly different p<0.005 at 12 weeks between the groups.

As shown in table 3, total of 18(66.66%) patient presented in the early group had excellent results and 13(68.4%) patients presented in the late group had excellent results. Two (7.4%) presented in early group had good result and 4 (21.1%) presented in the late group had good result. Two patients (7.4%) presented in early group had poor result and 2 (10.5%) presented in the late group had poor result.

None of the patients presented in either of the two groups had fair result. P-value was found to be 0.347 which is >0.05 so it is not significant.

**Table 1:** comparison of patient profiles between early and late surgery groups

Variables	Group (Mean± SD)		P value
	Early	Late	
Age (Years)	8.23±2.981	7.84±3.955	0.446
Injury to surgery time (Hours)	53.63±41.03	338.53±134.31	0.000
Hospital stay (Days)	4.78±2.517	4±1.667	0.252
Intra op time (Mins)	48.85±8.887	45.42±11.43	0.721
Baumann's angle (Deg)			
3 weeks	71.37±4.106	70.37±7.819	0.210
6 weeks	70.44±3.117	73.26±8.306	0.382
12 weeks	70.04±3.240	71.42±8.329	0.513
Loss of ROM 12 weeks (Deg)	3.89±4.685	6.42±9.822	0.668

**Table 2:** Comparison between arc of motion and range of motion

Variables	Early(mean± SD)	Late (mean ±SD)	P value
Arc of Motion 3 wks	59.815 ± 22.81	46.053±9.657	0.301
Arc of Motion 6 wks	91.815±18.616	71.632±14.705	0.234
Arc of Motion 12 wks	132.22±6.224	123.368±18.559	0.696
Extension loss 12 wks	4.63±23.077	4.211±14.265	0.992
Flexion loss 12 wks	3.148±3.8301	5.263±8.0336	0.522

**Table 3:** Comparison of functional criteria by Flynn

Flynn's criteria	Group		p-value
	Early (%)	Late (%)	
Excellent	23(85.2)	13(68.4)	0.347
Good	2(7.4)	4(21.1)	
Fair	0	0	
Poor	2(7.4)	2(10.5)	
Total	27(100)	19(100)	

### Discussion

In our study age of the patients was  $8.23 \pm 2.981$  years in early group and  $7.84 \pm 3.95$  years in the late group which is nearly similar to the studies done by others [35-36]. Males were found to be more commonly involved both in early and late groups which are 63.0 % and 68.4 % respectively. Although some studies have concluded that females are more susceptible to such injuries [35-41]. Both the early and late groups have been evaluated and it has been found that left upper limb extremity has been commonly involved, which is 74.1% in the early group and 57.9% in the late group. Significant co-relation has not been found as p-value  $< 0.249$  which is consistent with study by Matuszweski L *et al.* [42]. On further evaluation it has been found that non-dominant extremity is more commonly involved than dominant extremity which is consistent with a study by Farnsworth *et al.* & Cheng *et al.* [35, 36]. Fall injury causes major injury. In our study it has been found that fall while playing and fall from bicycle causes maximum injury in the early group which is 33.33% while in the late group it was found that fall while playing causes maximum injury which is 42.1%, which is consistent with other studies [35-39]. In our study it was found that radial nerve was the commonest nerve involved, although slightly higher than described in the literature in early group (14.8%) and median nerve palsy (7.4%), while patients presenting late had no such complications [43-44]. In our study none of the patients had ulnar nerve injury at the time of presenting to the hospital, and none had similar complains in the postoperative period. It may be due to open technique which allows fracture reduction under visual guidance, which limits the risk of ulnar nerve injury. Literature suggests that ulnar nerve injury as high as 22% in percutaneous pinning of the fracture [25]. The once frequent complications of surgical treatment of a supracondylar fracture, i.e. myositis ossificans, in our study which was done by lateral approach with minimal incision on the medial side to visualize ulnar nerve none of the patient developed myositic mass. Hence open reduction itself does not increase the morbidity [1, 6, 26, 27, 33]. In our study 3(6.52%) patients developed pin tract infections which was managed by pin tract dressing and oral antibiotics. Our results are similar to other studies which report 2-7% of pin tract infection [44-45]. In study done by Pirone *et al.* suggested that open reduction and internal fixation increases risk of wound infection, we found only one case of superficial wound infection which was managed by wound dressing and oral antibiotics. Hence think by open reduction itself only doesn't increase risk of infection. Our study, in early group, minimal discharge seen

in 1 patient (3.7%) where as no such complaints were seen in late presenting group [9, 47]. In our study we have done crossed medial and lateral pinning via lateral approach with minimal incision on medial side to visualize ulnar nerve. Although percutaneous medial pinning has shown injury to ulnar nerve, in our study no postoperative ulnar nerve injury was found. There were no cases of reduction loss after the operation as we tried to engage opposite cortex in all the cases. Although recent literature shows that only lateral pinning may be sufficient to fix supracondylar fracture [48]. In our study, there are no cases of non union in both the groups as distal humerus is uncommon location. All the patients in both groups had clinical and radiological union in 3 weeks and had united fractures at 12 weeks follow up which is corresponding to studies done by others as open reduction and internal fixation is not the concern for union [11]. Our assessment of outcomes using Flynn's criteria showed no significant difference between early group and late group of open reduction and k wire fixation (85.2% versus 68.4;  $P = 0.342$ ). According to Flynn's criteria in early group, excellent results was seen in 85.2% cases, good result in 2.4% and poor result was seen 7.4% cases. In the late group, excellent result was seen in 68.4 % cases, good result in 21.1% cases and poor result in 10.5% cases. 15% of 132 Malaysian children with supracondylar fractures were reported to present late [48, 49, 50]. In our study arc of motion, range of motion, loss of flexion, extension and change in Baumann's angle were comparable between early and late groups with p value  $> 0.005$ . Motion range limitation of the elbow is common after supracondylar fractures, with a rate of 15% in the study by Damsin and Langlais [51]. The causes include soft tissue injuries, posttraumatic remodeling, fibrous surgical scars, and malunion. Nonetheless stiffness can be minimized by less number of manipulations and mediolateral approach to decrease trauma to soft tissue [50]. Our study has limitations due to less number of sample size and less duration of follow up. Our study shows displaced supracondylar fracture of humerus in children should be treated with anatomical reduction and stable fixation to avoid late complications. Hence Gartland type III supracondylar fractures of humerus irrespective of time of presentation within 3 weeks of injury has comparable results between early and late presentation by open reduction and fixation with Kirschner wires and complications like myositic mass, neural, vascular injury and compartment syndrome are not found in our study as mentioned in the literature.

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