

## Original Research Article

# A comparative study on outcome of conservative and surgical treatment of type III supracondylar fracture of humerus in children

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### ABSTRACT

**Background:** Supracondylar fracture of humerus is most common of all the fractures around the elbow in children. They occur most commonly in children more so in male child with the peak around 5-8 years. Objective of this study was to compare the outcome of 3 different modalities of treatment for supracondylar fracture of humerus.

**Methods:** Children with type III supracondylar fracture of humerus were categorized into group A, group B, group C based on conservative, closed reduction and percutaneous K wire fixation and open reduction and K wire fixation modalities of treatment given. All the children were followed for 6 months and the outcome of treatment was evaluated using Flynn's criteria.

**Results:** 40 children were treated with 3 different modalities of treatment. The rate of complications was less in children who were operated on first day of admission ( $p=0.02$ ). Group B and group C had 80% and 61.11% excellent results and group A had 47.05% poor results. The outcome was better with cross K wire pinning than lateral pinning ( $p=0.015$ ).

**Conclusions:** Supracondylar fracture of humerus should be operated as early as possible to reduce the rate of complications. The outcome of surgical treatment was better than conservative treatment evaluated in terms of Flynn's criteria. Cross wire pinning was better than lateral pinning in terms of outcome, but the rate of neuropraxias was more with cross wire pinning.

**Keywords:** Supracondylar humerus fractures, Elbow, Kirschner wires, Open fracture reduction, Conservative treatment

### INTRODUCTION

Supracondylar fracture of humerus constitutes about 55% to 75% of all the fractures around the elbow in children.<sup>1</sup> They occur most commonly during the childhood with the peak around 5-8 years. Boys are most commonly affected in the non-dominant side.<sup>2</sup> Supracondylar fracture of humerus is a highly complicated fracture if not treated properly it leads to neurovascular injury, malunion and elbow stiffness.

Undisplaced type I supracondylar fracture require simple immobilization of the elbow in above elbow plaster of Paris (POP) slab with the elbow in 90° flexion. Even type

II fractures are treated conservatively with closed reduction and POP slab. There are various treatment options for type III fracture which include closed reduction with POP, closed reduction with skeletal traction, closed reduction with percutaneous pinning, open reduction with percutaneous K wire fixation.<sup>3</sup> The traditional conservative method of closed reduction and POP slab application has various challenges which include difficulty in reduction and maintenance of reduction post manipulation of fracture. Most of the patients had malunion and elbow stiffness during follow up of this traditional method of treatment. A better understanding of bio-mechanics, quality of implants, principles of internal fixation, soft tissue care, antibiotics and asepsis have all

contributed to the radical changes in the treatment modalities of supracondylar fractures in children.<sup>4</sup>

So, the other treatment options for displaced supracondylar fractures of the humerus include closed reduction with percutaneous pinning or open reduction with internal fixation. Surgical treatment of the displaced supracondylar fractures has its principal advantages: more stable fixation, better anatomical and functional outcome.<sup>5</sup> Our study is entitled to compare the outcome of conservative and surgical treatment of supracondylar fracture of the humerus by analysing range of motion and carrying angle using Flynn’s criteria during the follow up of the patients.

**METHODS**

A prospective observational comparative study conducted among the patients admitted in Kodagu Institute of Medical Sciences, Madikeri with supracondylar fracture of humerus considering the inclusion and exclusion criteria. The study period was for 1 year conducted from April 2019 to March 2020. The institutional ethical committee clearance was taken before the start of this study.

**Inclusion criteria**

Inclusion criteria were all children upto 14 years of age with closed supracondylar fractures of humerus.

**Exclusion criteria**

Exclusion criteria were all children of age more than 14 years, all open fractures, and cases associated with other fractures around elbow.

**Methodology**

All the children attending our OPD/emergency with history of fall on outstretched hand and presenting with injury to elbow were examined for the soft tissue swelling, ecchymosis, skin puckering, deformity, punctured wound, fracture and any evidence of compartment syndrome. Vascular and neurological status of the extremity were thoroughly assessed. X-rays were taken in two planes, lateral and AP view and the presence of supracondylar fracture noted. In some instances when a supracondylar fracture was suspected but not visualized on the routine

anteroposterior and lateral views, an oblique view was taken to assess the fracture line.

The supracondylar fracture was classified according to Gartland’s classification as class I/II/III (Table 1).<sup>6</sup> The children with type I non-displaced fractures were treated conservatively with above elbow POP slab with the elbow in 90° flexion and pronation. Type II displaced fracture with intact posterior cortex was also treated conservatively after closed manipulation and reduction. Children with type III supracondylar fracture were included in this study and grouped according to the treatment given to them. Group A children treated with closed reduction and POP slab application, group B with closed reduction and percutaneous pin fixation and group C with open reduction and internal fixation. All the surgical procedures were done under general anaesthesia. Post-operatively child was monitored for neurovascular deficit and treated with antibiotics and analgesics. On post-operative day 1 and after 1 week, post op X-rays were taken to determine the maintenance of reduction. After 3 weeks, the POP slab was removed and active range of motion exercises were encouraged. Patient was warned to avoid massage and passive stretching of elbow joint. The K wires were removed after 4 to 6 weeks.

**Table 1: Gartland’s classification of supracondylar fracture of humerus.<sup>6</sup>**

Type	Classifications
<b>Type I</b>	Undisplaced
<b>Type II</b>	Displaced (with intact posterior cortex)
<b>Type III</b>	Displaced
	Posteromedial
	Posterolateral

Regular follow up was done every month for a period of 6 months. The patients were examined clinically and radiologically, assessed for any complications, range of motion and carrying angle using Flynn’s criteria (Table 2). The results were graded as excellent, good, fair and poor according to loss of range of motion and loss of carrying angle.

The results were compared between groups and analysed. Chi-square test was used for comparing the outcome between conservative and surgical treatment using SPSS software and p<0.05 was considered as significant.

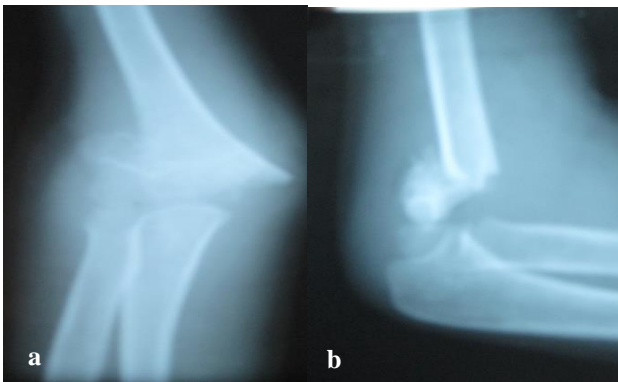
**Table 2: Flynn’s criteria for assessing the range of motion and loss of carrying angle.<sup>3</sup>**

Result	Rating	Cosmetic factor: carrying angle loss (degrees)	Functional factor: motion loss (degrees)
<b>Satisfactory</b>	Excellent	0-5	0-5
	Good	6-10	6-10
	Fair	11-15	11-15
<b>Unsatisfactory</b>	Poor	>15	>15

## RESULTS

In this study, totally 60 patients were diagnosed with supracondylar fracture but 17 children were excluded from the study as they don't fit into the inclusion criteria. Out of 43, 3 patients were lost for follow-up, so finally 40 patients were included in this study. In this study, 3 (7.5%) children were <4 years of age, 28 (70%) of patients were between 4-8 years, 8 (20%) between 8-12 years and 1 (2.5%) child was >12-14 years of age. Majority of the children were males i.e., 25 (62.50%) and 15 (37.50%) children were females (Table 3). In this study, the most common cause of injury was fall while playing (sports related injury) which was seen in 30 (75%) patients, followed by fall from height in 10 (25%) patients. In this study, 32 (80%) patients sustained fracture on left side and 8 patients (20%) had on right side.

All the 40 fractures were type III closed extension type of fractures (Figure 1). No vascular compromise or compartmental syndrome was seen in any of the cases of supracondylar fractures. In this study, 17 cases belong to group A who were managed conservatively with closed reduction and POP slab, 5 cases were group B who were treated with closed reduction and K wire fixation and group C had 18 cases operated surgically with open reduction and K wire fixation (Figure 2). In all these 23 patients who were treated surgically, cross K wire pinning was done in 19 cases and lateral K wire pinning was done in 4 case (Figure 3). 13 (56.52%) cases were operated on first day of admission, 6 (26.08%) cases were done on 2<sup>nd</sup> day and 4 (17.39%) cases on 3<sup>rd</sup> day.



**Figure 1: X-ray showing the type III extension type supracondylar fracture of humerus; (a) AP view and (b) lateral view.**

In this study, 3 patients had radial nerve injury. 2 cases of radial nerve injury were iatrogenic occurred during open reduction and 1 case was seen in conservatively treated child. Intra-operatively 5 patients had iatrogenic ulnar nerve palsy and all these 5 cases were seen in open reduction cases. All the 8 patients with radial and ulnar nerve palsy had progressive improvement with full functional recovery in 4-6 months of follow up. Post-operatively 3 children had superficial pin tract infection

occurred in open reduction and percutaneous cross K wire fixation cases which was treated with antibiotics and subsided. During the 6 months follow up of all the 40 patients, 9 patients developed cubitus varus deformity. Among these 8 patients were treated conservatively with closed reduction and POP slab and 1 with open reduction.



**Figure 2: Intra-operative picture shows open reduction.**



**Figure 3: (a) Post-operative and (b) follow up pictures showing AP and lateral view X-ray showing cross K wire pinning.**



**Figure 4: The child with (a) cubitus varus deformity and (b) loss of range of movements.**

**Table 3: Age and sex distribution of children with supracondylar fracture of humerus.**

Sex	Age group (in years)				Total
	<4	4-8	9-12	13-14	
Male child	2	17	5	1	25
Female child	1	11	3	0	15
<b>Total</b>	3	28	8	1	40

**Table 4: Comparison between conservative and surgical method of treatment of supracondylar fracture of humerus.**

Type of fracture	Treatment	Excellent	Good	Fair	Poor	Total
Type III	Conservative (group A)	-	4	5	8	17
	Surgical (group B and C)	15	5	2	1	23
<b>Total</b>		15	9	7	9	40
<b>Total (%)</b>		37.5	22.5	17.5	22.5	100

P=0.0013.

In this study all the fractures were united in 4-6 weeks. All the 40 patients were followed regularly and loss of carrying angle and motion loss was calculated at the end of 6 months of follow up. In this study out of 40 patients, 15 patients (37.5%) had loss of range of motion of 0-5°, 9 patients (22.5%) had 6-10°, 7 patients (17.5%) had 11-15° and 9 patients (22.5%) had >15° of range of motion. In our study of 40 patients, 15 patients (37.5%) had loss of carrying angle of 0-5°, 9 patients (22.5%) had loss of carrying angle 6-10°, 7 patients (17.5%) had loss of carrying angle 11-15° and 9 patients (22.5%) had >15° loss of carrying angle developed cubitus varus deformity (Figure 4). In group A, out of 17 (42.5%) patients, 4 (23.52%) patients had good results, 5 (29.41%) patients had fair results and 8 (47.05%) children had poor results. In group B, among 5 patients 4 (80%) had excellent outcome and 1 (20%) had fair outcome. In group C, 11 (61.11%) patients had excellent results, 5 (27.77%) patients had good results, 1 (5.55%) patients had fair and 1 (5.55%) poor result (Table 4).

**DISCUSSION**

The average annual incidence of elbow fractures in childhood was 12 per 10,000. Supracondylar humerus fracture is the most common elbow fracture in children. It constitute about 55% of all the elbow fractures.<sup>7</sup> As the skeleton is immature in children, the fractures occur commonly in the first decade of life. The incidence of supracondylar fractures has two peaks, one between 4-5 and other in 5-8 years of age. In this study, majority 70% of children were in the age group of 4-8 years. In this present study, the mean age of presentation was 6 years. According to Ramsey et al, the mean age of presentation was 7 years.<sup>8</sup> According to a study done by Andrew et al, the average age of presentation was 6.7 year.<sup>5</sup> There was male predominance in this study. In a study done by Mazda et al., male predominance was seen just like our study.<sup>9</sup> In the present study, majority 75% sustained fractures due to sports related injury. Fransworth et al, in their study 70%

of cases sustained fracture due to fall.<sup>10</sup> Left sided fracture was seen in 80% of children in this study as majority of the children have right sided dominance. All the cases reported in our study was extension type of supracondylar fractures, no cases of flexion type reported. According to the literature extension type constitute 97-98% and flexion type constitute only 2-3%.<sup>11</sup>

In this study, majority (56.5%) of children were operated within 24 hours of injury. According to a study by Ramsey et al, all 100% cases were operated on the same day of admission.<sup>8</sup> According to David Skaggs, the average interval of time of injury and operation was 1.4 days in their study.<sup>1</sup> In the present study, complications were less for children who were operated on the first day then those who were operated on the second and third day of admission. There was statistically significant association between rate of complication and timing of surgery (p=0.02). There was no association between outcome of surgical treatment and timing of surgery.

42.5% were managed conservatively with closed reduction and POP slab in this study. In a study done by Pham et al, 75.8% of children with Gartland type IIB and III supracondylar fractures were treated conservatively with Blount’s method. The authors had satisfactory outcome of 90% according to Flynn’s criteria and only 2% of cubitus varus deformity in their study. So according to Pham, Blount’s method shows reasonable results and can be followed for type III fractures.<sup>12</sup> One more study by Muccioli et al also had satisfactory results with Blount’s technique.<sup>13</sup> In the present study, 12.5% were treated by closed reduction and percutaneous K wire fixation. In a comparative study done at Serbia, 37 (39.78%) children who were treated with closed reduction and percutaneous pinning 100% had satisfactory outcome according to Flynn’s criteria (Table 5).<sup>14</sup> In the present study, majority 45% of cases were operated by open reduction and percutaneous K wire fixation.

**Table 5: Comparison between present study and other methods of treating displaced supracondylar fracture.**

Treatment	Author	No. of cases	Flynn's grading			
			Excellent N (%)	Good N (%)	Fair N (%)	Poor N (%)
<b>Conservative (group A)</b>	Present study	17	0	4 (23.52)	5 (29.41)	8 (47.05)
<b>Closed reduction and percutaneous K wire fixation (group B)</b>	Present study	5	4 (80)	0	1 (20)	0
<b>Open reduction and K wire fixation (group C)</b>	Present study	18	11 (61.11)	5 (27.77)	1 (5.55)	1 (5.55)
<b>Conservative</b>	Pham et al <sup>12</sup>	238	205 (86.13)	21 (8.82)	5 (2.1)	7 (2.94)
<b>Closed reduction and percutaneous K wire fixation</b>	Ducic et al <sup>14</sup>	37	26 (70)	9 (24)	2 (6)	0
<b>Open reduction and K wire fixation</b>	Li et al <sup>15</sup>	83	75 (90.36)	3 (3.61)	2 (2.4)	3 (3.61)

In the study done by Weiland et al, all the 52 displaced supracondylar fractures were treated surgically by open reduction and K wire fixation.<sup>5</sup> In a Chinese retrospective study, all 83 patients who were treated by open reduction and K-wire fixation had 90.4% excellent results in the treatment outcome evaluated by Flynn criteria (Table 5).<sup>15</sup> In a study done by Gowda et al, all 50 patients who were treated by open reduction and internal fixation with K-wire had reported 10% of ulnar nerve palsy and 83.3% had excellent/good outcome.<sup>16</sup> In a study done by Mazda et al, 92% of children who had undergone open reduction with internal fixation had excellent outcome according to Flynn criteria.<sup>9</sup>

In this study, cross K wire pinning was done in 19 cases and lateral K wire pinning was done in 4 cases. Cross K wire pinning offers a good biomechanical stability than unilateral pinning, so most of the cases in our study were operated with cross wire pinning.<sup>17</sup> In the present study, ulnar nerve palsy was seen in 23.5% of children who were operated with cross K wire and 11.7% patients had iatrogenic radial nerve palsy. All the nerve palsies were neuropraxias which resolved over a period of 3 weeks to 6 months. Ulnar nerve palsy was reported in 1 out of 6 cases in our study with lateral pinning. Superficial pin tract infection was also seen in 17.64% children with cross wire fixation, which resolved with antibiotics. 68.4% children had excellent and 26.3% had good outcome with cross wire pinning in this study. 50% had fair and 50% had excellent outcome with lateral wire pinning. There was statistically significant association between excellent/good outcome with cross wire pinning than lateral pinning (p=0.015). According to Gudda et al, there was no significant difference between cross wire and lateral pinning both radiologically and functionally assessed by Flynn's criteria. But cross wire pinning had 6.8% cases of ulnar palsy which was transient and resolve over a period

of 3 weeks' time. Superficial pin infection was seen in both cross wire and lateral pinning in Lokesh study.<sup>18</sup>

In our study, 61.11% had excellent and 27.77% had good results in group C children operated with open reduction and internal fixation. 80% had excellent results in group B children who were treated with closed reduction and percutaneous K wire fixation. 47.05% of group A children had poor results who were treated conservatively with closed reduction and POP slab. There was an association between outcome of treatment and mode of treatment of supracondylar fracture of humerus. There was highly significant association of satisfactory (excellent/good/fair) outcome with surgical treatment than with conservative treatment (p=0.0013).

**CONCLUSION**

Supracondylar fracture of humerus should be operated as early as possible to reduce the rate of complications. The outcome of surgical treatment was better than conservative treatment evaluated in terms of Flynn's criteria. Cross wire pinning was better than lateral pinning in terms of outcome, but the rate of neuropraxias was more with cross wire pinning.

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