

Original research article

# The functional outcomes of surgical management of supracondylar fractures of humerus in children

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## Abstract

Closed reduction with plaster of Paris slab immobilization has traditionally been used for supracondylar fractures, but loss of reduction and necessity of repeated manipulation likely results malunion producing varus or occasionally valgus deformity of elbow and elbow stiffness.

Because of lower percentage of good results and higher percentage of early and late complications compared with skeletal traction, percutaneous pinning and open reduction, casting is appropriate only for undisplaced fractures. The clinical material for the study consists of 30 cases of fresh supracondylar fractures of humerus in children of traumatic etiology meeting inclusion and exclusion criteria. Out of 19 patients which were treated by closed reduction, 16 patients (84.2%) showed excellent result and remaining 3 showed good results (15.8%) according to Mitchell and Adams criteria. Out of 11 patients treated by open reduction, 5 patients (45.5%) showed excellent results and 4 patients (36.4%) showed good results and 2 poor results (18.2%) were obtained with a statistically moderate significant value of p 0.045.

**Keywords:** Functional outcome, surgical management, supracondylar fractures of humerus

## Introduction

Supracondylar fracture of humerus are the fractures which involves the lower end of the humerus usually involving thin portion of the humerus through olecranon fossa or just above the fossa or through the metaphysic. Supracondylar fracture of the humerus in children is one of the most common fracture seen in orthopaedic outpatient department all over the world <sup>[1]</sup>. It accounts for 50% to 70% of all elbow fracture in children in the first decade of life <sup>[2]</sup>. The incidence increases steadily at first five years of life with the peak incidence at 5-6 years <sup>[3]</sup>. It becomes progressively more uncommon as the age increases.

Being the most common fracture around elbow in children, it requires great care in its

management especially while treating displaced supracondylar fractures as complications like nerve injury, vascular injury, volkman's ischemic contracture, stiffness of elbow and malunion as quite frequent.

In the beginning of 20th century, Sir Robert Jones echoed the opinion of that era about elbow injuries: "The difficulties experienced by surgeons in making an accurate diagnosis; the facility with which serious blunders can be made in prognosis and treatment; and fear shared by so many of the subsequent limitation of functions, serve to render injuries in the neighborhood of the elbow less attractive than they might otherwise have proved <sup>[4]</sup>". These concerns are applicable even today.

Depending on the type of fracture there are four basic types of treatment modalities described; e.g. side-arm skin traction, overhead skeletal traction, closed reduction and casting, closed reduction with percutaneous pinning and open reduction with internal fixation. Although there is a general consensus regarding the treatment of undisplaced supracondylar fracture of humerus, treatment of partially displaced and completely displaced supracondylar fracture of humerus has been surrounded by considerable controversy.

Closed reduction with plaster of paris slab immobilization has traditionally been used for supracondylar fractures, but loss of reduction and necessity of repeated manipulation likely results malunion producing varus or occasionally valgus deformity of elbow and elbow stiffness.

Because of lower percentage of good results and higher percentage of early and late complications compared with skeletal traction, percutaneous pinning and open reduction, casting is appropriate only for undisplaced fractures <sup>[5]</sup>.

Traction (skin or skeletal), which has also been used for many years, has been shown to be safe and reliable, but it has the drawback of requiring a long stay in the hospital <sup>[6]</sup>.

Closed reduction and percutaneous pinning promises to be the best method at present but closed reduction is not always achievable because intense soft tissue swelling and intrinsically unstable nature of the supracondylar fracture of humerus. Closed reduction is also not recommended in supracondylar humerus fractures with vascular compromise. In these cases open reduction becomes mandatory.

The goal in treating these fractures is to reestablish the anatomy of distal humerus perfectly with least complications and with enough stability to permit early painless, functional elbow motion. With the advent of the image intensifier, which facilitates accurate pin placement, Blount's <sup>[7]</sup> caution against operative management is now of only historic interest.

Much attention has been paid to the problem of malunion of supracondylar fractures of humerus by obtaining as anatomical reduction as possible either by closed or open method because it is no longer acceptable to hear: "*Not bad for a supracondylar fracture of Humerus*" <sup>[8]</sup>.

## Methodology

The clinical material for the study consists of 30 cases of fresh supracondylar fractures of humerus in children of traumatic etiology meeting inclusion and exclusion criteria.

## Inclusion criteria

1. Gartland's type 2 and type 3 fracture.
2. Age less than 16 years.
3. Supracondylar fractures with or without neurovascular complication.

### Exclusion criteria

1. Type 1 Gartland's fracture.
2. Fractures more than 2 week old.
3. Patient not fit and willing for surgery.

As soon as the patient was admitted, a detailed history was taken and a meticulous Examination of the patient was done. The required information was recorded in the proforma prepared. The patients radiograph was taken in antero-posterior and lateral views. The diagnosis was established by clinical and radiological examination.

In this study, supracondylar fracture of humerus was classified according to Gartland's classification

**Type 1:** Undisplaced Supracondylar fracture of humerus.

**Type 2:** Displaced Supracondylar fracture with intact posterior cortex.

**Type 3:** Displaced Supracondylar fracture with no cortical contact.

- a) Postero-medial.
- b) Postero-lateral.

Temporary closed reduction was done on admission and above elbow posterior pop slab was applied in 90° of flexion at elbow. The limb was elevated to reduce swelling of the elbow.

All patients were taken for surgery as soon as possible after necessary blood, urine and radiographic pre-operative work-up.

Patients' attenders were explained about the nature of injury and its possible complications. Patients' attenders were also explained about the need for the surgery and complications of surgery.

Written and informed consent was obtained from the parents of the children before surgery.

All patients were started on prophylactic antibiotic therapy. Intra-venous cephalosporins were used. It was administered according to body weight of the children, prior to induction of anesthesia and continued at 12 hourly interval post-operatively for 2 days. Only those cases which showed signs

Of infection, iv antibiotics were continued. Following iv antibiotic, patients Were discharged with oral antibiotic given for next five days. Suture removal was done on the 12<sup>th</sup> Post op day. Post operatively patient was advised active finger movements. iv antibiotics cephalosporins was given for 2 days every 12 hourly interval. Dressing was done on 2<sup>nd</sup> post op day, followed by a post op x ray and assessed for any signs of infection. If any signs found then iv antibiotic was continued otherwise patient was discharged after 2 days of iv antibiotics followed by oral antibiotics for next 5 days.

Patients were reviewed on 12<sup>th</sup> post op day for suture removal. K-wires were removed at 3 weeks post-operatively after X-ray confirmation of satisfactory callus formation. Pop splint was discarded at the same time and patient was encouraged to do active elbow flexion-extension and supination-pronation exercises.

### Results

Among 30 patients, we were able to get good reduction by closed means. In 19 patients and 11 patients required open reduction.

**Table 1:** Reduction Procedure

Reduction Procedure	Number of patients	%
CRIF	19	63.3
ORIF	11	36.7
Total	30	100.0

Among thirty patients we operated, Pin tract infection occurred in three patients which were controlled by antibiotics and following removal of pin after satisfactory union of fracture, all pin tract infections healed without any adverse effect on fracture healing.

**Table 2:** Post Op complications

Post-op complications	Number of patients (n=30)	%
No	28	93.3
Yes	2	6.7
P T I	2	6.7

Duration of hospital stay ranged from 2 days to 8 days with mean duration of 3.5 days. Out of 19 patients which were treated by closed reduction, mean duration of stay was  $3.00 \pm 0.47$  and out of 11 patients who underwent open reduction the mean duration of Stay was  $4.36 \pm 1.91$  which gave a statistically significant p value of 0.006.

**Table 3:** Duration of stay

Duration of hospital stay (days)	Number of patients	CRIF (n=19)	ORIF (n=11)
1-2	3	2(10.5%)	1(9.1%)
3-5	23	17(89.5%)	6(54.5%)
5-7	3	0(0%)	3(27.3%)
>7	1	0(0%)	1(9.1%)
Mean $\pm$ SD	$3.50 \pm 1.36$	$3.00 \pm 0.47$	$4.36 \pm 1.91$

$t=2.990$ ;  $P=0.006^{**}$

The range of motion of normal elbow joint ranged from a minimum of 0-130 degree to maximum of 0-150 with mean of 138.83. Compared with that of injured elbow whose range of motion Ranged from 100-150 with a mean of 133.17 gave a statistically significant p value of  $<0.001$ .

**Table 4:** Range of Motion

Range of Motion	Minimum-Maximum	Mean $\pm$ SD
Normal	130-150	$138.83 \pm 4.29$
Injured	100-150	$133.17 \pm 8.59$
Significance	$d=5.67$ ; $t=4.59$ ; $P=<0.001^{**}$	

Comparison of Range of motion according to reduction procedure:

Out of the 19 patients who underwent closed reduction with a mean normal range of motion Of 139.2 degree showed a mean range of motion of operated limb of 135.6 degree. The mean Range of motion of normal limb is 138.1 degree and the operated limb is 128.8 degree out of 11 patients who underwent open reduction.

**Table 5:** Comparison of Range of motion according to reduction procedure

Range of motion	CRIF (n=19)	ORIF (n=11)	P value
Normal	$139.21 \pm 3.44$	$138.18 \pm 5.60$	0.536
Injured	$135.68 \pm 5.63$	$128.82 \pm 11.14$	0.032*

Among 30 patients, 23 patients had loss flexion less than 10 degree and 7 patients Had loss of flexion ranged from 10-20 degree.

**Table 6:** Loss of Flexion

Loss of Flexion	Number of patients	%
0-10	23	76.7
10-20	7	30.4
>20	0	0.0
Total	30	100.0

Among 30 patients, the carrying angle of normal elbow ranged from 10-16 degree with mean of 13.20. Compared with that of injured elbow whose carrying angle ranged from 6-16 with mean of 10.32 degree, gave us statistically significant p value of <0.001.

**Table 7:** Carrying Angle

Carrying Angle	Minimum-Maximum	Mean $\pm$ SD
Carrying angle normal	10-16	13.20 $\pm$ 1.42
Carrying angle injured	6-16	10.32 $\pm$ 2.31
Significance	d=3.04; t=8.57; P=<0.001**	

Out of 19 closed reduction cases whose carrying angle of normal limb was 13.3 degree, showed.

A mean carrying angle of 10.3 degree of the operated limb. Similarly out of 11 open reduction cases whose carrying angle of normal limb was 12.9 degree showed a mean carrying angle of 10.2 degree.

**Table 8:** Comparison of Carrying Angle according to reduction procedure

Carrying Angle	CRIF (n=19)	ORIF (n=11)	P value
Normal	13.36 $\pm$ 1.30	12.91 $\pm$ 1.64	0.404
Injured	10.36 $\pm$ 1.97	10.22 $\pm$ 3.03	0.879

Out of thirty patients, 24 patients (80%) had less than 5 degree loss of carrying angle and 4 patients had carrying angle loss ranged from 5-15 degree (13.3%). Carrying angle could not be calculated in 2 patients who had fixed flexion deformity.

**Table 9:** Loss of carrying angle

Loss of CA	Number of patients	%
<5	24	80.0
5-15	4	13.3
>15	0	0.0
Not applicable	2	6.7
Total	30	100.0

In our series thirty cases were operated by closed or open reduction and internal fixation using K wire and the results were calculated according to Mitchell and Adam's criteria.

Among 30 patients, 21 patients had excellent results (70%). 7 patients had good results (23.3%) and 2 poor results (6.7%) were found.

Out of 19 patients which were treated by closed reduction, 16 patients (84.2%) showed excellent result And remaining 3 showed good results(15.8%) according to Mitchell and Adams criteria.

Out of 11 patients treated by open reduction, 5 patients (45.5%) showed excellent results and 4 patients (36.4%) showed good results and 2 poor results (18.2%) were obtained with a statistically moderate significant value of p 0.045.

**Table 10: Results**

Results	CRIF (n=19)	ORIF (n=11)	P value
<b>MA results</b>			
Excellent	16(84.2%)	5(45.5%)	0.045*
Good	3(15.8%)	4(36.4%)	
Poor	0(0%)	2(18.2%)	

## Discussion

The mean duration of stay at hospital in our study was 3.5 days. Mean duration of stay in other series is as shown below which shows our study is well comparable with other studies.

**Table 11: Mean duration of stay in days**

Series	Mean duration of stay in days
Nacht JL. <i>et al.</i> [9]	4.2
Flynn JC <i>et al.</i> [10]	2.4
Our study	3.5

Out of 30 patients, one patient had a loss of pulse at the time of presentation which was immediately operated and pulse was regained as soon as fracture was reduced. Two patients had nerve injury in which one had radial nerve injury and other had median nerve injury. Compared with other studies we did not encounter any compound injury or associated ipsilateral fractures and the incidence of nerve injury is much less when compared with other series.

**Table 12: Associated Injury**

Series	Years	Nerve injury			Brachial artery Injury	Compound Injury	Ipsilateral Fractures
		R	M	U			
Nacht <i>et al.</i> [9]	1983	4 (11%)			4 (11%)	0	5 (13%)
		2 (50%)	2 (50%)				
Aronson & Prager [11]	1987	1 (5%)			0	0	0
		0	1(100%)	0			
Hamid <i>et al.</i> [3]	2000	4 (9.5%)			3(7.14%)	0	2(4.76)
		2 (50%)	1 (25%)	1 (25%)			
Davis <i>et al.</i> [12]	2000	9 (10.0%)			0	0	6 (7%)
		3(3.3%)	3(3.3%)	3(3.3%)			
Saad <i>et al.</i> [13]	2000	4 (8%)			3(6%)	1(2%)	1(2%)
		0	2(50%)	2(50%)			
Present study	2013	2 (6.6)			1 (3.3%)	0	0
		1(50%)	1(50%)				

Out of 30 patients who were operated, two patients who underwent open reduction and internal fixation developed pin tract infection. Compared with other study we did not encounter any iatrogenic ulnar nerve injury or cubitus varus in our study.

**Table 13: Post Op complications**

Series	Pin tract infection	Ulnar nerve injury	Cubitus varus
Aronson & Prager [11] (1987)	-	5%	-
Pirone <i>et al.</i> [2] (1988)	1%	0	14%
Hamid <i>et al.</i> [3] (2000)	2.4%	-	-
Present study	6.7%	-	-

In the present study we achieved twenty one (70%) Excellent, seven (23.3%) good and two (8.8%) poor results. This makes 93.3% (Excellent + good) satisfactory results compared to 6.7% unsatisfactory (poor) results. The results in this study are well comparable to previous studies.

**Table 14:** Results

Series	Year	Percentage of Satisfactory results	Percentage of Unsatisfactory results
Fowles <i>et al.</i> <sup>[14]</sup>	1974	87.5%	12.5%
Aronson & Prager <sup>[11]</sup>	1987	100%	-
Pirone <i>et al.</i> <sup>[2]</sup>	1988	80%	20%
Davis <i>et al.</i> <sup>[12]</sup>	2000	80%	20%
Present series	2013	93.3%	6.7%

## Conclusion

- The open reduction method is also a safe and effective method which also helps in neurovascular exploration in case of any injury associated with the fracture. The duration of stay is slightly longer When compared with that closed reduction as the chances of infection is high in open reduction Technique and hence the requirement of i.v. antibiotics.
- By open reduction technique we have achieved good range of movements however, restriction of range of elbow movements in few patients and presence of scar has reduced both the cosmetic and functional outcome of open reduction technique.
- Hence the surgical fixation remains the treatment of choice for displaced supracondylar fracture of humerus in children.

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