

# Assessment of Open Reduction and Internal Fixation of Displaced Supracondylar Fracture of Humerus among Children with K Wire: A Prospective Study

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## ABSTRACT

**Introduction:** The fall while playing or while riding the bicycle is usually observed among children which results in injury to the supracondylar region of the humerus leading to fracture and complete displacement of the fragments in majority of the cases. This type of fracture is more commonly seen in children and contributes to 60% of all the elbow injuries. The most useful option for the treatment of supracondylar fractures is open reduction and internal fixation. The aim of the study was to study the results and complications of displaced supracondylar fracture among 30 children treated with open reduction and internal fixation using K wire.

**Material and Methods:** In this study, total 30 children who reported to the Department of Orthopaedics, Mamata General Hospital, Khammam were recorded. Those children who were below the age of 11 were selected irrespective of the sex including those with displaced supracondylar fracture of the humerus after thorough pre-operative investigation treated with open reduction and internal fixation with the use of K-wire were studied.

**Results:** An excellent result was obtained in 54% of the patients, good in 30% and fair in 10% and poor results in 6% of the patients. The results were poor due to open fracture and in 1 case the patient reported very late to the hospital. Various complications were found such as nerve injuries, vascular injuries and infections which healed following short course of the treatment. 5 patients had cubitus varus and 2 patients had flexion loss on follow-up study.

**Conclusion:** Open reduction and internal fixation with K-wire is an easy, simple, inexpensive method, which gives excellent results and good outcome.

**Keywords:** Supracondylar Fracture of Humerus in Children, K-wire, Open Reduction, Internal Fixation

## INTRODUCTION

At the turn of the 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 serious blunders can be made in prognosis and treatment; and the fear shared by so many of the subsequent limitation of function, serve to render injuries in the neighborhood of the elbow, less attractive than they might otherwise have proved'. These concerns are applicable even today. It has been found that when the child is presented with a swollen and injured elbow, it creates anxiety to the treating Orthopaedic surgeon.<sup>1</sup>

The most frequent fractures of the pediatric elbow are supracondylar fractures of the humerus seen among children

with 5 to 8yrs of age. They represent a significant burden of injuries in children, accounting for 12-17% of all pediatric fractures. It is the fracture of the lower end of humerus usually involving the thin portion of humerus through olecranon fossa, or just above the fossa or through metaphysis. The amount of hard work required taken into consideration, the number of patients injured and the severity of the initial injury, it is not easy to obtain excellent result. Various debilitating complications, such as Volkmann's ischaemic contracture, myositis ossification, stiffness, permanent nerve injuries and malunion are also observed in such types of fractures.<sup>2,3</sup>

It has been recorded from the literature that maximum number of these fractures are treated with closed reduction and long arm casting in a flexion position. This flexed posture helps in the maintenance of the fracture reduction leading to compromise in the vascularity following Volkmann's contracture. It is associated with the fracture of distal humerus just above the elbow joint. The fracture is usually transverse or oblique and above the medial, lateral and epicondyles. This type of fracture pattern is rarely seen in adults but is commonly found in children. Boys have more predominance than girls.<sup>4,5</sup>

The most recurrent mechanism of injury is when a patient falls onto an outstretched hand with the arm fully extended. The olecranon engages with the olecranon fossa which acts as a fulcrum. Flexion injuries result from direct trauma or falling onto a flexed elbow. Various complications can occur such as Volkmann's ischemic contracture, neurovascular injury and myositis ossificans along with stiffness of elbow and malunion.<sup>6</sup>

Different kinds of treatment procedures have been tried for the displaced supracondylar fractures of humerus in children such as closed reduction, skin traction, percutaneous pin fixation and open reduction with internal fixation. It is commonly seen in children with age group of 6- 7 years

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of age among skeletally immature children as compared to adults. It is at this age when the supracondylar area undergoes remodeling leading to thinner cortex making the area more susceptible to fracture. The mechanism in which there is a fall onto an outstretched hand that puts a hyperextension load on the arm is a typical one resulting in displaced distal fragment in about 95 of the cases.<sup>7</sup>

Gartland classified supracondylar fractures according to the degree of displacement of the distal fracture fragment as Type I is undisplaced or minimally displaced. Type II fracture is displaced with angulation but maintain with an intact posterior cortex and this is further divided into Type II a fracture and II b fracture which is angulation and angulation with rotation. Type III fracture is completely displaced and lack of cortical contact but with a periosteal hinge intact. This is also further subdivided into Type III a fracture and III b which includes medial periosteal hinge intact with distal fragment goes posteromedially and lateral posterior hinge is intact with distal fragment goes posterolaterally. Type IV fracture is to have no periosteal hinge and are unstable both in flexion and extension i.e., they have a multidirectional instability. A thorough history with a detailed clinical examination is required to deal with such kind of fractures.<sup>8,9</sup> Thus, we have advanced from the conservative treatment to manage such fractures with a good acceptable rate which has better anatomical reduction with minimum complications. Hence, the aim of the study was to assess the anatomical and functional results of treatment of supracondylar fractures of humerus with open reduction and internal fixation with kirschner (k) wires and also to find out the reasons for failed closed reduction with post-operative complications.

## MATERIAL AND METHODS

The present study was a prospective study which was conducted at Mamata Medical College, Khammam. The duration of the study was 2 years from 2009 to 2011 and was done in children among 11 years of age. The ethical clearance was obtained from the Institutional Review Board and written informed consent was taken from their parents. A detailed history of the mode of injury was obtained from the parents as well as from the patients. In this study, 30 cases which had completely displaced supracondylar fractures of the humerus were studied. Out of 30 cases, 15 patients (50%) sustained fracture due to a fall while playing and the remaining 15 patients due to fall from cycle. Most of the cases had history of fall on outstretched hand.

All patients presented with pain, swelling, "S" shaped abnormality of the lower arm and fails to move the affected elbow. On examination, at the site of fracture, all patients developed diffuse swelling all around the elbow. The puckering of the skin was present in 6 cases and 4 cases had fracture blebs and presented after 2 days. All patients developed with shortening of the arm when matched with the unaffected side. The time period from injury to presentation was ten hours, the mean age being 6.8 years. There were 23 boys and 7 girls. About 19 patients presented with involvement of left side and 11 patients on the right side.

History of receiving massage from osteopaths was observed in total 4 cases. Patients who were above 11 years of age and medically unfit for the surgery were not included in this study.

Additionally, X-ray was taken for the elbow in antero-posterior and lateral planes. Gartland's grade III type of supracondylar fractures was included in all 30 cases. These were further classified into fractures with postero medial, postero lateral and posterior displacement. Out of 30 cases, 16 presented with posterior-medial, 11 had posterior-lateral, and 2 had posterior displacement. Out of 30 cases, 11 were given one trial and 3 cases were given two trials of closed reduction under sedation with advice to take good care in order to preserve good radial artery pulsation. In 6 cases, the radial artery pulsation had to be restored by open reduction and internal fixation.

## Operative Procedure

Open reduction and internal fixation was done with the help of criss-cross Kirschner wires. A posterior longitudinal incision was taken in the lower third of the arm extending up to the olecranon. In 15 cases, triceps-splitting approach was adopted and in the remaining 15, tongue shaped incision was made in the triceps reflecting it proximally. Fracture site was exposed, hematoma was evacuated. Fracture was reduced by levering the distal fragment anterior. Reduction was assessed by taking into consideration the pillar anatomy with the help of radiographs (Figure no. 1 and 2). The medial and lateral pillars were palpated to ascertain the reduction in the triceps splitting approach, and were visualized in the tongue shaped incision approach.

Perfect anatomical realignment of the pillars was difficult to achieve due to its comminution. The ulnar nerve was not exposed. Elbow was held in reduced position. A 1.5mm K-wire was mounted over a hand drill.

The K-wire was passed from the medial epicondylar region obliquely across the fracture site to engage the opposite cortex. (Under palpation in triceps splitting approach and under direct vision in tongue shaped approach). In a similar way, another 1.5mm of K-wire was passed from the lateral epicondyle obliquely across the site of fracture to engross the opposite cortex. In about 5 cases two parallel 'lateral K wires' were passed from the lateral epicondylar region obliquely across the site of fracture involving the opposite cortex. Fracture stability was assessed. The K-wires were bent and cut. The wound was closed in layers and sterile dressing applied. Tourniquet was released. Above elbow posterior POP slab was applied and patient was shifted to the ward.

## Post-operative management

The affected limb was elevated. Antibiotics and analgesics were given. A check X-ray was taken on the 2nd day. The patient was discharged and advised to do active finger movements. Patient was called back on the 10th day in the out-patient department and the sutures were removed. Above elbow plaster of Paris slab was reapplied and patients were called after 3 weeks (Figure no. 3 and 4).

### Follow-Up

Patients were recalled after 3 weeks of surgery after which the slab of plaster of paris was also removed. Clinically, evaluation was done to rule out distal neurological deficit. After removal of plaster of Paris slab check X-ray was taken to see whether union had taken place or not. Most of the patients had union at about three weeks. The K-wires were removed in the out-patient department. The Plaster of Paris slab was discarded and sling was given for one week. Patients were advised active elbow movements after demonstrating it to the patient.

A specific mention and warning was given after removal of the slab, about avoiding oil massage and passive stretching exercises which is a favorite method of treatment advocated by the village bone setters. They were advised to come once in three weeks to assess the range of the elbow movements. They were then called at 3 months following surgery. For the assessment x-rays were taken the range of elbow movements and carrying angle was recorded (figure no.5 and 6). Patients who were having neurological involvement were followed up every week following surgery. Later follow-ups were made at end of 6 months (figure no.7 and 8). The range of movements and presence of deformities were measured by using a goniometer at these intervals.

### Flynn's criteria<sup>10</sup>

Ratings	Cosmetic factor Carrying angle loss (degrees)	Functional factor Movements loss (degrees)
Excellent	0 to 5	0 to 5
Good	6 to 10	6 to 10
Fair	11 to 15	11 to 15
Poor	>15	>15

### RESULTS

In the present study, the results were satisfactorily recorded according to Flynn's criteria after regular postoperative follow ups, about 54% cases were found to be excellent. 30% were found to be good. 10% cases were fair. 6% cases were poor (Table no.1). Among 30 cases with fracture, it was found that there were 23 boys (76%) and 7 girls (23%) in the study with an average age of 6.8 years (Graph no. 1) out

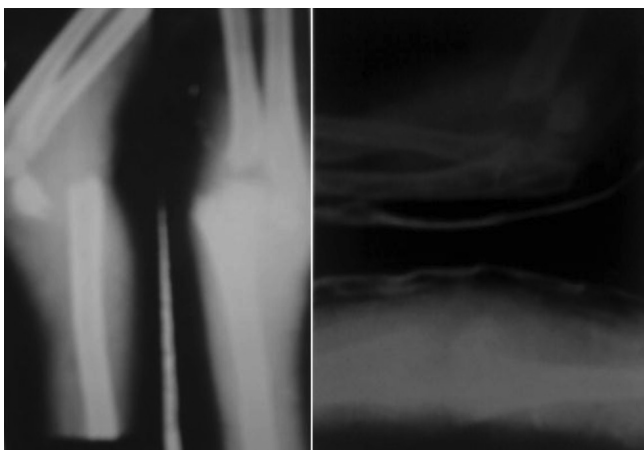


Figure 1 and 2: Showing Pre-Operative images

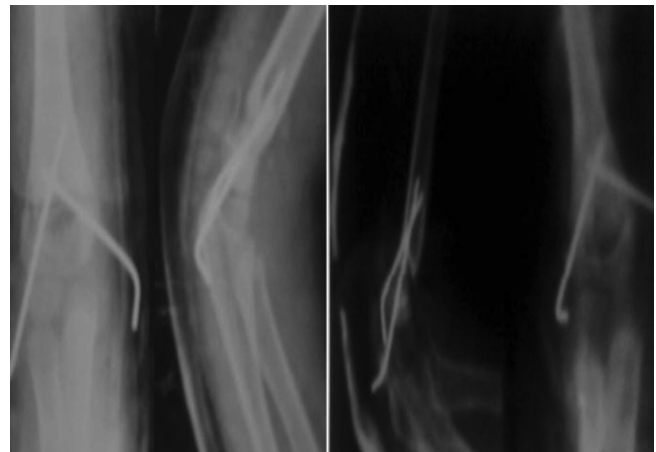


Figure 3 and 4: Showing Post-Operative images

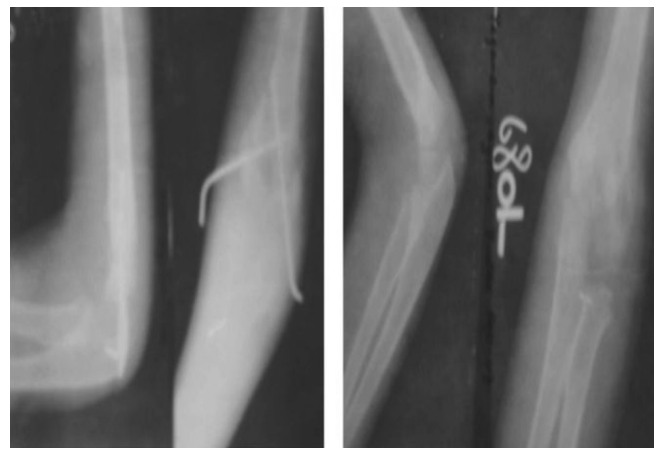


Figure 5 and 6: After 3 weeks and 6 months follow-up



Figure 7 and 8: Showing follow-up images of a child

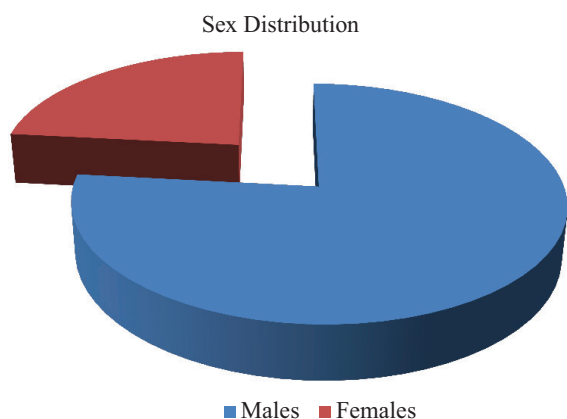
Results	Flynn's criteria	Number of Patients	Percentage
Satisfactory	Excellent	16 cases	54%
	Good	9 cases	30%
	Fair	3 cases	10%
Unsatisfactory	Poor	2 cases	6%

Table-1: Shows satisfactory and unsatisfactory results according to Flynn's criteria in fracture cases

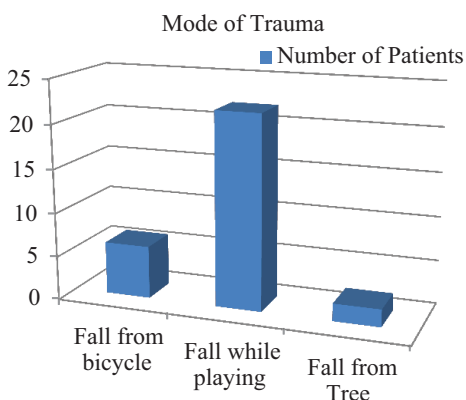
of which 7 cases had open fracture and 23 cases had closed fracture.

Out of 23 cases, 11 cases were given a trial of closed reduction

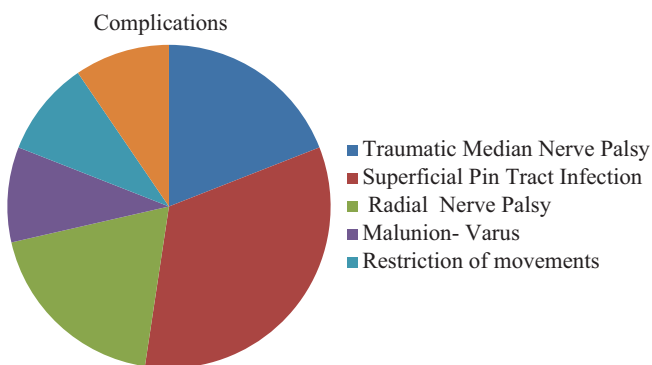




**Graph-1:** Shows distribution of sex among the fracture cases of children



**Graph-2:** Shows the graph regarding mode of trauma among fracture cases



**Graph-3:** Shows pie chart about complications among fracture cases in children

and 12 were taken up for primary open reduction. All the cases for which closed reduction was attempted failed and had to be taken up for open reduction and internal fixation with Kirschner wires. Out of 30 cases of displaced fractures, all were extension type of fractures. Of the 30 cases, 16 cases had postero-medial displacement, 12 cases had posterior-lateral, and 2 cases had only posterior displacement. In this study, the most common reason for fracture among children was found to be fall while playing followed by fall from bicycle and fall from tree (Graph no.2). The most common reason for complication of fracture among children was found to be superficial pin tract infection followed by median and radial nerve palsy. The most common

complications were found to be superficial pin tract infection, medial nerve palsy and radial nerve palsy and the least common were observed to be operative wound infection, malunion and restriction of movements (Graph no.3).

**DISCUSSION**

Supracondylar fractures of the humerus in children are frequent injuries where complete displacement of the fragments occurs in most of the cases. The main objective of the surgeon is to restore function as early as possible with maintenance of anatomical reduction. There is a need to understand the concept of biomechanics, quality of implants, principles of internal fixation, soft tissue care antibiotics and asepsis as they are revised and modified. That is why there is advancement from conservative approach to open reduction and internal fixation in fractures as an acceptable mode of treatment.<sup>11</sup>

Most frequently used method of treatment are closed reduction, application of cast, skeletal traction, closed reduction, percutaneous K-wire fixation, open reduction and internal fixation with K-wires. In our study out of 30 patients 20 had posterolateral displacement and 10 had posteromedial displacement which was in relation with the studies done by Prasad and Nabeel.<sup>12</sup> 80% of the patients were between 6-7 years of age. Also in this study, maximum number of patients sustained fractures due to fall while playing (22) followed by fall from bicycle (6) and fall from tree (2) and this finding is similar to the studies conducted by Edward and Fransworth et al.<sup>13,14</sup>

In a study it was found that 38 of the 83 patients had a varus deformity following treatment. 60% of those of the above 38 who showed a varus deformity were treated by manipulative reduction and immobilization and 18% of those 38 patients who were treated by Dunlop’s traction exhibited such a deformity. The average change in the carrying angle was greater, in the group that was treated by manipulation and immobilization only. Skeletal traction is the only method besides surgery, which can prevent the error of internal or rarely external rotation that persists after manipulative reduction or even skin traction. This however requires precision management of the traction system and confines the child to the bed.<sup>15</sup>

In the present series, all the patients have been followed up for a period of 6 months. In addition 6 patients were subjected to local massage by an osteopath according to their history, but clinico-radiologically showed no evidence of myositis ossificans. The considerable amount soft tissue oedema is an expression of the underlying injury and its severity, and it indicates a regional vascular compromise. Immediate exploration in such cases leads to good soft tissue decompression, allows ease of reduction, and as a result of anatomic restoration of the span of soft tissue, the progression of oedema was arrested.<sup>16</sup>

Flexion types of S.C. fractures are much less common than the extension types, with a reported frequency ranging from less than 1% to 10% of S.C. fractures. It is suggested that if the posterior periosteum is torn then the anterior periosteum

functions as a tension band by extending the arm but if the elbow is extended is then it does not control the proximal migration of the fracture. Open reduction and pinning is therefore suggested for displaced flexion type of Supra condylar fractures. Pirone AM, et al conducted a study in which he found that out of 230 patients, there were about 20 injuries of the ipsilateral forearm, 18 fractures of the distal third of the radius and ulna, 1 fracture of the middle 3rd of radius and ulna and 1 monteggia fracture dislocation.<sup>17</sup>

In a study conducted by David L Skuggs et al, he estimated that about 204 patient's average interval of time of injury and operation was 1.4 days. In a study done by Andrew J Weiland et al, he found among study of 58 cases, 51 patients underwent surgery within 24 hours. Also in a study conducted by Edward E Palmar et al assessed series of 78 patients with supracondylar fractures, and found that 69 patients sustained injury due to fall while playing and Fransworth CL et al, in her series found 70% of cases with sustained fracture due to fall.<sup>18,19,13,14</sup>

Among the thirty cases of displaced fractures, all were extension type. Among 30 cases, sixteen had posterior-medial displacement, twelve had posterior-lateral, and two had only posterior displacement. About 30 cases, seven had open fracture and twenty three had closed fracture. Of the 23 cases, 11 were given a trial of closed reduction and 12 were taken up for primary open reduction. All the cases for which closed reduction was attempted failed and had to be taken up for open reduction and internal fixation with K- wires.

In 11 cases, the closed reduction failed due to various reasons such as, rotation in horizontal plane (as visualized in check x-ray), interposition of soft tissues between fragments, insufficiency of radial artery pulsations even after closed reduction. The remaining 12 cases were treated with primary open reduction and internal fixation with K-wires. The time taken from injury to surgery on an average was 24-36 hours. In a nutshell all the 30 cases finally had to undergo open reduction and internal fixation with K-wires. Special care was taken while introducing the K-wire anteriorly into the medial epicondyle so as to prevent ulnar nerve injury. After regular postoperative follow ups, the results were assessed as follows according to Flynn's criteria. Open reduction of supracondylar fractures is a safe and effective procedure, for which one should lower their threshold regarding its indications.<sup>20-24</sup>

## CONCLUSION

Open reduction and internal fixation with K wires gives more stable fixation, better anatomical reduction with negligible complication. Therefore, it is recommended that open reduction and internal fixation with K wires should be performed for the treatment of displaced supracondylar fracture of humerus among children when done at appropriate time.

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