

Functional Outcome after Close Reduction Internal Fixation with K Wire of Type III Supracondylar Fracture Humerus in Children under C-Arm

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Abstract: ***Introduction:** Supracondylar fractures of the humerus are the most common type of elbow fractures in children, accounting for 50-70% of all fractures about the elbow. Supracondylar fractures takes place through a relatively weak portion of the lower end of the humerus between the condyles distally and the strong shaft of the humerus proximally. Although the incidence of these fractures generally has been reported to be higher in boys, more recent reports indicate that the frequencies of supracondylar humeral fractures in girls and boys seem to be equalizing, and some series actually have reported higher rates in girls. The left side or nondominant side is most frequently injured in almost all studies. The peak age range in which most supracondylar fractures occur is 5 to 6 years. **Materials and Methods:** The study was conducted on 30 children undergoing surgical management of unstable or irreducible type III supracondylar humeral fractures during 2020 to 2022 in Department of Orthopaedics, Government Medical College Kota. The patients were followed up at 3, 6 weeks, 12 weeks and 6 months after the surgery. The assessment of pain, swelling, tenderness at fracture site, movements of the elbow, carrying angle of the elbow, union of the fracture and bauman's angle was assessed at 6 months, follow-up and scored according to Modified Flynn et al grading. **Results:** The excellent to fair results were found in 96.66% of cases. This is probably due to good anatomical alignment, stable fixation, and early mobilisation with monitoring and early physiotherapy. One patient [3.33%] had unsatisfactory result as they presented late to us. We found two patients having pin tract infection and two patients with cubitus varus deformity in our study. **Conclusion:** From the present study it is concluded that, 1. It is increasingly difficult to obtain an excellent result from a displaced supracondylar fracture if the definitive treatment is delayed. 2. To obtain a perfect result, an accurate anatomical reduction is needed; this can be achieved by close reduction and fixation of these fractures with K-wires, thus stabilizing the fracture fragments and lessening the risk of vascular and nerve complications. 3. Close reduction with fixation with k wire of displaced supracondylar fracture of humerus allows decompression of the haematoma with correct anatomic restoration. 4. Closed reduction and medial-lateral percutaneous K-wire fixation is the treatment of choice for displaced pediatric supracondylar fractures of the humerus.*

Keywords: Supracondylar fractures; Modified Flynn et Al Grading System; K wire fixation; bauman's angle; Carrying angle

1. Introduction

Supracondylar fractures of the humerus are the most common type of elbow fractures in children, accounting for 50-70% of all fractures about the elbow. Supracondylar fractures takes place through a relatively weak portion of the lower end of the humerus between the condyles distally and the strong shaft of the humerus proximally. Although the incidence of these fractures generally has been reported to be higher in boys, more recent reports indicate that the frequencies of supracondylar humeral fractures in girls and boys seem to be equalizing, and some series actually have reported higher rates in girls. The left side or nondominant side is most frequently injured in almost all studies. The peak age range in which most supracondylar fractures occur is 5 to 6 years.

They usually are caused by a fall onto the outstretched hand (FOOSH) with the elbow in full extension. Treatment of supracondylar fracture is based on the classification more precisely, type 1 fractures are treated with simple immobilization in a plaster cast without any manipulation; type 2 fractures are treated by manipulation followed by immobilization in a plaster cast. The cast is kept for three weeks, while type 3 requires operative treatment. An attempt is made to reduce the fracture without exposing the bone fragments through an incision. If successful then the fracture is held in place by 1.5 or 2mm stainless steel wires called kirschner (k) wire. If this is unsuccessful then the fracture is exposed by an incision and the bone fragments are aligned under vision, they are then held in place by K wires.

Treatment is controversial and often technically difficult; complications are common. Cubitus varus is the most frequent problem with a mean incidence of 30% in the series reviewed by Smith N^[1]. This deformity is due to medial tilting of the distal fragment, associated with rotation. It does not remodel with growth, is not progressive and is not due to physeal injury.

Arino et al^[2] reported the incidence of the cubitus deformity about 21%. The radial pulse is absent in about 3% after reduction of the fracture. Volkmann's ischaemic contracture is rare, with an incidence of 1.1 in 1000. Forearm pressure after supracondylar fracture are greatest in the Deep volar compartment and closer to the fracture site. To avoid unnecessary elevation of pressures, should not be immobilized in less than 90 degree flexion. Stiffness of the elbow may occur, particularly after repeated manipulation and the use of the posterior approach for open reduction. Complications, including Volkmann's ischaemic contracture, myositis ossificans and permanent nerve lesions (Henrikson 1966)^[3]. Although these may result in serious loss of function, they are fortunately uncommon. A variety of methods of treatment for displaced fractures has been recommended including closed reduction and cast immobilization, traction by various methods and closed or open reduction stabilized by k wire.

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2. Aims and Objectives

To study functional outcome after close reduction internal fixation with k wire of type III supracondylar fracture humerus in children under c-arm.

3. Material and Methods

This is a prospective study including patients attending the outpatient and in patient department of Orthopedics at Government medical college Kota with unstable or irreducible type 3 supracondylar humerus fractures fulfilling inclusion criteria during study period from 2020 to 2022.

Inclusion Criteria:

- 1) Both sexes (Male and Female)
- 2) Age group 3-12 years.
- 3) Type III supracondylar humeral fracture

Exclusion Criteria:

- 1) Undisplaced fractures.
- 2) Open fractures.
- 3) Comminuted fracture
- 4) Open Fractures with complex Elbow injuries
- 5) Fractures with other skeletal fractures of same side limb
- 6) Pathological fractures
- 7) Type 1 and type 2 Gartland fracture
- 8) Fractures which require open reduction if closed reduction fails to achieve satisfactory reduction.
- 9) Patient not willing for surgery.

X-rays will be taken both anteroposterior and lateral views.

Routine investigation was done for all patients included in surgery. K wiring was done under general anesthesia. The patients were followed up at 3, 6 weeks, 12 weeks and 6 months after the surgery. The assessment of pain, swelling, tenderness at fracture site, movements of the elbow, carrying angle of the elbow, union of the fracture and bauman's angle was assessed at 6 months, follow-up and scored according to Modified Flynn et al grading.

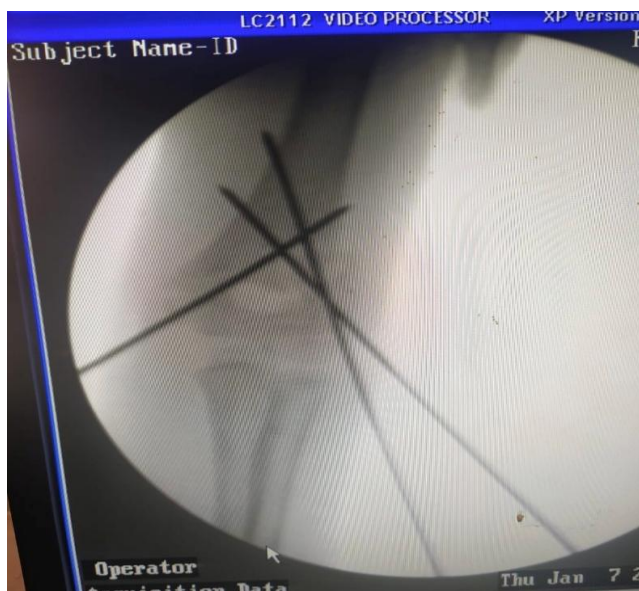
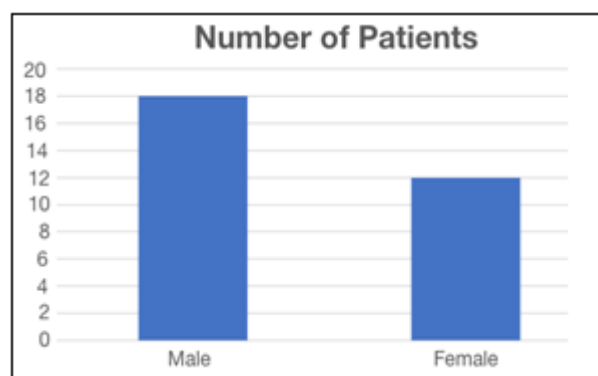


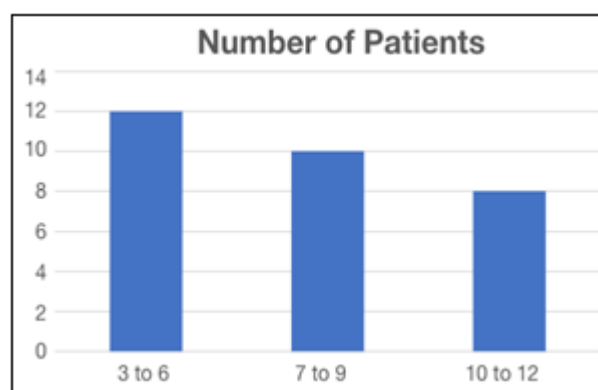
Figure 1: Intraoperative image showing fixation of K – wires

4. Observation

A total of 30 cases of type 3 supracondylar humerus fractures attending department of orthopedics in GMC KOTA during study period FROM 2020 to 2022 were managed by K-WIRING. All patients in present series were in age group of 3-12 years. Youngest person was 3 yrs old and oldest was 12 yrs. Mean age was 7.4 years. Out of 30 patients 18 (60%) were male and 12 (40%) were female in the present study. In 36.66 % of case dominant hand was found to be involved in present case series. At the end of follow up of 6 months it was noted that, the loss of ROM in 21 [70%]pts was 0-5°, in 6 [20%]pts was 6°-10°, in 2 [6.66%]pts was 11°-15° and in remaining 1 [3.33%] pts was 15°-20° or more. Loss of carrying angle in 22 [73.33] pts was 0°-5°, in 5 [16.66] pts was 6°-10°, in 2 [6.66] pts was 11°-15° and 1 [3.33] pts was more than 15°. 10 patients have extension <0 degree, 12 patients between 0-5 degree and in 8 patients extension ranges >5 degree. 2 patients flexion ranges between 110-120 degree, 11 patients have flexion range between 120-130 degree and 17 patients flexion ranges >130 degree.



Graph 1: Sex Distribution



Graph 2: Age Distribution

Complications

In our study 2 pts [6.6%] pin tract infection occurred and in 2 pts [6.66%] cubitus varus deformity occurred.

5. Results

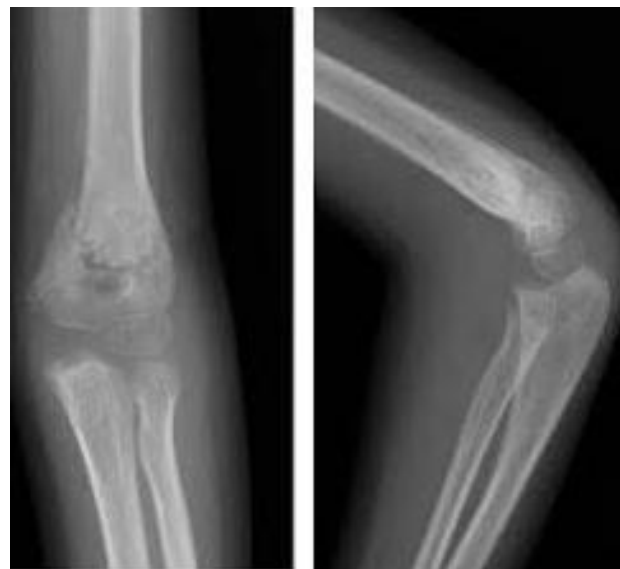
Results were assessed as per Modified Flynn et Al classification at 6months for functional results.

Table 1: Functional Results in our Study on Basis of Restriction of Movement

Result	Rate	Loss in movement (range)	No. of cases	Percentage (%)
Satisfactory	Excellent	0°-5°	21	70
	Good	6°-10°	6	20
	Fair	11°-15°	2	6.66
Unsatisfactory	Poor	15°-20° or more	1	3.33

Table 2: Result Based on Loss of Carrying Angle

Result	Rate	Loss of carrying angle	No. of cases	Percentage (%)
Satisfactory	Excellent	0°-5°	22	73.33
	Good	6°-10°	5	16.66
	Fair	11°-15°	2	6.66
Unsatisfactory	Poor	15° or more	1	3.33



E 3 – Preoperative, Postoperative and 6 Months Follow Up Radiograph of Patient



Figure 2: 6 Months Follow Up Showing Excellent Functional Outcome



6. Summary and Conclusion

From the present study it is concluded that,

- 1) It is increasingly difficult to obtain an excellent result from a displaced supracondylar fracture if the definitive treatment is delayed, due to rapid organization of fracture haematoma leading to myositis ossificans and stiffness of elbow.
- 2) To obtain a perfect result, an accurate anatomical reduction is needed; this can be achieved by close reduction and fixation of these fractures with K-wires, thus stabilizing the fracture fragments and lessening the risk of vascular and nerve complications.
- 3) Close reduction with fixation with k wire of displaced supracondylar fracture of humerus allows decompression of the haematoma with correct anatomic restoration.
- 4) Closed reduction and medial-lateral percutaneous K-wire fixation is the treatment of choice for displaced pediatric supracondylar fractures of the humerus with an acceptably low risk of iatrogenic ulnar nerve injury.
- 5) As these fractures unite in 3 to 6 weeks in children, immediate proper management of these fractures is essential to minimize or to avoid immediate or late complications.
- 6) There are many treatment methods in supracondylar humerus fractures whether conservative or surgical.

These methods vary according to fracture type and displacement grade, edema in soft tissues and condition of neurovascular structures. Basic aim in supracondylar humerus fractures is to gain full range of motion of elbow and to obtain a normal appearance of elbow in case of cosmetic.

7. Discussion

Displaced fractures of supracondylar humerus in pediatric population are a common presentation to the orthopedic OPD. The treatment is aimed towards complication avoidance and return of function and cosmesis.

Displaced supracondylar fracture of humerus in children when accompanied by marked swelling, presents a formidable challenge. Some displaced fractures are stable after reduction and may be managed satisfactorily after closed reduction by collar and cuff or by plaster slab immobilization. However many of these fractures are unstable after reduction except in acutely flexed position. If considerable swelling is present this acutely flexed position may compromise circulation and predisposes to Volkmann's ischemic contractures. Immobilization in safer right angle position will frequently allow the fragment to slip producing varus deformity. Mac Lauglin called this "The Supracondylar fracture is a dilemma". Displaced supracondylar fractures are managed with various methods;

- 1) Closed reduction with plaster
- 2) Traction
- 3) Closed reduction and percutaneous pinning
- 4) Open reduction and k wire fixation; lateral divergent pins or crossed pins.

Management of displaced supracondylar fracture of humerus in children may present problems in management including limb threatening Volkmann's ischemia, neurovascular complications and deformity. It demands considerable skill and experience. Complications can occur due to injury itself or may follow treatment. It is essential to minimize additional trauma to already traumatized joint and periarticular tissues.

Stable fixation of the fracture prevents rotation, angulation and displacement, significant reduction in the duration of hospitalization. The treatment of grade 3 supracondylar humerus fractures should ideally be minimally invasive as possible, they must have quick learning curve, and they need to carry low rates of complications both early and late.

Nerve injuries have been reported in 12-20% and they mainly consist of neurapraxias. Absent radial pulse has been reported in 10-20% of children with a displaced supracondylar humerus fracture. Brachial artery lesion may be due to entrapment, division, spasm, intimal tear, or thrombus formation. Urgent brachial artery exploration is indicated in pale pulseless limb. For pink pulseless hand, some authors recommended observation claiming that the rich collateral circulation is sufficient for the viability of the arm, other authors recommended exploration of the cubital fossa only if intraoperative angiographic evaluation showed a brachial artery injury and some authors preferred surgical exploration in all cases.

According to Gartland's classification, extension pediatric supracondylar fractures of the humerus can be distinguished in three types: type I, incomplete fracture without displacement; type II, moderate displacement with intact posterior cortex; while in type III, there is no contact between the fracture ends. Closed reduction and percutaneous pinning is the treatment of choice for Gartland type III, but controversy exists for the optimal pin configuration.

Crossed pinning had superior biomechanical stability to lateral pinning, but it carries the increased risk of iatrogenic

ulnar nerve injury. On the other hand, lateral pinning has less risk of iatrogenic ulnar nerve injury, but with less biomechanical stability. Some authors claimed that three lateral entry pins or two lateral entry pins that are divergent and are located in both the lateral and the central column provide torsional rigidity similar to that achieved with the crossed pinning.

Sankar and colleagues identified important technical errors associated with loss of fracture reduction after lateral entry pin fixations. These errors include failure to engage both fragments with at least two pins, failure to achieve bicortical fixation with at least two pins, and failure to achieve more than or equal to 2 mm of pin separation at the fracture site. They advised checking the stability of fixation by stressing the fracture under fluoroscopy at the completion of the procedure and when instability found a third lateral pin or a medial pin was added.

In a retrospective review of 622 patients after pinning of supracondylar distal humerus fractures, Bashyal and colleagues found a total of 32 (5.1%) complications. The most common complication was pin migration (1.8%) total infection rate of 1.0%, one (0.2%) patient had a malunion, three (0.5%) patients developed compartment syndromes, and only one (0.3%) postoperative ulnar nerve injury occurred with a medial pin.

Crossed pin fixation has been compared with lateral entry pin fixation in numerous studies.

Skaggs and colleagues reported no difference in maintenance of reduction between the two methods, but iatrogenic ulnar nerve injury was seen in 7.7% of cases treated with a medial pin compared with no injuries in their lateral wire group.

In a study of 27 patients treated with crossed pins compared with 20 patients treated with lateral pins only, Topping and colleagues found no loss of reduction in either group and one ulnar nerve injury in the group with crossed pins.

Similarly, in a study of 56 fractures, Shamsuddin and colleagues found three iatrogenic ulnar nerve injuries associated with crossed pin fixation and two iatrogenic radial or anterior interosseous nerve injuries associated with lateral entry pin fixation, although there was no difference in loss of reduction.

Foad and colleagues performed a randomized clinical trial in which 34 fractures were treated with medial and lateral pin fixation and 32 were treated with lateral pin fixation. There were no significant differences in terms of loss of reduction, the Baumann angle, or elbow motion between the two groups. There were five iatrogenic ulnar nerve injuries in the medial and lateral entry group, and there were two iatrogenic ulnar nerve injuries and one iatrogenic radial nerve injury in the lateral entry group.

In our study, we haven't found any radial nerve and ulnar nerve injury. We found no cases with elbow stiffness and no case with secondary loss of reduction after percutaneous pinning reduction.

We found two patients having pin tract infection and two patients with cubitus varus deformity in our study.

Table 3: Comparing with other series

Series	Satisfactory			Unsatisfactory
	Excellent	Good	Fair	Poor
Bhan S et al	72%	3.2%	21.3%	4.5%
Laud N S et al	0%	94%	2%	4%
Pirone A et al	67%	11%	0%	22%
V Gurkan et al	71.2%	15.4%	5.4%	8%
Our study	70%	20%	6.66%	3.33%

We had 96.66% of satisfactory (Excellent+ Good+ Fair) results which is comparable with other studies. This is probably due to good anatomical alignment, stable fixation, and early mobilisation with monitoring and early physiotherapy. One patient [3.33%] had unsatisfactory result as they presented late to us.

Series	Percentage
Fowells J et al	7.7%
Hamid rm, Charles s	7.2%
Our study	6.66%

In my study pin tract infection was less as compared to others.

Stability studies had demonstrated that crossed pins provided the best stability. **Bobby Dezfuli** et al. found that the crossed-wire configuration, placed from the medial and the lateral condyles, was the most stable arrangement. They promoted the use of the crossed-pin configuration, but mentioned that with significant swelling, the two lateral parallel pins could be considered as an inferior but acceptable option.

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