



Original Research Article

MANAGEMENT OF SUPRACONDYLAR FRACTURES OF HUMERUS IN CHILDREN- EXTENSION TYPE

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ABSTRACT

Background: Supracondylar fractures are the most common elbow fractures in children and the most frequent fracture requiring surgery. The peak age for supracondylar fractures is 5-7 years. Fractures are usually caused by a fall onto an outstretched hand with the elbow in extension. They are reported to be 18% of paediatric fractures. They are also associated with neurovascular injuries and compartment syndrome. Complications like deformity, malunion, and stiffness can also occur.

Materials and Methods: This is a retrospective review on displaced supracondylar fractures of the humerus of extension type in 30 children (5-12 years) who were treated at SRI LAKSHMI NARAYANA INSTITUTE OF MEDICAL SCIENCES (SLIMS), PUDUCHERRY from 2022 and 2023 with closed reduction and percutaneous fixation with two K-wires from the lateral side. This study included Gartland type II and III fractures. There was a higher incidence in boys (20 patients,) than in girls (10 patients), and injury was further common on the right elbow (19 patients) than on the left elbow (11 patients). This study included 17 patients with Type II fractures and 13 patients had Type III fractures. 6 patients had emergency treatment for their injuries, 18 patients were treated within 24 hours of being injured, and 6 patients were treated between 24 and 48 hours after the fracture took place.

Results: The results were according to Flynn's criteria- excellent in 24 patients, fair in 4 patients, and poor in 2 patients. The reduction was considered sufficient in 25 patients and insufficient in 3 patients. In 2 patients, there was a subsequent loss of reduction. In one patient, the full range of motion was not reached; there was a loss of 5° of flexion and a loss of 8° of extension. There were no cases of nerve injury or compartmental syndrome. In 2 patients, infection developed in the K-wire tract postoperatively. No significant variation in results was found in the patients getting emergency treatment when compared to patients treated within 24 hours or, 24-48 hours after their injuries.

Conclusion: So, to conclude, the advantages of fixing K-wires from the lateral side are low occurrence of nerve injury, better stability, and a good range of movements. Divergent pin and parallel pin had better outcomes in supracondylar fractures of humerus. Usage of additional K-wires always provides superior fixation. In order to prevent post-operative Pin tract infection of K-wire, adequate antibiotic support and sterile OT theatres are an absolute mandate.

Keywords: Supracondylar distal Humeral fractures, Elbow joint, Humeral fractures.

INTRODUCTION

Supracondylar fractures are the most common elbow fractures in children and the most frequent fracture requiring surgery. Supracondylar fractures are more common in 5-7 years. According to the Gartland classification system, Type I requires non-operative treatment whereas other types,^[1] require surgical intervention. Fractures are usually caused by a fall onto an outstretched hand with the elbow in extension. They reported to be 18% of pediatric fractures. They are also associated with neurovascular injuries and compartment syndrome. Complications like deformity, malunion, and stiffness can occur. These fractures are characterized by deformity, swelling, pain, and functional impairment. Mostly children avoid falling to the ground by extending and then hyperextension of the elbow occurs. The distal humeral metaphysis is weak and thin and prone to fracture.

The fractures are differentiated into extension fractures (most common) and flexion fractures based on the above mechanism. Depending upon displacement, Gartland classified the fractures into 3 types: Type I (no displacement), Type II (moderate displacement with the posterior cortex intact), and Type III (complete displacement). Wilkins further modified the above classification in regards to distal fragment position (either posterolateral or medial). The brachial artery and median nerve are commonly injured in posterolateral displacement, while the radial nerve is damaged in posteromedial displacement.

The concerned limb is to be assessed for the consistency of the soft tissue and any neurovascular injury. Other injuries should be ruled out. The extremity must be monitored adequately for swelling, which can increase with time, and for neurovascular status (to avoid compartmental syndrome).

Treatment is done by percutaneous K-Wire fixation. If stability of the fixation is compromised, additional K-wire fixation may be sought. We then re-evaluate our knowledge to establish whether this technique is superior to other methods.

MATERIAL AND METHODS

This study is a retrospective review of displaced supracondylar fractures of the humerus (of extension type) in 30 children (5-12 years) who were treated at SRI LAKSHMI NARAYANA INSTITUTE OF MEDICAL SCIENCES (SLIMS), PUDUCHERRY from 2022 and 2023 with closed reduction and percutaneous fixation with two K-wires from the lateral side. The fractures were classified as Gartland Types II and III. There was a higher incidence in boys (20 patients,) than in girls (10 patients), and injury was further common on the right elbow (19 patients) than on the left elbow (11 patients). According to the Gartland classification system, 17 patients had Type II fractures and 13 patients had Type III fractures. 6 patients had emergency treatment for their injuries,

18 patients were treated within 24 hours of being injured, and 6 patients were treated between 24 and 48 hours after the fracture took place.



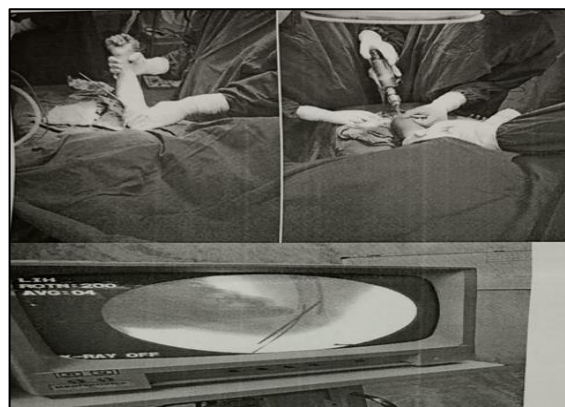
The position of the patient is usually kept close to the border of the operating slab and traction of the fractured arm should be perpendicular to the operating table at 90 degrees of abduction with countertraction applied just about the patient's chest, using a sheet. A C-ARM fluoroscopy is placed at the end of the table, opposite to the operative limb. In the anteroposterior plane, by steady traction and undertaking varus valgus correction reduction is done. Mostly, in extension fractures, the elbow is flexed with steady traction on the wrist side while maintaining counter traction on the anterior side of the arm. It is a constructive procedure. While flexing the elbow, thrust is given with the thumb onto the olecranon while maintaining traction all through the step. Utmost flexion of the elbow will be required to get a fine reduction. The fragments that also need correction are internally rotated. To get the reduction,

forearm pronation with utmost flexion of the elbow is done by keeping it in 90° abductions while simultaneously externally rotating to 90°. This makes the fracture reduction complete and confirmed under C-ARM guidance.

After the reduction, K-wire fixation with the percutaneous technique was done. It is preferable to use smooth K-wires of mostly 1.8mm and 2.0mm diameters. It is fixed with the arm flexed, pronated, and in externally rotated position. Place the K-wire from the lateral aspect of the distal humerus under the C-ARM guidance in view, that it is in line with the diaphysis (as seen in the lateral view). Also, the K-wire is directed obliquely toward the medial aspect of the humerus. Both the K-wires should be parallel or divergent. Then the shoulder is brought to neutral and under C-ARM guidance, Anteroposterior view is confirmed.

It was convergent in 25 patients, divergent in 3 patients, and parallel in 2 patients. Wires are curved and are out nudged through the patient's skin to make easy removal afterward and the elbow is immobilized with a above elbow plaster cast. There is a definite danger of infection that can be prohibited with preoperative and postoperative antibiotic treatment. So, after discharge, patients were advised with oral antibiotics for 10 days. The cast was removed after one week postoperatively and the K-wire sites were assessed. The cast after that was reapplied for three more weeks. The cast and the K-wires were finally removed after 3-4 weeks altogether, followed by initiation of rehabilitation. The mean follow-up was 15-18 weeks.

Following this, results were evaluated using Flynn's criteria which divides the results according to loss of motion and loss of carrying angle for functional outcomes into 4 categories.



If fixation was not ideal or the reduction was not satisfactory, K-wires were removed and percutaneous pinning was again attempted. For checking the fixation stability, internal rotation should be done to get a lateral view of the elbow, with a cautious watch for fragment rotation. The fracture margins were seen differently in the lateral view and in the oblique view, respectively. To reduce the fracture, externally rotate the arm to 90° and fix it with another K-wire. The third K-wire fixation, if done through the medial side, should avoid any kind of injury to the ulnar nerve. While inserting the K-wire from the medial side, the epitrochlear should be pushed with the thumb in order to avoid hyperflexion. Then move the thumb to the posterior aspect and insert the K-wire by using a T-handle, simultaneously.

Table 1: Flynn Criteria^[1]

Result	Rating	Cosmetic factor: Cubitus angle loss	Functional factor: Motion loss
Satisfactory	Excellent	0-5	0-5
	Good	6-10	6-10
	Fair	11-15	11-15
Unsatisfactory	Poor	Over 15 or, Cubitus varus	Over 15

Statistical processing of data was done with SPSS Pack (SPSS Inc., Chicago, IL) using Fisher's exact test for normal values and chi-square and using Mann-Whitney analysis for nonparametric values.

RESULTS

The mean age of patients in our study was 6 years. The results were excellent in 24 patients, fair in 4 patients, and poor in 2 patients. Callus was observed in 25 patients and rehabilitation treatment was initiated for them. The reduction was considered sufficient in 25 patients and insufficient in 3 patients.

In 2 patients, there was a subsequent loss of reduction, and in these 2 patients, another procedure was done using closed re-manipulation and fixation with a third K-wire. In the 3rd patient with insufficient results, the full range of motion was not achieved; there was a loss of 5° of flexion and a loss of 8° of extension.

There were no cases of nerve injury or compartmental syndrome, although two patients had a loss of pulse in their arms at the initial examination that was quickly recovered once the fracture was reduced. In 2 patients, infection developed in the K-wire tract postoperatively as prophylactic antibiotics were not consumed by them properly. In one of the above patients, the infection was treated with K-wire removal and intravenous antibiotics. The predominant infection found was *Staphylococcus aureus*. There also was a residual cubitus varus in one patient.

When evaluating the delayed displacement according to fracture type and the position of the K-wires, displacement in Type III fractures was found more often. Displacement was found less normally when the wires were divergent. No significant variation in results was found in the patients getting emergency treatment when compared to patients treated within 24 hours or, 24-48 hours after their injuries.

DISCUSSION

In our study, the mean age of children treated for supracondylar fractures was 6 years which was more or less similar to that of the study by Moratelli et al.^[2] According to Flynn's criteria, we found excellent results in 80% of patients which was in congruence with that of a study by Dekkar et al (84.8 %).^[3] The overall percentage of satisfactory results in our manuscript was 93.3%.^[4] Pennock et al. reported the loss of reduction in 4.2% of patients. We, on the other hand, found a slightly increased percentage of loss of reduction (6.6%).

The most established outlook is acquired either from lateral or from both-sided (lateral and medial) applications of K-wires. The medial side application has a risk of ulnar nerve damage^[5,6]. The lateral approach is the only exclusive way to avoid ulnar nerve injury. Furthermore, two cross-pin configurations are associated with a much-increased risk of ulnar nerve injury. Na et al. preferred the three lateral pin configurations in place of a crossed pin configuration.^[7] We used two K-wires from the lateral side and checked for the rotation of fragments and if found unstable, a third K-wire was fixed from the medial or the lateral side. In this study, the third K-wire fixation was done in two patients who showed good results.

Guy et al.^[8] and Sapkota et al.^[9] recommended lateral pinning (in a divergent fashion) as the best operative treatment for supracondylar fracture. Lee et al.^[10] suggested that Gartland II fractures and Gartland III fractures were well managed by divergent pins and parallel pins which was similar to our study. Convergent pins were associated with a greater occurrence of a rotated fragment.

In our research, we found that the pink pulseless hand was reversed as soon as proper fracture reduction was achieved. Many studies,^[11,12] proved the same. Not so

infrequently, children do present with acute vascular injury,^[11,12,13] which are then only treatable by vascular exploration and subsequent treatment of the cause. Gartland type III is always unstable in comparison Gartland type II may or may not be unstable.^[14,15] Type III fractures most of the time present with a vascular injury.^[16] However, we were fortunate enough to not have not encountered any vascular injury.

The most common nerve involved in supracondylar fracture is the anterior interosseous nerve which is a branch of the median nerve- that can be identified by the patient's inability to do the OKAY sign.^[16] The radial nerve is also injured and common.^[17] They heal with time on their own and there were no nerve lesions in this study.

2 patients had K-wire pin tract infection postoperatively. K-wire should be buried deep under the skin as an exposed K-wires pose a potential risk for pin tract infection.^[18]

Remodeling of bone in children especially in elbow fractures is not of good potential and is not easy to get better results always.^[19] If there are secondary displacements noted after initial reduction, there are chances of myositis ossificans, if we consider a secondary reduction.

CONCLUSION

So, to conclude, the advantages of fixing K-wires fixation from the lateral side are low occurrence of nerve injury, better stability, and a good range of movements. Divergent pin and parallel pin had better outcomes in supracondylar fractures of humerus. Usage of additional K-wires always provides superior fixation. In order to prevent post-operative Pin tract infection of K-wire, adequate antibiotic support and sterile OT theatres are an absolute mandate.

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