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A comparative study of percutaneous pinning techniques (Cross K wire vs lateral K wire) for Gartland type III pediatric supracondylar fracture of the humerus

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Abstract

Background: Supracondylar fractures of Humerus are one of the most common fractures in the children. Closed reduction and percutaneous k wire fixation are one of the most commonly used and widely accepted treatment modality in Gartland type 3 fracture, but controversy continues regarding the ideal pin fixation techniques. This study was conducted to compare lateral divergent k wires versus cross k wire (medial and lateral) in terms of the stability, functional outcome and iatrogenic ulnar nerve injury.

Material and Method: This was a retrospective record based study. Total 30 patients of displaced supracondylar fracture of the humerus of age 3-12 years were divided into 2 groups which were evaluated from post-surgery. In group one crossed pinning was done for type 3 supracondylar fractures and other group was treated with lateral pinning and outcome of these patients record was assessed on basis of pain, motion, stability and function according to Flynn's criteria and follow-up record of 2 year was studied. Data was analysed with the help of SPSS 20.0 version.

Results: According to Flynn criteria, the final result was excellent in 90 % and good in 10 % of cases with 0% fair and 0% poor results. There was no statistically significant difference between medial-lateral entry group and lateral entry group.

Conclusions: Lateral pinning is an equally good as compared to crossed pinning treatment of choice in terms of terms of the stability and functional outcome. The risk of ulnar nerve injury was zero in lateral divergent k wires. Both these methods give comparable functional and cosmetic results.

Keywords: Supracondylar fractures, Gartland type 3 fracture, lateral pin fixation, cross pin fixation

Introduction

Supracondylar fractures of the humerus constitute half to three fourth of all the elbow fractures in children in the first decade of their life with peak incidence in between the age of 4 to 7 years [1, 2].

Out of the common complications like malunion, ischemic contracture and neurovascular damage which are fairly common with supracondylar fractures, if left untreated [3, 4] Therefore proper management is what is of utmost importance. Many different methods are described such as close reduction and long arm cast or slab, Dunlop skin traction, olecranon traction, but all of these methods had large complication rate [5-9] Current method of treatment of this fracture is based on Gartland classification. Closed reduction and percutaneous k wire fixation is the currently preferred method of treatment in Gartland type 3 supracondylar humerus fractures in children [2]. This method has given excellent results as reported in many studies.

Flynn *et al.* [10] reported the 5% incidence of cubitus varus deformity after treatment while in the study by Ariño *et al.* [11] it was more than one fifth, ulnar nerve deficit was found in 15% of patients treated with cross pinning.

However, there has always been a difference of opinion for better method of fixation between cross (medial- lateral) k wiring and divergent lateral k wire fixation [4]. Hence, outcomes and complications like deformity due to loss of reduction and rate of iatrogenic ulnar nerve palsy help us define a better method of fixation [12-15].

The advantage of medial-lateral entry pin fixation is probably increased biomechanical stability, although iatrogenic ulnar nerve injury may result from placement of the medial pin [2, 4, 16]. Conversely, the advantage of lateral entry pin fixation is avoidance of iatrogenic ulnar nerve injury, although the construct may be less stable biomechanically [2, 17-19]. The aim of this study was to compare the efficacy in terms of stability, functional outcome and iatrogenic ulnar nerve injury between lateral entry pin fixation and medial-lateral entry pin fixation of completely displaced (type-III) extension supracondylar fractures of the humerus in children.

This retrospective study was conducted to know the outcome of percutaneous lateral pinning in the management of displaced supracondylar fracture of humerus in children, at the same time to see the possibility of complication like iatrogenic ulnar nerve palsy.

Objective

To compare parallel k wires to cross k wire (medial and lateral) in terms of the stability, functional outcome and iatrogenic ulnar nerve injury.

Material and Methods

This was a retrospective, record-based study conducted in the Department of Orthopaedics, in Cooper Hospital, Mumbai, a tertiary care hospital in Maharashtra. A record of 30 eligible patients as per inclusion and exclusion criteria was analysed from the post-surgery for a period of one year.

Inclusion criteria

1. All the patients aged between 3 and 12 years,
2. Closed Gartland type III supracondylar humeral fracture
3. Duration of injury < 4 days
4. Normal neurological and vascular status of the affected limb.

Exclusion criteria

1. Compound fractures.
2. Fracture requiring open reduction or neurovascular exploration,
3. Previous ipsilateral elbow fracture, and
4. Floating elbow injury.

Total 30 patients with supracondylar fractures of humerus were included in the study from the patients that were admitted in the orthopedic wards either through the outpatient department or emergency services who fulfilled our inclusion criteria. The method of patient selection for lateral entry or medial-lateral entry was random. Our analysis included 30 patients who were followed up for at least 6 months at 3, 6, 10, 14, and 24 weeks. All the children with suspected supracondylar fractures of the humerus were assessed for vascular and neurological status. Anteroposterior and lateral radiographs were performed. All displaced supracondylar fractures of humerus were admitted and limb immobilized in an above-elbow splint with limb elevation. Surgical techniques were standardized in terms of pin location, pin size (weight < 20 kg size 1.5 mm and weight > 20 kg size 2 mm), stability on the table and the position of the elbow for pin placement. Surgery was performed by a senior orthopedic surgeon who was well trained in this technique. General anesthesia was used for all patients, in supine position with the injured upper limb on the side of the table. Closed reduction was performed and confirmed by the image intensifier. First, longitudinal traction was applied with the

elbow in hyperextension and the forearm in supination. While the traction was maintained, the medial or lateral displacement was corrected by applying a valgus or Varus force at the fracture site. The posterior displacement of the distal fragment was then corrected by applying a force to the posterior aspect while the elbow was gently hyper flexed and the elbow was secured in hyperflexion, and the reduction was confirmed by the image intensifier. For the lateral pin fixation technique, two or three pins were inserted as per stability from the lateral aspect of elbow across the lateral cortex to engage the medial cortex keeping the elbow in hyperflexion. Pins were placed either in parallel or divergent configuration with adequate separation at the fracture site. For the cross (medial-lateral) fixation technique, first the lateral pin was inserted from lateral cortex to engage the medial cortex keeping the elbow in hyperflexion. The elbow was then extended to >90° and the ulnar nerve rolled back with the opposite thumb and the medial pin was inserted to engage the lateral cortex with the elbow in 45 to 50 degree of flexion. This reduces the incidence of neuropraxia while doing medial to lateral pinning. The adequacy and stability of the reduction were checked under image intensification. The pins were bent to prevent migration and cut off outside the skin to allow removal in the outpatient clinic. A single preoperative parenteral dose of cefotaxim was given at the time of induction and postoperatively, as per weight. Postoperatively, the extremity was placed in a well-padded posterior splint with the elbow flexed to 90°. For all patients, immediate postoperative radiographs were taken to determine the maintenance of the reduction. The operated limb was elevated and carefully observed at regular intervals for any neurovascular deficit. During follow-up in the outpatient department, clinic-radiological evaluation was performed for maintenance of reduction (at first follow-up) and functional outcome, which included passive range of motion, measurement of carrying angle, neurovascular status, superficial and deep infection. Clinical evaluation was graded according to carrying angle and elbow range of motion using the criteria of Flynn *et al.* [10]. Radiographic evaluation was performed by anteroposterior and true lateral view at 6 weeks and at 3 and 6 months. In the 6th week, the pins were removed. At 3 and 6 month follow-up, the children were evaluated for full function, minor limitation of function and major loss of function. The final results were graded as excellent, good, fair and poor, according to the loss of range of motion and loss of carrying angle using the criteria of Flynn *et al.*

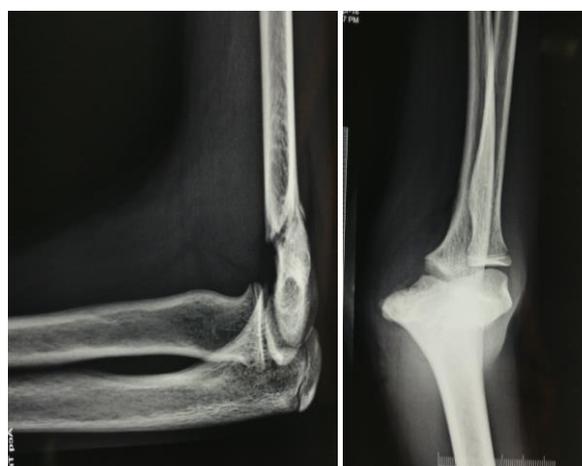


Fig 1: Preoperative X Ray

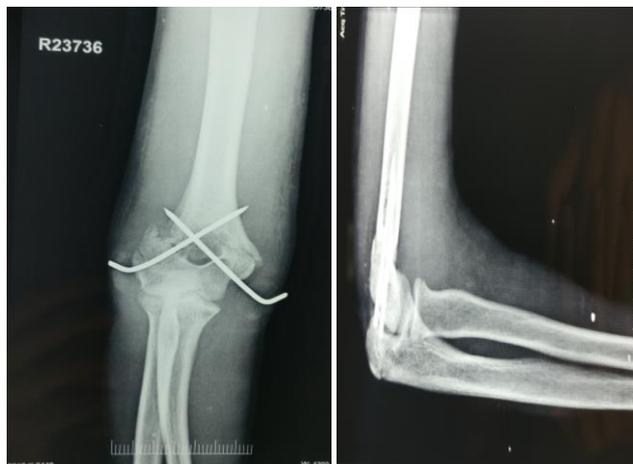


Fig 2: Immediate postoperative x ray Operated with cross K wire.

Results

Table 1: Outcome as per Flynn’s Criteria

Result	Lateral Group	Medial Lateral /Cross wire Group
Excellent	10(66.67%)	13(86.67%)
Good	5(33.33%)	2(13.33%)
Fair	0 (0%)	0 (0%)
Poor	0 (0%)	0 (0%)

In our study, the difference with regard to the loss of range of movement between the two groups was statistically insignificant (P =0.3893), with both groups showing an excellent or good range of movements. The functional outcome following medial- lateral pinning was excellent in 86.67 % and good in 13.33 % of cases. There were no poor results, while cases treated with lateral pinning showed 66.67% excellent and 33.33 % good results with no poor results.

Table 2: Postoperative Ulnar Nerve injury

	Lateral Group	Cross wire Group
Ulnar Nerve injury	0(0%)	5(33.33%)

There were 5 cases of ulnar injury in case of Cross wire/medial-lateral pinning as compared to none in lateral pinning group. The association of ulnar nerve injury was statistically significant with the type of pinning surgery. (p=0.0421, significant)

Discussion

The treatment for Gartland type III supracondylar fractures of the humerus in children is closed reduction and percutaneous pin fixation. However, there is still a discrepancy in ideas regarding the optimal technique, whether lateral or crossed (medial–lateral) pin fixation is better.

According to earlier studies, the advantage of medial–lateral entry pin fixation is that there is increased biomechanical stability as compared to the lateral pin ^{16, 20]}, although iatrogenic ulnar nerve injury may result from placement of the medial pin.⁴ On the other hand, the advantage of lateral entry pin fixation is avoidance of iatrogenic ulnar nerve injury, although the construct may be biomechanically less stable ^[19, 21-23] It does not provide torsional stability. A biomechanical study by Zionts *et al.* ^[16] demonstrated that crossed pinning is more stable than lateral pinning as far as rotational, varus and valgus stability is concerned. However, a study by Skaggs *et al.* ^[19] demonstrated no clinical difference in stability between

crossed and lateral pins. The average loss of the carrying angle and range of motion in the lateral pinning cases in our study may be related to a comparatively less stable construct with two lateral pins compared to crossed medial–lateral pins. Although radiological and clinical union occurred in a similar time period without any residual deformity, the loss of both the range of motion and the carrying angle was relatively more in this patient, compared to those without loss of reduction. The risk of loss of reduction after lateral entry pin fixation can be minimized by following proper pin placement technique, with divergent pins, pins that engage both the lateral and medial column. In our study, two cases showed only neuropraxia along the ulnar nerve distribution, which subsided spontaneously within 6 weeks following removal of k wires. The incidence of ulnar nerve injury in our study was low because of precautions such as inserting the lateral pin first, avoiding hyperflexion of the elbow during medial pin placement and by retracting the nerve more posteriorly digitally before inserting the medial pin. According to studies, iatrogenic ulnar nerve injuries associated with medial pin fixation resolve after replacement of the medial pin at a new location ^[24].

Conclusions

The functional outcome of both medial group and medial-lateral group were comparable (almost similar) and there were no poor results in any of these groups. Thus lateral pinning is an equally good treatment of choice in these situations a. There is no risk of ulnar nerve injury in lateral divergent k wires as compared to cross wire.

Limitations

The major limitation of the study was the small number of cases in each group. A randomized controlled trial involving a large number of patients with long-term follow- up is needed to compare between these two techniques and asses the better plan of treatment according to the need and situation. Also it is single centered hospital based study, the results may not be applicable to difference in environment, population groups, ethnicity, hospital set up, skill of surgeon etc.

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