

Crossed pinning versus lateral pinning for displaced extension type supracondylar fractures of the humerus in children

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Abstract

Back ground: highest incidence of supracondylar fracture of humerus is in Pediatric age group and the most common being the extension type of supracondylar fracture. Precise diagnosis evaluation and planning is required for deciding the best modality of treatment for these fractures. They are most widely managed by utilizing two methods; lateral pinning and crossed pinning. So aim of study remains to determine the superiority of either of these techniques over the other.

Materials and Methods: A prospective, single blinded, randomized control trial with 53 cases, out of which 39 were boys and 14 were girls was conducted. Mean age group of study was 6.9 years. According to Gartland classification Type III supracondylar fractures were included in this study. Detailed post-operative primary assessment for major loss of reduction and iatrogenic ulnar nerve injury was done. Clinical outcome, elbow range of motion, radiographic measurement, Flynn's grading and complications were the secondary parameters which were assessed.

Results: Both groups exhibited no major loss of reduction. Change of Boumann angle was statistically insignificant. Metaphysial-Diaphysial angle, Flynn grade, carrying angle and total elbow range of motion between the two groups showed no statistically significant difference.

Conclusion: Lateral pin fixation offers parallel results in terms of functional and radiological outcomes and nearly equal mechanical stability compared to medial-lateral pinning without the added shortcoming of possibility of iatrogenic ulnar nerve injury.

Keywords: fracture fixation, crossed versus, pinning, humerus, supracondylar fractures

Introduction

Supracondylar fractures of the humerus are the most common elbow injuries in children and make up approximately 60% of all elbow injuries in the first decade of life ^[1]. These injuries can be one of the most difficult to treat, owing to the presence of associated immediate and late complications like compartment syndrome, neurovascular damage, Volkman's ischaemic contracture and malunion ^[2-4].

Pediatric age group between ages 4 to 7 has the highest incidence, the most common being the extension type (95%) ^[5, 6]. The most commonly used classification is based on degree of displacement which is known as Gartland classification ^[6].

According to this classification they are classified as follows:

Type 1: Undisplaced.

Type 2: Displaced with intact posterior cortex.

Type 3: Displaced with no cortical contact.

A precise evaluation and planning is required for deciding the modality of treatment for these fractures.

While the general consensus for Type I and few Type II fractures has been closed reduction and cast application,

Type III fractures usually warrants closed reduction and pinning. Conservative treatment is associated with complications such as loss of reduction, compartment syndrome and malunion^[7]. The most common choice of pinning are either a medial or a lateral pin in a cross manner or two lateral pins^[2,3].

The task at hand remains to determine the superiority of either of these techniques over the other.

The aim of this study is evaluation and comparison of the two techniques with respect to parameters such as Stability, Functional outcome and Complications, if any, in rural population.

Materials and Methods

A prospective, single blinded, randomized control trial in the Department of Orthopaedics, MGG General Hospital and GMERS medical college Navsari, India from August 2021- July 2022 was conducted after obtaining approval from College Ethical Committee. Written informed consent was undertaken from parents/legal guardians before enrollment to the study.

Inclusion criteria

Age-4 to 11 years, Closed Gartland type 3 Supracondylar Humerus Fracture, Duration of injury-Less than 5 days and intact neurological and vascular status of affected limb.

Exclusion criteria

Undisplaced fracture, Flexion type Supracondylar Humerus Fractures, Open Fractures, Associated Ipsilateral limb Fracture and Previous Ipsilateral Elbow injury.

A total of 53 patients with Displaced Supracondylar Humerus Fractures were admitted to the Orthopaedic ward either on Outpatient or Emergency basis. Patients were selected for Lateral entry or Medial-Lateral entry using a Randomization table. The study included 39 boys and 14 girls with a mean age of 6.9 years. All patients enrolled had Type 3 Supracondylar Humerus fractures based on Gartland's Classification. Above Elbow Slabs were applied to all patients upon admission. All patients were operated within 72 hours by operating surgeons.

Rockwood and Wilkins^[5] standard Technique was used for closed reduction. Reduction was confirmed in both True Antero-Posterior and Lateral plane using an Image intensifier. Standard surgical techniques in terms of size and location of pin as well as position of the elbow for pin placement were used. Surgery was performed under General Anaesthesia with injured upper limb on the side of the table.

Method of lateral pinning

After reduction evaluation, two pins were inserted from the lateral aspect of the elbow. The pins were parallel or divergent and engaged the medial cortex. For insertion of lateral pins, the elbow was kept hyperflexed and in pronation. Fracture reduction and stability was assessed, after fully extending the elbow, clinically as well as radiologically under image intensifier.

Method of crossed pinning

After reduction evaluation, the lateral pin was inserted first using an approach similar to lateral pinning technique. After extending the elbow to less than 90 degree position, the medial pin was inserted. The surgeon palpated the ulnar nerve and pushed it posteriorly with the thumb for medial pin insertion. Three patients required a separate incision over the Medial epicondyle to explore the ulnar nerve. To avoid skin complication, the excess length of the pin was cut and bent. Post-operative radiographs were taken immediately to determine the maintenance of reduction. With the elbow in 90 degree flexion, an above elbow slab was applied.

The patients were discharged on 3rd post-operative day. Removal of both slabs and pins were done after 4 weeks following which elbow range of motion exercises were encouraged. They were followed up at 4 weeks and subsequently at 6 months for clinical evaluation of carrying angle, elbow range of motion, neurovascular complications and pin tract infections along with a radiological evaluation of fracture displacement, Boumann's angle and humero-capitellar angle.

Table 1: Flynn's criteria

Results	Rating	Loss of carrying angle	Loss of motion
Satisfactory	Excellent	0°-5°	0°-5°
	Good	5°-10°	5°-10°
	Fair	10°-15°	10°-15°
Unsatisfactory	Poor	>15°	>15°

Results

The study consisted of 53 patients amongst which 27 were treated with lateral pinning and 26 were treated with cross pinning technique based on randomization. The two groups had no noteworthy differences based on baseline characteristics such as age, gender and type of fracture. Fracture union among the patients had a mean period of 6.1 weeks.

Baseline characteristics of patients who underwent either lateral pinning or cross pinning (n=53) were evaluated using Flynn's criteria [7].

Amongst the patients who were treated with Lateral pinning technique, 20 (74%) patients had an excellent outcome, 5 (18.5%) patients had a good outcome while 2 (7.5%) had fair outcome. Correspondingly, amongst patients treated by the cross pinning technique, 21 (81%), 4 (15) and 1 (4%) were accorded excellent, good and fair outcomes respectively.

Superficial Pin Tract infections developed in two patients which were treated effectively with regular dressings and oral antibiotics. Iatrogenic Ulnar nerve injury wasn't observed in any of the patients who underwent the crossed pinning technique. None of the patients among both the groups developed any neurovascular complications during the follow up.

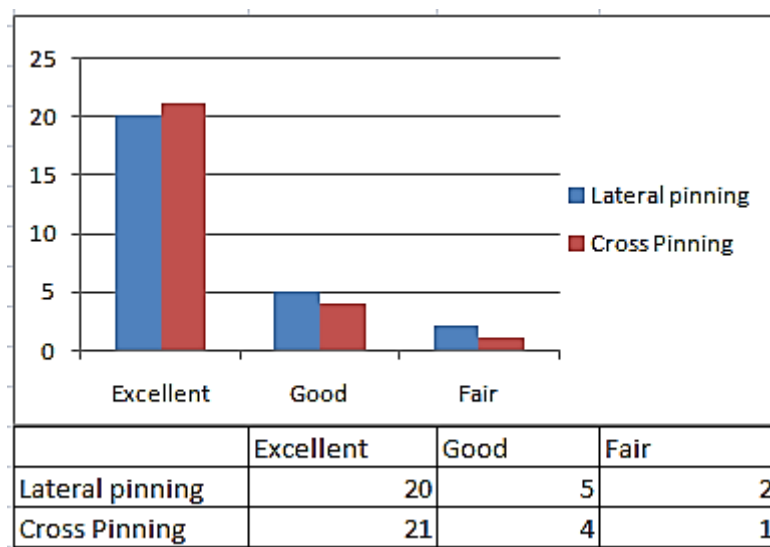
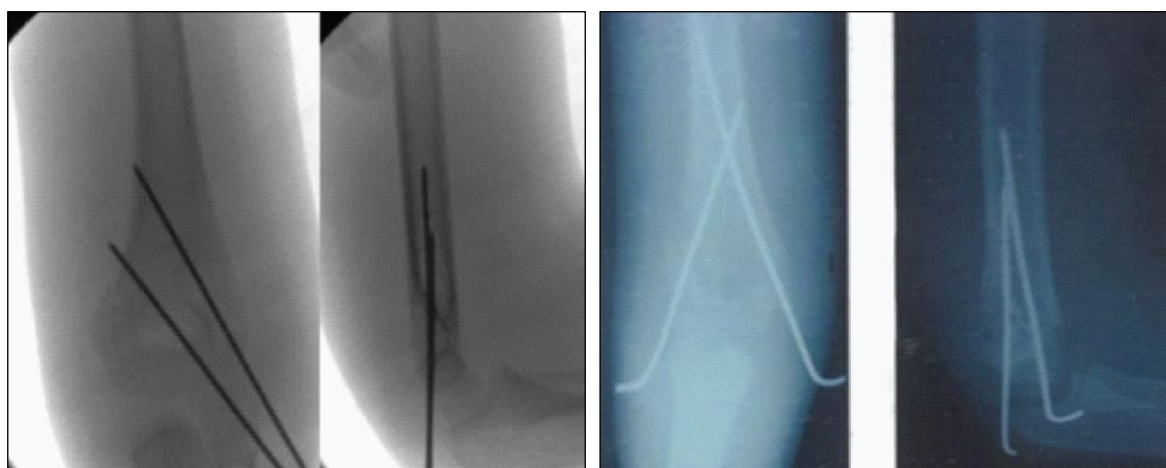


Fig 1: Outcome in patients receiving either lateral pinning or crossed pinning based on Flynn's grading



i) Radiograph with Lateral K wire Group A

ii) Radiograph with Cross K wire Group B

Discussion

Among the fractures around the elbow in the Paediatric age group, Supracondylar fracture of Humerus is the most common [8, 9]. Neurovascular complications are commonly associated with these fractures [10, 11]. In order to avoid severe complications, aggressive and apt treatment is advised. Type 1 fractures according to Gartland classification can be treated conservatively by immobilization using an above elbow cast. The treatment of Gartland type II (displaced) is controversial. Traction, closed reduction and casting, closed reduction and percutaneous pinning and open reduction and pinning are the various methods which have been described for the treatment of displaced (Gartland Type II) Supracondylar Humerus fractures.

Parikh *et al.* [12] suggested closed reduction and casting for the treatment of Extension Type II Supracondylar Humerus fractures. Dorgan's Technique [13] (Lateral cross pinning technique) was also recommended by some authors. Nevertheless, we don't have any familiarity with this technique. Li *et al.* suggested a minimally invasive technique for reduction of severely displaced Supracondylar Humerus fractures using a mosquito forceps. Fahmy *et al.* described the treatment of extension type Supracondylar Humerus fractures using a Posterior intrafocal pinning technique [14]. A biomechanical model to evaluate the four osteosynthesis techniques for management of Supracondylar fractures was described by Weinberg *et al.* which found external fixators as a good substitute to cross pinning when fracture reduction is tricky due to

swelling ^[15].

The Hospital in which this study was conducted is located in a backward rural region in the south gujrat where prolonged hospitalization or frequent follow up is difficult and a financial burden on the patient. Hence the method of closed reduction with K-wiring for displaced Type III Supracondylar Humerus fractures was the most viable option. This method offers ample stabilisation, reduces the soft tissue damage and swift recovery is anticipated when done by the book.

A few Studies suggested that the timing of surgery for an uncomplicated displaced supracondylar humerus fracture can be delayed upto 24 hours. In a study by Ramachandran *et al.* they cautioned against delaying the surgery in uncomplicated supracondylar fracture of Humerus due to the threat of development of compartment syndrome ^[17]. In our study, none of the study participants had any evidence of neurovascular complications upon presentation to the hospital as well as during hospital stay and all of them were operated within 72 hours of Hospitalization. An intact posterior periosteum prevents rotational misalignment among Type II fractures but the fractures are completely displaced and are innately unstable in Type III fractures. To add to this, the presence of a comminution of medial cortex which is generally seen adds to this instability. This is by far the most important reason put forth by the followers of crossed pinning technique along with its higher torsional rigidity. Many studies propose that the lateral pinning is as good as crossed pinning which also diminishes the incidence of Iatrogenic Ulnar nerve injury.

The occurrence of iatrogenic ulnar nerve injury varies significantly based on type of pin insertion technique. A systematic review done by Brauer *et al.* found the probability of iatrogenic nerve injury to be 1.84 times higher in patients who undergo crossed pinning techniques compared to patient who underwent lateral pinning ^[18]. Nonetheless, none of the patients who underwent crossed pinning technique in our study had any incidence if iatrogenic ulnar nerve injury. In addition, a separate medial incision is advocated to explore the ulnar nerve for medial pin insertion. However, only one patient in our study who had gross swelling required a medial incision as the swelling hindered the palpation of the ulnar nerve. The Ulnar nerve was palpated and pushed posteriorly with the thumb in the rest of the patients before the insertion of the medial pin.

There was no significant disparity between the two methods of pinning techniques used in this study based on the clinical and functional outcome. The results of this study advocate the use of lateral pinning for displaced Supracondylar humerus fractures (Gartland type II and type III). Prospective design, standardized protocol for reduction of fracture, pin placement and follow up of the patients is the strength of this study.

The limitations of this study is the lack of randomization regarding the selection of pinning technique as this was decided by the operating surgeon at the time of surgery. A relatively shorter follow up further weakens this study. Nonetheless this study strengthens the conclusions of other authors with respect to the usage of lateral pinning technique in displaced supracondylar fractures of humerus in children.

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