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Case Series

Comparative study of lateral entry versus crossed entry pinning for paediatric supracondylar humerus fractures: a case series

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ABSTRACT

Closed reduction and percutaneous pin fixation techniques have been proposed as treatment strategies for displaced supracondylar humeral fractures (SCHFs) in children. Commonly lateral pinning and cross pinning techniques are utilised for fixation. However, controversy exists regarding the selection of the appropriate procedure. A prospective study with 24 cases of displaced fracture supracondylar humerus, treated by lateral pinning and cross pinning, was conducted between August 2022 and May 2024 at Department of Orthopaedics at J.J.M. Medical College, Davangere. Patients were treated with either the lateral entry pin alone or the cross pinning with a combination of lateral entry pin and medial entry pin. Age, gender, fractured side, duration of surgery, postoperative complications, surgical approach, direction of pin application (lateral or cross), and Modified Flynn grading system grade was noted for study outcome. No difference was found between lateral pinning and crossed pinning groups in terms of the grade of the modified Flynn grading system and complications like iatrogenic ulnar nerve damage, loss of reduction. Pin tract infection was seen in one patient.

Keywords: Supracondylar humeral fractures, Pediatric, Pin fixation

INTRODUCTION

Pediatric supracondylar humerus fractures are the most common fractures that account for more than 50% of fractures around the elbow in children.[1] These injuries are divided into extension and flexion types. The extension type is the most common type.[2] The most widely accepted classification is the Gartland classification.[3] While type I fractures are typically treated non-surgically, some type II and almost all type III fractures usually require surgical intervention.[4] Closed reduction and percutaneous pinning is the universally accepted modality for displaced fractures. Pin configuration has been the focus of many recent research studies on the treatment of displaced fractures.[5-7]

There are two common pin fixing techniques: lateral pinning only and cross pinning with medial and lateral pins.[8] Theoretically, cross-entry pins have the advantage of improved mechanical stability of the configuration, however, this technique increases potential injury to the ulnar nerve.[9,10] Lateral entry pins can reduce the mechanical stability of the construct but injury to the ulnar nerve can be avoided.[11] Biomechanical tests have shown that both medial and lateral cross pinning is more advantageous.[12,13] Nevertheless, the risk of iatrogenic ulnar nerve injury during medial pin placement is high.[14] In this study, it was aimed to analyze the functional outcomes and complications treated with lateral pinning and cross pinning.

CASE SERIES

This study was approved by ethics committee of the institute. A prospective study with 24 cases of displaced fracture supracondylar humerus treated by lateral pinning and cross pinning was conducted between August 2022 and May 2024 at Department of Orthopaedics at J.J.M.

Medical College, Davangere. Inclusion criteria were defined as; patients with a Gartland type II and III supracondylar fracture, aged between 5-10 years, and minimum upto 12 weeks of follow-up. Patients who had multiple fractures at the time of injury, whose data could not be accessed, and whose follow-up was delayed or lost were excluded from the study. After applying our criteria, 24 patients (15 boys and 9 girls) who underwent surgery for a Gartland type II and III pediatric supracondylar humerus fracture were documented and analyzed. The recorded data were as follows; age, gender, fractured side (right or left), operation time, postoperative complications, surgical approach, number of pins, direction of pin application (lateral or cross), and modified Flynn grading system grade.

All interventions were performed under general anesthesia. A closed reduction maneuver was performed to all fractures. An anterior approach was performed to patients with preoperative anterior interosseous nerve (median nerve) injury. After reduction, it was stabilized in the reduced position with percutaneous K-wires (k-wires determined according to the patient's age and bone cortex thickness). Two K-wires were placed laterally or one K-wire was placed medially in a mini-open technique along with lateral pin, in case of instability additional k wire was placed, stability assessed by the intraoperative C-arm fluoroscope. After the wires were cut, the ends were bent. After the K-wire pin tract dressing, the elbow joint was splinted to be immobilized in neutral rotation and 90° flexion position for three weeks. Postoperative follow-up was made routinely, radiologically, and clinically at the first, third, eighth, twelfth, twenty-fourth weeks and at the end of the first year. K-wires and splint were removed in the fourth week on outpatient basis. Active-passive movements of the elbow were started. Evaluation of clinical results was made with the modified Flynn grading system at 12 weeks and at the end of the first year. Modified Flynn grading system's criteria include two factors: cosmetic factor (loss of carrying angle degree) and functional factor (motion loss in degrees). Results were grouped into satisfactory [excellent (0 to 5), good (6 to 10), fair (11 to 15), and poor (>15).[15] The final modified Flynn grade result was noted according to whichever cosmetic or functional factor was worse. The range of motion of the joint was measured with the goniometer. Measurements were made considering passive movements. Restoration of a full range of motion of the elbow was defined as the range of motion of elbow flexion/extension less than 10° as measured by the uninjured elbow.

The mean age of the patients in cross pinning was 7.41 years and 6.58 years in lateral pinning. There were 9 (37.5%) females and 15 (62.5%) males in the present study. Among the 24 patients enrolled in the study, 19 (79.16%) had a fall while playing, 3 (12.5%) had road traffic accident whereas 2 (8.4%) had fallen from height. As per the Gartland classification system, 15 (62.5%) patients were type II and 9 (37.5%) patients had type III fracture. The average surgical time was 25±4.4 minutes in patients of cross pinning and 23±4.1 mins in patients of lateral pinning. As per the Flynn criteria, 16 (66.6%) patients had excellent, 7 (29.16%) patients had well and 1 (4.16%) patient had an unsatisfactory cosmetic outcome in cross pinning. The functional outcome scores in cross pinning was excellent in 9 (75%) and good in 3 (25%) patients. The functional scores were excellent in 7 (58.4%), good in 4 (33.3%) patients and poor in 1 (8.3%) patient.

Case 1

8-year male child sustained injury left elbow resulting in left supracondylar humerus fracture fixed with closed reduction and cross pinning.

Figure 1 (a and b): Pre-operative X-ray.

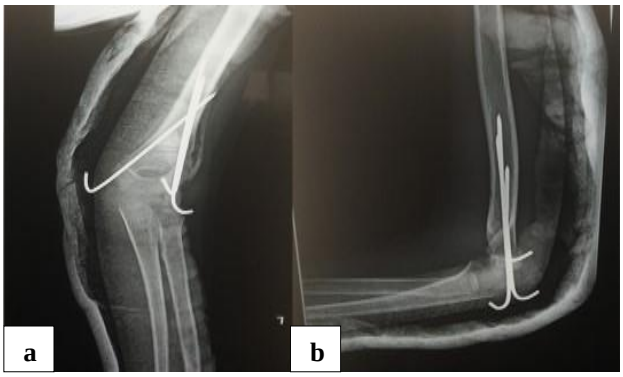

Figure 2 (a and b): Post-operative X-ray.

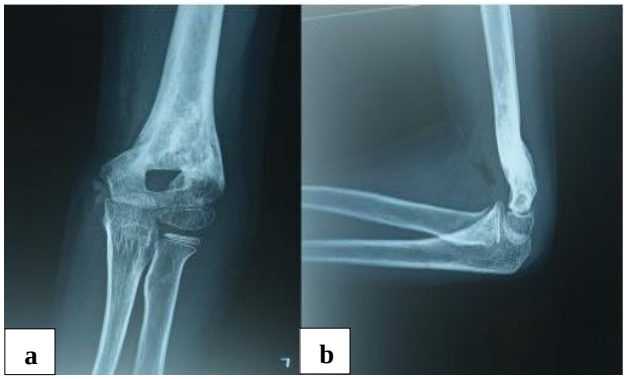

Figure 3 (a and b): 6 months post-operative X-ray.

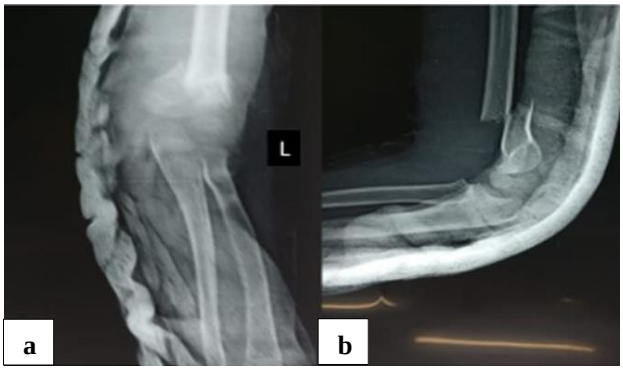

Figure 4 (a and b): Pre-operative X-ray.

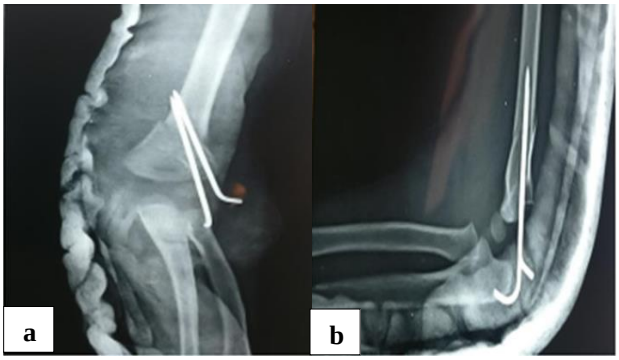

Figure 5 (a and b): Post-operative X-ray.

Table 1: Demographic characteristics.

Parameters	Cross pinning n=12 (50%)	Lateral pinning n=12 (50%)
Mean age (years)	7.41	6.58
Sex		
Male	6 (50)	9 (75)
Female	6 (50)	3 (25)
Side		
Left	5 (41.6)	7 (58.4)
Right	7 (58.4)	5 (41.6)
Mechanism of injury		
Playing	9 (75)	10 (83.4)
Road traffic accident	2 (16.6)	1 (8.3)
Fall from height	1 (8.4)	1 (8.3)
Type		
II	5 (41.6)	10 (83.3)
III	7 (58.4)	2 (16.7)
Modified Flynn grading system (in degree)		
Loss of carrying angle	5.41	7.25
Loss of ROM	3.3	4.5
Duration of surgery (in minutes)	25 ±4.4	23 ±4.1
Complications		
Superficial infection	1 (3.5)	1 (3.4)
Ulnar nerve neuropraxia	-	-
Pin loosening	1 (3.5)	2 (6.8)

Case 2

4-year-old male child with left supracondylar humerus fracture treated with closed reduction with lateral pinning.

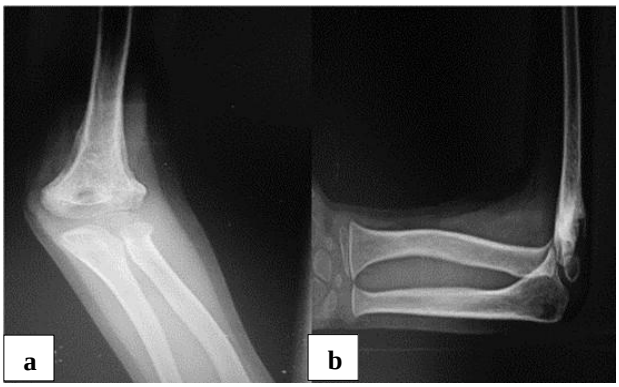

Figure 6 (a and b): 12-weeks post-operative.

DISCUSSION

Supracondylar fractures of the humerus are among the most common and challenging injuries in children. The primary objective of treatment is to achieve anatomical reduction and secure internal fixation. A comprehensive clinical evaluation and accurate assessment are essential during the initial examination of each patient. The gold standard for managing these fractures is closed reduction with K-wire fixation. K-wires are favored due to their simplicity, affordability, and ability to minimize hospital stays.[14,16]

In the present study, the mean age of patients was 7.41 years in cross pinning group and 6.58 years in lateral pinning group, aligning with findings from studies by Gudda et al, Babal et al and Molhosseini et al.[17-19] A predominance of male patients was also observed, consistent with the series of 159 patients reported by Barr et al.[20]

Ulnar nerve neuropraxia is a significant concern in patients treated with a cross-pinning configuration. The risk of neuropraxia can be minimized by maintaining the elbow in 45-50 degrees of flexion rather than hyperflexion during lateral pin insertion. In this study, for all patients undergoing cross-pinning, a mini-open approach was utilized. The medial epicondyle was exposed, the ulnar nerve was palpated, and the K-wire was inserted with the elbow in a semi-extended position, further reducing the risk of nerve injury. None of the patients had ulnar nerve injury.

In the present study, one patient in lateral pinning group developed a superficial infection, which resolved completely with oral antibiotics. No cases of deep-seated infection were observed, and no revision surgeries were necessary.

The present study found no significant differences between the two groups regarding K-wire insertion techniques. These findings align with studies by Yen and Kocher, as well as Reynolds et al, which also reported no significant differences between the techniques.[21,22]

According to the modified Flynn scoring system, approximately 80% of patients in both groups achieved excellent to good outcomes, which is comparable to the study by Vito et al, where over 90% of patients demonstrated excellent results.[23]

Statistical analysis was not conducted in this study as the small sample size, which was inadequate for achieving sufficient statistical power. Instead, the findings are reported as mean to and percentage to highlight observed patterns. Further research with larger sample sizes will be necessary to confirm these results and enable comprehensive statistical evaluation.

CONCLUSION

Pinning for supracondylar humerus fractures has shown to be an effective treatment option, yielding excellent results. However, in terms of technique, no significant differences were observed in cosmetic and functional outcomes between the two methods.

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