

A comparative study of Functional outcome of lateral pinning versus cross pinning in the management of supracondylar fractures of humerus in Pediatric Age Group.

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Abstract:

Background: The present study was conducted to compare the effectiveness of lateral pinning and cross pinning in the management of supracondylar fractures in humerus in children.

Method: A total of 30 cases of children with Type II, Type IIIA and Type IIIB Gartland Classification supracondylar fracture of humerus were selected by consecutive sampling. Out of 30, 15 were included in the lateral pinning group and other 15 were included on the cross pinning group. Outcome measures that were used to compare and evaluate the outcome of treatment were: Flynn's criteria for functional outcome, ASK-p (Activities Scale for Kids-performance version), Loss of carrying angle and range of motion.

Results: Both the lateral pinning group and cross pinning group showed similar functional outcome, ASK-p score, loss of carrying angle and range of motion with no statistically significant difference. The lateral pinning method showed no iatrogenic ulnar nerve injury but there were 2 cases of iatrogenic ulnar nerve injury with the cross pinning method

Conclusion: Both the lateral and cross pinning methods showed successful management of supracondylar fracture of humerus in children with a few iatrogenic ulnar nerve injuries with the cross pinning method.

Keywords: Supracondylar fractures in humerus, lateral pinning, cross pinning, iatrogenic ulnar nerve injuries

Introduction:

Due to the enormous capacity for bone growth and remodelling in children, paediatric fractures require special attention. A fracture treated in the paediatric age group may have long-term functional outcomes and radiological appearances that are very different from the appearance immediately following management.¹

With a male predominance accounting for 16% of all paediatric fractures and 60% of all paediatric elbow fractures, supracondylar fracture of the humerus is one of the most discussed and frequently encountered injuries in the paediatric age group. It typically results from falling on an outstretched hand.^{2,3} The second most frequent fracture in children is the supracondylar humeral fracture.⁴ Their incidence rises steadily during the first five years of life before peaking between 5-8 years old. They are most common in the first decade of life.^{5,6}

Treatment is contentious and frequently technically challenging.⁷ Vascular injury occurs 0.5%–0.8% of the time; nerve injury occurs 6–16% of the time; cubitus varus occurs 30% of the time and does not remodel with growth. It is difficult to maintain reduction as this fracture is close to the joint and it is also difficult to keep the limb immobilized in the children. One of the most difficult situations to manage is a displaced supracondylar humerus fracture in order to avoid complications. Since the remodelling potential of the supra-condylar fracture is poor, the fixation needs to be suitable to avoid deformity. Therefore, saying "not bad for a supracondylar fracture" is no longer acceptable.⁵

Closed reduction with splint or cast immobilisation and treatment with traction has traditionally been recommended for displaced supracondylar fractures, but difficulty in reduction, necessity of repeated manipulations, loss of reduction postoperatively or during follow up leads to malunion and elbow stiffness. Supracondylar fracture of humerus often installs 'sense of apprehension' even in the mind of most experienced surgeon. Various studies have shown that for displaced supracondylar fractures of humerus, open reduction and internal fixation with K-wires gives more stable fixation, better anatomical reduction with minimal complications.^{7, 8}

The present study was conducted to compare the effectiveness of lateral pinning and cross pinning in the management of supracondylar fractures in humerus in children.

Materials and methods:

This study was carried out in Orthopaedic OPD and Ward, Dr. D.Y. Patil Medical College, Pune. Ethical approval was obtained from the Institute Ethics Committee. A total of 30 cases of supracondylar fracture of humerus were selected by consecutive sampling. Out of 30, 15 were included in the lateral pinning group and other 15 were included on the cross pinning group.

Inclusion and exclusion criteria

Children aged 5-15 years presenting Type II Gartland Classification with unstable, displaced or irreducible fractures, Type IIIA & IIIB Gartland Classification and Type IV Gartland Classification Fracture where closed reduction was achieved were included in the study. Patients who had undisplaced fractures, pathological fractures, Type IV Gartland Classification Fracture where closed reduction was not achieved, open fracture and fractures with neurological or/and vascular compromise in the fractured limb were excluded from the study.

Procedure

Patients were kept in a supine position under general anaesthesia with the injured limb off the table for manipulation and for visualization under C-arm for closed reduction cast or pinning. All the fractures were reduced preoperatively by traction-countertraction technique and keeping the elbow in hyperflexion with pronation at the forearm. Two 1.8 mm and 2 mm K-wires were used laterally or in the cross manner under C-arm guidance. At the time of insertion of cross wires, a small incision was taken medially and the wire was inserted as anterior as possible with the elbow in some extension in order to avoid advert injury to the ulnar nerve. After satisfactory reduction, the fracture was held with the K-wires, the wires were bent and cut ends were inserted just beneath the skin. An above elbow splint was then applied at 90 degrees of flexion. After the fixation, the elbow was moved through its full range. Above-elbow plaster of Paris slab is given after properly padding the arm and forearm. The first 12 hours is critical for observing the radial pulse, sensations and finger movements. The limb is elevated and a full range of movements at metacarpo-phalangeal and inter phalangeal joints are advised. The elbow movement is started after the PoP slab and K-wires were removed at the end of 3 weeks. Patients were followed up in 2nd and 3rd postoperative weeks. X rays were taken to see the callus formation which would be better seen in lateral views. Physiotherapy was continued after slab removal till 12 weeks and followed for any swelling, any pin track infection. Outcome measures that were used to compare and evaluate the outcome of treatment were: Flynn's criteria for functional outcome, ASK-p (Activities Scale for Kids-performance version), Loss of carrying angle and range of motion.

Statistical analysis

The data is tabulated in Microsoft excel and analysed with SPSS V.24 software. The continuous variables are presented with mean and standard deviation. The categorical variables are presented

with frequency and percentage. Independent t test and chi square test are used for the comparisons. The p value ≤ 0.05 is considered as statistically significant.

Results:

There were 17 males and 13 females among the study participants. The lateral pinning group had 8 males and 7 females and the cross pinning group had 9 males and 6 females. In the lateral pinning group, there were 4 Type II fractures, 5 Type IIIA fractures and 6 Type IIIB fractures whereas in the cross pinning group, there were 3 Type II fractures, 7 Type IIIA fractures and 5 Type IIIB fracture. In the lateral pinning group, 14 cases showed excellent and 1 case showed good score according to the Flynn's Criterion and in the cross pinning group, 13 cases showed excellent and 2 cases showed good score according to the Flynn's Criterion. There were no statistically significant differences in the distribution of gender, type of fracture and Flynn's Criterion between the groups (Table 1 & 2).

When the functional outcomes were compared between the two methods, the mean ASK-P score was 93.71 ± 3.81 in the lateral pinning group and 91.55 ± 3.24 in the cross pinning group ($p=0.892$). The mean loss of carrying angle was 4.17 ± 2.94 in the lateral pinning group and 4.21 ± 2.97 in the cross pinning group ($p=761$). The mean range of motion was 141.77 ± 3.72 in the lateral pinning group and 140.93 ± 3.46 in the cross pinning group ($p=905$). None of the differences were statistically significant (Table 3). The lateral pinning method showed no iatrogenic ulnar nerve injury but there were 2 cases of iatrogenic ulnar nerve injury with the cross pinning method (Table 4).

Table 1. General characteristics

General characteristics		Lateral Pinning	Cross Pinning	P value
Sex	Male	8 (53.3%)	9 (60.0%)	0.712
	Female	7 (46.7%)	6 (40.0%)	
Type of fracture	Type II	4 (26.7%)	3 (20.0%)	0.864
	Type IIIA	5 (33.3%)	7 (46.7%)	
	Type IIIB	6 (40.0%)	5 (33.3%)	

Table 2. Comparison between the techniques based on Flynn's Criterion

Flynn's Criterion	Lateral Pinning	Cross Pinning	P value
Excellent	14 (93.3%)	13 (86.7%)	0.542
Good	1 (6.7%)	2 (13.3%)	

Table 3. Comparison between the techniques based on functional outcomes

Functional outcomes	Lateral Pinning	Cross Pinning	P value
ASK-P score	93.71 ± 3.81	91.55 ± 3.24	0.892
Loss of carrying angle	4.17 ± 2.94	4.21 ± 2.97	0.761
ROM	141.77 ± 3.72	140.93 ± 3.46	0.905

Table 4. Comparison between the techniques based on ulnar nerve injury

Iatrogenic ulnar nerve injury	Lateral Pinning	Cross Pinning	P value
Absent	15 (100.0%)	13 (86.7%)	0.143
Present	0 (0.0%)	2 (13.3%)	

Discussion:

Supracondylar fracture of humerus has always been one of the most common and challenging fractures among the paediatric age groups. The main goal of the treatment is anatomical reduction and

stable internal fixation. Thorough clinical examination with proper assessment is very crucial during the initial assessment of every patient. Closed reduction with K-wires fixation has been the gold standard in the management of these injuries. K-wires have the advantage of ease of use, decreased cost and reduced hospitalization stay.^{9,10}

Ulnar nerve injury has been the major concern in patients where cross pinning configuration has been used. In a series of 375 patients by Lyons JP et al., they observed that 6% of the patients had an iatrogenic ulnar nerve palsy postoperatively¹¹. They also stated that these conditions resolved almost completely in majority of the situations. There were 2 cases in the cross pinning group in the present study, who had iatrogenic ulnar nerve injury. The incidence of ulnar nerve injury can be reduced by keeping the elbow in 45-50 degrees of flexion rather than the usual hyperflexed position used while inserting the lateral pin.

As per the Flynn scoring system, above 85% of the patients in both the groups had excellent results which were comparable to the study by Vito P et al., who observed more than 90% excellent results.¹² In the present study, no significant difference was observed in both the groups in terms of the ASK-p (Activities Scale for Kids-performance version), Loss of carrying angle and range of motion. Our results are comparable to the studies by Yen YM et al. and Reynolds RA et al., who found no significant difference in both the techniques.^{13,14}

Conclusion:

Management of supracondylar fractures of the humerus in children with pinning methods has been proven to be a good surgical modality with excellent results. The present study showed that both the lateral and cross pinning methods showed successful management of supracondylar fracture of humerus in children with a few iatrogenic ulnar nerve injuries with the cross pinning method.

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