



FUNCTIONAL OUTCOME AND ANALYSIS OF CROSS PINNING VERSUS LATERAL PINNING IN SUPRACONDYLAR FRACTURES OF HUMERUS IN CHILDREN

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ABSTRACT

AIM OF STUDY: To compare the cosmetic and functional outcome of displaced supracondylar fractures of the humerus in children treated with cross pinning and lateral pinning

MATERIALS AND METHODS: The study population comprised of 21 was conducted in govt villupuram medical college between may 2017 to april 2018. During this period 21 cases of displaced supracondylar fractures of humerus in children were treated with cross pinning and lateral pinning with Kirschner wires according to surgeons preference. All patients were extension type injuries and all patients were type 2, type 3 by Gartland classification

RESULTS: Out of 21 cases, 13(61%) cases were operated by closed reduction and 8 (39%) cases were operated by open reduction. Out of 9 cross pinned cases 8 were operated by closed reduction. Out of 12 lateral pinned cases 4 were operated by closed reduction. All 9 cross pinned patients had satisfactory results 4 had excellent and 5 cases had good results. All 12 lateral pinned cases had satisfactory results. 2 had excellent results, 8 had good results and 2 had fair results.

CONCLUSION: Cross pinning is the most stable configuration in maintaining the reduction of supra condylar fracture of humerus in children than lateral pinning. Cross pinning has a definitive risk iatrogenic ulnar nerve injury in spite of taking precautions to protect the nerve than lateral pinning

KEYWORDS : supracondylar fractures, humerus ,Cross pinning, Lateral pinning

INTRODUCTION:

Supracondylar Humerus Fracture is the commonest elbow fracture in children. Undisplaced fractures are treated conservatively with posterior splint. Displaced fractures are to be reduced by closed or open method and to be stabilized with Kirschner wires to avoid loss of reduction leading to malunion and cubitus varus deformity. Kirschner wires can be applied in various configurations to stabilize the reduced fracture. One of the configuration is insertion of one pin medially and one pin laterally through the corresponding epicondyles. Although this configuration is biomechanically superior, there is a risk of iatrogenic ulnar nerve injury during insertion of medial pin. Most of these nerve injuries recover completely over two to three months duration. Rarely it may lead to permanent deficit leading to functional disabilities. To overcome this complication, two or three Kirschner wires were inserted through lateral epicondyle. But lateral pin fixation is biomechanically less stable as rotation at fracture site may occur. It has been argued that lateral pinning if done by proper technique provides almost equal stability similar to cross pinning without any risk of iatrogenic ulnar nerve injury. It is the commonest fracture of elbow in children. Between 5 to 6 years of age, the incidence of occurrence of fracture is maximum. It is more common in male children than in female children. The nondominant or left side is commonly involved than the right side. Extension type (97%) of injury is more common than flexion-type injuries

Classification

Modified Gartland classification.

Type 1: undisplaced or displaced by less than 2 mm. Anterior humeral line is intact. Osseous injury may or may not be seen in xray. Posterior fat pad sign may be the only radiological evidence. The periosteum is intact all around and it is the most stable type

Type 2 : Displaced by more than 2 mm. The posterior cortex is hinged. The anterior humeral line will not go through middle third of capitellum. No rotational deformity will be seen in

anteroposterior radiograph. Posterior periosteum is intact.

Type 3: There is no cortical contact. the distal fragment is in extension in sagittal plane and rotated in transverse plane. The periosteum is torn. Soft tissue and neurovascular injury is more common. Medial column comminution may be present.

Treatment

Initial Management

All children with supracondylar humerus fracture are splinted in an above elbow slab in 20-40 degrees of elbow flexion to provide pain relief. Tight bandaging is avoided. Excessive flexion or extension is avoided as it may increase the compartment pressure and decrease the vascularity. The arm is elevated. Complete neurological and vascular examination done. Radiographs are then taken.

Closed Reduction And Pin Fixation

Under general anaesthesia supine position the fracture is reduced in transverse plane by applying traction and medio lateral plane. The elbow is flexed and olecranon is pushed anteriorly to correct sagittal deformity. The following are the criteria for satisfactory reduction. In anteroposterior radiograph bawmanns angle should be greater than 10 degree. In oblique radiograph both medial and lateral column should be intact. In lateral view anterior humeral line should pass through middle third of capitellum. In case of cross pinning lateral wire is inserted first followed by medial pin after taking precaution to avoid ulnar nerve injury. In case of lateral pinning two wires in divergent or parallel configuration applied and checked for rotational stability. If found unstable a third pin. The elbow is stabilized in 60 to 90 degree of flexion depending on vascular status. If any gap is noted in the fracture site or fracture is irreducible with rubbery feeling then median nerve and brachial artery may be entrapped in the fracture site needing open reduction.

Open Reduction

Open reduction is done in case of failed closed reduction, compound fracture, vascular injury. Open reduction can be

done by medial approach, lateral approach, anterior approach or posterior approach. Open reduction may be associated with stiffness of elbow, myositis ossificans, surgical scar and iatrogenic neuro vascular injury. Anterior approach is preferred in neurovascular injury as both fracture reduction and entrapped neuro vascular structure will be released. Posterior approach is not recommended because of the risk of elbow stiffness and risk of avascular necrosis of trochlea due to disruption of posterior blood supply to it.

MATERIALS AND METHODS

This study was conducted in govt villupuram medical college between may 2017 to april 2018. During this period 21 cases of displaced supracondylar fractures of humerus in children were treated with cross pinning and lateral pinning with Kirschner wires according to surgeons preference. The total study population comprised of 21 children.

Inclusion Criteria

- Displaced supracondylar fractures (TYPE 2, Type III)
- Fractures treated by closed and open reduction
- Age group less than 15 years

Exclusion Criteria

Undisplaced fractures (Type I)
Age more than 15 years

A detailed history of mode of injury and initial treatment was obtained from parents and children. The distal neurovascular status was thoroughly examined. Fractures were classified by modified Gartland classification. Cases were done as an emergency or elective procedure according to surgeons preference and by different surgeons. The availability of C-arm determined the mode of reduction. The pin size used was 1.6 mm in younger children and 2mm in older children. In cases of closed reduction, reduction was checked with C-arm. In case of cross pinning lateral pin was first done in flexion. Precautions were taken to protect ulnar nerve and then medial pinning was done in extension. In case of lateral pinning 2 or 3 Kirschner wires were used depending upon the stability of fracture reduction. The configuration of kirschner wires (parallel, divergent) was according to surgeons preference. In case of open reduction the triceps was longitudinally split or a tongue shaped incision of triceps was made according to surgeon's preference. The elbow was immobilized in posterior slab. All patients were examined for distal neurovascular status in immediate post operative period. The above elbow slab and Kirschner wires were removed at 3 to 4 weeks when there was no tenderness at fracture site and after check X-Ray. After this patient was allowed to actively mobilize the elbow without physiotherapy. Check X-Rays were taken at monthly intervals postoperatively.

The following were noted in the postoperative X-Rays for adequacy of reduction.

- Anterior humeral line
- Crescent sign
- Baumann's angle

Result	Rating	Cosmetic Factor - Loss in carrying angle (in degrees)	Functional - Limitation of elbow flexion (in degrees)
Satisfactory	Excellent	0-5	0-5
	Good	6-10	6-10
	Fair	11-15	11-15
Unsatisfactory	Poor	>15	>15

was measured in immediate post op x ray, and the x ray before k wire removal at three to four weeks. Loss of reduction is determined by change in baumann's angle. The displacement is graded by Skaggs. Check X-rays were taken when the splint and K wires were removed which helped us to assess union as well as identify any loss of reduction. The patients were followed up at monthly intervals after k wire removal. The cosmetic and functional outcome were assessed using Flynn's criteria.

RESULTS

- During the period from May 2012 to November 2013 a total of 21 displaced supracondylar humerus fractures in children were operated. Out of 21, in 9(43%) cases cross pinning was done and in 12(57%) cases lateral pinning was done.
- 11 children were males (52%) and 12 children were females(48%). 9(43%) children were under 6 years, 8(38%) children were between 6 to 10 years and 4(19%) children were above 10 years. Mean age was 6.5 years. (range from 6 months to 13 years).
- 11 were left sided (52%) and 12 were right sided(48%) fractures.
- All patients had a history of fall. 10(48%) children had fall from height. 9(43%) children fell down while playing. 2(09%) children fell down from bicycle.
- All patients were extension type injuries and all patients were type 3 by Gartland classification
- Out of 21 cases, 13(61%) cases were operated by closed reduction and 8 (39%) cases were operated by open reduction. Out of 9 cross pinned cases 8 were operated by closed reduction. Out of 12 lateral pinned cases 4 were operated by closed reduction.
- Out of 21 cases 17(81%) cases were operated within 1 day and 4(19%) cases were operated after 24 hours and within 1 week due to delayed presentation. (2 cases by cross pinning and 2 cases by lateral pinning). Mean duration between injury and surgery was 1.85 days.
- All fractures united by 3 to 4 weeks duration. The mean duration of fracture union was 3.3 weeks.
- Out of 21 cases, 14 (66%) patients had limitation of terminal flexion compared with normal contralateral side. Out of 9 cross pinned cases, 4 cases had full range of flexion and 5 cases developed limitation of terminal flexion. Out of 12 lateral pinned cases 2 had full range of flexion
- 8 cases had flexion loss between 5 to 10 degree 2 cases had flexion loss of more than 10 degrees. Out of 9 crossed pin cases 4 cases showed no loss of carrying angle and 5 cases showed less than 5 degree loss of carrying angle whereas in lateral pinning 2 cases showed no loss of carrying angle 8 cases showed less than 5 degree loss of carrying angle and 1 case had greater than 10 degree loss of carrying angle 1 case had greater than 15 degree loss of carrying angle. The loss of carrying angle was due to inadequate initial reduction achieved at the time of surgery.
- There was no loss of reduction in both initial postoperative radiograph and in the radiograph taken at time of kirschner wire removal.
- No patient in cross pinning as well as in lateral pinning group had any loss of reduction.
- Out of 9 cross pinned cases 8 cases were treated by closed reduction. one patient developed post operative partial ulnar nerve injury following cross pinning which resolved completely in 3 weeks after Kirschner wire removal. The medial pin was maintained for 2 weeks. Pin removal was done after 2 weeks and above elbow cast was given for 2 weeks. Nerve injury recovered completely.
- one patient with cross pinning developed pin site infection which resolved with pin removal and oral antibiotics.
- No case in both groups developed any vascular injury or

compartment syndrome or myositis ossificans or non union.

All 9 cross pinned patients had satisfactory results 4 had excellent and 5 cases had good results. All 12 lateral pinned cases had satisfactory results. 2 had excellent results, 8 had good results and 2 had fair results

Table-1

FLYNN'S GRADING OF CROSS & LATERAL PINNED CASES		
GRADING	CROSS PIN	LATERAL PIN
Excellent	4	2
Good	5	8
Fair	0	2
Poor	0	0
Total cases	9	12

Table-2

LOSS OF CARRYING ANGLE IN CROSS PINNING AND LATERAL PINNING		
Range	Cross Pin	Lateral Pin
no loss	4	2
0-5	5	8
5-10	0	1
10-15	0	1
>15	0	0

Table-3

LOSS OF FLEXION IN CROSS PINNING AND LATERAL PINNING		
	Cross Pin	Lateral Pin
no loss	4	2
0-5	5	8
5-10	5	1
10-15	0	1
>15	0	0

DISCUSSION

The management of displaced supracondylar fracture humerus in children is closed or open reduction and maintenance of the reduction by kirschner wires. The success of surgical treatment depends upon initial accurate reduction and maintenance of reduction till union.

There is a continuing debate regarding best modality of pin fixation of displaced supracondylar humerus fracture in children. The most commonly used treatment methods are crossed medial and lateral pinning and lateral pinning alone. The advantage of cross pinning is its greatest fracture stability but iatrogenic ulnar injury can occur while placing the medial pin.

The advantage of lateral pinning is iatrogenic ulnar nerve injury will not occur, but it is less stable biomechanically. Biomechanical studies by Hilton et al using adult cadaver and paediatric bone model has found cross pinning provides greater rotational stability than lateral pinning .however by

proper site of entry of pin ,the configuration of pin and the number of pins applied via lateral side can also provide equal stability as that of cross pinning.

In our study of 21 patients, cross pinning was done in 9 patients and lateral pinning was done in 12 patients. All patients had satisfactory results according to flynn's criteria. Out of 9 cross pinned patients 4 had excellent results and 5 patients had good results. Out of 12 lateral pinned patients two had excellent results, 8 had good results and two had fair results. Though divergent or parallel lateral configuration is advised 2 patients had converging lateral pin configuration in our study and they had good outcome.

Out of 9 cross pinned patients 5 had less than 5 degree loss of carrying angle which was not due to loss of reduction but due to inadequate reduction initially. out of 12 cross pinned patients 8 patients had loss of carrying angle less than 5 degree, 1 patient had loss between 5 to 10 degree and one patient had loss between 10 to 15 degree. This was also due to initial inadequate reduction and not due to loss of reduction. These results were comparable with the study by Foead et al who compared the above two methods of percutaneous pin fixation in displaced supracondylar humerus fractures in children.

Out of 9 crossed pin patients 5 had loss of 5 to 10 degree flexion. Of 12 lateral pinned patients 8 patients had loss of 5 to 10 degree flexion and 2 patients had loss of flexion between 10 to 15 degree. 2 lateral pinned patients who had flexion loss between 10 to 15 degree was due to inadequate reduction . More number of lateral pinned patients had loss of flexion between 5 to 10 degree when compared to cross pinning group was due to open reduction. 8 out of 9 cross pinned cases was done by closed reduction where as 4 out of 12 cases lateral pinned cases was done by close reduction. This may have led to more loss of flexion in lateral pinning group and not due to configuration of pinning.

There was no loss of reduction in both cross pinning and in lateral pinning group. This was comparable to Skaggs et al who reported no loss of reduction in series of 55 type III fractures treated by lateral pinning. Topping et al and Foead et al12 also had no loss of reduction in lateral pinning in their series.

In our study we had one case of partial ulnar nerve injury in total of 8 (12.5%) cases of crossed pinning of supracondylar fracture of humerus in children.. Skaggs et al13 had 8% of ulnar injury in cross pinning group. We did flexion extension method to avoid ulnar nerve injury.In our case ulnar nerve injury recovered completely after 3 weeks duration. We also had no nerve injury in lateral pinned case comparable with skaggs et al13 study.

Example 1 lateral pinning



Example 2 cross pinning



CONCLUSION

1. Cross pinning is the most stable configuration in maintaining the reduction of supra condylar fracture of humerus in children.
2. Lateral pinning is an equally stable configuration in maintaining the reduction of supracondylar fracture of humerus in children .
3. Cross pinning has a definitive risk iatrogenic ulnar nerve injury in spite of taking precautions to protect the nerve.
4. Lateral pinning is a safer procedure to avoid iatrogenic ulnar nerve injury in supracondylar humerus fracture management in children

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