

**Analysis of outcome of cross pinning versus lateral pinning in supra condylar fracture humerus in children**

<sup>1</sup>Dr. Pawan Kumar K M, BGS Global Institute of Medical Sciences, Bengaluru, Karnataka

<sup>2</sup>Dr. Rakshith, BGS Global Institute of Medical Sciences, Bengaluru, Karnataka

<sup>3</sup>Dr. Madhu Chandra P, BGS Global Institute of Medical Sciences, Bengaluru, Karnataka

<sup>4</sup>Dr. Sangamesh, BGS Global Institute of Medical Sciences, Bengaluru, Karnataka

**Corresponding Author:** Dr. Pawan Kumar K M, BGS Global Institute of Medical Sciences, Bengaluru, Karnataka

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**Abstract**

**Introduction:** Displaced supracondylar fracture of humerus in children is commonly treated by closed or open reduction and reduction held by Kirschner wires. Biomechanically cross pinning is superior to lateral pinning but there is a risk of ulnar nerve injury. Recent studies suggest lateral pinning if properly done has equal stability and there is no risk of ulnar nerve injury.

**Aim of study:** To compare the cosmetic and functional outcome of displaced supracondylar fracture humerus in children treated with cross pinning and lateral pinning.

**Materials & methods**

**Inclusion Criteria**

- Type II, Type III Gartland fractures
- Fractures treated by closed or open reduction
- Age less than 15 years

**Exclusion Criteria**

- Type I Gartland Fractures
- Age more than 15 years.

In cross pinning precautions were taken to protect ulnar nerve in closed reduction. In lateral pinning 2 or 3 wires

placed in divergent or parallel configuration. The cosmetic and functional outcomes were done by flynn's criteria.

**Results:** All 9 cross pinning patients had satisfactory results. All 12 cross pinning patients had satisfactory results. There was a single case of ulnar nerve injury in cross pinning group and no such case in lateral pinning group.

**Conclusion:** Cross pinning is the most stable configuration whereas lateral pinning is equally stable configuration in maintaining the reduction of displaced supracondylar fractures of humerus in children. Cross pinning has a definitive risk of iatrogenic ulnar nerve injury where as there is no risk of ulnar nerve injury in lateral pinning.

**Keywords:** Fractures, Humerus, X-Rays

**Introduction**

Supracondylar humerus fracture is the commonest elbow fracture in children. The displaced supracondylar humerus fracture known for its complications of malunion, Volksmann's ischaemic contracture etc. Astley Cooper <sup>1</sup>(1826), Robert Jones <sup>1</sup>(1921), Watson Jones<sup>1</sup>

(1952-55), Charnley (1961) treated with cuff and collar with elbow in flexion for a minimally displaced fracture. Various methods of skin traction and skeletal traction were used as treatment methods to maintain reduction which are of historic interest only. Treatment for a displaced fracture with severe swelling was advised by Blount et al<sup>1</sup> 1951 by closed reduction aided by posterior periosteum and triceps. Secondary displacement occurred in plaster and cubitus varus occurred –Dambroisa<sup>1</sup>(1972). The problem of Mc Laughlin “Supracondylar Dilemma”<sup>1</sup> was identified. That is the fracture gets reduced by flexion of elbow but the vascularity gets affected by flexion needing extension of elbow resulting in loss of reduction. Rang<sup>1</sup> (1974) Charnley<sup>1</sup> in 1961 pointed out that flexion of swollen elbow increased pressure in cubital fossa compromising vascularity and on extension pressure decreases suggested to avoid hyperflexion particularly in existing neurovascular injury. Open reduction and internal fixation was done by Ramsey and Griz<sup>1</sup> (1973), Shifrin<sup>1</sup> (1976), Weiland et al<sup>2</sup> (1978). The complication of postoperative stiffness was high. Blind pinning was done by Flynn et al<sup>3</sup> (1974) to maintain reduction and avoid postoperative stiffness by open reduction and decrease the vascular complications. But the occurrence of ulnar nerve injury was high. Threaded Kirschner wires were used initially but damage to soft tissues including ulnar nerve was more. Removal of threaded wire was difficult. Smooth Kirschner wires were used to minimize soft tissue damage and to facilitate easy removal. With the availability of the intra-operative imaging systems attempts were made to reduce the fracture by closed methods and to stabilize the fracture by percutaneous pinning<sup>1</sup>. The complication of ulnar nerve injury following medial pinning was avoided by Arino et

al<sup>4</sup> by doing lateral pinning alone. In lateral pinning complication of ulnar nerve injury did not occur Various configurations of Kirschner wires were evaluated for stabilizing the reduction.

Various bio mechanical studies were done in animal and human cadaveric models to determine the appropriate pin size, number, configuration to equalize the stability of cross pinning. Zionts et al<sup>5</sup> in his study found the two cross pins placed from medial, lateral epicondyles provided maximum stability. The torque required to produce 10 degree of rotation was 37% less with the use of 2 parallel pins, and 80% less with two lateral cross pins. (p<0.05 for both).

The torque required to produce 10 degree of rotation with the use of three lateral pins was 25% than with the use of medial and lateral crossed pins. Reza Omid<sup>6</sup> et al in their study has recommended lateral pinning is the current modality of treatment which when placed properly provides stability without iatrogenic ulnar nerve injury.

David L Saggs et al<sup>7</sup> has concluded the use of lateral pins alone was effective for the most unstable supracondylar humerus fractures without loss of reduction and iatrogenic ulnar nerve injury if the pins engaged both cortex, and both fragments maximally separated at fracture site.

The incidence of ulnar nerve injury during medial pin fixation varied between 0 % to 15%. Mark Eidelman<sup>8</sup> et al described flexion-extension cross pinning to prevent iatrogenic ulnar injury during medial pinning of supracondylar fracture humerus in children.

The decision regarding with the management of pulseless supracondylar humerus fracture in children has outlined by Amanda wWeller et al<sup>9</sup>. There is no indication to explore even if pulse is not felt after closed reduction can

be observed as long as there is doppler signal and distal perfusion.

#### Aim of study

To compare the cosmetic and functional outcome of displaced supracondylar fracture humerus in children treated with cross pinning and lateral pinning.

#### Materials and methods

This study was conducted in BGS Global Institute of Medical Sciences between July 2020 and August 2021. 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 II, 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.

1. Anterior humeral line
2. Crescent sign
3. Baumann's angle

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.

Table 1:

Displacement	Change in Baumanns angle
No	$<6^{\circ}$
Mild	$6^{\circ}-12^{\circ}$
Major	$>12^{\circ}$

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 was assessed using Flynn's criteria.

Table 2: Grading of results Modified Flynn’s criteria.

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

**Results**

During the period from July 2020 to August 2021 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 13years). 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 21cases 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 5cases had good results. All 12 lateral pinned cases had satisfactory

results. 2 had excellent results, 8 had good results and 2 had fair results.

### 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 bio mechanically. Bio mechanical studies by Hilton<sup>12</sup> 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 degrees. This was also due to initial inadequate reduction and not due to loss of reduction.

These results were comparable with the study by Foe ad<sup>10</sup> 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 degrees. 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 whereas 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<sup>11</sup> et al who reported no loss of reduction in series of 55 type III fractures treated by lateral pinning. Topping et al and foe ad<sup>10</sup> et al 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<sup>11</sup> et al 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<sup>11</sup> et al study.

### Conclusion

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

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