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ORIGINAL RESEARCH ARTICLE

Cross Pinning Versus Lateral Pinning in Supracondylar Fractures of Humerus in Children -Outcome Analysis in Southern India

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ABSTRACT

Background: Supracondylar humerus fractures (SHF) account for major elbow fractures observed among the paediatric population. The most commonly used treatment methods are crossed medial and lateral pinning and lateral pinning alone.

Methods: The present study was conducted in Department of Orthopaedics, Government Villupuram medical college, 42 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 supracondylar fractures were classified based on Modified Gartland classification.

Results: The fractures were common among males (52.4%) and also a left sided predominance was observed. Majority of the patients were aged less than10 years. We observed that among the cross pinned cases 11 cases developed limitation of terminal flexion. While in the lateral pinned cases 17 had limitation of terminal flexion. Among the cross pinned patients 9 had excellent and 10 cases had good results. Among the lateral pinned cases 12 had excellent results, 8 had good results and 3 had fair results. No patient in cross pinning as well as in lateral pinning group had any loss of reduction. Post-operative partial ulnar nerve injury and pin site infection was observed in the cross pinned groups.

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 fractures (SHF) and forearm fractures account for major fractures observed among the paediatric population. Studies have shown that 58% of the elbow fractures were found to be humeral supracondylar fractures. Studies have also reported that there is a higher incidence of sequelae such compartment syndrome, Volkmann ischemic contracture, Malunion, and even gangrene due to the lack of awareness of such injuries and the predominance of local bonesetter. Fractures that are undisplaced are managed conservatively with a posterior splint. Most of fractures require open reduction to prevent Malunion and cubitus varus deformity.[1-3]

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The fractures are stabilised by Kirschner wires. Inserting one pin medially and one pin laterally through the appropriate epicondyles is one configuration. Even though this arrangement has better biomechanics, inserting the medial pin could injure the ulnar nerve unintentionally. The majority of these nerve injuries heal completely within two to three months. In rare cases, it could result in a persistent impairment that causes functional problems. Two or three Kirschner wires were put into the lateral epicondyle to resolve this issue. However, because rotation at the fracture site is possible, lateral pin fixation is less biomechanically stable. It has been stated that when done correctly, lateral pinning offers stability that is nearly equivalent to cross pinning without any risk of iatrogenic ulnar nerve injury. The present study was undertaken to compare the cosmetic and functional outcome of displaced supracondylar fractures of the humerus in children treated with cross pinning and lateral pinning.[4-6]

MATERIALS AND METHODS

This study was conducted in Department of Orthopaedics, Government Villupuram medical college, between May 2017 to April 2019. During this period 42 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 42 children. The supracondylar fractures were classified based on Modified Gartland classification.[8]

In the present study, patients with displaced supracondylar fractures (TYPE 2, Type III), Fractures treated by closed and open reduction and children aged less than 15 years were included in the study. Children aged more than 15years and those with undisplaced fractures (Type I) were excluded from the study.

Initial assessment – Pre-op

After obtaining informed consent and assent, a detailed history about socio-demographic characteristics, 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.

Intra-op

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 surgeon's 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.

Post-op

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.

Adequacy of reduction 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 was graded by Skaggs criteria.[9] Check X-rays were taken when the splint and

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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.[10]

RESULT

During the period from May 2017 to April 2019 a total of 42 displaced supracondylar humerus fractures in children were operated. We observed that 22 children were male (52.4%) while 20 (47.6%) children were female. The age distribution showed that 18 (42.8%) children were under 6 years, 16 (38.1%) children were between 6 to 10 years and 8 (19.1%) children were above 10 years. Mean age was 6.5 years. (Range from 6 months to 13years).

Majority of the fractures were left sided 24 (57.1%) and 18 were right sided (42.9%) fractures. All patients had a history of fall, Most of them reported to have fell from height 20 (47.6%), 18 (42.8%) children fell while playing and 4 (9.5%) children fell while cycling. All the study participants had extension type injuries and all fractures were classified as type 3 based on gartland classification. Out of 42 participants, cases cross pinning was done in 19 (45.2%) patients and lateral pinning was done in 23 (54.8%) cases.

Out of 42 cases, 26 (61.9%) cases were operated by closed reduction and 8 (38.1%) cases were operated by open reduction. Out of 19 cross pinned cases 18 were operated by closed reduction. Out of 23 lateral pinned cases 7 were operated by closed reduction. Out of 42 cases 34 (81%) cases were operated within 1 day and 8 (19%) cases were operated after 24 hours.

All fractures united by 3 to 4 weeks duration. The mean duration of fracture union was 3.3 weeks. Out of 42 cases, 28 (66.7%) patients had limitation of terminal flexion compared with normal contralateral side. Out of 19 cross pinned cases, 8 cases had full range of flexion and 11 cases developed limitation of terminal flexion. Out of 23 lateral pinned cases 6 had full range of flexion.16 cases had flexion loss between 5 to 10 degrees. Flexion loss of more than 10 degrees was observed in 1patient. Out of 19 crossed pin cases 8 cases showed no loss of carrying angle and 11 cases showed less than 5 degree loss of carrying angle whereas in lateral pinning 7 cases showed no loss of carrying angle, 14 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. Three patients 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. Three patients with cross pinning developed pin site infection which resolved with pin removal and oral antibiotics. Vascular injury, compartment syndrome, myositis ossificans and non-union were not observed among both groups in the present study.

Among the cross pinned patients 9 had excellent and 10 cases had good results. Among the lateral pinned cases 12 had excellent results, 8 had good results and 3 had fair results.

Table 1 Characteristics of the study population

Variable	Frequency (n=42)	Percentage
Age (in years)		

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< 6 years	18	42.8
6 – 10 years	16	38.1
> 10 years	8	19.1
Gender		
Male	22	52.4
Female	20	47.6
Side		
Right side	18	42.9
Left side	24	57.1
History of fall		
Fall from height	20	47.6
Fell while playing	18	42.8
Fell while cycling	4	9.6
Surgery		
Cross pinning	19	45.2
Lateral pinning	23	54.8

Table 2 Duration for fracture union and fixator removal

Variable	Cross pinning (n=19)	Lateral pinning (n=23)
Flexion		
Full range	11	6
5 – 10 degrees	8	16
> 10 degrees	0	1
Loss of carrying angle		
No loss	8	7
< 5 degrees	11	15
> 10 degrees	0	1

Table 3 Functional outcome of the study participants

Variable	Cross pinning (n=19)	Lateral pinning (n=23)
Objective results		
Excellent	9	12
Good	10	8
Fair	0	3
Poor	0	0

Table 4: Complications among the study participants

Complications	Cross pinning (n=19)	Lateral pinning (n=23)
Pin tract infection	3	0
Partial ulnar nerve injury	3	0
Non-union	0	0
Vascular Injury	0	0
Myositis Ossificans	0	0

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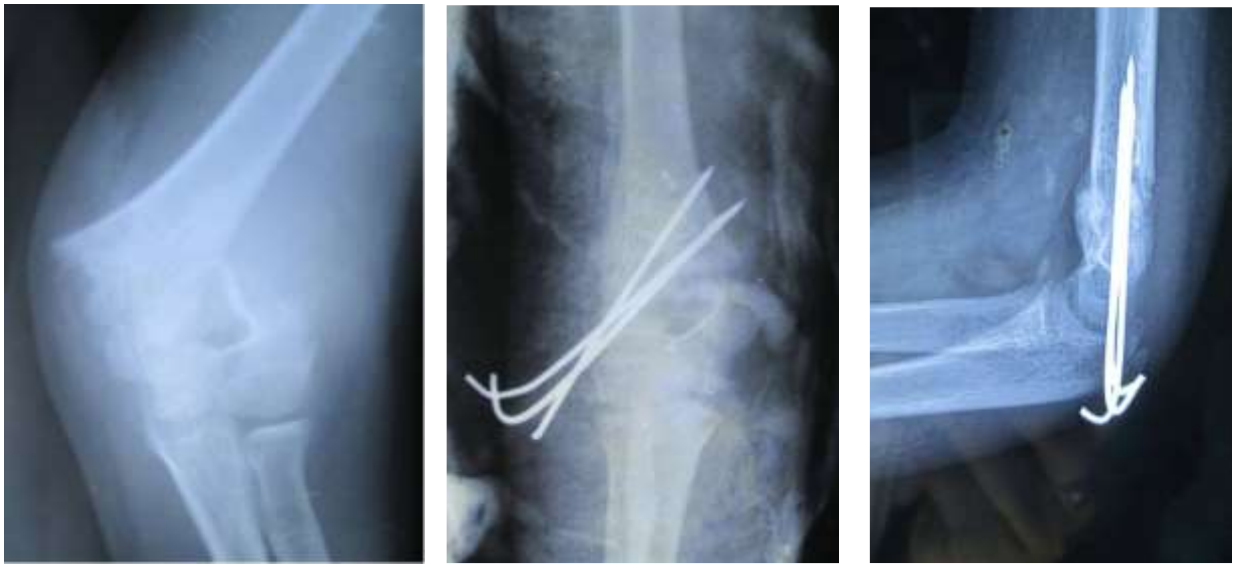

Photograph Template 1 - Lateral Pinning

Photograph Template 2 - Cross Pinning

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.[1-3]

Our results showed that predominantly the fractures were common among males (52.4%) and also a left sided predominance was observed. Similar results was observed in a study conducted by Barr et al.[11] In the present study majority of the patients were aged less than10 years, studies conducted by Naik et al,[1] Babal et al,[12] and Khademolhosseini M et al,[13] have also reported that the majority of the study participants belonged to a similar age group.

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We observed that among the cross pinned cases 11 cases developed limitation of terminal flexion. While in the lateral pinned cases 17 had limitation of terminal flexion. These results were comparable with the study by Foead et al[14] who compared the above two methods of percutaneous pin fixation in displaced supracondylar humerus fractures in children. 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.[15] Foead et al also had reported similar findings. The advantage of cross pinning is its greatest fracture stability but iatrogenic ulnar injury can occur while placing the medial pin. Among the lateral pinned cases majority had flexion loss between 5 to 10 degrees. Among the crossed pin cases 8 cases showed no loss of carrying angle and 11 cases showed less than 5 degree loss of carrying angle whereas in lateral pinning 7 cases showed no loss of carrying angle, 14 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.[11-13]

In the present study we observed post-operative partial ulnar nerve injury and pin site infection in the cross pinned groups. Zarad et al had reported similar complications in the cross pinned groups. But in our study the lateral pinned groups showed no complications.[16] Studies by Pirone et al showed decreased incidence of complications.[17]

In the present study, among the cross pinned patients 47.3% had excellent and 52.7% had good results. Among the lateral pinned cases 52.1% had excellent results, 34.7%.We observed no significant difference in the outcome as both the groups had produced similar results. Zarad et al had reported that no any significant difference was observed in outcomes among both the cross pinned and lateral pinned groups.[16] Studies conducted by Raffic et al[18] and Ariño et al[19] had also reported similar outcomes in their studies.

The advantage of lateral pinning is iatrogenic ulnar nerve injury will not occur, but it is less stable biomechanically. Biomechanical studies by Gottschalk 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.[20]

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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