Treatment of Displaced Lateral Condyle Humerus Fractures in Children by Closed Reduction and Percutaneous Pinning.

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ABSTRACT

BACKGROUND: Open reduction and internal fixation is the ideal treatment for displaced unstable lateral condyle humerus fractures. Very few studies have focused on closed reduction and percutaneous pinning (CRPP) for displaced lateral condyle humerus fractures in children. We prospectively studied CRPP for displaced lateral condyle fractures (except completely rotated fractures) to evaluate the functional and radiological outcomes.

METHODS: We classified the fractures according to the Song et al classification system based on the pattern and displacement of fractures. We included stages II ,III and IV of lateral condyle fractures excluding Stage I and V. Twenty-three patients were finally enrolled in the study. Fractures were reduced under C arm guidance by varus and longitudinal traction and fixed with 2 or 3 parallel K wires. Functional outcomes were evaluated according to the Hardacre et al scores.

RESULTS: The average age of patients in our study was 7.91±2.44 years with 15 (65.22%) male and 8 (34.78%) female patients. There were 13 (50.52%) fractures on the left side and 10 (43.48%) on the right side. 9 (39.13%) of fractures were caused by fall from height. Time till union of the fracture was 6.21±1.08 weeks and total duration of hospital stay was 1.65±0.57 days. There were 22 (95.65%) excellent and 1 (4.35%) good results according to the Hardacre et al scores.

CONCLUSION: Closed reduction and percutaneous pinning can be tried successfully in minimally displaced unstable as well as displaced unstable lateral condyle fractures with excellent functional outcomes, provided good assessment of pattern and displacement of fractures by internal oblique radiographic views is done.

Key Words: Children, Closed Reduction, Lateral condyle humerus fracture, percutaneous pinning

INTRODUCTION

Several studies have confirmed that open reduction and internal fixation with K wires is the treatment of choice for displaced lateral condyle humerus fractures in children to prevent malunion, nonunion and further displacement[1,2]. Undisplaced or minimally displaced lateral condyle fractures are also successfully managed with posterior plaster splint or long arm cast even though there is a possibility of re-displacement of fractures. Very few studies have reported closed reduction and percutaneous pinning of pediatric humeral lateral condylar fractures[1,3]. Those who fixed the fractures by closed methods believe that satisfactory reduction and stable fixation can be achieved by closed reduction and percutaneous fixation without the need of further open reduction. There is no doubt that outcomes after closed reduction and

percutaneous pinning (CRPP) is always better than the open reduction and fixation of fractures if satisfactory reduction can be achieved.[1] We prospectively evaluated functional outcomes, complications, fracture union for minimally displaced as well as displaced lateral condylar fractures of distal humerus (Stage II, III and IV of Song et al classification) in children.

MATERIALS AND METHODS

This was a descriptive analytical study performed in Civil Service Hospital from November 2011 to October 2015. Informed consent was taken from the parents of all patients. All the lateral condyle humerus fractures in our hospital were evaluated by the orthopedic surgeon on duty. We followed the classification pattern given by Song et al as shown in Table 1.

To describe the classification pattern more accurately we advised additional internal oblique and external oblique radiographic views besides routine antero-posterior and lateral views of the injured elbow joint. Displacement of fracture fragment was measured from the distal end of lateral metaphyseal cortex of distal humerus to lateral cortex of fractured fragment in AP, internal oblique and external oblique views. In lateral view posterior cortex was used to measure the displacement. The greatest displacement in any view was used to measure the amount of displacement of fracture fragment. Stage I and V fractures as described by Song et al were excluded from the study because stage I fractures can be well managed with long arm cast application without undue complications. In case of stage V fractures, it was assumed to be difficult to reduce the fractures by closed method alone which was better managed with open reduction and fixation. All surgeries were performed under general anesthesia. For children upto 5 years of age, K-wire of 1.5 mm was used for fixation while in patients older than 5 years, K-wires of 1.8 mm was used. In case of stage II fractures, K-wires were inserted in situ without further manipulation. In stage III or IV fractures, longitudinal traction was applied on the elbow joint with slight varus force while fracture fragment was compressed simultaneously in antero-medial direction with surgeon's thumb. Once fracture fragment was reduced to within 2 mm in all the views under fluoroscopy, a slight valgus force was applied on the elbow joint with the forearm supinated and elbow slightly extended to maintain the fracture in position. Normally, two parallel K-wires were applied from lateral side to fix the fracture. If there was doubt regarding the stability, fixation was reinforced with a third K-wire. If the fracture could not be reduced to within 2 mm of displacement, it was managed with open reduction and fixation. Besides pre-operative intravenous antibiotics, patients were given 3 days of oral antibiotics. Posterior plaster slab was applied at the time of fixation of fracture and continued for 5 to 6 weeks. At six weeks both posterior slab and percutaneous K-wires were removed once union was confirmed on check X rays. Degree of fracture displacement, elbow range of movement, radiographic changes, varus-valgus deformities, carrying angle and any other related complications were noted at latest follow-up of patient and results were evaluated according to the criteria given by Hardacre et al[4].

Table 1 Classification According to Degree of Displacement and Fracture Pattern given by Song et al [1].

Stage	Degree of displacement	Fracture pattern	Stability
I	≤2 mm	Fracture limited to metaphysis	Stable
II	≤2 mm	Lateral gap	Indefinable
III	≤2 mm	Gap as wide laterally as medially	Unstable
IV	>2 mm	Without rotation of fragment	Unstable
V	>2 mm	With rotation of fragment	Unstable

RESULTS

All the results regarding the demographic profiles, fracture union time, hospital stay and complications are tabulated in Table 3 and functional results are tabulated in Table 4.

Initially 26 patients were enrolled in our study, however only 23 patients were available during the final follow-up. So total number of patients included in our study was only 23.

Table 2. Evaluation of treatment outcomes in lateral condyle fractures of children (Hardacre et al criteria) [4]

Excellent	Full range of motion Normal carrying angle and appearance No symptoms Complete healing of fracture
Good	Good Efficient range of motion Loss of extension less than 15 degrees Mild and subtle deformity No arthritic or neurological symptoms Complete healing of fracture
Fair	Loss of motion to the extent of disability Alterations in carrying angle and prominent deformity Presence of arthritic or neurological symptoms Presence of nonunion or avascular necrosis

Table3. Demographic profile, fracture union, hospital stay, and complications

Parameters	**Mean±Standard deviation/ Percentages**
Age (Years)	7.91±2.44
Sex	
Male	15 (65.22%)
Female	8 (34.78%)
Side	
Right	10 (43.48%)
Left	13 (56.52%)
Mechanism of injury	
Fall From Height	9 (39.13%)
Playing indoor games	8 (34.78%)
RTA	3 (13.04%)
Sports	3 (13.04%)
Number of Lateral Pins	
Two Pins	18 (78.26%)
Three Pins	5 (21.74%)

Parameters	Mean±Standard deviation/ Percentages
Time to union of the fracture	6.21±1.08
Hospital Stay (Days)	1.65±0.57
Complications	
Pin tract infection	1 (4.35%)
Pseudovarus deformity	1 (4.35%)
FFD less than 10 degree	2 (8.70%)

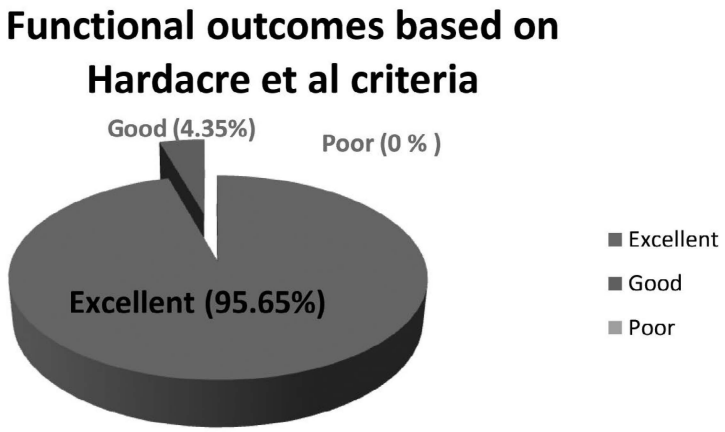

Fig 1. Piechart showing the functional outcomes based on Hardacre et al criteria.

DISCUSSION

Lateral condyle fracture of distal humerus is the second most common fracture around the elbow in children. Sometimes it may be difficult to diagnose the fracture both clinically as well as radiologically, and poorly treated fractures are associated with functionally significant long term loss of elbow movement[1,5]. Management of undisplaced or minimally displaced pediatric lateral condyle fractures is controversial. Some authors advise that undisplaced or minimally displaced fractures have good results with nonoperative treatment while others have expressed concern about subsequent displacement of fractures. Advocates of non-operative treatment for minimally displaced fractures suggest that these fractures should be closely monitored for the first two weeks after injury because subsequent displacement may occur during this period, especially between the sixth and ninth days after fracture[6]. Many researchers recommend open or closed reduction and internal fixation in minimally displaced fractures. Some authors argue that open reduction and internal fixation is advised even in undisplaced fractures in order to prevent further displacement and any disabling complications[7].

Treatment of minimally displaced fracture may be difficult, primarily because of lack of appreciation of displacement of the distal fracture fragment. The common practice of performing only antero-posterior and lateral view radiographs may be insufficient to assess the fracture stability, to prevent further displacement and to find the appropriate modality of treatment[8,9]. Many authors suggest magnetic resonance imaging, ultrasonography, arthrography and stress tests to assess the fracture stability. However routine use of these investigations is not advised because of requirement of sedation for the children and their cost[10,11,12].

The importance of the internal oblique radiograph for proper assessment of fracture

pattern and stability in pediatric lateral condylar humeral fractures has been well established[8]. In this study we use the classification system given by Song et al with the help of internal oblique radiograph. Use of the internal oblique view is definitely useful, in classifying the fracture and making an appropriate treatment plan. As in the other studies, male children have higher incidence as compared to female children and left sided fracture has higher incidence as compared to the right side in our study. It is presumably because of increased participation in outdoor and sports activities by male children. The right hand is usually engaged in performing some kind of activity while the left hand is used to perform protective function during a fall, so the left hand frequently sustains injuries. Total duration of hospital stay in our study was 1.65±0.57 days, and time to union of the fracture was 6.21±1.08 weeks. Short duration of hospital stay is because the surgery is performed closed, and this ultimately reduces the cost of surgery as well.

The study of Jenyo T and Mirdad T showed that most of their fractures had healed by eight weeks; K-wires being removed at six weeks. Delayed union may be due to inadequate internal fixation or external immobilization alone, or an increased degree of initial displacement of fracture[5]. Flynn et al, in a 10 year study of 31 lateral condyle humeral fractures in children noted that those fractures with less than 2 mm of displacement healed rapidly and those with 3 mm or more of initial displacement took relatively longer to unite[13]. Because of the high prevalence of poor functional and cosmetic results associated with closed reduction and long arm casting, open reduction and internal fixation has become the treatment of choice for displaced unstable Jakob stage II or III lateral condyle fractures. However, even with open reduction and internal fixation there may be the possibility of malunion because of lack of proper intra-operative assessment of fracture reduction or osteonecrosis of capitellum following excessive stripping of soft tissues[14]. Very few reports have been published regarding percutaneous pinning of lateral condyle fractures. Mintzer et al[15] found that good results can be achieved after percutaneous pinning of lateral condyle fractures with more than 2 mm of displacement. They concluded that this method is suitable for fractures with 2 to 4 mm of initial displacement and arthrographically congruent joint space. Foster et al[16] demonstrated that percutaneous pining of undisplaced and minimally displaced fractures is a good alternative when close clinical and radiological assessment can not be ensured. Song et al[1] mentioned that closed reduction and percutaneous pinning is even possible for displaced unstable and rotated lateral condyle fractures with 73 % success rate in their study while others[17] believed that closed treatment was not possible for Jakob stage 3 fractures. The reason behind the high success rate in the study of Song et al is due to accurate interpretation of direction and amount of fracture displacement on the basis of their new classification, intraoperative confirmation of fracture reduction in anteroposterior and internal oblique views, and finally stable fixation with two parallel K-wires. Our study did not include the Jakob stage 3 or Song stage 5 completely displaced and rotated fractures, however we included displaced fractures of more than 2 mm with 95.65% of excellent and 4.35% of good results according to Hardacre criteria. We found 1(4.35%) case of pin tract infection, 1 (4.35%) case of pseudovarus deformity and 2 (8.7%) of less than 10 degree fixed flexion deformity of elbow joint with no cases of nonunion, malunion, valgus/varus deformity, osteomyelitis, avascular necrosis of capitellum.

CONCLUSION

Closed reduction and percutaneous pinning can be performed successfully in minimally displaced unstable as well as displaced unstable lateral condyle fractures with excellent functional outcomes, provided good assessment of pattern and displacement of fractures by internal oblique radiographic views is performed.

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FIGURES

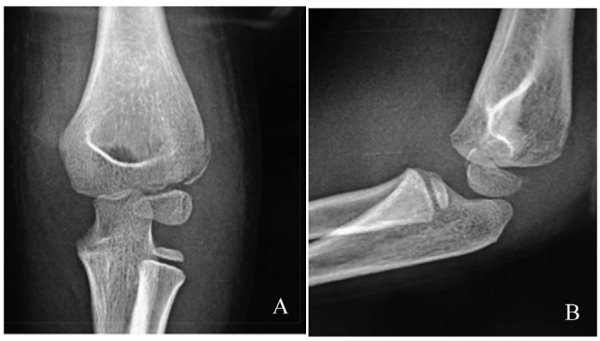

Fig 1(A) Xray elbow joint showing minimally displaced lateral condyle fracture and

Fig 1(B) internal oblique view of elbow showing reduction of fracture after traction and compression at fracture site

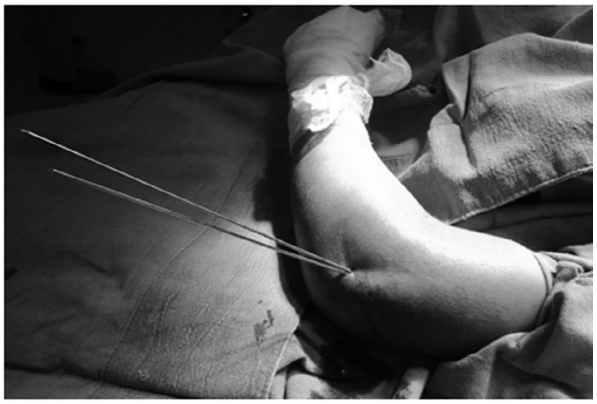

Fig 2 Showing percutaneous fixation of lateral condyle with two K wires.

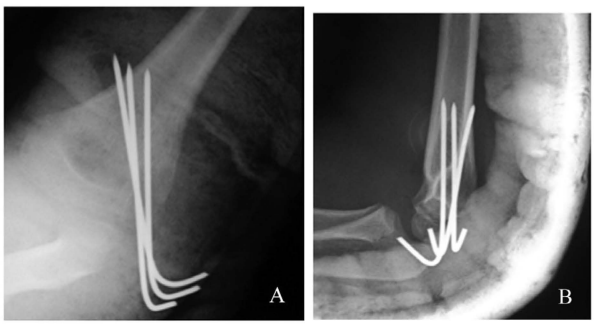

Fig 3(A) AP view and **Fig 3(B)** laterrl view of elbow joint after percutaneous fixation with three K wires

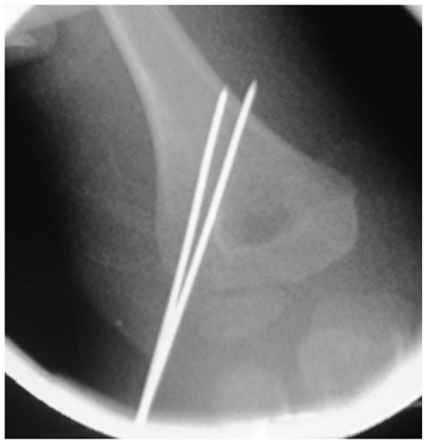

Fig 4 AP view of elbow joint showing percutaneous fixation of elbow joint with two K wires.

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