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Study of intercondylar fractures of the distal humerus treated with 90-90 plating

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Abstract
Intra articular fractures of the distal humerus cause considerable morbidity to the patients. There are several controversies regarding the approach and fixation of the fracture. AO advocated 90-90 plating of both columns while recent biomechanical studies demonstrated superior mechanical strength with parallel plating. But parallel plating is associated with many complications. We performed bicolumnar perpendicular plating in 15 intraarticular AO type C fractures through transolecranon approach. Ulnar nerve was isolated and carefully protected, but ulnar nerve transposition was not done. We achieved union in all cases with functional range of movement in 13 patients. We had no case of post-operatively developed ulnar nerve neuropathy or heterotopic ossification. The average Mayo Elbow Performance Score was 85 points. We infer that 90-90 plating is effective in intercondylar fractures of distal humerus with minimal complications.

Keywords: Distal humerus fracture, intercondylar fracture of humerus, transolecranon approach, perpendicular plating of humerus

Introduction
Distal humerus intraarticular fractures are one of the complicated fractures managed by orthopaedic surgeons. They comprise approximately 2% of all fractures in adults[1]. They follow bimodal distribution, with low energy fractures occurring in older individuals and high energy fractures in younger people. Osteoporosis and comminution of the fracture render internal fixation difficult. Articular surface should be reconstituted anatomically and fixed rigidly to attain useful function of the elbow joint. We did a prospective study of 15 distal humerus AO type C fractures operated in KIMS, Narketpally from July, 2015 to February, 2017.

Materials and Methods
Patients with AO type C fractures were included in this study. Of 15 fractures, three were type C1, five were type C2, seven were type C3 fractures. Two patients had 1-2 cm wounds over olecranon. Eight patients were females and seven were males. Nine patients sustained fractures due to motor vehicle accidents. Six fractures were due to fall at home in individuals aged more than 60 years. The average age of the patients was 40 years. Ulnar nerve neuropathy was seen in four patients pre-operatively. There was no other neural or vascular involvement. The patients were operated within one week of injury.

All patients were operated in lateral position with forearm hanging down on a sandbag at 90 ^{o} with the arm. Tourniquet was applied and distal humerus was approached through chevron osteotomy of the olecranon. Ulnar nerve was isolated and protected. Bicolumnar plating was done in all cases along with lag screw fixation of articular fragments. We used precontoured locking plates or dynamic compression plates on lateral column and locking or regular reconstruction plates on medial column in all the patients. The plates were applied orthogonally in 10 patients. In the remaining five patients with a low medial column fracture, a small five holed plate was placed on the dorsal aspect of the medial column, along with the lateral plate. Fracture stability was checked by doing flexion and extension of the elbow after fixation. Olecranon osteotomy was fixed with k wires and tension band wiring. Ulnar nerve transposition was not done. The two pre-operative wounds were separately sutured, away from surgical incision.

Post-operatively, elbow movements were started on fifth post-operative day in all patients. All wounds healed primarily, with no wound dehiscence. Removable splint support was given to older patients as the bones were osteoporotic. The splint was removed after six weeks.

The patients were followed up for one year at regular intervals. X-rays of the elbow were taken to check union of the fracture and displacement of the fragments. At the end of one year, elbow function was assessed clinically with Mayo Elbow Performance Score.

Fig 1: Type C3 fracture AP view

Fig 2: Lateral view

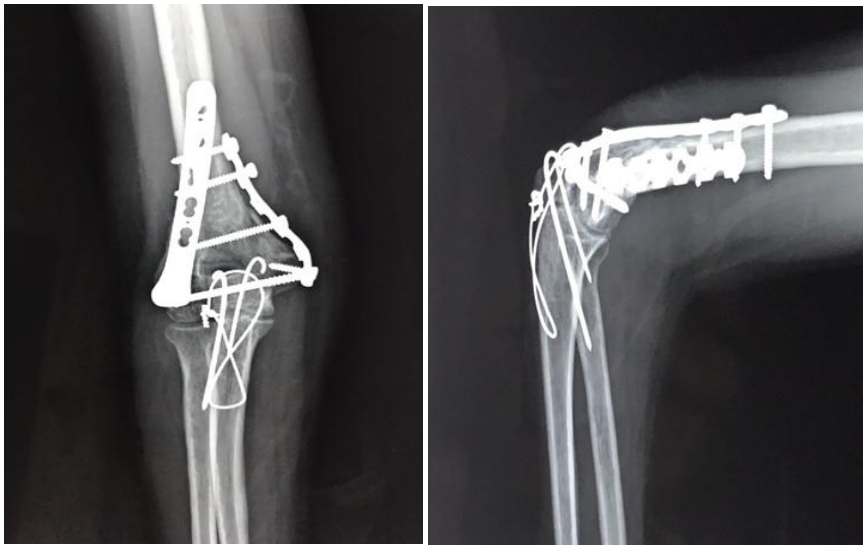

Fig 3: Fixation of the same fracture - AP and lateral views

Results

Fracture was considered to be united when fracture line was not visible and cortical continuity was seen on x-rays. Fracture union was achieved in all patients by 16 weeks. There was no displacement of fragments.

There was a flexion deformity of less than 20 º in six patients. Complete extension was possible in nine patients. Flexion of the elbow joint attained at the end of one year was shown in figure 1.

Functional range of 30 º -120 º was achieved in 13 patients. Less than 120 º of flexion was seen in individuals aged more than 70 years. The average flexion-extension arc was 110 º. Pronation and supination were unrestricted.

All elbow joints were stable. Moderate degree of pain was present in two patients. Remaining patients were pain free. The functional status of the patients was assessed with Mayo Elbow Performance Score. The result was graded as shown in table 2. The average MEPS was 85 points.

Table1: Flexion of the elbow joint attained at the end of one year

Flexion at the elbow	No. of patients
110 º	2
120 º	2
>120 º	11

Table 2: Grading according to MEPS

Grade according to MEPS	No. of patients
Excellent (>90)	5
Good (75-89)	7
Fair (60-74)	2
Poor(<60)	1

Olecranon osteotomy was united in all the cases, but the hardware was prominent in four patients. Olecranon implants were removed after one year in these patients.

Patients with pre-operative ulnar nerve neuropathy recovered in three months. No fresh ulnar nerve dysfunction was seen in post-operative period.

There was no case of heterotopic ossification or infection in our series.

Fig 4: Flexion and extension of the elbow in the same patient.

Discussion

The anatomy of distal humerus is complex. It consists of two columns ending in capitulum laterally and medial epicondyle medially.

Capitulum is angled 40 º forwards compared to the shaft. Hence, the lateral plate should be contoured anteriorly in the distal end or precontoured plates should be used. The screws in capitulum should not reach anterior cortex as it is covered with articular cartilage. Also, the space available on the capitulum distal to the fracture may be too small to accommodate three to four screws in a dynamic compression plate. Hence, if the fracture is low, use of precontoured locking plate which contains adequate number of holes on the capitulum provides good stability. The screws locked in the plate need not penetrate the anterior cortex to gain purchase. Locking plates are especially useful in osteoporotic individuals and comminuted fractures, where adequate purchase of screws cannot be secured. The only problem with locking plate is that the trajectory of screws is predetermined. This may be overcome with polyaxial locking plate. We have no experience with this plate, but we did not encounter any problem with the regular locking plate. We used dynamic compression plates in younger individuals with fracture exiting high on the lateral column where at least two screws can be fixed in the distal part of lateral column. If the fracture was very low or comminuted or if the bone was osteoporotic, we used a precontoured locking plate. All the plates were placed posteriorly on the lateral column.

Medium column was fixed with regular or locking reconstruction plate.

Young patients attained good movements at the elbow joint with active physiotherapy. Patients above 70 years could not be motivated much, and they had 10 º -20 º of flexion deformity and loss of terminal degrees of flexion.

We protected the ulnar nerve throughout the procedure, but never did ulnar nerve transposition. No patient developed ulnar nerve dysfunction in the post-operative period. Heterotopic ossification also was not seen in our patients. This may be because periosteal dissection was not extended anteriorly. []

Rakesh *et al.* [2] analyzed 55 intercondylar fractures of the humerus. The patients were treated with bicolumnar plating on dorsal side of humerus with no ulnar nerve transposition. They had 93% excellent to good results with significant heterotopic ossification in one case (2%) and transient ulnar nerve neuropraxia in three cases (5%). They reported breakage of one one-third tubular plate. They attributed less incidence of complications in their series due to the fact that less dissection was required for dorsal plating than for parallel plating along the supracondylar ridges.

184 patients with intra-articular fracture of distal humerus were analyzed by Sudhir Babhulkar *et al.* [3]. They performed orthogonal plating in 174 patients and parallel plating in 10 patients. Good result was seen in 79% of cases, with persistent ulnar nerve neuropathy in 1% of patients.

Orthogonal plate fixation for type C distal humerus fractures in 56 patients was done by Shao-hua Li *et al.* [4]. Union was achieved in all cases with heterotopic ossification in two patients (3%).

Parallel plating of intercondylar fractures is a recent modification to the established 90 º -90 º orientation of the plates. The strength of parallel plating is more according to biomechanical studies [5]. But, the strength of both types of plating is above the required threshold [6]. Hence, additional strength imparted by parallel plating may not be necessary [7]. Parallel plating implies greater periosteal stripping and elevation of triceps and brachialis. This excessive dissection may be the cause for the increased incidence of ulnar nerve dysfunction and heterotopic ossification seen in the patients treated with parallel plating [2].

Parallel plating of comminuted distal humerus fractures was reported by few authors. Atalar AC *et al.* [8] evaluated 21 such cases. All fractures were united and the average MEPS score was 86 points. But the complications were higher with heterotopic ossification in 33% of patients and chondrolysis in one patient. Similarly, higher rate of complications occurred in the series of 32 patients treated with parallel plating by Athwal GS *et al.* [9]. They reported post-operative nerve injuries in 16% of patients, with an overall complication rate of 53%, though union was seen in all cases. Sanchez-Soleto *et al.* [10] found that parallel plating was efficient in comminuted fractures, but they needed to do additional surgery in 15% of the patients to treat elbow stiffness.

Few surgeons operated on distal humerus fractures through alternate exposures other than transolecranon approach. They claimed adequate visualization of comminuted intraarticular fractures with eventual good results [11]. Olecranon osteotomy in all our patients united along with humerus fractures, but

four (out of 15) patients felt the implants were too prominent. Hence, only implants used for olecranon fixation were removed after one year. The muscle power of triceps was almost equal to that of opposite limb in young patients. Sixty one patients with olecranon osteotomy for distal humerus fractures were followed up for six years by Coles CP *et al.* [12]. They found adequate articular reduction of humerus in all the cases. All osteotomies united. 30% of patients got the olecranon implants removed. The only problem with olecranon osteotomy seems to be the prominence of implants and resultant irritant effect on the surrounding soft tissue.

Conclusion

Distal articular fractures of the humerus can be adequately treated with orthogonal plating through transolecranon approach with minimal complications.

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