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ORIGINAL RESEARCH

A Hospital Based Observational Study to Assess the Early Mobilization and Functional Outcome of Distal Humerus Fracture (AO Type 13-C) Treated with Open Reduction and Internal Fixation with Bi-Columnar Plating at Tertiary Care Centre

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ABSTRACT

Background: Patients treated with bi columnar locking compression plates show a greater functional range of motion, better restoration of articular congruity, secure bony fixation, better bone healing, and early rehabilitation. The aim of this study to assessed whether distal humerus fractures (AO type 13-C) treated with open reduction and internal fixation with bi columnar plating allows early mobilization and improves functional outcomes in patients and also to assess its associated complications.

Materials& Method: This is prospective study where in consecutive 50 cases of distal humerus fractures (AO type 13C) admitted in orthopedic ward in SMS Medical College, Jaipur, Rajasthan, India during one year period. Functional outcome was assessed through The Mayo Elbow Performance Score. All the cases in the study were posttraumatic. Patients were following u pregularly for a period of 1year post operatively.

Results: The mean age of patients was39.68 years,withthe youngest being 21years and oldest is 80years. Male to female ratio was 2.3:1. In 32patients left side was involved and in 18patients had right side involved. 30cases were due to Road traffic accidents and 20cases due to self-fall. 48patients had a closed type and only two patients had an open typeII fracture. The mean arc of movement in the flexion–extension plane was 116.78^0 with a mean fixed extension of 8.56^0. MEPS was excellent in 35 patients, good in 8 patients, fair in 5 patients and poor in 1patient at end point of follow up. Patient with poor score had severe stiffness and experienced difficulty in performing daily routine activities.

Conclusion: We concluded that distal humerus fractures operated with bicolumnar locking compression plates using trans olecranon approach by chevronosteotomy has good functional outcome with particular advantage in intra-articular typeC3 which allows early mobilization of the patients even in fractures with comminution due to the enhanced stabilityof the construct.

Keywords: MEPS Score, Distal Humerus Fracture, AO Type, Bi Columnar Plating, Functional Outcome.

INTRODUCTION

Distal humerus fractures in adults are very difficult and challenging to treat due to intra articular and inter condylar involvement, high comminution, reconstruction difficulty of the articular surfaces, maintaining stability and morbidity, if not constructed anatomically. It accounts for 2% to 6% of all fractures and one third of humerus fractures.[1]

In a study conducted by Palvanen elderly individual aged (> 60 years) were predicted to have a three-fold rise in incidence by 2030 hence it's important to understand these fractures and their treatment protocol.[2] According to Prateek Jain et al,open reduction and internal fixation with 90-90 plating provides reliable, rigid fixation allowing early functional mobilization of the elbow joint. Distal humeral locking plates proved to be useful in C 3 type of fractures and in elderly osteoporotic bones. Complication rates in the study were low and comparable to other studies in literature.[3]

Non-surgical treatment can be justified in cases of hemiplegia sequelaeinvolving the ipsilateral upper limb, advanced osteoporosis and fractures withextensive bone loss but to avoid fixation failure, stiffening is almost assured andarthrolysis will have to be performed later on. The main goal of surgical treatment isto obtain fixation that is stable enough to allow immediate post operative elbowmobilization to prevent it from stiffening, mal-union and non–union, henceopen reduction and internal fixation allows early mobilization and good functional outcomes. Trans olecranon approach and Chevron osteotomy technique exposes thearticular surface of the distal humerus more than other approaches.[4-6] Patients whounderwent Open reduction and internal fixation through an olecranon osteotomyshowed good range of movement and good to excellent results than those who underwent open reduction and internal fixation through other approaches.[7-9]

Locking compression plates are more beneficial in distal humerus fractures thandynamic compression plates and k - wires. Single columnar plating, recon platingand conventional plates have more fixation failures. Complete fixation with two precontoured anatomical locking compression plates in 90 degree is the most suitabletechnique for distal humerus fractures.[10]

Patients treated with bi columnar locking compression plates show a greaterfunctional range of motion, better restoration of articular congruity, secure bonyfixation, better bone healing, and early rehabilitation.[11] The aim of this study to assess whether distal humerus fractures (AO type13-C) treated with open reduction and internal fixation with bi columnar platingallows early mobilization and improves functional outcomes in patients and alsoto assess its associated complications.

MATERIALS& METHODS

This is prospective study where in consecutive 50 cases of distal humerus fractures (AO type 13C) admitted in orthopedic ward in SMS Medical College, Jaipur, Rajasthan, India during one year period.

INCLUSION CRITERIA

1. Age more than 18 years belonging to both sexes with distal humerus fractures [AO type 31C].
2. Closed and Gustilo-Anderson type 1 and 2 open fractures.
3. Subjects with bilateral fractures will be included.

EXCLUSION CRITERIA

1. Age less than 18 years.
2. Gustilo-Anderson type 3 fractures.
3. Closed fractures with neuro-vascular injuries.
4. Pathological fractures.
5. Revision surgeries or operated elsewhere.
6. Upper limb congenital deformity.
7. Established inflammatory or degenerative arthritis of the elbow.

PRE-OPERATIVE EVALUATION

Patients admitted to the hospital with distal humerus fractures ‘AO’ type ‘C3’ were examined clinically with the following details

1. Mode and velocity of injury
2. Condition of the skin and subcutaneous tissue.
3. Classification into Open and closed fractures, open fractures are further classified according to the Gustilo-Anderson classification.
4. Presence of other injuries.
5. Distal neurovascular status with examination of Ulnar, Radial and Median nerves.
6. Presence of compartment syndrome.
7. Routine anterior – posterior and lateral radiographs were taken for the involved elbow joint and classified according to ‘AO’ classification.
8. Temporarily immobilize the elbow with above elbow slab and give adequate analgesics, for open fractures give thorough wound debridement depending on the status of the wound and its contamination. Fix the fracture electively after fulfilling the pre anesthetic clearance check list.

SURGICAL TECHNIQUE

Radiographs and CT images were reviewed for selection of plate size plate position and for inter – fragmentary screws.

Under all aseptic medications and under general anaesthesia or regional Brachial plexus block patient is positioned in lateral position arm on a side bar and a high pneumatic tourniquet is used. Entire upperlimb is painted and drapped with strict sterile technique. Posterior, midline, longitudinal incision was given, firstly identified ulnar nerve then Chevron

olecranon osteotomy was done to expose the articular surface. Articular surface was visualized fully, and morphology of the fracture was reassessed. Fracture fixed with bi-columnar, orthogonal plating technique using AO Synthes® fixed angle locking compression plates. Inter condyles are fixed with cannulated cancellous screws. Osteotomy repaired by tension band wiring. Wound closure was done by restorable sutures.

Post operatively immobilize the patient with above elbow slab with elbow in 90^0 flexion and forearm in supine position for a period of two weeks. Literature insists on early mobilization with active assisted range of movements.[1,7,12,13]

For early mobilization stable fixation of the fracture is necessary.[14] When the fracture fixation is not stable immobilize in a slab for short period but immobilizing more than 3 weeks has poor outcomes.

Third generation cephalosporins was administered parentrally for 48 hours post-operatively till the drain tubes were removed. Then oral antibiotic was started and continued till the suture removal. Oral indomethacin (75mg/day) was started on post-op day one and continued for three weeks.

Active assisted mobilization started after suture removal after two weeks under supervision of a senior physiotherapist.

COMPLICATIONS

Post traumatic stiffness and decreased range of movements are most common in distal humerus fractures, but it is possible to achieve a functional range.[15]The other complications are Nonunion, Surgical site infection, Ulnar neuropathies and Heterotopic ossification.[16]

Post-traumatic stiffness can be intrinsic, extrinsic or both, and it is best prevented than treating. Early active movements have good functional outcome.[1]

Nonunion is around 10% at the osteotomy site. Gofton[9] reported that when the osteotomy site is fixed with compression plate the nonunion rate is less compared with tension band wiring. Chevron osteotomy has greater uniting chance than transverse osteotomy.[17]

Infection rate at surgical site is low and around 0-9%.[17] It is managed with wound debridement and antibiotics according to culture and sensitivity. Sometimes implants may have to be removed because of biofilms which facilitates bacterial growth.

The most common complication is ulnar neuropathy, and it is transient.[18]It is due to excessive manipulation and retraction during surgery and due to scarring and fibrosis. Hence during surgery, it is imperative to identify, protect and not de vascularize the ulnar nerve. This can be treated symptomatically post operatively.[17]

Incidence of Heterotopic ossification is 49% which is a common complication, and it is more common in patients with head injury, spinal cord injury and also in open fractures.[6] Heterotopic ossification is associated with delayed surgeries of more than 2 weeks.[19] Gofton[9] reported in his study that the chance of Heterotopic ossification is less with Indomethacin prophylaxis.

Patients were evaluated at 6 weeks, 3months, 6months and 1 year. End point of follow up was 1 year.

DATA ANALYSIS

Data so obtained was fed into computer using Microsoft Excel software. The data was analyzed using Statistical Package for Social Sciences, version 21.0. Paired 't'- and Kruskal-Wallis test was used to compare the data. The confidence level of the study was kept at 95%, hence a 'p' value less than 0.05 indicated a statistically significant association.

RESULTS

The mean age of patients was39.68 years, with the youngest being21yearsandoldestis80years. Male to female ratio was 2.3:1. In 32patients left side was involved and in 18patients had right side involved. 30cases were due to Road traffic accidents and 20cases due to self fall. 48patients had a closed type and only two patients had an open type II fracture (table 1).

Table 1: Demographic and clinical profile of patients

Demographic and clinical profile	No of patients	Percentage
Age (yrs) (Mean±SD)	41.23±4.86	
Gender		
Male	35	70%
Female	15	30%
SideInvolved		
Left	32	64%
Right	18	36%
Mode of injury		
RTA	30	60%
Self fall	20	40%
Type of Injury		
Closed	48	96%
Open	2	4%

The mean arc of movement in the flexion–extension plane was116.78^0 with a mean fixed extension of 8.56^0 (table 2).

Table 2: Range of movement

Range of movement	N	Mean ± SD	Minimum	Maximum
Arc of flexion in degree	50	116.78 ± 20.68	50	140
Extension deficit in degrees	50	8.56 ± 5.04	5	30
Pronation in degrees	50	71.23 ± 6.25	50	75
Supination in degrees	50	71.46 ± 6.17	50	75

MEPS was excellent in 35 patients, good in 8 patients, fair in 5 patients and poor in 1patient at end point of follow up. Patient with poor score had severe stiffness and experienced difficulty in performing daily routine activities (table 3). Paired 't' test was used to analyze the comparison of MEPS between different time intervals. A 'p' value of < 0.001 was obtained signifying that the comparison was statistically highly significant in every follow up (table 3).

Table3:Mayo elbow performance score

MEPS	6 Weeks	3 Months	6 Months	1 Year
Excellent	0(0)	5 (10.0%)	18(36%)	35 (70.0%)
Good	12 (24%)	30 (60.0%)	25 (50.0%)	8 (16%)
Fair	27(54%)	12 (24%)	3(6%)	5 (10.0%)
Poor	12 (24%)	3(6%)	3(6%)	1(4%)

Table 4: Post-operative complications

Post-operative complications	Number of cases	Percentage
Infection		
Absent	45	90.0%
Infected	5	10.0%
Ulnar neuritis		
Absent	47	94%
Present	3	6%

5 patients had superficial skin infection for them early removal of protruding 'K'wires from TBW site after union at osteotomy site and parenteral antibiotics started according to culture and sensitivity then the infection subsided. Three patients had post operative ulnar neuritis in their early follow up (less than 3months). The main complaint was paresthesisa in the ulnar nerve distribution, they had no motor deficits and are treated symptomatically however at the final follow up none of them had ulnar neuritis.

DISCUSSION

The Gold standard for the management of 'AO' type 'C' distal humerus fracture isopen reduction and internal fixation. In case of osteopenia, severe comminution or in the presence of preexisting inflammatory condition such as Rheumatoid arthritis, open reduction and internal fixation is not feasible and in such cases a primary elbow arthroplasty may be indicated.[20]

Palvanen[2] and Robinson[21] observed in their respective studies, abimodalage distribution, 18 patients aged 18- 38 years and rest of the 11 patients more than 40years. Our study showed that mean age of patients was39.68 years, with the youngest being 21years and oldest is 80years.

In our study 30 patients had Road traffic accident and 20 had self fall11 had a trivial fall from standing height, indicating that osteoporosis may be a pre – disposing factor. Osteoporosis is the major risk factor leading to these type of fractures in the elderly.

Even though the elbow joint is superficial posteriorly open fractures are not common, if present with open fracture it will be due to high velocity injury. Min et al[22] stated in their study that open distal humerus fractures are about 2.7% of all the open long bone fractures, 85.7% of these fractures are AO type C 3. Only two patients presented with open type II fracture due to high velocity trauma, tetanus immunoglobulin andtetanus toxoid was given, and empirical parenteral antibiotics initiated to cover grampositive, gram negative and anaerobic bacteria. The patient underwent emergency wound debridement, then temporarily

immobilize the elbow with above elbow slab, internal fixation was done at a later date when there were no clinical signs of infection. Post-operative period was uneventful.

Single transolecranon approach and single technique wasappliedforallthe fractures, chevron osteotomy was done in all the cases for good articular visualization and then the fracture was fixed with 3.5 mm bicolumnar locking compression plates. Wilk in son and Stanley[4] recommended in their studies that olecra nonosteotomy exposes the articular surface fully than other approaches. Jupiter[8] stated in his studythat chevron olecranon osteotomy is the workhorse for exposing the articular surface. Gofton[9] and Kundel[23] used Chevronolecranon osteotomy and obtained good to excellent outcomes.

We used trans olecranon approach with Chevron osteotomy which gave very good visualization of the articular surface, and it gave sufficient working space to attainanatomic reduction and excellent result with respect to the ability to reconstruct the articular surface.

Open reduction and internal fixation with bi columnar locking compression plating isthe gold standard treatment for distal humerus AO type 3 C fractures. However, theposition of the two plates with respect to each other has been a matter of discussion. The traditional concept was to place the plates inanorthogonal fashion (twoperpendicular planes) and this has been challenged by the parallel plating technique. There are three studies in the literature which have compared the two techniques.Gofton[9], Kundel[23] and Aslam[18] all obtainedexcellenttogoodfunctionaloutcomewithorthogonalplatingtechnique.Further,Korner[10]comparedfixationusinglockingcompressionplates(LCP)withconventionalreconstructionplatesandopinedthatLCPprovidesbetterstability, especially in areas where screw purchase is poor and also provide an increased resistance to bending, torsion and axial compression loading as compared to conventional plates. The locking capability is important for a fixed angle construct in osteopenic bone or multi-fragmentary fractures where screw purchase is compromised. We followed orthogonal plating using 3.5mm fixed angled AOSynthes® anatomic locking compression plates and obtained excellent to good outcome. This technique offered adequate stability of the construct to permit early mobilization. Gofton[9] reported about loss of initial reduction and 40% of his patients required an additional plate to achieve stability. However, we did not come across such an event.

The mean arc of movement in the flexion–extension plane was 116.78^0 with a mean fixed extension of 8.56^0 in our study. This is comparable to that obtained by Gofton[9], Kundel[23] and Aslam[18] in their study on AO type3C fractures of the distal humerus.

Radiologically, all the fractures showed union at final follow-up. Helfet[5] reportednon-union rate of distal humerus fractures treated by ORIF at 2-10%. We did not come across implant loosening or implant breakage leading to loss of fixation. In literature we came across authors observing non-union, implant failure and Heterotopic Ossificationon post-operative radiographs.

The common complications seen following surgical management of distal humerusAO type 3 C fractures as noted by Jupiter[8] in a review article include elbow stiffness, infection, non-union, ulnar neuropathy and heterotopic ossification (HO). Althoughalmost all patients in our study had certaindegree of elbow of stiffness, 49 of themhad a functional range of movement. Helfet[5]observednon-unionin2-10%ofpatientstreatedbyORIF,anditiscommonin patients with severe comminution, bone loss and inadequate fixation. In our study,allthe patients showed union at the timeof final follow-up.

Transient ulnar neuritis is a common post-operative complication described in theliterature. Kundel,[23] Yilmaz[24] and Aslam[18] all have reported transient ulnar neuritis inthe post-operative period. There has been a debate as to whether routine anterior transposition of the ulnarnerve during the exposure has any role ulnar neuritis. Gofton[9], Eralp[25] and Wang[26] demonstrated less than 1%incidence of ulnar neuritis following routine transposition, as opposed to Helfet[5] who showed 7% incidence on not performing the transposition. This opinion was, however, challenged by Chen[27] and Vazquez[28] who advised against transposition.

Chen[27], in his study, concluded that routine transposition is associated with higher incidence of post-operative ulnar neuritis. There is, hence, a conflict as to perform the transposition or not. In all the cases, we identified the ulnar nerve by dissection along the muscle fibre and protected it during the surgery. Care was taken to avoid excessive de vascularisation and forceful retraction. However, we did not perform anterior transposition. We had three patients presenting with symptoms of ulnarneuritis, mainly paraesthesia. All of them developed the symptoms within 6 weeks post operatively. None of them had motor deficits. All were managed symptomatically. At final follow-up, none of them had any residual symptoms.

CONCLUSION

We concluded that distal humerus fractures operated with bicolumnar locking compression plates using trans olecranon approach by chevron osteotomy has good functional outcome with particular advantage in intra-articular typeC3 which allows early mobilization of the patients even infractures with comminution due to the enhanced stability of the construct.

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