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Original Research Article

Functional and Radiological Outcome following Surgical Management of Distal Humerus Fractures (AO Type-13C) by AO Technique

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Abstract: Distal humerus fractures (AO type-13C) are complex injuries and effective management is challenging. Treatment recommendations varied from strictly conservative treatment to open reduction and internal fixation

Materials and Methods: 14 consecutive patients who were operated from June 2021 to July 2022 for distal humerus fractures(AO type-13C) using the LCP distal humerus plating system were included in the study.

Results: Radiographically, union was achieved in patients at 3 months postoperatively. There were no cases of primary malposition or secondary dislocation. The mean MEPS was 92 +/- 11.0 points out of 100 (range 70–100) with a mean elbow flexion of 122°+/- 20.5 (range 95°–150°).

Conclusion: The management of AO type-13C distal humerus fractures is a challenging prospect that demands anatomic reconstruction for restoration of elbow function.

Keywords: Distal Humerus Fracture, Locking compression plate, Ulnar nerve irritation, DASH score, MEPS.

Introduction

Distal humerus fractures(AO type-13C) are complex injuries and effective management is challenging. Treatment recommendations varied from strictly conservative treatment to open reduction and internal fixation [1,8,13,22] However open reduction and internal fixation has become gold standard treatment.[7] These injuries are rare and account for approximately 2% of all fractures.[14] Moreover, the complex anatomy of the distal humerus and its articular surface together with its relatively low amount of cancellous bone makes surgical intervention difficult.[6,19] The goal of treatment for distal humerus fractures is restoration of a painless and stable elbow with satisfactory function. The Low Compression Plate (LCP) distal humerus system allows angular stable fixation of these complex fractures with anatomically preshaped plates. Hence early aggressive functional rehabilitation is possible and functional outcome might be improved. Therefore, aim of the study was to evaluate early radiographic fracture healing, function and subjective patient satisfaction after open reduction with an angular stable fixation of distal humerus fractures.

Materials and Methods

14 consecutive patients who were operated from June 2021 to July 2022 for distal humerus fractures(AO type-13C) using the LCP distal humerus plating system were included in the study. These patients were identified using the diagnosis and their unique UHID number given by the hospital.

Their case sheets, X-rays and CT-scans were reviewed.

Inclusion criteria

1. Closed distal humerus fractures(AO type-13C)
2. Minimum follow up of 12 months
3. Patients who are above the age of 18 years

Exclusion criteria

1. Open fractures.
2. Poly-trauma.
3. Concomitant fractures in the ipsilateral upper limb.
4. Pathological fracture.
5. Concomitant neurovascular injury in the ipsilateral lower limb.
6. Extraarticular/Partial articular fractures (AO type A and B).

All patients were above18 years old and completed at least 1 year of follow up. Pertinent data on patients demographics, clinical assessments, pre-operative X-ray and CT-scan findings, operative details, post-operative X-rays and complications were extracted and analyzed statistically. We identified 14 patients with AO type 13-C distal humerus fractures. Eight patients were women and six were men. The average age of the patients was 56.2 years (range 22–85). Two patients were lost to follow up (one patient died

not related to the fracture, one patient refused to be re-evaluated).

Operative details

All surgeries were performed under brachial block and fluoroscopy guidance. Plate and screw constructs were used in a standard manner. Patient was placed in lateral decubitus position with arm support.

A standard dorsal approach was performed in each case. For direct visualization of the articular surface an olecranon osteotomy was performed.

Figure 1: C-arm position during surgery

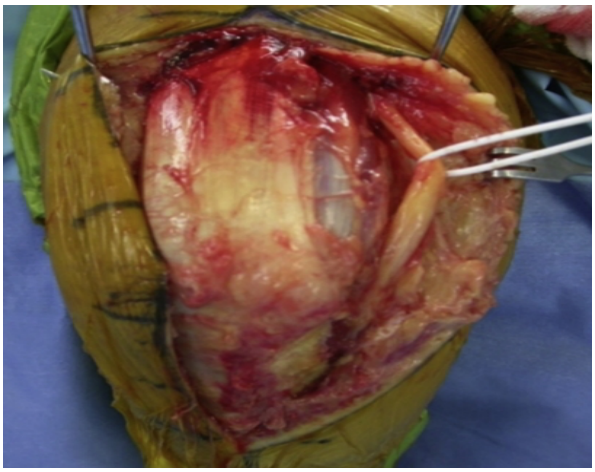

Figure 2: Posterior approach to exposure the elbow

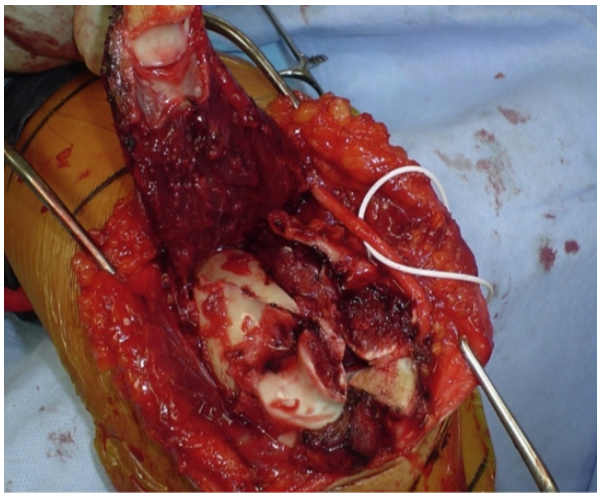

Figure 3: Triceps reflected once olecranon osteotomy

The ulnar nerve was identified and mobilized if necessary to prevent iatrogenic damage. The fracture was exposed and reduced to a anatomic position, paying special attention to the articular surface. Either self-locking or cortical screws were used to fix the plate proximally, whereas the distal fragments were fixed only with self-locking screws.

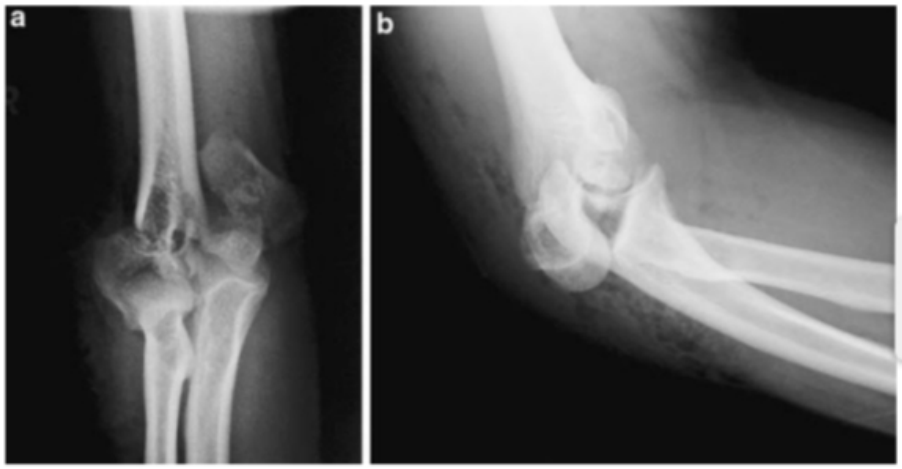

Figure 4:

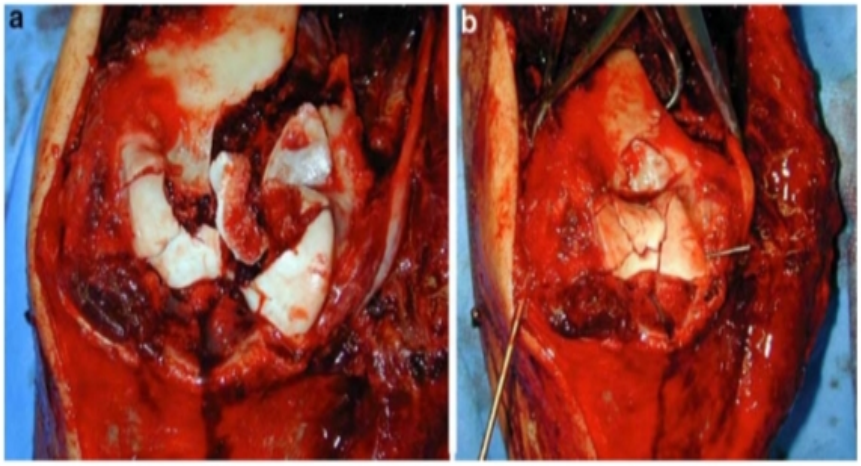

Figure 5: Fractures were reduced and provisionally fixed with K-wires

Once the fracture was fixed, fracture reduction, joint restoration and placement of plates and screws was analyzed radiographically in two planes (AP and lateral views) and documented. Further, the range of motion (ROM) of the elbow was checked intraoperatively.

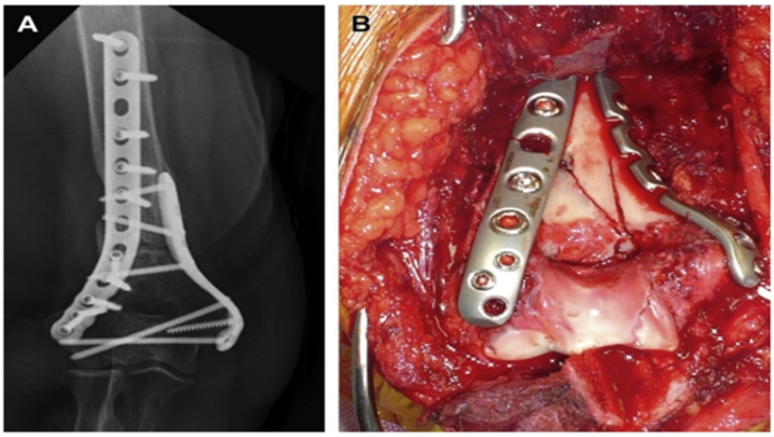

Figure 6: Distal humerus fractures were finally fixed using 90-90 plating (AO TECHNIQUE)

Follow-up protocol

Post-operatively an arm pouch was applied and limb elevation was given. Early controlled passive mobilization of the elbow was started 48 h postoperatively. After discharge, patients completed a physical therapy program with passive and active mobilization of the joint in full range of motion. All patients were reviewed at 2 weeks for wound inspection and suture removal. The clinical and radiographic follow up (MEPS, DASH Score, elbow AP and lateral view,) was performed at 2–6 weeks, 3, 6, and 12 months postoperatively. Radiographs were taken regularly to check the position of the plate and the progress of fracture healing.

Results

Radiographically, union was achieved in patients at 3 months postoperatively. There were no cases of primary malposition or secondary dislocation. The mean MEPS was 92 +/- 11.0 points out of 100 (range 70–100) with a mean elbow flexion of 122°+/- 20.5 (range 95°–150°). The mean deficit in extension was 17.9°+/-10.3 (range 5°–35°). All elbows were stable with no difference in radial or ulnar stress opening in comparison to the contralateral side, a negative pivot shift test and a negative moving valgus stress test. The mean functional result of the MEPS was 22 points of 25.(Table-1). The majority of patients reported no pain at all, three patients reported moderate pain over 24 h and usual activities of daily living and working (Table 2). The DASH Score revealed good subjective overall evaluation with a mean of 18.5 +/-10.5 points range with 0 points as best possible score result and 100 points as worst possible score result.

There were no complications with respect to the fixation with plates (LCP) and the retention of the fragments in anatomical position. One patient had transient ulnar nerve irritations with hypo and dysesthesia of the fifth and fourth finger, which completely subsided further on.

Table 1: Results with Distal humerus fractures fixation

	Distal humerus fractures AO type 13C (n = 14)
Age	56.2 years
Male gender, n (%)	06(42.9%)
Female gender, n (%)	08(57.14%)
Residual pain, n (%)	03(21%)
Residual stiffness, n (%)	02(14.3%)
Residual swelling, n (%)	--------
Mean MEPS	92
Mean satisfaction with surgery, n (%)	10(83.33%)

Table 2: Results using Mayo elbow performance score (MEPS)

Mayo elbow performance score (MEPS)	**Distal humerus fractures AO type 13C (n = 26)**
Excellent (90-100)	07 (58.3%)
Good (75-89)	03 (25%)
Fair (31-60)	02 (16.7%)

One patient showed delayed union of the olecranon osteotomy which was stabilized with k-wires and loop cerclage. The patient was, therefore, revised using open reduction and plate fixation and the osteotomy healed completely. There were no perioperative complications, deep infections, or non-unions at the fracture site.

Case-1

Figure 7: Pre-op X-ray- AO 13C 3.1 Distal humerus fracture

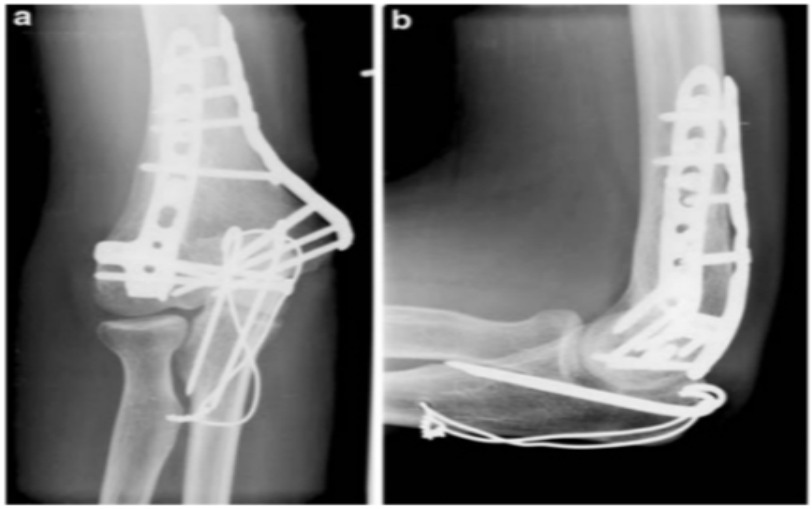

Figure 8: Post-operative X-ray

Case-2

Figure 9: Pre-op X-ray- AO 13C2.1 Distal humerus fracture

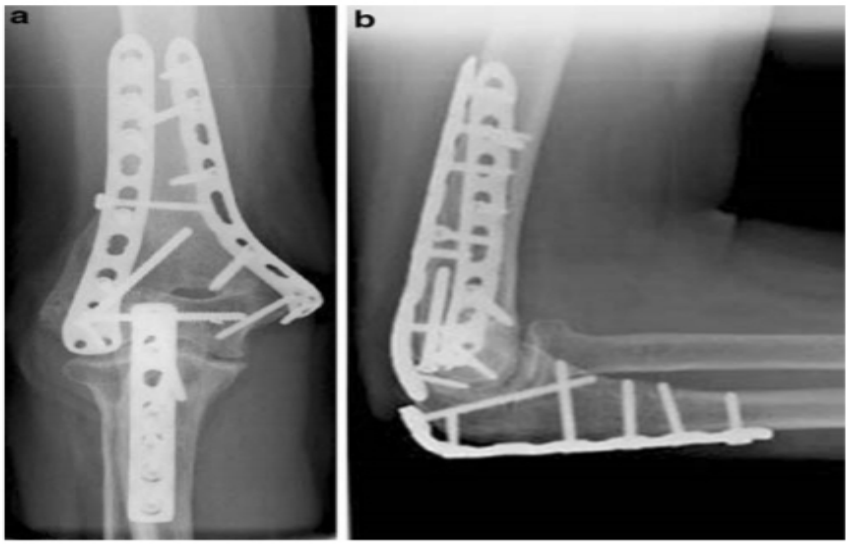

Figure 10: Post-operative X-ray

Case-3

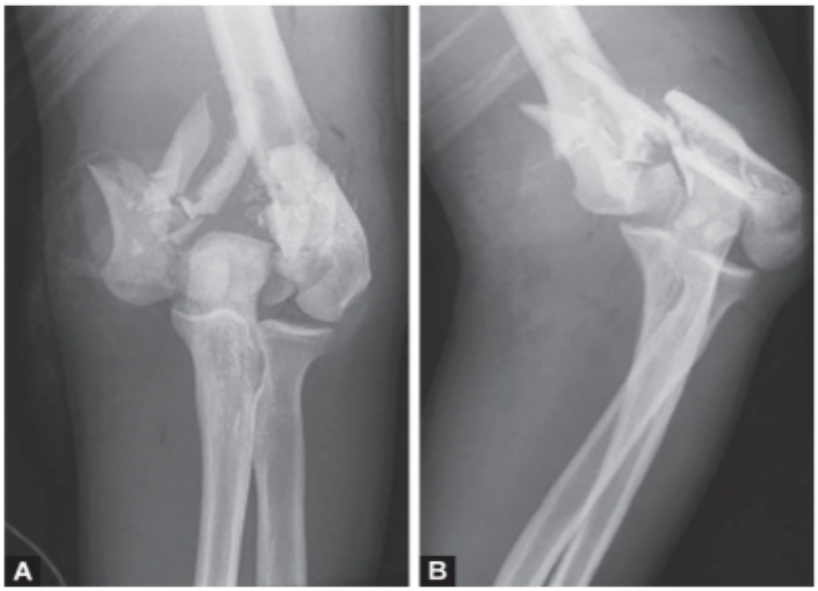

Figure 11: Pre-op X-ray- AO 13C3.3 Distal humerus fracture

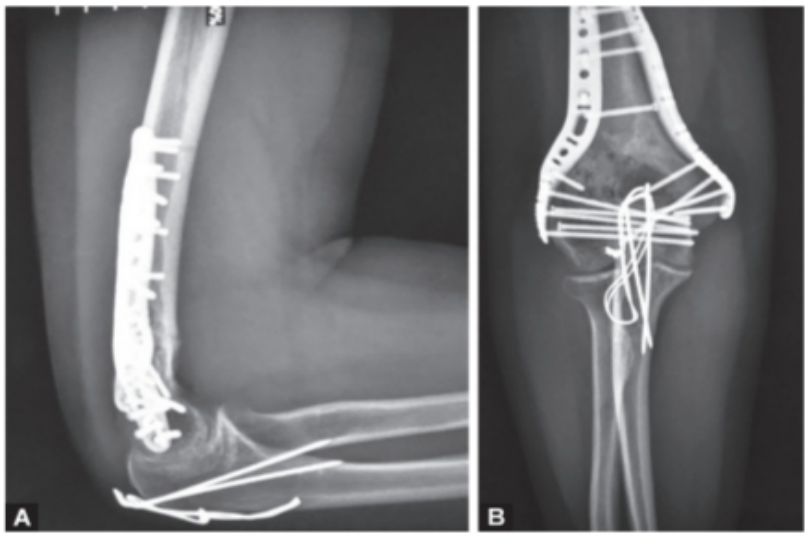

Figure 12: Post-operative X-ray

Discussion

AO type-13C distal humerus fractures are relatively rare and are difficult to manage. The distal fragments are frequently small and have a limited amount of subchondral bone. Moreover, the bone is often osteoporotic especially in the elderly patients. This may lead to a decreased screw-holding strength in the distal fragments. The complex anatomy of the distal humerus requires challenging three-dimensional plate modeling in order to provide an optimal biomechanical outcome. Elbow joint has a tendency to react with stiffness and loss of active range of motion to trauma, surgery or immobilization and, therefore, requires stable internal fixation to allow early rehabilitation. Many authors called for greater implant rigidity, anatomically preshaped plates and locking mechanisms to achieve and maintain rigid and stable fixation. [3]Korner et al. demonstrated that primary anterio–posterior and torsional stiffness increased by fixation with two plates placed in 90° configurations. Additionally angular stable LCP are able to prevent compression forces on the cortex and thereby impairment of the periosteal blood supply. Our main complications were transient ulnar nerve irritation, delayed union after olecranon osteotomy (1 case) and a loss of range of motion. Presented nonmechanical complications are comparable with the literature.[6]The DASH score as a subjective evaluation of functional and psychosocial impairment due to the injury showed mean results of 81.2% of the maximal possible value. Regarding clinical investigation with the MEPS, results were good to excellent with a mean of 92 points and 7 excellent, 3 good and 2 fair results (Table 2).These

results suggest that the distal humerus LCP system is a promising plate for the fixation of distal intraarticular humerus fractures.

Limitations of our study include a small cohort of patients and shorter duration of follow-up. Our study is also retrospective in design.

Conclusion

The management of AO type-13C distal humerus fractures is a challenging prospect that demands anatomic reconstruction for restoration of elbow function. The posterior approach with olecranon osteotomy allows a satisfactory exposure of the joint and preshaped LCP achieve a stable fixation even in cases of excessive comminution. Distal fixation options with smaller angular stable screws improve reconstruction and retention of the articular surface. With above fixation postoperative mobilization can be more aggressive and clinical results may be improved by preventing elbow stiffness. The investigated group is heterogenic considering patients age and activity level with a relatively more number of young patients in comparison to the literature. Even though early results are promising, long term follow-up and larger patient groups are necessary to confirm the presented data.

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