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Original Research Article

INTERNAL FIXATION OF TYPE C FRACTURE OF DISTAL HUMERUS

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ABSTRACT

Background: Type C fractures of the distal humerus is a relatively rare injury. The fracture pattern in Type C injuries usually results from high-energy trauma like motor vehicle accidents or fall from height. It is more commonly seen in younger and active individuals but they can also occur in older patients mostly due to low energy trauma like a trivial fall. These fractures are challenging to fix because of the complexity of restoring the alignment of the articulating surfaces and it is also difficult to achieve stable fixation. Even though internal fixation of the distal humerus can be challenging, it is essential to achieve anatomical reduction to avoid poor functional outcomes and degenerative changes development. Any misalignment of articular surfaces may result in early onset arthritis with poor functional outcomes and reduced range of motion in the elbow joint. So accurate anatomical reduction and stable internal fixation are the most critical steps to ensure a good long-term prognosis and avoid complications like a stiff joint or development of degenerative changes. **Material and Methods:** A total of 32 cases of Type C distal humerus fractures including 10 with Grade I compound fractures were treated with ORIF. In 25 patients dual 3.5 mm reconstruction plates were applied in two planes while in 7 patients one plate was used. The patients were followed up for an average period of 45 months which ranged from 24 to 60 months. **Result**: All fractures had showed adequate union within an average of 13 weeks (range: 8–20 weeks). The average extension loss or flexion deformity was 28° with a range of 5°–60° and the mean range of motion achieved was 106°. Complications were minimal which primarily involved restrictions of movements in the elbow joint. **Conclusion:** Internal fixation is really effective in the treatment of this type of fracture. It ensures the restoration of the articular surface anatomy, provides a stable fixation for the fracture and allows early mobilization of the joint.

INTRODUCTION

Intra-articular bi-condylar fractures of distal humerus that is Type C of AO classification are quite challenging to manage which often leads to complications like mal-union, joint stiffness and osteoarthritis of the joint. Various treatment methods have been followed which includes various modalities like closed reduction, hanging arm cast, sustained traction, limited internal fixation, open reduction with rigid internal fixations and elbow replacements or elbow arthroplasties.

In the last few decades, reduction and internal fixation has gained popularity as the preferred treatment modality. Given the intra-articular nature of these fractures, achieving anatomical reduction is the most crucial step. Surgical modality of reduction and internal fixation allows for precise joint surface restoration. Recent studies emphasize that accurate anatomical reduction, a stable fixation with early joint mobilization yield the best outcomes.

Here we report the outcomes of internal fixation of Type C distal humerus fractures in young adults.

MATERIALS AND METHODS

Between 2018 and 2022, 32 cases which comprised of 25 males and 7 females with type C distal humerus fractures (AO classification) were treated. Patients aged between 20 to 45 years. Ten of these patients had Grade I compound fractures. Patients with delayed surgeries were excluded from the study.

During surgery, patients were positioned laterally with the arm resting on a bolster placed anterior to the chest. Tourniquet was used till the complete exposure of fracture parts and was further released. All cases were approached using the transolecranon method. A transverse osteotomy was performed but the

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subchondral bone fractured by levering the osteotome rather than cutting, which created a ragged edge that facilitated accurate reduction during olecranon fixation.

After clearing the fracture hematoma, the fracture anatomy was again assessed as it could differ from pre-op X-ray findings. All fragments were preserved except for the very small ones. The fracture was reduced and temporarily fixed using 1.5 mm K-wires. Pointed reduction forceps were helpful in stabilizing both the condyles. Anatomical reduction was the primary goal with special attention given to trochlear reconstruction. Care was taken to prevent stenosis of the olecranon fossa. Valgus and varus alignment as well as the normal anterior tilt of the condyle or the humero-capitulum angle were carefully checked.

Any defects in the inter-condylar area were filled with cancellous bone graft. The intercondylar fractures were secured using 4 mm cancellous screws which acted as lag screws. Compression was avoided if comminution was present. If the medial or lateral column had a butterfly fragment or wedge it was first fixed to the proximal fragment with a lag screw to simplify the fracture anatomy before plate fixation. Two 3.5 mm reconstruction plates placed in perpendicular planes were used in 25 cases. One 3.5 mm reconstruction plate was placed on the posterior surface of the lateral column and another on the medial side of the medial column. The primary challenge was achieving strong distal screw purchase in low fractures. In such cases, the lag screw securing the intercondylar component of the fracture was passed through the distal-most hole of the plate to enhance the stability.

Figure 1: Pre-operative X-ray of a 30 years old male with type C fracture

Figure 2: Post-operative X-ray. Two 3.5 plates were used

This technique improved fixation of the distal fragment. A single plate was used in seven patients. If the plate encroached on the ulnar groove, the nerve was anteriorly transposed and carefully documented for future reference. Fixation of the olecranon was done using tension band wiring.

Postoperatively, a below-elbow slab was applied with the elbow positioned in 70º to 80º of flexion. Exercises were initiated as soon as pain reduced which was usually within a week. Only active range of movements were allowed and no passive mobilization was performed. Muscle-strengthening exercises were introduced after fracture union.

Outcomes were evaluated using the criteria of Riseborough and Radin (1969), Jupiter et al., (Tables I, II).and the Mayo Elbow Performance Score (Table III).

RESULTS

Mean age of the patient was 34 years (20 to 45 years). Patients were followed up for a mean duration of 45 months with an average of 24 to 60 months. All of the fractures united in a mean duration of 13 weeks which ranged from 8 to 20 weeks. Mean loss of extension or flexion deformity was 28 degrees (5degrees to 60 degrees). Mean range of movement of elbow joint obtained was 106 degrees (45 to 130 degrees).

The functional outcomes, assessed using three different evaluation systems, are presented in Table III. The mean Mayo Elbow Performance Score was recorded as 84. No patients exhibited clinically significant any varus or valgus deformity.

Complications included fixation collapse in three patients and superficial infection in five patients. However, no cases of myositis ossificans, any nerve injury, or olecranon non-union were observed. Three patients underwent arthrolysis at the time of implant removal which led to some functional improvement in the patients. The two cases with fixation collapse were managed with cast immobilization. They ultimately achieved union but with relatively poor functional outcomes.

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Table 1: Criteria of Riseborough and Radin. (1969)

	FLEXION CONTRACTURE	FLEXION	SUBJECTIVE SYMPTOMS
GOOD	<30	>115	Minor
FAIR	30-60	>115	Minor
POOR	>60	>115	Major

Table 2: Criteria of Jupiter etal (1985) Range of movement (degrees)

	LOSS OF EXTENSION	FLEXION	PAIN	DISABILITY
EXCELLENT	<15	>130	NONE	NONE
GOOD	<30	>120	SLIGHT	MINIMAL
FAIR	<40	>90	WITH ACTIVITY	MODERATE
POOR	<40	>90	VARIABLE	SEVERE

Table 3: Functional results with three assessment criteria (expressed in number of patients and its percentage in bracket.)

	RISEBOROUGH AND RADIN CRITERIA	JUPITER ET AL CRITERIA	MAYO ELBOW PERFORMANCE SCORE
EXCELLENT	-	2(6.25%)	11(34.37%)
GOOD	19(59.37%)	15(46.87%)	15(46.87%)
FAIR	10(31.25%)	7(21.87%)	6(18.75%)
POOR	3(9.37%)	8(25%)	0

DISCUSSION

Type C fractures of the distal humerus are challenging to treat, even with modern advances in fixation techniques. Although surgical intervention generally results in improved range of motion, joint stiffness remains the most common and troublesome complication. The stiffness is often due to intra-articular adhesions, peri-articular fibrosis, myositis ossificans or malunion. Precise reconstruction of the articular surface is crucial to minimizing the risk of post-traumatic osteoarthritis.

A mean range of motion of 47° has been reported in conservatively treated patients.[8] In comparison, the mean range of motion achieved in this series was 106°, which was slightly lower than the 115° and 108° reported in other studies.[4,9] However, the results appear more favourable when assessed using the Mayo Elbow Performance Score, with 26 patients (81.25%) rated as having excellent or good outcomes. This is likely because the Mayo score assigns only 20 points to range of motion, while the remaining 80 points assess pain, stability, and function—areas in which these patients had minimal complaints.

Figure 3: Pre-operative X-ray with a wedge fragment on the medial column

Figure 4: X-ray after the fracture union. The medial wedge fragment was fixed with inter-fragmentary screw from the lateral side and a single plate for lateral column was used. Perfect bony anatomy was restored.

The trans olecranon approach is essential for managing these fractures. In our series, we encountered no difficulty in the reduction and fixation of the olecranon, and none of the patients developed olecranon nonunion. Anatomical reduction of the articular surface was successfully achieved in all cases without articular comminution. However, in fractures with comminution, a small degree of step-off at the articular surface was frequently observed. Fixation of the distal fragment in low fractures remains challenging due to the limited bone stock, which makes it difficult to accommodate two screws per plate.

Preoperatively placement of the screws should be meticulously planned. Putting the lag screw which fixes the inter-condylar fracture through the plate, is one of the ways to increase the fixation (fig.2). If the screw purchase is poor, double tension band wiring is another good option.[9] If there is any wedge fragment on the lateral or medial column it should be first fixed to the humeral shaft with lag screws to make the anatomy of the fracture simple. In young patients, this type of fracture should be treated with internal

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fixation via the trans-olecranon approach. A single fixation method is not suitable for all the cases; therefore a meticulous preoperative planning is essential for each of the individual fracture patterns. Notably, functional outcomes often surpass the radiological results, emphasizing the importance of restoring joint function over achieving perfect radiographic alignment.

CONCLUSION

Internal fixation is really effective in the treatment of this type of fracture. It ensures the restoration of the articular surface anatomy, provides a stable fixation for the fracture and allows early mobilization of the joint.

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