SURGICAL MANAGEMENT OF COMPOUND DISTAL HUMERUS FRACTURE BY JESS EXTERNAL FIXATOR
Utkal Gupta¹, Sanjay Gupta², Gaurav Aggrawal³, Arjun Gandotra⁴, V. P. Pathania⁵

HOW TO CITE THIS ARTICLE:

ABSTRACT: BACKGROUND: Intraarticular displaced distal humerus fractures in adults always require open reduction and internal fixation with some plate and screw osteosynthesis after accurate reduction and alignment of fracture fragments. But high velocity trauma or gun-shot injuries often lead to a compound fracture with contamination and devitalization of soft tissue cover which requires some kind of external fixation. We thereby report the outcome of a series of ten patients who were treated definitively by extensive debridement and JESS type external fixation. This external fixator construct gave excellent fracture fragment stability and early mobilization of elbow joint. It provided patient friendly definitive fixation assembly resulting in early fracture consolidation with reasonably good range of elbow movement for such difficult fractures. MATERIAL AND METHODS: Ten cases of compound intercondylar distal humerus fracture between January 2007 to December 2011 were treated by early debridement & uniplanar bilateral JESS fixator application at the same sitting. This study includes cases of age group 18- 65 yrs. of which 3 were females & 7 were males. Mean age was 31.5yr. Only one case had injury to elbow with Gun-shot injury & rest were of high energy road traffic accidents. All patients reported within 40 hrs. average time to emergency department except 2 cases. A case of Gun-shot injury reported after 5 days & one case reported after 7 day with pus discharge wound. According to A.O. Classification, 4 cases with C 3 type & 6 were C 2 type. All cases were operated within a mean of 8.7hrs of presenting to the emergency department. The average interval between injury & operation was 48.7 hrs. RESULTS: Complete painless supination pronation movement was achieved in six weeks At the end of six months of aggressive physiotherapy, the average extension was 9 degrees (range = 5 – 15 degrees) and average flexion was 106 degrees (range = 70 – 120 degrees). Clinical evaluation of elbow functions was done at sixth month using Mayo elbow score where 20% excellent, 60% good, 10%fair and10% poor results were obtained. CONCLUSION: This is a relatively new technique of fixing compound intra-articular distal humerus fractures with JESS external fixator without spanning and immobilizing elbow joint has given good results, good patient compliance, least complications in our series of ten cases. KEYWORDS: Humerus, Intercondylar, Compound, Intraarticular, Jess, External Fixator.

INTRODUCTION: There is an increase in incidence of high velocity injury to lower end of humerus. These cases with compound comminuted intercondylar fractures present a challenge to orthopedic surgeons. Controversies & challenges exist regarding management of compound comminuted intercondylar fracture distal end humerus. Dual locking anatomical or reconstruction plates have become a gold standard for open reduction & internal fixation of closed distal humerus fractures. But, severe contamination of bone fragments, bone loss, surrounding soft tissue devitalization & contamination prevents usage of reconstruction plates for these compound intra-articular fractures.
We treated a series of cases with compound, comminuted intercondylar distal humerus fractures with new technique of uniplanar bilateral JESS type of external fixator. This fixator was applied immediately after doing extensive debridement of the compound fracture. This frame design allows dressing of open wound, rigid anatomical fixation of fracture fragments & very early mobilization of elbow even when the open wound is still in process of healing.

**CLASSIFICATION:** Intercondylar fractures of the distal humerus are the most difficult fractures involving the humerus in adults. The overall incidence of this fracture in adults is small, and comprises less than 0.5% of all fractures. The overall review of the incidence and the distribution of the injury leads one to the observation that although this injury occurs infrequently, but when it does, the nature of injury is commonly severe and not uncommonly associated with injury to surrounding soft tissue and nerves.6

The A.O. classification: The A.O. classification of the fractures at this level is widely used and is the basis of the orthopedic trauma association (OTA) alpha numeric classification system.

**MODALITIES OF MANAGEMENT:**
**CLOSED TECHNIQUES:**
A) **Cast Immobilization:** This involves closed manipulation and immobilization in cast. This management represents the worst of both worlds, due to inadequate reduction and prolonged immobilization.7,8

B) **Traction:** Most popular of the closed technique, used only in type intravenous injury. Commonest method is the overhead olecranon pin traction. This method is very cumbersome and requires prolonged stay in the hospital. Accurate reduction is not possible and reporting methods are inconsistent. Only very small series are documented supporting this method.
C) **Bag of Bones Technique:** promoted by Eastwood and Thomas, where the arm is placed in a cuff & collar sling with elbow in as much flexion as possible. Elbow is left hanging free and early mobilization of hand, shoulder and elbow is encouraged.

**Open Reduction and Internal Fixation:**

Open reduction and internal fixation with plating is well accepted as the standard treatment for these fractures. This allows for a painless elbow motion and maximizes the likelihood of full functional restoration of the brachium while the anatomically reduced and internally fixed distal humeral fracture fragments heal.  

Surgery is best performed within the first 24 to 48 hours. If the wound is open, individual judgment must be exercised in management. All factors relating to the possibility of infection must be considered, such as type of wound, time of surgery, associated vascular injury and environment in which the wound occur.  

If all factors are optimal, rigid internal fixation for these intraarticular fractures is advised when the wound is a Gustilo type I or type II. Secure fixation is a definite deterrent to infection in such wounds. However, extensive internal fixation should not be used for type III open wounds or injuries inflicted in excessively contaminated areas. Similarly, in cases where surgery is delayed for fear of increasing rather than reducing the chance of infection, it is recommended that the wound should be treated by irrigation and debridement before open reduction and internal fixation is carried out.  

**External Fixator** has been used for blast injuries involving fractures of lower end of humerus.  

Ring fixator and compass elbow hinge external fixator have been applied for badly comminuted fractures of distal humerus.
JOSHI’S EXTERNAL STABILISATION SYSTEM (JESS):

A simple, light, highly modular mini external fixator system which systematically addresses a wide range of complex problems in the management of forearm and hand. Invented by Dr. B. B. Joshi from Bombay. This system has high safety profile and unparalleled ease of application. It can be applied easily by any surgeon in even the most remote areas with minimum instrumentation.\textsuperscript{32-34} It provides a simpler alternative to the presently available modalities of treatment. It allows minimum invasive techniques.

**JESS has following Components:**

**Link Joints:** This is the basic clamping unit of jess system. It has cross holes at different levels. One oval hole and other round hole perpendicular to it. Three sizes, 2x2, 3x3, 4x4. The small size and design of the clamping unit allows inter digital application comfortable. It can hold wires of very small sizes.

Tightening of the grub screw clamps the rods and wires. The connecting rod is placed through the lower hole and the wire placed in the upper hole. The wire has pressure from both sides, hence has less chances of loosening.
Universal Link Joint: This consists of tightening screws on both ends of the joint. This link joint can hold all sizes of rods up to 4mm diameter. It has an advantage over the other joints as when part of assembly is removed, it does not affect the other components as it independently clamps both rods.

Connecting Rods: These are smooth steel rods of diameter varying from 2mm to 4mm. They are available in different length as per indication. The connecting rods can be bent to the required shape using simple instrumentation.

MATERIAL & METHODS: Ten cases of compound intercondylar distal humerus fracture between January 2007 to December 2011 were treated by early debridement & uniplanar bilateral JESS fixator application at the same sitting. Age group was between 18yrs – 65yrs of age, of which 3 were females & 7 males. Mean age was 31.5yrs. Only one case was of gun-shot injury to elbow & rest were of high energy road traffic accidents. All reported within 40 hrs. average time to emergency department except 2 cases. A case of gun-shot injury reported after 5 days & one case reported after 7 day with pus poring wound. According to A.O. classification, 4 cases were with C 3 type & 6 were C 2 type. All cases were operated within 8.7 hrs. of presenting to the emergency department. The average interval between injury & operation was 48.7 hrs.

OPERATIVE TECHNIQUE: Tourniquet was applied in all cases but inflated only if required. This helped in appropriate debridement& removal of devitalized, avascular tissue. In supine position an extensile lateral approach (Kocher's) to elbow joint & distal humerus was used for debridement & external fixator application. We preferred lateral approach, as, the usual posterior approach necessitates incising, cutting or splitting and then repairing the already intact extensor mechanism of elbow in presence of contamination and some duration of immobilization is required for its proper healing till an aggressive mobilization schedule could be followed.

This lateral approach was further preferred as the compound wound on all the cases was on anterolateral or posterolateral aspect which was included in the surgical incision on lateral aspect of elbow. A sterile sheet roll was kept below elbow to improve the exposure. After adequate soft tissue debridement, fractured bone edges were curetted. Contaminated very small fragments without soft tissue attachment were discarded. Pulsatile lavage with normal saline, povidone iodine, and H2O2
solution was done to sterilize the wound as possible. The bony fragments containing the articular surface were realigned and reduced achieving a good reconstruction of trochlea.

A thin K wire was introduced from lateral epicondylar area to medial epicondylar area, after holding the fragments with large reduction forceps & stabilization with K-wire, a 4.5mm or 5mm cannulated cancellous screw was used to secure the fragments rigidly. C–Arm assistance was used to confirm reduction. After this, remaining fragments were rearranged to reconstruct the medial & lateral column.

Palpation, direct visualization under C–Arm (image intensifier) are used to confirm accurate reduction. K-wires are used to temporarily stabilize the fragments checking the varus & valgus position of elbow. Two cross K-wires & two horizontal wires are used to stabilize the distal humerus fracture & uniplanar bilateral frame constructed to rigidly hold the anatomically aligned fragments. If the sterilization of wound is adequate, wound is closed over closed suction drain or the wound is left open for regular dressing for delayed secondary closure or skin grafting or flap coverage if required.

POST OPERATIVE TREATMENT: Arm sling pouch was used for support & no post-operative Plaster of Paris slab support was used. Gradual passive mobilization was started on 3rd day as pain & swelling subsided. Patient was discharged after 5 to 15 days depending on the condition of wound. At the time of discharge, patients were advised active assisted mobilization & maintenance of sling support in between. First few follow up visits were at weekly interval & then at 6th, 12th, 18th, 24th week when clinico-radiological evaluation was done. The final clinical evaluation was done at 6 months. The elbow & forearm movements were measured with standard goniometer. The results graded according to Mayo’s elbow performance score.

CLINICAL EVALUATION: The functional results were assessed by the use of Mayo’s elbow performance score which includes separate evaluations of pain, range of movement, stability of fracture site & functional outcome.

The overall score were then classified as follows:

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>POINT SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>45</td>
</tr>
<tr>
<td>Mild</td>
<td>30</td>
</tr>
<tr>
<td>Moderate</td>
<td>15</td>
</tr>
<tr>
<td>Severe</td>
<td>0</td>
</tr>
<tr>
<td>Motion</td>
<td></td>
</tr>
<tr>
<td>arc 100°</td>
<td>20</td>
</tr>
<tr>
<td>arc 50° – 100°</td>
<td>15</td>
</tr>
<tr>
<td>arc &lt; 50°</td>
<td>5</td>
</tr>
<tr>
<td>Stability</td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td>10</td>
</tr>
<tr>
<td>moderately instable</td>
<td>5</td>
</tr>
<tr>
<td>Gross</td>
<td>0</td>
</tr>
<tr>
<td>Daily function</td>
<td></td>
</tr>
</tbody>
</table>
### Mayo’s Elbow score

<table>
<thead>
<tr>
<th>Score Greater Than 90°</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score between 75 To 89°</td>
<td>Good</td>
</tr>
<tr>
<td>Score between 60 To 74°</td>
<td>Fair</td>
</tr>
<tr>
<td>Score below 60°</td>
<td>Poor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Age/ sex</th>
<th>Mode of injury</th>
<th>Type of fracture</th>
<th>Range of movements at 6 months</th>
<th>Weeks required for complete radiological fracture union</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>34yr/ M</td>
<td>RTA</td>
<td>C3 compound Gr III B</td>
<td>10° - 70°</td>
<td>18 weeks</td>
</tr>
<tr>
<td>2</td>
<td>20yr/ M</td>
<td>RTA</td>
<td>C21 compound Gr II</td>
<td>10° - 120°</td>
<td>10 weeks</td>
</tr>
<tr>
<td>3</td>
<td>18yr/ F</td>
<td>Gun shot on elbow</td>
<td>C3 compound Gr III A</td>
<td>15° - 110°</td>
<td>12 weeks</td>
</tr>
<tr>
<td>4</td>
<td>60yr/ F</td>
<td>RTA</td>
<td>C2 compound Gr II</td>
<td>10° – 1 20°</td>
<td>12 weeks</td>
</tr>
<tr>
<td>5</td>
<td>35yr/ F</td>
<td>RTA</td>
<td>C2 compound Gr II</td>
<td>5° - 120°</td>
<td>12 weeks</td>
</tr>
<tr>
<td>6</td>
<td>22yr/ M</td>
<td>RTA</td>
<td>C2 compound Gr III A</td>
<td>10° - 120°</td>
<td>10 weeks</td>
</tr>
<tr>
<td>7</td>
<td>36yr/ M</td>
<td>RTA</td>
<td>C3 compound Gr III B</td>
<td>10° - 70°</td>
<td>16 weeks</td>
</tr>
<tr>
<td>8</td>
<td>30yr/ M</td>
<td>RTA</td>
<td>C3 compound Gr III A</td>
<td>10°- 100°</td>
<td>14 weeks</td>
</tr>
<tr>
<td>9</td>
<td>20yr/ M</td>
<td>RTA</td>
<td>C2 compound Gr II</td>
<td>5° - 120°</td>
<td>12 weeks</td>
</tr>
<tr>
<td>10</td>
<td>40yr/ M</td>
<td>RTA</td>
<td>C2 compound Gr III A</td>
<td>5° - 110°</td>
<td>12 weeks</td>
</tr>
</tbody>
</table>

**OBSERVATIONS (on the basis of pain, range of movements & complete radiological union)**
Patient C

X-ray of compound gun shot injury elbow

Compound gun shot injury elbow

30° Extension on 3rd post OP

90° Flexion on 3rd post OP day

Articular alignment achieved with k wires in position
Patient D

Immediate debridement and k wire stabilization as the viability of crushed forearm distal to the elbow fracture was controversial

Manipulation of elbow at 6th week under anesthesia as the patient did not comply the physiotherapy mobilization schedule achieving 120° intra op flexion

Intra op photo after complete JESS fixator fixation

k wires & exposed aligned fracture fragments on lateral aspect of elbow

Manipulation under anesthesia achieving complete extension
6th week X-ray showing fracture in process of union along with an AO fixator stabilizing the dislocated elbow.

Fracture union with JESS fixator at 12th week.

Complete consolidation of fracture at 18th week just before removal of fixator.
0° or complete extension at 12th week

80° flexion at 12th week

100° flexion at 16th week

Complete extension at 16th week

120° flexion at 24 week
SUMMARY: There were 10 patients, 7 male and 3 female with mean age 31.5 years who were treated by the above technique.

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>Age/ sex</th>
<th>Mode of injury</th>
<th>Injury and admission time interval</th>
<th>Injury and surgery time interval</th>
<th>Duration of hospital stay days</th>
<th>Type of fracture</th>
<th>Range of movements at 6 months</th>
<th>Weeks required for complete radiological fracture union</th>
<th>Observed mayo’s elbow score at 6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>34yr/ M</td>
<td>RTA</td>
<td>7 days (192 hrs.)</td>
<td>7 days &amp; 6 hrs. (198hrs)</td>
<td>15</td>
<td>C3 compound Gr III B</td>
<td>10°-70°</td>
<td>18 weeks</td>
<td>45 = poor</td>
</tr>
<tr>
<td>2</td>
<td>20yr/ M</td>
<td>RTA</td>
<td>3hrs</td>
<td>9hrs</td>
<td>5</td>
<td>C21 compound Gr II</td>
<td>10° - 120°</td>
<td>10 weeks</td>
<td>95 = excellent</td>
</tr>
<tr>
<td>3</td>
<td>18yr/ F</td>
<td>Gun shot on elbow</td>
<td>5 days (120hrs)</td>
<td>5 days 10 hrs. (140hrs)</td>
<td>10</td>
<td>C3 compound Gr III A</td>
<td>15° - 110°</td>
<td>12 weeks</td>
<td>80 = good</td>
</tr>
<tr>
<td>4</td>
<td>60yr/ F</td>
<td>RTA</td>
<td>12 hrs.</td>
<td>18 hrs.</td>
<td>7</td>
<td>C2 compound Gr II</td>
<td>10° - 120°</td>
<td>12 weeks</td>
<td>85 = good</td>
</tr>
<tr>
<td>5</td>
<td>35yr/ F</td>
<td>RTA</td>
<td>18hrs</td>
<td>28hrs</td>
<td>5</td>
<td>C2 compound Gr II</td>
<td>5° - 120°</td>
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<td>20hrs</td>
<td>7</td>
<td>C3 compound Gr III A</td>
<td>10° - 100°</td>
<td>14 weeks</td>
<td>75 = good</td>
</tr>
<tr>
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<td>RTA</td>
<td>12hrs</td>
<td>18hrs</td>
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RESULT: The mean age of patients was 31.5 years. Average 12.8 weeks were required for complete radiological and clinical union of fracture. External fixator was removed at the completion of fracture union.

Aggressive active assisted physiotherapy was started after complete fracture union. The average range of movements achieved at six months after active aggressive physiotherapy at home which was supervised during the routine regular hospital visits was 97 degree range of elbow flexion and extension. Complete painless return of supination and pronation movement comparable to uninjured opposite elbow, was achieved in all patients in six weeks as pop slab immobilization was not used. There were three patients who reported at around one and half year after injury who had 5 to 140 degree range of painless movement. Clinical evaluation of elbow functions was done at sixth
month using Mayo elbow score where 20% excellent, 60% good, 10% fair and 10% poor results were obtained.

Pin tract infection, loss of soft tissue cover, and resultant delayed wound healing resulted in elbow stiffness in two cases where fair and poor results according to Mayo’s elbow score were obtained.

**DISCUSSION:** Type C compound fractures of distal humerus are difficult to manage even after availability of many advanced anatomical fixation plates for distal humerus fracture. The management algorithm for these fractures is appropriate debridement with multiple K wires for temporary stabilization along with above elbow slab application till at least three weeks till the wound heals and the tissues become relatively free of infection. This immobilization period results in intraarticular and periarticular adhesions and resultant joint stiffness.

After this definitive plating with anatomical or reconstruction plates is done by posterior approach under cover of long term antibiotic therapy to prevent recurrence of infection. But the end results are never satisfactory in such cases for surgeon as well as patient in spite of two surgeries and increased monetary expenses and hospital stay.

But in our study we have achieved good results with one stage surgery with fewer expenses, less antibiotics, early post op mobilization from 3rd day onwards after surgery. After meticulous debridement good compression across fractured surfaces along with rigid fixation was achieved by cannulated cancellous lag screw for fixing inter-condylar articular fragments and the uniplanar bilateral JESS external fixator frame which span across the medial and lateral column fractures with its bent and pre-tensioned thick K wire construct compressing the fractures. Minimum metal implant in the injured area assured least chances of deep infection. Regular dressings and even secondary closure could be done without disturbing the fixator.

Checking the articular surface alignment and prevention of any K wire or bony fragment obstructing the olecranon fossa was important to achieve good intra-op and post op range of movements. There was no complaint of pin skin junction pain as is common in Ilizarov fixator in thigh and leg. In only one case, patient had pin tract infection, which resolved with dressings and antibiotics.

**CONCLUSION:** This relatively new technique of fixing compound intraarticular distal humerus fractures with JESS external fixator without spanning and immobilizing the elbow joint has shown good results, good patient acceptance, least complications in our series of ten cases. We recommend this fixation technique with JESS construct to give good results in such difficult cases.

**REFERENCES:**


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