

## Comparative study of olecranon fracture stabilized with tension band suturing v/s tension band wiring

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### Abstract

**Introduction:** Olecranon fracture occur either by direct blow usually result in comminuted fractures or indirect blow like fall on outstretched upper extremity and usually results in transverse or oblique fractures <sup>[5]</sup>. In the past, close reduction and plaster cast application was the treatment of fracture olecranon. But prolonged immobilisation with its complications increased morbidity and mortality of patients <sup>[6]</sup>. So keeping this in consideration, it has become important surgically. Active mobilisation after surgery will restore the patient to normal function as soon as possible. The active and early movement not only prevents the tissue from fracture disease but greatly influence quality and rapidness of fracture union.

**Aims and objectives:** To compare complications and benefit of tension band wiring and tension band suturing.

**Methods:** The present comparative study of fracture olecranon treated by Tension band wiring with K wire and Tension band suturing, at Hamidia hospital, GMC Bhopal between January 2018 to July 2019 in which 30 cases were included.

Although there are many methods of evaluation of results given by many authors, the treated olecranon fractures were evaluated in our study with Mayo Elbow Performance index (MEPI). Functional evaluation of the elbow <sup>[16]</sup> for functional outcome and Standard radiographs for radiological out come

**Discussion:** No complications were recorded in cases of TBS whereas in TBW 3 cases of stiff elbow, 4 cases of SSI, 1 case of non-union and 3 cases of hardware failure observed.

Time of union was faster in case of TBS as observed and compared with cases of TBW by mean time of around 3.4 weeks.

Out of 15 cases of TBW on basis of Mayo elbow performance score, 2 had excellent results while 5 had fair, 3 had good and 5 had poor results.

Whereas out of 15 cases of TBS all had excellent results.

**Conclusion:** From the present study it is concluded that the technique of open reduction and internal fixation with Kirschner wires and tension band wiring for simple transverse and oblique fractures is gold standard technique of treating fractures of olecranon and is based on sound biomechanical principle but also using ETHIBOND 5-0 as in place of tension band wiring serve better in cases with complications we observed in TBW.

**Keywords:** olecranon fractures, tension band suturing, tension band wiring, complications

## Introduction

Olecranon fractures are a diverse group of injuries, ranging from simple nondisplaced fractures to complex fracture-dislocations of the elbow joint <sup>[1]</sup>. The human's unique prehensile skill largely depends on the integrity of the bones, ligaments, and muscles around the elbow joint. The elbow not only bends the arm but also permits pronation and supination of the hand. Fractures of the olecranon are common and are usually detected easily but require careful treatment for an optimal result <sup>[2, 3, 4]</sup>.

Olecranon fractures has bimodal distribution. In young patients it is due to high energy trauma like Road traffic accidents while in elderly due to low energy falls. Mechanism of fracture is either by direct blow *usually* result in comminuted fractures or indirect blow like fall on outstretched upper extremity and *usually* results in transverse or oblique fractures <sup>[5]</sup>.

In the past, close reduction and plaster cast application was the treatment of fracture olecranon. But prolonged immobilisation with its complications increased morbidity and mortality of patients <sup>[6]</sup>. So keeping this in consideration, it has become important surgically. Active mobilisation after surgery will restore the patient to normal function as soon as possible. The active and early movement not only prevents the tissue from fracture disease but greatly influence quality and rapidness of fracture union.

A successful functional outcome after olecranon fractures correlates directly with accuracy of anatomic joint reduction, restoration of mechanical stability that allows early motion, respect for the soft tissues, and maintenance of an intact extensor mechanism <sup>[7]</sup>.

Since ages many treatments have been put forward for fracture olecranon. Many treatment related complications also came in light, to avoid these complications many improved and better treatments plans were introduced.

### **Surgical treatment is indicated for the following <sup>[8]</sup>**

- Fractures with significant displacement (>1-2 mm)
- All patients having extensor mechanism weakness
- Most fractures associated with elbow instability
- Cases in which nonoperative treatment has failed

The AO has advised fixation of these fractures with two k-wire and tension band wiring with metal wire. But this usual approach has significant complications, such as

- Soft tissue irritation
- Wound breakdown and Implant exposure
- Infection

In these cases it is necessary to remove metalware in next surgical operation which is 75% for tension band wiring and 50% for plate fixation <sup>[9-11]</sup>.

To reduce complications due to metal impingement and to reduce infection rate metal free technique tension band suturing has been introduced. In which a k wire is used to reduce the fracture and ETHIBOND 5-0 (high strength braided suture) being used to compress the fracture site. Later on k wire used for reduction being removed <sup>[8]</sup>.

This dissertation is directed towards evaluation of olecranon fractures managed by metal free surgical technique.

**Aims and Objectives:** To compare complications and benefit of tension band wiring and tension band suturing.

### **Material and Method**

The present comparative study of fracture olecranon treated by Tension band wiring with K wire and Tension band suturing, at Hamidia hospital, GMC Bhopal between January 2018 to

July 2019 in which 30 cases were included.

Study was conducted with due emphasis for clinical observation and analysis of results after surgical management of fractures of olecranon by K wires with Tension band wiring and Tension band suturing.

### Inclusion criteria

- Displacement of more than 2 mm.
- Mayo type IIa olecranon fractures
- Patient with informed consent.

### Exclusion criteria

- Patient other than type IIa olecranon fractures.
- Patient not given informed consent.

## Methods

### 1. Surgical procedure for tension band wiring

- a. Anesthesia - The operation was performed under general anesthesia or brachial block.
- b. Position and Tourniquet - Mid arm tourniquet was applied with patient in lateral position. Site of the surgery was thoroughly painted with iodine and spirit and draped.
- c. Exposure - Exposure of the olecranon was done by Campbell's posterolateral approach. A vertical incision was taken over the posterior aspect of the elbow about 2.5 cm proximal to olecranon, curving distally along the lateral aspect of olecranon reaching the subcutaneous border of the ulna and extending distally for about 7.5 cm distal to olecranon. Fascia was incised along the line of skin incision and fracture site was exposed. Fracture hematoma was cleared off and the fracture site was gently curettage. Accurate anatomical hairline reduction was achieved and held with either reduction clamp or long towel clip.

2 K-wires is introduced parallel from the tip of the olecranon i.e., the proximal fragment across the fracture site to the distal fragment. Periosteum was stripped from the shaft of ulna distal to fracture site and a transverse hole was drilled approximately 3 to 5cms distal to fracture site. A No.18 stainless steel malleable wire was passed through this transverse hole and crossed over the posterior surface of olecranon in a figure-of-eight manner and then passed around the protruding Kirschner wires and tightened using AO tensioner and then secured with a twist. Bend the proximal ends of the K wires 180<sup>0</sup> and tap the cut ends back into the proximal fragment. Accuracy of reduction was checked and stability was tested by moving the joint. Wound closed in layers and sterile dressing and compression bandage given.<sup>[2,12,13,]</sup>

### 2. Surgical procedure for tension band suturing

- a. **Anesthesia:** The operation was performed under general anesthesia or brachial block.
- b. **Position and Tourniquet:** Mid arm tourniquet was applied with patient in lateral position. Site of the surgery was thoroughly painted with iodine and spirit and draped.
- c. **Exposure:** Exposure of the olecranon was done by Campbell's posterolateral approach. A vertical incision was taken over the posterior aspect of the elbow about 2.5cms proximal to olecranon, curving distally along the lateral aspect of olecranon reaching the subcutaneous border of the ulna and extending distally for about 7.5 cm distal to olecranon. Fascia was incised along the line of skin incision and fracture site was exposed. Fracture hematoma was cleared off and the fracture site was gently curettage. Both the fragment held with help of reduction clamp or towel clip. A k wire of 1.8 cm

inserted from proximal fragment to distal fragment and fracture reduction was stabilized. With help of another k wire a transverse tunnel was made distally in ulna for passing of suture. ETHIBOND 5-0 passed below tendon insertion of triceps proximally and tied with figure of 8 manner after passing through tunnel made in distally in ulna. After 3 turn of figure of 8 knot is tied. Incision was closed in layers after thorough wash. Sterile dressing done [8, 14, 15].

**Follow Up**

This part of the study should be done very carefully and meticulously. In our study the patients on discharge were advised to report for follow up after 2 weeks for suture removal, 4 weeks and 12 weeks and thereafter every 3 months. The result is assessed 1 month and 3 months after the procedure. At follow up a detailed clinical examination was done and patient was assessed subjectively for the symptoms like pain, swelling, restriction of joint motion according to MEPI. On clinical examination, swelling of the joint, tenderness, movements of the elbow joint, nutrition and power of the muscles acting on the joint were noted.<sup>[80]</sup> Patients were instructed to carry out physiotherapy in the form of, active flexion-extension and pronation-supination without loading <sup>[8]</sup>.

**Evaluation of results**

Although there are many methods of evaluation of results given by many authors, the treated olecranon fractures were evaluated in our study with Mayo Elbow Performance index (MEPI). Functional evaluation of the elbow <sup>[16]</sup> for functional outcome and Standard radiographs for radiological out come.

| OLECRANON FRACTURE                                 |            |
|--|------------|
| Mayo elbow performance score (MEPS) <sup>11</sup>  |            |
| <b>Section - 1 Pain Intensity</b>                  | <b>45</b>  |
| None   | 45         |
| Mild   | 30         |
| Moderate   | 15         |
| Severe   | -          |
| <b>Section - 2 Motion</b>                          | <b>20</b>  |
| Arc of motion greater than 100 degrees             | 20         |
| Arc of motion between 50 and 100 degrees           | 15         |
| Arc of motion less than 50 degrees                 | 5          |
| <b>Section - 3 Stability</b>                       | <b>10</b>  |
| Stable   | 10         |
| Moderate instability                               | 5          |
| Grossly Unstable                                   | -          |
| <b>Section 4 - Function (Tick as many as able)</b> | <b>25</b>  |
| Can comb hair                                      | 5          |
| Can eat  | 5          |
| Can perform hygiene                                | 5          |
| Can don shirt                                      | 5          |
| Can don shoe                                       | 5          |
| <b>Total</b>                                       | <b>100</b> |

| Score greater than 90 | Score 75-89 | Score 60-74 | Score below 60 |
|-----------------------|-------------|-------------|----------------|
| Excellent             | Good        | Fair        | Poor           |

**Fig 1:** Interpreting the mayo elbow performance score

**Observation and Results**

30 patients including 24 male and 6 female patients who had olecranon fracture with right side dominance, majority due to road traffic accident were treated in department of

orthopaedics, Gandhi medical college and associated Hamidia hospital Bhopal and were followed up for study. The duration of longest follow up was 12 month and shortest duration was 6 months.

**Table 1:** Comparison of background characteristics in TBW & TBS

|                            | TBW (N=15) | TBS (N= 15) | Significance |
|----------------------------|------------|-------------|--------------|
| Mean Age (SD)              | 32.5 (3.2) | 34.4 (2.6)  | 0.64         |
| <b>Gender</b>              |            |             |              |
| Male                       | 11         | 13          | 0.65         |
| Female                     | 4          | 2           |              |
| <b>Nature of Trauma</b>    |            |             |              |
| Fall                       | 3          | 10          | 0.01         |
| RTA                        | 11         | 3           |              |
| Assault                    | 1          | 2           |              |
| <b>Associated Injuries</b> |            |             |              |
| # MC                       | 0          | 1           | 1            |
| # SOF                      | 1          | 0           |              |
| #SOH                       | 0          | 1           |              |
| Nil                        | 14         | 13          |              |
| <b>Type of Fracture</b>    |            |             |              |
| Trans                      | 14         | 13          | 1            |
| Oblique #                  | 1          | 2           |              |

**Table 2:** Comparison of mayo elbow performance score

|                             | TBW (N=15)   | TBS (N= 15) | Significance |
|-----------------------------|--------------|-------------|--------------|
| Mean Score at 1 month (SD)  | 48 (5.3)     | 61 (6.3)    | <0.00        |
| Mean Score at 3 months (SD) | 59.33 (11.8) | 80 (5.0)    | <0.00        |
| Mean Score at 6 months (SD) | 70.67 (11.8) | 99.33 (1.7) | <0.00        |

**Table 3:** Comparison of complications

|                  | TBW (N=15) N (%) | TBS (N= 15) N (%) | Significance |
|------------------|------------------|-------------------|--------------|
| No complications | 4 (26.7)         | 15 (100)          | <0.00        |
| Hardware Failure | 3(20)            | 0                 |              |

|             |         |   |  |
|-------------|---------|---|--|
| Non Union   | 1(6.7)  | 0 |  |
| SSI         | 4(26.7) | 0 |  |
| Stiff Elbow | 3 (20)  | 0 |  |

**Table 4:** Comparison of time for union

| Comparison of Time for union |                          |               |              |
|------------------------------|--------------------------|---------------|--------------|
|                              | Mean time for union (SD) | 95% CI        | Significance |
| TBW (N=14)                   | 10.6 (1.02)              | (9.98- 11.16) | <0.00        |
| TBS (N= 15)                  | 6.6 (0.99)               | (6.05 - 7.15) |              |

**Table 5:** Comparison of Outcome

|                  | TBW (N=15) N (%) | TBS (N= 15) N(%) | Significance |
|------------------|------------------|------------------|--------------|
| <b>Excellent</b> | 2 (13.3%)        | 15 (100%)        | <0.00        |
| <b>Fair</b>      | 5 (33.3%)        | 0(0)             |              |
| <b>Good</b>      | 3 (20%)          | 0                |              |
| <b>Poor</b>      | 5 (33.3%)        | 0                |              |

## Discussion

The objective of the surgical treatment of olecranon fracture is achieving union as well as optimum function of joint. As it is intra-articular fracture, a perfect anatomical reduction of the fragments to gain joint congruity and rigid fixation is of importance, to gain early movements one is to prevent complications like traumatic arthritis, infection, joint stiffness and hardware impingement. Tension band suturing with ETHIBOND 5-0 provides the strength of fixation similarly as TBW i.e. by converting tensile force to compressive force at the fracture site.

In present study 15 cases of fractures of the olecranon were treated with Tension band wiring and Kirschner wires and 15 cases by Tension band suturing for simple transverse and oblique fractures. This newer method of fixation has given excellent results. The findings, the end results and various other data will be analyzed and compared in the following discussion.

### (A.) Age incidence

**Table 6:** Average age incidence in various study groups

| Series  | Average age |
|---|-------------|
| Daniel A. Muller (2018) <sup>[71]</sup>       | 39 years    |
| Macko Donald and Szabo (1985) <sup>[11]</sup> | 35.5 years  |
| Present study                                 | 33.4 years  |

The average age incidence; in the present study was found to be 33.4 years. This is well in accordance with the authors Daniel A. Muller (2018) is his study average age was 39 years and Macko Donald and Szabo California (1985) average age was 35.5 years.

### (B.) Sex incidence

**Table 7:** Average sex incidence in various study groups

| Series   | Male        | Female      |
|--|-------------|-------------|
| Daniel A. Muller (2018) <sup>[71]</sup>        | 30(73.17% ) | 11(26.82% ) |
| Wolfgang G <i>et al</i> (1987) <sup>[34]</sup> | 27(60%)     | 18(40%)     |
| Present study                                  | 24(80%)     | 6(20%)      |

The present study of fracture olecranon revealed greater incidence in males (80%). Similarly male predominance was found in the study of Daniel A. Muller and Garry Wolfgang *et al* series.

### (C.) Side Incidence

**Table 8:** Average side incidence in various study groups

| Series  | Right       | Left        |
|---|-------------|-------------|
| 1Wolfgang G., <i>et al</i> (1987) <sup>[34]</sup> | 25(55.55 %) | 20 (44.44%) |
| Daniel A. Muller (2018) <sup>[71]</sup>           | 16(39.2% )  | 25 (60.9%)  |
| Present study                                     | 16(56%)     | 14(44%)     |

In this study the involvement of right side 16 patients (56%) was seen more frequent than left side. But according to author Wolfgang G. *et al*, study right side is more and according to author Daniel A. Muller left is more.

### (D.) Mechanism of injury

**Table 9:** Mechanism of injury in various study groups

| Series  | No. of cases | Percentage |
|---|--------------|------------|
| <b>Daniel A. Muller (2018) <sup>[71]</sup></b>          |              |            |
| Traffic accident  | 9            | 60%        |
| Fall from height  | 6            | 40%        |
| <b>Wolfgang G., <i>et al</i> (1987) <sup>[34]</sup></b> |              |            |
| Fall  | 22           | 48.88%     |
| Motor vehicle accident                                  | 20           | 44.44%     |
| Direct blow   | 3            | 6.66%      |

| Present study         |    |        |
|-----------------------|----|--------|
| Road traffic accident | 14 | 46.66% |
| Fall from height      | 13 | 43.33% |
| Assault               | 3  | 10%    |

In this study, the patients with Road traffic accident were 14 (46.66%) patients, with Fall from height were 13 (43.33%) patients and 3(10%) patient was Assault. Where as according to Daniel A. Muller series, the patients with traffic accidents were 9(60%) and patients with fall from height were 6 (40%) and according to Wolfgang *et al*, 22 (48.88%) patients were fall from height 20(44.44%) were due to motor vehicle accident 3 (6.66%) were due to direct blow.

### (E.) Type of fracture

**Table 10:** Type of fracture in various study groups

| Series  | No. of cases | Percentage |
|---|--------------|------------|
| <b>Murphy <i>et al</i> (1987) <sup>[36]</sup></b> |              |            |
| Transverse fracture                               | 26           | 68.42%     |
| Oblique fracture                                  | 12           | 31.68%     |
| <b>Present study</b>                              |              |            |
| Transverse fracture                               | 27           | 90%        |
| Oblique fracture                                  | 3            | 10%        |

In the present series 27 (90%) transverse fractures, 3 (10%) oblique fractures. In Murphy *et al*., series 26 (68.42%) transverse fracture 12 (31.68%) oblique fractures.

### (F.) Postoperative complications of tension band suturing

**Table 11:** Post op complications in various study groups

| Complications              | Present study | Joideep phadnis <i>et al</i> <sup>[9]</sup> |
|----------------------------|---------------|---|
| 1. Surgical site infection | -             | -   |
| 2. Hardware failure        | -             | -   |
| 3. Stiff joint             | -             | -   |
| 4. Malunion/non-union      | -             | 1   |

In the present series superficial infection in none of operated patients. In Joideep phadnis series only one malunion came into light and that is due to cut through of suture as bone was osteoporotic.

### (G.) Results

**Table 12:** Results in various study groups



| Study  | Results in percentage |      |      |      |
|--|-----------------------|------|------|------|
|  | Excellent             | Good | Fair | Poor |
| Murphy <i>et al</i> <sup>[36]</sup>          | 60                    | 10   | 30   | -    |
| Joideep phadnis <i>et al</i> <sup>[19]</sup> | 71.4                  | 28.5 | -    | -    |
| Present study                                | 100                   | -    | -    | -    |

The results were evaluated according to the Mayo elbow performance score. The results obtained in our series were excellent in all patients (100%). The results in our series are better than Joideep phadnis study.

## Conclusion

From the present study it is concluded that the technique of open reduction and internal fixation with Kirschner wires and tension band wiring for simple transverse and oblique fractures is gold standard technique of treating fractures of olecranon and is based on sound biomechanical principle but also using ETHIBOND 5-0 as in place of tension band wiring serve better in cases with complications we observed in TBW.

The above technique for fractures of the olecranon has the following distinct advantages, provided the surgery is performed as early as possible, giving due care to all the technical details.

1. By this method post-operative immobilization in POP is greatly minimized. Thereby avoiding fracture disease.
2. Because of no implant used there will be no hardware impingement and no decrease in joint movement due to pain by it.
3. Early active movement at the involved joint induces compression between the fragments. This compression hastens fracture healing. Because of early union of fracture, patient is back to work earlier. This aspect is very important both from the psychological and economical point of view.

Considering all the distinct advantages and relatively no complications as there is no hardware in situ it and early joint mobilization, tension band suturing will soon be treatment of choice for olecranon fractures.

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