

## ORIGINAL ARTICLE

## Tension Band Wiring for Displaced and Uncomminuted Fractures of the Olecranon

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## ABSTRACT

**Objective:** To evaluate the functional results of tension band wiring in patients with olecranon fractures.

**Study Design:** Prospective case series.

**Place and Duration of Study:** Department of trauma and orthopedics Jinnah Postgraduate Medical Centre, Karachi from December 2017 to June 2018.

**Materials and Methods:** We included 62 patients having closed fracture of olecranon process. Brief history regarding the fracture duration, presence of infection, smoking habits and comorbidities such as hypertension and diabetes mellitus was obtained. Tension band wiring for the olecranon fracture was performed after patients met the inclusion criteria. Final results were assessed at the end of three months postoperatively using mayo elbow performance score (parameters include: pain (45 points), motion arc (20 points), stability (10 points), and daily function (25 points) with a maximum of 100 points. A score of 90-100 points was considered as excellent, good 75-89, fair 60-74 and poor score of less than 60 points. Excellent and good results were considered as satisfactory.

**Results:** Mean age of the patients was  $35.03 \pm 7.87$  years. There were less female patients (n=23, 37.1%) as compared to male (n=39, 62.9%) patients. Mean fracture duration of  $2.97 \pm 1.28$  days was observed while mean mayo elbow performance scale (MEPS) was found to be  $83.11 \pm 10.02$ . According to Mayo Elbow Performance scale excellent and good functional results found in 51(82.26%) cases were considered as satisfactory outcome. Satisfactory outcome was significantly higher in patients belonging to  $\leq 30$  years age group in contrast to above 30 years of age patients (p=0.037). Results were not significantly related to gender, hypertension, diabetes mellitus, smoking and obese cases. Significant association was found with duration of fracture.

**Conclusion:** Tension band wiring is an effective way of treating olecranon fractures particularly those which are displaced and un-comminuted and provide good to excellent functional results in most cases.

**Key Words:** Mayo Elbow Performance Score, Olecranon Fracture, Tension Band Wiring.

## Introduction

Olecranon process is an important part of the proximal ulna which gives stable configuration to the elbow joint. Fractures of the Olecranon involving adults of either sex are a frequent injury of upper extremity caused by moderate to severe trauma.<sup>1</sup> Olecranon fractures account for approximately 40% of all fractures in proximity to elbow joint<sup>2</sup> and near about 10% of all upper extremity fractures.<sup>3,4</sup>

Mechanism of injury of olecranon fracture involves a direct blow to the bony prominence of elbow,

indirect injury from fall on outstretched hand or combination of both.<sup>4</sup> Combined injury results in a more comminuted and displaced fracture even leading to fracture dislocations of elbow.<sup>5</sup> Periosteal damage around olecranon process and fascia of the triceps combining violent triceps muscle contraction results in a more displaced fractures.<sup>5,6</sup> Besides low-velocity extra-articular fractures, many olecranon fractures extend into the joint of the elbow producing articular step off and lead to reduced mobility, late rehabilitation, development of osteoarthritis, and other morbidities. Therefore, absolute fracture reduction and stable fixation are key steps to avoid instability and stiffness of the joint and development of osteoarthritis.<sup>5,6</sup>

There is a variety of systems which classify olecranon fractures but most widely accepted mayo clinic classification is described by Morrey.<sup>7</sup> Type I are undisplaced, type II fractures have step off of more than 2 mm, but stable joint, while 3<sup>rd</sup> type are

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unstable and displaced. 2<sup>nd</sup> and 3<sup>rd</sup> Type are further sub classified into uncomminuted (A) or with comminution(B).

Cast splints at 45-90° of flexion can be applied to patients with non-displaced type I olecranon fractures.<sup>3</sup> Since most of these fractures are displaced, therefore these fractures need internal fixation. Various internal fixation techniques are available for olecranon fractures such as figure of 8 steel wire fixation, anatomical locking plate, intramedullary fixation using screw or rush nails and excision of fractured fragments in case of severe comminution, however the most frequently applied procedures are tension band wiring and more rigid method of plate and screws fixation.<sup>6,8,9</sup> These two fixation methods have equal and comparable results particularly in mayo type II uncomminuted variety, which are the most usual types. Plate fixation is a good alternative particularly in comminuted and unstable fractures.<sup>10, 11</sup> Tension Band Wiring (TBW) first described by Weber and Vasey<sup>12</sup> is a relatively simple and easy procedure which can be performed by even junior residents during early training.<sup>2</sup> It requires minimum instrumentation and implants in comparison to plate fixation.<sup>13</sup> Although there are chances of proximal migration and protrusion of implant (K-Wires) related to this procedure necessitating its removal<sup>4</sup>, implant prominence is less likely since smaller amount of implant is used in TBW in contrast to plate fixation.<sup>13,14</sup> In addition TBW is better in terms of cost and operative time in comparison to plate fixation<sup>14</sup> particularly in our part of the world. Rate of infection and revision surgery is also found to be low in TBW technique than other methods like plate fixation.<sup>14</sup>

The local data on this topic is sparse. The present study was designed not only to generate local data but also to authenticate the previous literature. The rationale of our study was to evaluate the functional results of tension band wiring in patients with olecranon fractures.

### Materials and Methods

This prospective case series was conducted at the Department of trauma and Orthopedic Surgery, Jinnah Postgraduate Medical Centre, Karachi from December 2017 to June 2018. A total of 62 participants between age ranges of 18 to 50 years of either sex with displaced and uncomminuted

olecranon fractures less than one week old were recruited from emergency or outpatient department with Confidence level of 95%. Technique used to collect sample was Non-probability consecutive.

Patients with Comminuted fracture (presence of multiple bone fragments on X-rays), associated distal humerus fracture (assessed on physical examination and fracture confirmed on X-rays), open fracture (presence of wound along with the fracture), infection at the fracture site (presence of redness, hot, tender on physical examination or presence of discharge from the wound), and with neurovascular deficit (wrist drop or no sensation in hands on pin prick was taken as Neurovascular deficit ) were ruled out from the study.

Permission was obtained from the institutional review board and Patients were considered for study on meeting the inclusion criteria and informed consent was taken from the patients. The purpose, procedure, risks and benefit of the study were explained to all the patients. Confidentiality of the study participants was ensured. Relevant history such as age, gender, BMI, duration of fracture, smoking status (patients smoking 5 or more cigarettes per day for more than 6 months or more), history of comorbid conditions like diabetes mellitus and hypertension (known case of hypertension for more than 2 years or more on treatment assessed through physicians prescription and patients record) was obtained.

Surgery was done by a senior resident (year two or beyond) or author himself. The procedure was performed in lateral decubitus position after the induction of general anesthesia under pneumatic tourniquet control applied at the upper arm. The incision was made posteriorly in midline curving around the olecranon tip and the fracture was explored and reduced. The fracture was fixed with two parallel k-wires inserted just distal to the olecranon tip and engaged into the opposite (anterior) border of the ulna. Anchoring in the opposite cortex of the ulna avoids migration of the implant in proximal direction. The circlage wire was passed through a bone tunnel just distal to the fracture and tightened in a figure of eight manner. Patients were discharged and followed in outpatient department on regular interval. Functional Outcome was assessed using Mayo elbow performance score<sup>15</sup>

at the end of three months postoperatively. This system is based on points in four categories which include: pain (45 points), motion arc (20points), stability (10 points), and daily function (25 points) with a maximum of 100 points. Excellent score is 90-100 points, good 75-89, fair 60-74 and poor score less than 60 points. Excellent and good results were considered as satisfactory.

Data was entered and analysis was done on Statistical package for social sciences (SPSS) version 21 for windows. Age of the patients and duration of fracture, height, weight, body mass index and mayo elbow performance score was presented as mean ± standard deviation. Gender, smoking status, history of diabetes mellitus and hypertension and functional outcome as excellent, good, fair and poor and satisfactory outcome was presented in terms of frequencies and percentages.

Effect modifiers/confounders like age, duration of fracture, gender, smoking status, body mass index, history of diabetes mellitus and hypertension was dealt through stratification to see the effect of these on outcomes. Post stratification chi square test was applied and significance level was set at 0.05.

**Results**

A total of 62 patients with closed olecranon uncomminuted fractures were included in our series. The average age of the patients was 35.03 ± 7.87 years. Patient related demographics such as Average weight, height, BMI, duration of fracture and MEPS (Mayo Elbow Performance Score) are reported in table I. There were 23(37.1%) female and 39(62.9%) male patients. Hypertension was observed in 45.16% (28/62), and diabetes mellitus in 51.61% (32/62). There were 24(38.71%) smokers and all were men.

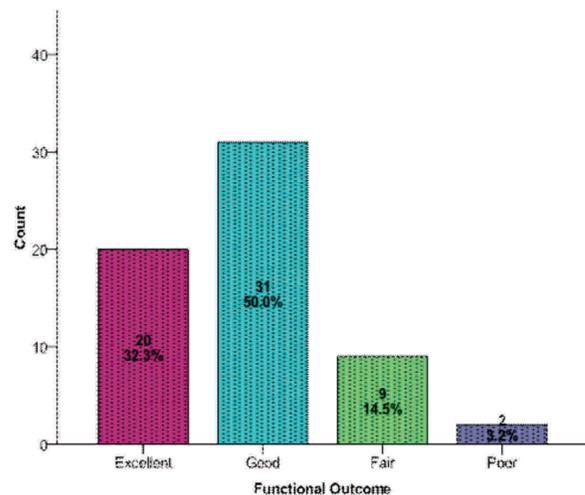
Regarding functional outcome, 20(32.3%) cases had excellent results, 31(50%) good, 9(14.5%) fair and 2(3.2%) had poor results as shown in figure 1. Excellent and good results found in 51(82.26%) cases were considered satisfactory. Regarding complications related to this procedure, we noted proximal migration of wires in 10 patients requiring removal and infection in three patients. Poor results were related to infection and skin breakdown found in two patients.

Satisfactory outcome was significantly high in ≤ 30 years of age patients as compare to above 30 years of age patients (p=0.037) as shown in Table I.

Satisfactory outcome was not statistically significant with gender, hypertension, diabetes mellitus, smoking and obesity while it was significant with duration of fracture.

**Table I: Demographics of the Patients (N=62)**

Variables	Mean
Age (Years)	35.03
Weight (kg)	72.26
Height (cm)	160.97
BMI (kg/m <sup>2</sup> )	27.863
Duration of Fracture (days)	2.97
MEPS	83.11



**Fig 1: Functional Outcome According to MEPS**

**Discussion**

Main purpose of surgical treatment of olecranon fractures is Anatomic restoration and stable fixation which permits immediate movement and decreased postoperative morbidities like joint stiffness.<sup>6,8</sup> Out of the broad range of surgical methods available for internal fixation of these fractures, the method of tension band wiring (TBW) is the unanimously established method.<sup>16</sup> This technique converts tensile surfaces of proximal ulna into compressive forces thereby promoting fracture healing.<sup>2</sup>

We found good to excellent results in more than 80% (Excellent 20, 32.3%, Good 31, 50%) of the cases with mean MEPS of 83.11 ± 10.02 which is supported by national study conducted in 2012 where combined good to excellent results were found near to 80% (Excellent 13, 44.8%. Good 10, 34.5%).<sup>16</sup> Similar results were also found in an international study

conducted by Chalidis BE<sup>17</sup> et al where good to excellent results were observed in 53 (85.5%) patients out of 62 patients. They concluded the TBW as gold standard treatment for displaced but uncomminuted fractures. Long term results are also satisfactory for olecranon fractures treated with TBW. In a prospective study over a period of 20 years, patient related outcomes were excellent in majority of patients and the technique of TBW for olecranon fractures was found to be sufficient and durable.<sup>18</sup>

In a cohort comparison between locking plate and tension band wiring (TBW) used for olecranon fractures, there was no statistically significant difference in functional outcomes measured according to mayo elbow performance score (MEPS).<sup>13</sup> Both groups had excellent to good results in all patients (10 patients in each group). This study further addressed that the cost of locking plate system was nearly double the cost of TBW used for olecranon fractures. Furthermore the operative time required to fix olecranon fractures with TBW was about half an hour less than the plate group.

Various complications reported with TBW technique include palpable implant requiring removal, proximal migration of wires, infection, implant failure, nonunion, arthrosis and radioulnar synostosis.<sup>14,19,20</sup> Although the overall complication rate reported is higher than plate fixation because of the more protruding and painful wires, the more serious complications such as repeat surgeries and infection are more commonly related to plate group<sup>14</sup>. We found prominent implant due to proximal migration in 10(6.2%) patients. In a comparative prospective trial conducted by duckworth AD et al<sup>14</sup>, approximately 50% of the symptomatic patients required implant removal who underwent TBW for olecranon fractures. However none of the patients in TBW group developed infection. Similarly in a recent comparative series of patients with olecranon fractures nine out of 46 patients in TBW group developed prominent hardware which later required removal.<sup>21</sup>

In a study done by Anani A et al<sup>22</sup> out of 63 patients with fractures of the olecranon, six patients developed infection, in contrary to our study where we found infection in three patients which required subsequent implant removal and repeat surgeries to achieve healing. Similarly in a recent retrospective

study, two patients out of 47 in intramedullary group of TBW developed infection.<sup>23</sup> Both patients needed repeat debridements and hardware removal.

We found better results in patients younger than 30 years, although literature is sparse in this regard. This may be related to the impaired inflammatory response and delayed fracture healing with increasing age.<sup>24</sup>

## Conclusion

Tension band wiring is an effective way of treating olecranon fractures particularly those which are displaced and un-comminuted and provide good to excellent functional results in most cases.

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