



(Original Research Article)

## Tension Band Wiring Vs Reconstruction Plate for the Treatment of Proximal Ulna and Olecranon Fractures

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### Abstract

**Aims:** To clinically compare the result of tension band wiring technique for simple transverse fracture of olecranon and proximal ulna & plate fixation for comminuted fracture of olecranon and proximal ulna and to discuss the merits and demerits of each procedure.

**Materials and Methods:** 30 consecutive cases of the fracture of the olecranon or proximal ulna of skeletally mature patients of either sex, admitted in the Department of Orthopaedics, Rajindra Hospital and Government Medical College, Patiala were taken up for the study. Patients with Olecranon fractures were distributed alternative into two groups. Group A was managed by open reduction and internal fixation (ORIF) with tension band wiring (TBW), while group B was treated with ORIF with 3.5 mm reconstruction plate. All patients were assessed both clinically with measurement of flexion-extension and pronation- supination arcs and radiologically with elbow X-Rays. Functional outcome was estimated using the criteria laid by Weseley et al (1976), modified by Wolfgang et al (1987).

**Results:** Thirty patients (m: 20, f: 10) with a mean age of 43.7 years were operated. They were assessed at 12 weeks. Final result was Excellent in 20 patients (66.7%), Good in 7 patients (23.3%) and Fair in 3 patients (10%). The fracture olecranon was more common with direct blow on posterior aspect of the elbow (46.7%). Radiological union occurred in all the 30 cases with average union time 13.06 weeks in group A and 13.6 weeks in group B. The complications occurred in 11 (36.7%) cases with group A reporting higher number of complications than group B.

**Conclusion:** Tension band wiring fixation remains the "gold standard" for the treatment of simple transverse fractures while reconstruction plate is more effective treatment option for improved outcome, earlier return to function and decreased rate of complications.

**Keywords:** olecranon, tension band, fracture, ulna, reconstruction plate, union.

## Introduction

Proximal ulna and olecranon fractures are one of the most commonly seen orthopaedic injuries in the emergency room. Olecranon fractures account for about 20% of all proximal forearm fractures and approximately 10% of upper extremity fractures in adults.<sup>1,2</sup> The proximal ulna is a subcutaneous bone that is readily susceptible to trauma. In all fractures of the proximal ulna and olecranon, the severity of the fracture, fracture pattern and concomitant elbow trauma, and ligamentous instability influence surgical decision making and prognosis. The guiding principle in treating these fractures is to restore articular congruity and stability in order to begin a program of early active motion.<sup>3</sup> Fracture of olecranon and proximal ulna occurs due to direct and indirect trauma. Direct trauma as falling on the back of elbow or direct forceful impact at the posterior surface of the elbow. This mostly causes comminuted fracture of the olecranon. Degree of comminution depends on the severity of the trauma. Indirect trauma as falling on partially flexed elbow which can cause an indirect force generated by the pull of triceps muscle causing avulsion of small proximal fragment of the olecranon or two part transverse or oblique fracture.<sup>4,5</sup>

The standard treatment for displaced olecranon fractures is open reduction and internal fixation (ORIF), with typical methods including tension band wiring or plating.<sup>6,7</sup> The chosen method of surgical intervention depends on many factors, including the amount of bone loss, the amount of comminution, the stability of the joint and the ability to reduce the articular surface.

Displaced noncomminuted olecranon fractures were traditionally treated using tension band wiring, which was first described by Weber and Vasey.<sup>8</sup> This method was designed with the theory that early mobilization would create tensile forces across the fracture that would be converted to compression forces and prevent nonunion, while minimizing the loss of range of motion.<sup>9</sup> It has recently been shown that this principle is

applicable only during active extension through a range of 30–120° of elbow flexion.<sup>10</sup> However, tension band wiring remains a popular method of internal fixation of olecranon fractures.<sup>9</sup> The advantages of tension band wiring compared with plate fixation include shorter surgery<sup>11</sup> and lower cost.<sup>12</sup> Fixation with tension band wiring have shown good fracture healing and acceptable range of motion. However, the rates of hardware removal following tension band wiring are significant and reported to be as high as 80%.<sup>13,14</sup> Plating techniques have been used for both comminuted<sup>6</sup> and noncomminuted fractures of the olecranon.<sup>11</sup> Plating offers the advantage of increased stability and may be associated with lower rates of hardware prominence.<sup>6,9,11,14</sup> However, such a construct may be considered too bulky for simpler noncomminuted fractures, be associated with longer surgery and be more costly.<sup>15</sup>

## Material and Methods

In the present study 30 consecutive cases of the fracture of the olecranon or proximal ulna of skeletally mature patients of either sex, admitted in the Department of Orthopaedics, Rajindra Hospital and Government Medical College, Patiala were taken up for the study. These cases were distributed alternatively to two groups as follows:

Group A was treated by open reduction and internal fixation with tension band wiring.

Group B was treated by open reduction and internal fixation with 3.5 mm reconstruction plate.

Cases were classified as per Horne and Tanzer’s Classification<sup>16</sup> (Table-1)

**Table - 1**

Horne and Tanzer Classification of Olecranon Fractures			
I	Transverse	Intraarticular, Proximal 1/3 of Olecranon Articular Surface or Oblique Extraarticular, Involving the tip of the Olecranon	
II	Oblique or transverse, Involving Middle 1/3 of Greater Sigmoid notch		
III	Oblique or transverse, Involving Distal 1/3 of the Greater Sigmoid Notch With or without Coronoid Fracture		

**Postoperative range of motion was initiated within 2 weeks postoperatively.**

**Follow up:**

The patients were examined on 3<sup>rd</sup>, 6<sup>th</sup>, 8<sup>th</sup>, 12<sup>th</sup>, 16<sup>th</sup> and 20<sup>th</sup> week and at four weekly intervals after that. On every visit patients were examined clinically and x-rays of the elbow taken in anteroposterior and lateral view. Radiological signs of union, displacement or any angulation were recorded. Any metal reaction or loosening of

screws was also recorded. Clinically, patients were examined for any tenderness, infection or pain. Movements of elbow were recorded. During the period of follow up, only active exercises in physiotherapy centre or at home were advocated. Every patient of each group then is graded during his follow up for clinical and radiological results as per criteria laid by Weseley et al (1976), modified by Wolfgang et al (1987).<sup>17</sup>

**Table – 2** Showing Basis of Grading

Result	Range of Movement		Pain
	Flexion/Extension	Supination/Pronation	
Excellent	<5 <sup>0</sup> loss	No loss	Absent
Good	<20 <sup>0</sup> loss	Minimum loss	Absent
Fair	>45 <sup>0</sup> useful motion	50% present	Minimal
Poor	<45 <sup>0</sup> useful motion	50% present	Present

**Functional Results**

In this series normal movements of the upper extremity were taken as: -

**Elbow:**

- Flexion 0-145<sup>0</sup>
- Extension 0<sup>0</sup>
- Supination 0-80<sup>0</sup>
- Pronation 0-75<sup>0</sup>

**Discussion**

The patients in our study ranged in age from 20 to 82 years (mean 43.73 years). Mean age of group A was 41.07 years and that of group B was 46.40 years. There is no significant difference between the ages of two groups (p value 0.50 by chi square test). The fracture of olecranon was more common

in males (66.7%) as compared to females (33.3%). Kara *et al* (2012)<sup>18</sup> had shown similar observations where 65.8% were males and 34.2% were females in their studies of 38 patients in the treatment of Olecranon fractures using the two different tension band techniques.<sup>16</sup> The present study showed that the right side was more commonly involved (53.3%). In the present study, the fracture olecranon was more common with direct blow on posterior aspect of the elbow (46.7%) followed by road side accident in 11 cases (36.7%). Only 5 patients (16.7%) had injury subsequent to fall on outstretched hand. The present study showed that the middle one third of the articular surface i.e. type 2 was the most common site of fracture involving 15 (50%) cases.

The findings our study were consistent with those reported by Barhua et al and Horne et al. Barhua *et al* (1998)<sup>19</sup> showed that middle articular surface was most common site of fracture in his study contributing 58.5% of their study cases. Horne and Tanzer (1981)<sup>16</sup> showed that type II fractures constituted the bulk of the cases of their study i.e. 77%. In the present study 30 cases of the fracture of olecranon, 21 cases (70%) were simple. Only 9 (30.0%) cases in this study were comminuted, five of which were road side accident cases. Majority of the cases 23 (76.7%) presented within 48 hours of injury. 5 patients (16.6%) reported within 7 days and 2 cases (6.7%) reported after 7 days but within 21 days of injury. In the present study, 14 (46.4%) cases had of associated injuries.

Radiological union occurred in all the 30 cases with average union time 13.06 weeks in group A and 13.6 weeks in group B (Table – 3). In 14 (46.7%) cases radiological union occurred at 12 weeks. In fourteen (46.7%) cases, 8 (53.4%) cases of both group A and 6 (40%) cases of group B had radiological union at 12 weeks. In 11 (36.7%) cases, 5 (33.3%) of group A and 6 (40%) of group B had union at 16 weeks. 4 cases (13.3%) achieved the union at < 12 weeks. 1 case (3.3%) that too of group B had union at 20 weeks. The difference is statistically not significant (p value 0.71 by chi square test). Hume and Wisset *et al* (1992)<sup>11</sup> showed that in their study radiographic union occurred within 2 to 6 months in 95% of patients with average healing time of 3 months. The average union time in this study was also 13.3 weeks i.e. 3 months. Fan *et al* (1993)<sup>20</sup> reported bony union at 14 weeks. In a study conducted by Roel Langshong *et al* (2013)<sup>21</sup> clinical union was seen at 12 weeks in all cases. Radiological cortical bridging was seen at 12 weeks post-operatively. Macko *et al* (1985)<sup>22</sup> reported radiological union in all the cases at 12 weeks.

In the present study, the complications were encountered in 11 (36.7%) cases (Table – 4). Group A reported higher number of complications as compared to group B. Group A had 8 (72.7%) cases with complications and group B had 3

(10%) cases with complications. Superficial infection occurred in 3 (10%) cases, 2 (13.3) in group A and 1 (6.7%) in group B, which was treated with I/V antibiotics and surgical debridement. In a study conducted by Byron E Chalidis *et al* (2008)<sup>23</sup>, wound infection developed in 4 patients (6.5%). Only one (3.3%) that too in group A had deep seated infection which resulted in loosening of K-wires and its proximal migration. This patient was treated with implant removal after the bone healed along with I/V antibiotics resulting in resolution of infection. Proximal migration of k-wires was present in 1 (6.7%) patient that belonged to group A. In a study by Hume *et al* (1992)<sup>11</sup> conducted on forty-one adult patients with olecranon fractures treated with open reduction internal fixation with k-wires, true k-wire migration was seen in only one patient. Most common complication was symptomatic metal skin impingement in 7 (23.3%) cases, 4 (57.1%) in group A and 3 (42.9%) in group B. Laura Wiegand *et al* (2012)<sup>24</sup> in his study found that the most common complication after surgical treatment of olecranon fractures was symptomatic hardware, with tension-band wiring having a greater incidence than plate fixation. The complication rate was statistically not significant (p value 0.93) but comparable. Hume *et al* (1992)<sup>11</sup> suggested plate fixation should be strongly considered when treating displaced olecranon fractures. He compared TBW and plate fixation and showed that PF is superior to TBW, as prominence of the metal was frequently observed in TBW (42%). No case of delayed union or non-union complicated the post-operative period. Ulnar nerve injury was present in 2 (6.7%) cases, 1 case each in group A and group B. Stiffness of elbow joint was another common complication that occurred in 7 (23.3%) cases. Out of 7 cases, 4 (57.1%) belonged to group A and 3 (42.9%) belonged to group B. In a study by Wolfgang *et al* (1987)<sup>35</sup> loss of motion in terminal extension and elbow joint stiffness was a common aftermath occurring in 59% cases of displaced olecranon fractures treated with tension band

wiring. Various degrees of postoperative elbow stiffness and deficit of range of motion have been reported in literature after surgical treatment of olecranon fractures.



post op patient in pronation and supination



Pre- op.



Post-op. union

### Functional Assessment

In the present study, 66.7% patients had excellent results with 23.3% having good results, 10% had fair results and no implant failure was seen. In group A 9 (60%) cases had excellent results with 4 cases (26.7%) had good results. There were 2 (13.3%) cases with fair outcome in group A, both of these cases had comminuted fracture treated

with tension band wiring. 86.7% patients achieved good to excellent results in group A. In group B 11 (73.3%) cases had excellent results with 3 (20%) cases showing good results. In this group one case (6.7%) had fair outcome. In both the groups, none of the patient showed failure of implant. 93.3% patients in group B achieved good to excellent results. The difference was statistically not significant (p value 0.71 by chi square test) but comparable. The findings of the study are consistent with the findings of Schliemann B *et al* (2014)<sup>12</sup> who showed that 92% patients operated with plate osteosynthesis achieved a good to excellent results in comparison to 77% patients treated with TBW.

Byron E Chalidis *et al* (2008)<sup>23</sup> reported good to excellent results in 85.5 % patients treated with TBW. Konig *et al* (1990)<sup>25</sup> found 60 % excellent and good results with plate osteosynthesis of comminuted fracture of the olecranon. Hume and Wiss *et al* (1992)<sup>11</sup> showed 79% good and fair results with TBW and 91% good and fair results with plate fixation. Doursounian *et al* (1994)<sup>26</sup> reported 87% cases had good functional results and 13% fair functional results after tension band wiring of the olecranon fractures. Baruah (1998)<sup>19</sup> evaluated 72% excellent and 23 % good results after tension band wiring of olecranon without K-wires. Bailey (2001)<sup>27</sup> reported 88% excellent or good results after plate fixation of displaced fracture of the olecranon. Akman (2002)<sup>28</sup> found results of tension band wiring very good and good in 76% of his cases. Karlsson (2002)<sup>29</sup> reported 96% excellent or good results by open reduction and internal fixation with various implants in isolated closed olecranon fractures.

**Table 3** Showing Radiological Union

Time in weeks	Group A		Group B		Total	%age
	No. of cases	%age	No. of cases	%age		
<12 weeks	2	13.3	2	13.3	4	13.3
12 weeks	8	53.4	6	40.0	14	46.7
16 weeks	5	33.3	6	40.0	11	36.7
20 weeks	-	-	1	6.7	1	3.3
> 20 weeks	-	-	-	-	-	-
Total	15	100.0	15	100.0	30	100.0

**Table 4** Showing Complications

Complication	Group A		Group B		Total	%age
	No. of cases	%age	No. of cases	%age		
Superficial infection	2	13.3	1	6.7	3	10.0
Deep infection	1	6.7	-	-	1	3.3
Delayed union	-	-	-	-	-	-
Non union	-	-	-	-	-	-
Symptomatic metal skin impingement	4	26.7	3	20.0	7	23.3
Implant loosening (plate loosening/proximal migration)	1	6.7	-	-	1	3.3
Implant exposure	-	-	-	-	-	-
Implant failure	-	-	-	-	-	-
Ulnar nerve injury	1	6.7	1	6.7	2	6.7
Stiffness of elbow joint	4	26.7	3	20.0	7	23.3

**Conclusion**

TBW is still the most widely applied method to operatively manage olecranon fractures, with the transcortical method of using K-wires the most satisfactory. Plate fixation is a good alternative as complications are minimal. The cost effectiveness of tension band wiring is better to 3.5 mm reconstruction plate but comparing the clinical and radiological results of both the groups the 3.5 mm reconstruction plate shows better clinical and radiological statistics than TBW. The major deterrent for using tension band wiring for displaced comminuted fractures is that plating provides better stability. We conclude that reconstruction plate fixation is an effective treatment option for comminuted olecranon fractures with a good functional outcome and a low incidence of complications while TBW is sufficient in majority of the cases with simple transverse fractures.

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