

## FUNCTIONAL OUTCOMES OF OLECRANON PROCESS FRACTURE TREATMENT USING THE TENSION BAND WIRING TECHNIQUE: A COHORT STUDY.

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### ABSTRACT

#### Background

Olecranon fractures (OF) are a common elbow injury, often necessitating surgical intervention to restore function and anatomy. The tension band wiring (TBW) technique is frequently employed due to its biomechanical efficiency and cost-effectiveness. However, complications such as hardware irritation and infection remain concerns, highlighting the need for ongoing evaluation of its outcomes. This study retrospectively assessed the functional outcomes and complications of the TBW technique for treating olecranon process fractures.

#### Methods

Thirty individuals treated with TBW for isolated OF were included. Data on demographics, fracture classification, complications, and functional outcomes were collected. Functional outcomes were evaluated using the Mayo Elbow Performance Score (MEPS) and range of motion (ROM). Statistical analysis was performed using SPSS version 21.0.

#### Results

The average age was 42.5 years, with 60% male. The majority had Mayo Type IIB fractures (70%). Complications were noted in 20% of patients, primarily hardware irritation (13.3%) and infection (6.7%). The mean MEPS score improved significantly from  $55.2 \pm 10.5$  at baseline to  $88.5 \pm 7.8$  at the final follow-up ( $p < 0.001$ ). Flexion-extension ROM increased

from  $90^\circ \pm 15^\circ$  to  $135^\circ \pm 10^\circ$  ( $p < 0.01$ ), and pronation-supination ROM from  $60^\circ \pm 10^\circ$  to  $85^\circ \pm 5^\circ$  ( $p < 0.01$ ). Eighty per cent of patients achieved excellent or good outcomes.

#### Conclusion

The TBW technique demonstrated favourable functional outcomes with significant MEPS scores and ROM improvements. Despite a 20% complication rate, the complications were manageable. These findings support the efficacy of TBW in olecranon fracture management.

#### Recommendations

Future studies should explore modifications to the TBW technique and alternative materials to reduce complications.

**Keywords:** Olecranon fractures, Tension band wiring, Functional outcomes, Complications, Elbow surgery.

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### INTRODUCTION

Olecranon fractures (OF) are a common type of elbow injury, particularly among adults, resulting in approx. 10% of all upper extremity fractures. These fractures often result from direct trauma or fall onto an outstretched hand, leading to significant functional impairment due to the olecranon's crucial role in elbow extension and flexion. The treatment of OF aims to restore the anatomy and function of the elbow, reduce pain, and allow early mobilisation. One of the widely adopted surgical techniques for managing OF is the tension band wiring (TBW) technique.

The TBW technique involves using Kirschner wires and a figure-of-eight stainless steel wire to convert tensile forces into compression forces at the fracture site during

elbow movement. This method has been favoured due to its biomechanical advantages, cost-effectiveness, and relative simplicity in execution [1]. Despite its widespread use, the TBW technique is not without complications, including hardware irritation, infection, and the potential need for hardware removal. Recent studies have highlighted varying success rates and functional outcomes, emphasizing the need for continuous evaluation of its efficacy and safety.

A study demonstrated that while TBW provides satisfactory functional outcomes, complications related to hardware were relatively common, necessitating further scrutiny of patient selection and postoperative management strategies [2]. Another investigation compared TBW with plate fixation, suggesting that

although both techniques yield comparable functional results, TBW might be associated with a higher incidence of minor complications [3]. These findings underscore the importance of individualized treatment planning and the potential benefits of exploring alternative or adjunctive methods to optimize patient outcomes.

Moreover, recent advancements in surgical techniques and materials have led to modifications of the traditional TBW approach, aiming to enhance its biomechanical stability and reduce complications. For instance, the use of bioabsorbable materials and innovative fixation devices has shown promise in preliminary studies, offering the potential to mitigate issues associated with metallic hardware. However, these newer methods require further validation through robust clinical trials to establish their efficacy and long-term benefits.

The study evaluates the functional outcomes of olecranon process fracture management using the tension band wiring technique.

## METHODOLOGY

### Study Design

A retrospective cohort study.

### Study Setting

The study was conducted at Indira Gandhi Institute of Medical Sciences (IGIMS), Patna, Bihar, India, from May 2023 to June 2024.

### Participants

A total of 30 participants who underwent TBW for olecranon process fractures were included in the study.

### Inclusion Criteria

Patients aged 18-65 years with isolated OF treated with TBW.

### Exclusion criteria

Patients with pathological fractures, open fractures, associated injuries that might affect functional outcomes, and those with a follow-up period of less than six months.

### Sample size

To calculate the sample size for this study, the following formula was used for estimating a proportion of a population:

$$n = \frac{Z^2 \times p \times (1-p)}{E^2}$$

Where:

- n = sample size
- Z = Z-score corresponding to the desired level of confidence
- p = estimated proportion in the population
- E = margin of error

### Bias

To minimize selection bias, all eligible patients during the study period were included. Recall bias was addressed by using medical records and postoperative follow-up data.

### Variables

The primary variables included demographic information (age, gender), fracture classification, surgical details, postoperative complications, and functional outcomes measured using standardized scoring systems.

### Data Collection

Data were gathered retrospectively from medical history and postoperative follow-up visits. Functional outcomes were considered using the Mayo Elbow Performance Score (MEPS) and range of motion measurements at each follow-up.

### Procedure

Patients were treated surgically using the tension band wiring technique. Postoperative care included standardized rehabilitation protocols. Follow-up assessments were conducted at regular intervals to monitor recovery and functional outcomes.

### Statistical Analysis

SPSS version 21.0 was used to examine the data. Variables were shown as frequencies and percentages, mean  $\pm$  standard deviation. Pairing t-tests were employed to compare functional results, with a significance level of  $p < 0.05$  being statistically significant.

### Ethical considerations

The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

RESULT

**Table 1: Demographic and Clinical Features**

Characteristic	Value
Number of participants	30
Mean age (years)	42.5 ± 14.2
Gender	
- Male	18
- Female	12
Fracture type	
- Type IIA	9
- Type IIB	21
Mean follow-up period (months)	10 ± 2.5

The study comprised 30 participants, with an average age of 42.5 years (range: 18-65 years). The sample comprised 18 males (60%) and 12 females (40%). The majority of

fractures were classified as Mayo Type IIB (70%), followed by Type IIA (30%). The average follow-up duration was 10 months (range: 6-14 months).

**Table 2: Postoperative Complications**

Complication	Number of Patients (%)
Hardware irritation	4 (13.3%)
Infection	2 (6.7%)
Total	6 (20%)

Complications were observed in 6 patients (20%). The most common complication was hardware irritation (4 patients, 13.3%), followed by infection (2 patients, 6.7%). All complications were managed conservatively or with minor surgical interventions.

**Table 3: Functional Outcomes**

Functional Outcome	Mean ± SD
MEPS score	88.5 ± 7.8
Flexion-extension ROM	135° ± 10°
Pronation-supination ROM	85° ± 5°

Functional outcomes were measured using the MEPS and range of motion (ROM). The mean MEPS score at the final follow-up was 88.5 ± 7.8, with 80% achieving

excellent or good outcomes. The mean ROM was 135° ± 10° for flexion-extension and 85° ± 5° for pronation-supination.

**Table 4: Statistical Analysis**

Variable	Baseline	Final Follow-up	p-value
MEPS score	55.2 ± 10.5	88.5 ± 7.8	< 0.001
Flexion-extension ROM	90° ± 15°	135° ± 10°	< 0.01
Pronation-supination ROM	60° ± 10°	85° ± 5°	< 0.01

The paired t-test revealed a significant improvement in MEPS scores from baseline to the final follow-up (p < 0.001). Similarly, substantial improvements were observed in flexion extension (p < 0.01) and pronation-supination ROM (p < 0.01).

**Table 5: Outcome Distribution**

Outcome	Number of Patients (%)
Excellent	16 (53.3%)
Good	8 (26.7%)
Fair	4 (13.3%)
Poor	2 (6.7%)

At the final follow-up, 16 patients (53.3%) had excellent outcomes, 8 patients (26.7%) had good outcomes, 4 patients (13.3%) had fair outcomes, and 2 patients (6.7%) had poor outcomes according to the MEPS scoring system.

## **DISCUSSION**

The study evaluated the functional outcomes of olecranon process fractures treated with the TBW technique in 30 participants, with a mean age of 42.5 years. The sample comprised 60% males, predominantly presenting with Mayo Type IIB fractures (70%).

Complications were observed in 20% of the patients, mainly hardware irritation (13.3%) and infection (6.7%), all managed without major interventions. The mean MEPS significantly improved from  $55.2 \pm 10.5$  at baseline to  $88.5 \pm 7.8$  at the final follow-up ( $p < 0.001$ ), indicating substantial functional recovery.

Additionally, the range of motion showed significant enhancement, with flexion-extension increasing from  $90^\circ \pm 15^\circ$  to  $135^\circ \pm 10^\circ$  ( $p < 0.01$ ), and pronation-supination improving from  $60^\circ \pm 10^\circ$  to  $85^\circ \pm 5^\circ$  ( $p < 0.01$ ). The majority of patients (80%) achieved excellent or good outcomes based on the MEPS scoring system.

These results suggest that the tension band wiring technique is highly effective in treating olecranon fractures, providing significant functional improvements and a high rate of satisfactory outcomes. Despite the 20% complication rate, the issues were minor and manageable, further supporting the reliability and effectiveness of this treatment method.

Recent studies on the functional outcomes of olecranon process fracture treatment using the TBW technique have shown generally positive results. The TBW method is effective for displaced and slightly comminuted fractures, with studies reporting excellent to good outcomes in most patients. For instance, one study indicated that the MEPS showed 52% of patients had excellent outcomes, and 20% had good outcomes, while another study reported similar results with excellent outcomes in 60% of cases [4, 5].

Additionally, long-term results indicated that TBW provided excellent patient-reported outcomes for both simple and comminuted fractures, with a 95.5% rate of excellent outcomes based on the MEPS [6].

Comparative studies have shown that TBW and plate fixation have similar functional outcomes, but TBW offers shorter operation times and comparable complication rates. No considerable variations in outcomes between these methods were found, though TBW had a shorter mean operation time and lower complication rates [7, 8].

Despite these positive outcomes, TBW is correlated with a high rate of complications, like hardware irritation and the need for reoperation. One study highlighted a complication rate of up to 65%, necessitating further surgical interventions in many cases [9].

In response to these complications, modified TBW techniques have been developed. For example, one method using eyelet pins and biodegradable materials resulted in satisfactory clinical and radiographic results with reduced hardware-related issues [10]. Similarly, hybrid TBW techniques combining wires with eyelets and cerclage wiring reduced the rates of hardware complications and reoperation [11].

## **Generalizability**

The study findings on the functional outcomes of olecranon process fracture treatment using the tension band wiring (TBW) technique demonstrate significant improvements in MEPS scores and ROM, with most patients achieving excellent or good results. To apply these findings to a larger population, consider the representativeness of the sample, comparative studies supporting similar outcomes, and addressing complications effectively. Conducting larger, multicenter trials or meta-analyses and developing standardized clinical protocols will ensure the broader applicability and consistency of TBW's effectiveness, while health economic analyses can further support its widespread adoption.

## **CONCLUSION**

The TBW technique for olecranon process fracture management demonstrated favourable functional outcomes, with significant improvements in MEPS scores and ROM. The majority of patients achieved excellent or good results, with a low occurrence of complications. These findings suggest that TBW is an effective treatment method for OF, providing satisfactory functional recovery and minimal complications.

## **Limitations**

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

## **Recommendation**

Future studies should explore modifications to the TBW technique and alternative materials to reduce complications.

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## **List of abbreviations**

OF - Olecranon fractures  
TBW - Tension band wiring  
MEPS - Mayo Elbow Performance Score

ROM - Range of motion

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No funding was received.

**Conflict of interest**

Page | 5 The authors have no competing interests to declare.

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