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# Functional and Radiological Outcome of Transverse Olecranon Fracture Treated with Tension Band Wiring: Prospective Study

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**Abstract**

Fractures of the olecranon account for up to 10 % of all upper extremities fractures. Displaced transverse olecranon fracture is one of the most common fracture that requires surgery in the elbow joint. Olecranon fractures are commonly caused by a direct blow to the elbow, fall from a height, motor vehicle accidents. Fredrick Pauwel stated the principle of Tension Band Wiring (TBW) in 1935, regarding treatment of avulsion fractures like Olecranon, Patella and Medial Malleolus. If a fracture has to unite, it requires mechanical stability, which is obtained by compression of the fracture fragments. The principle of Tension band wiring is conversion of tensile forces into compressive forces. In this study, we are going to determine whether the tension band wiring is still a gold standard treatment for transverse fractures of olecranon even after evolution of various new fixation techniques. We are determining the functional outcome of TBW in transverse fractures of olecranon using Mayo Elbow Performance Score. To study the functional and radiological outcome of Transverse Olecranon Fracture Treated With Tension Band Wiring. After getting institutional human ethical committee and research committee approval, This Prospective Study, Nonprobability sampling technique, the study was conducted among 20 patients in Sree Mookambika Institute of Medical Sciences, Kulasekharam, who were diagnosed to have transverse fractures of patella and olecranon. We included patients with age >18 years, both males and females with closed displaced transverse fractures of olecranon (Mayo classification type II-A). We excluded patients with age <18 years, open fractures, mayo classification types I, II-B and III of olecranon fractures any established deformity elbow prior to the fracture and ligament injuries associated with fracture. Patients were treated with Open Reduction and Internal Fixation with Tension Band Wiring. The patients were regularly followed up for a period of 6 months in regular intervals at 4, 8, 12 and 24 weeks. Functional outcome of olecranon was measured using Mayo Elbow Performance Score. The data collected was subjected to data entry in MS Excel. The data was analysed using SPSS ( SPSS inc IBM Chicago city, Illinois state, USA) Version 20.0 using Chi square test. In our study, the functional outcome was assessed by using Mayo Elbow Performance Score among 20 patients with olecranon fracture; Based on the score the patients were graded as Excellent, Good, Fair and Poor. According to this score, 13 (65%) patients had excellent outcome, 5 (25%) patients had Good outcome, 1 (5%) patient had fair and poor outcome each. Transverse fracture of olecranon can be effectively treated with Tension Band Wiring. It is relatively a simple, inexpensive procedure which gives excellent to good functional results. A good surgical technique, optimal operation room environment, and judicious use of antibiotics will reduce the possibility of infection which intended results in excellent functional outcome. Physiotherapy protocol also plays an important role to improve overall functional outcome to overcome the late complications However, more number of cases are needed to determine the long term complications.

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**Key Words**

Transverse olecranon fracture, tension band wiring (tbw), mayo classification, mayo elbow performance score

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## INTRODUCTION

Fractures of the olecranon account for up to 10 % of all upper extremities fractures[1]. Displaced transverse olecranon fracture is one of the most common fracture that requires surgery in the elbow joint. Olecranon fractures are commonly caused by a direct blow to the elbow, fall from a height, motor vehicle accidents.

Fredrick Pauwel stated the principle of Tension Band Wiring (TBW) in 1935, regarding treatment of avulsion fractures like Olecranon, Patella and Medial Malleolus. If a fracture has to unite, it requires mechanical stability, which is obtained by compression of the fracture fragments. The principle of Tension band wiring is conversion of tensile forces into compressive forces[2]. This improves the fracture healing and stability is improved when tensile force is reduced at the fracture site. Tension band wiring enables immediate motion at the involved joints, which helps in improving the functional outcome.

Many treatment modalities are used for olecranon fractures such as tension band wiring, various types of plate and screw fixations and other evolved techniques like single intra medullary cancellous screw, crossing screw fixations, but still there is controversy regarding the proper modality of treatment. The main aim of tension band wiring (TBW) is to realign the fracture and bring stability to the elbow joint in transverse olecranon fractures.

In this study, we are going to determine whether the tension band wiring is still a gold standard treatment for transverse fractures of olecranon even after evolution of various new fixation techniques. We are determining the functional outcome of TBW in transverse fractures of olecranon using Mayo Elbow Performance Score[3]

## MATERIALS AND METHODS

After getting institutional human ethical committee and research committee approval, This Prospective Study, Nonprobability sampling technique, the study was conducted among 20 patients in Sree Mookambika Institute of Medical Sciences, Kulasekharam, who were diagnosed to have transverse fractures of patella and olecranon. We included patients with age >18 years, both males and females with closed displaced transverse fractures of olecranon (Mayo classification[4] type II-A). We excluded patients with age <18 years, open fractures, mayo classification types I, II-B and III of olecranon fractures any established deformity elbow prior to the fracture and ligament injuries associated with fracture. All the patients involved in the study were initially evaluated and stabilized in emergency room and after which patient is shifted to X-ray and if need CT scan was taken for better understanding of the fracture configuration followed which patient was admitted in orthopaedic ward and patient was explained in detail and informed consent forms were obtained. All required blood investigations were done. Patients were treated with Open Reduction and Internal Fixation with Tension Band Wiring. The patients were regularly followed up for a period of 6 months in regular intervals at 4, 8, 12 and 24 weeks. Functional outcome of olecranon was measured using Mayo Elbow Performance Score[5]. Patients were evaluated for complications such as infection, skin necrosis, k-wire migration, stiffness. The data collected was subjected to data entry in MS Excel. The data was analysed using SPSS ( SPSS inc IBM Chicago city, Illinois state, USA) Version 20.0 using Chi square test.

The key steps of the procedure are (1) preoperative planning with careful assessment of radiographs, (2) positioning the patient supine and gaining exposure with a posterior longitudinal direct midline incision, raising lateral and medial fascio cutaneous flaps and developing subperiosteal dissection in the interval between the flexor carpi ulnaris and extensor carpi ulnaris to visualize the fracture, (3) visual reduction maintained with a pointed reduction clamp, with joint congruity confirmed with an image intensifier if needed, (4) creation of the TBW construct with 2 parallel 1.6-mm Kirschner wires passed longitudinally from the proximal fragment into the distal part of the ulna, engaging the anterior cortex with care and a 1.2-mm flexible cerclage wire placed through a transverse tunnel 3-4 cm distal to the fracture, passed posterior to the 2 Kirschner wires and secured in a figure-of-8 configuration, (5) appropriate tensioning of the construct followed by trimming and burial of the wire ends, (6) layered wound closure according to surgeon preference and (7) a postoperative protocol consisting of application of an above-the-elbow synthetic bandage, which is worn for 10-14 days and gentle active mobilization under physiotherapy supervision. We advise against heavy lifting for at least 6-8 weeks and do not routinely remove implants unless they are symptomatic.

## RESULTS AND DISCUSSIONS

In our study population, the age group of patients who sustained transverse olecranon fracture, ranges from 20-65 years. The mean age of the study was 38 years. The majority of patients were between the age group of 20 and 45 years (75%).

In our present study the gender distribution was 17 (85%) males and 3 (15%) females of transverse olecranon fracture, which shows male predominance which is owing to more incidence of Road traffic accidents among males.

In our study of 20 patients with transverse olecranon fractures, the most common mode of injury

was found to be Road Traffic Accident (RTA) which is encounter 12 (60%) patients, followed by 5(25%) patients had history of domestic fall injury and 3(15%) patients had history of assault and least one patient (5%) had sports related injury. (Fig. 1).

Among 20 cases of transverse olecranon fractures, 11 (55%) were on right side and remaining 9 (45%) were on left side and 11 (55%) patients had direct mechanism of injury and remaining 9 (45%) patients had indirect mechanism of injury. 19 (95%) patients did not have any associated injuries whereas 1 (5%) patients had associated injuries in which 1 (2.5%) olecranon fracture patient had distal humerus fracture. In our study, Among 20 patients with olecranon fracture, 15 (75%) patients had union time in around 10-12 weeks, 3 (15%) patients had union time in 13-18 weeks and 2 (10%) patients had union time in 8-9 weeks. (Fig. 2).

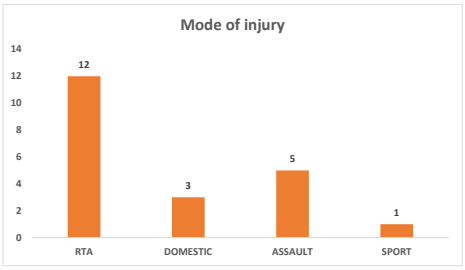


Fig. 1: Mode of injury for patella and olecranon fractures in our study cases

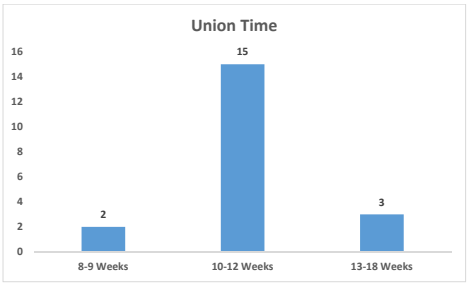


Fig. 2: Union time for patella and olecranon fractures in our study cases

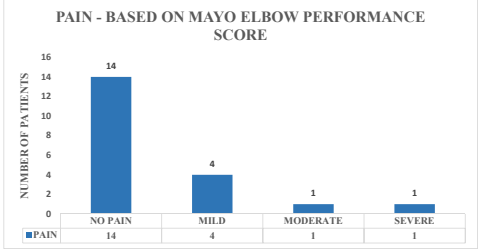


Fig. 3: Pain-based on Mayo Elbow Performance Score

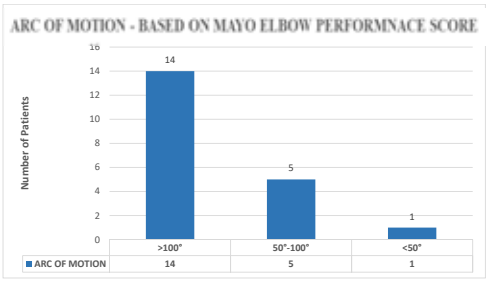


Fig. 4: Arc of motion-based on Mayo Elbow Performance Score


Fig. 5: Functional results of TBW in transverse Olecranon and Patella fracture cases

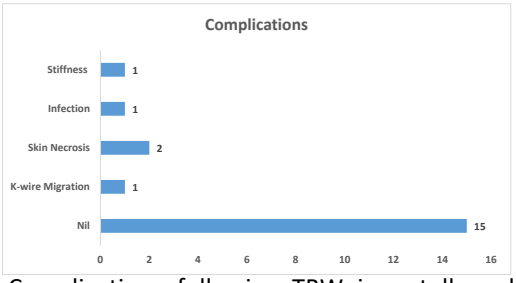


Fig. 6: Complications following TBW in patella and olecranon fractures in our study cases

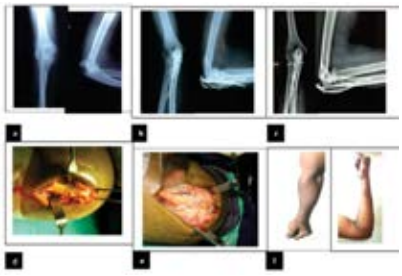

Figure 7: Case 1: (a) Preoperative X-Ray, (b) Immediate postoperative X-ray, (c) 12-week follow-up X-ray, (d) and (e)Intra-operative pictures, (f) Postoperative elbow extension and flexion.

Fig. 8: Case 2: Poor results and associated factors (a) Transverse olecranon fracture-with associated humerus fracture and

**Table 1: Comparison of average union time for olecranon fracture.**

| Study | Average union time for olecranon |
|---|---|
| Wu *et al*[7] | 14-18 weeks |
| Present Study | 10-12 weeks |

**Table 2: Comparison of functional outcome for olecranon fracture with other studies.**

| Studies | Transverse Olecranon fracture | | | |
|---|---|---|---|---|
| | Excellent | Good | Fair | Poor |
| Ahmed *et al*[8] | 40 | 33.3 | 20 | 6.7 |
| Pandit, Shah *et al*[9] | 75 | 25 | - | - |
| Mathews on *et al*[10] | 90.48 | 9.52 | - | - |
| Karra Bansilal *et al*[11] | 60 | 20 | 13.3 | 6.66 |
| Maini and Kochar *et al*[12] | 46.2 | 46.2 | 7.6 | - |
| Present Study | 65 | 25 | 5 | 5 |

Out of 20 patients with olecranon fracture, 14 (70%) patients had no pain, 4 (20%) had mild pain, 1 patient (5%) had moderate pain, 1 patient (5%) had severe pain, based on Mayo Elbow Performance Score[5] (Fig. 3).

Out of 20 patients with olecranon fracture, 14 patients (70%) had Arc of Motion >100°, 5 patients (25%) had Arc of Motion 50°-100° and remaining 1 patient (5%) had Arc of Motion <50° based on Mayo Elbow Performance Score[5] (Fig. 4).

In our study, the functional outcome was assessed by using Mayo Elbow Performance Score[6] among 20 patients with olecranon fracture, Based on the score the patients were graded as Excellent, Good, Fair and Poor. According to this score, 13 (65%) patients had excellent outcome, 5 (25%) patients had Good outcome, 1 (5%) patient had fair and poor outcome each. (Fig. 5).

In our study population, of 20 patients with olecranon fracture, Nil complication in 15 (75%) patients, 1 (5%) patient had K-wire migration, 2 (10%) patients had skin necrosis, 1 (5%) patient had infection and 1 (5%) patient had Elbow stiffness. (Fig. 6).

Our study main aim to assess the functional and radiological outcome of transverse olecranon fracture treated with Tension Band Wiring which shows favourable results. The results will be analysed and compared in the following discussion.

In our study population, the age group of patients who sustained transverse olecranon fracture, ranges from 20-65 years. The mean age of the study was 38 years. The majority of patients were between the age group of 20 and 45 years (75%). Saurabh Kumar[5] (2022) the age group of patients who sustained transverse olecranon fracture, ranges from 20-75 years. The mean age of the study was 43.2 years.

In our present study, there was 17 (85%) males and 3 (15%) females among transverse olecranon fracture. A study conducted by P.M. Rommens[6] in which There were 47 male patients and 48 female patients among olecranon fracture, which is comparable with present study.

In our study of 40 cases with both transverse olecranon fractures, the most common mode of injury was found to be Road Traffic Accident (RTA) in both olecranon 12 (60%) and patella fractures 13 (65%). Domestic in nature was around 9 (22.5%), Sports injury and Assault type was around 3 (7.5%) each which were the least common mode of injury.

Wu[7] (2010) had average union time of 14-18 weeks for transverse fracture of olecranon and in our study the average union time was 10-12 weeks. (Table 1).

The results of TBW in our study are compared with Ahmed[8], Pandit, Shah[9] ,Mathewson[10], Karra Bansilal[11], Maini and Kochar[12] for transverse fracture of olecranon. In that, study done by Ahmed[8], excellent outcome were 40% good outcome were 33.3%, fair outcome were 20% and poor outcome were 6.7%, in Pandit, Shah[9] series excellent outcome were 75% ,good outcome were 25% and there is no fair and poor outcome reported And similarly Karra Bansilal[11] had excellent outcome of 60%, good were 20%, fair were 13.3 % and poor outcome were 6.66%. The functional outcome in our present study (Fig. 7) with olecranon fracture had reviled that excellent outcome with 13 (65%), fair outcome with 5 (25%), fair outcome with 1 (5%) and poor outcome with 1 (5%) which is comparable with above mentioned studies (Table 2). One patient with poor outcome had stiffness due to associated distal humerus fracture for which plate fixation done (Fig. 8).

In our study population, out of 20 patients with olecranon fracture, nil complications in 15 (75%) patients, 1 (5%) patient had K-wire migration, 2 (10%) patients had skin necrosis, 1 (5%) patient had infection and 1 (5%) patient had Stiffness over elbow joint. Rommens[6] in his study about patients with olecranon fracture, had implant migration of 9.5%, delayed healing of 3.2%, infection of 2.1% and reinterventions in 14.7 % patients.

## CONCLUSION

Transverse fracture of olecranon can be effectively treated with Tension Band Wiring. It is relatively a

simple, inexpensive procedure which gives excellent to good functional results. A good surgical technique, optimal operation room environment, and judicious use of antibiotics will reduce the possibility of infection which intended results in excellent functional outcome. Physiotherapy protocol also plays an important role to improve overall functional outcome to overcome the late complications However, more number of cases are needed to determine the long term complications.

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