

# Outcome of two knots tension band wiring (TBW) in Mayo type-IIA olecranon fracture

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## Article Info

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Received : 2 January 2022  
Accepted : 16 February 2022  
Available Online : 15 May 2022

ISSN: 2224-7750 (Online)  
2074-2908 (Print)

DOI: <https://doi.org/10.3329/bsmmuj.v15i2.60861>

**Keywords:** Olecranon fracture, tension Band wiring, fixation

### Cite this article:

Choudhury ME, Hossen M, Chowdhury AZ, Kundu IK, Sutar MS, Rahman O, Ali MY, Islam MS. Outcome of two knots tension band wiring (TBW) in Mayo type-IIA olecranon fracture. *Bangabandhu Sheikh Mujib Med Univ J.* 2022; 15(2): 90-95.

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### Available at:

[www.banglajol.info](http://www.banglajol.info)

A Journal of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

## Abstract

Olecranon fracture is relatively common and accounts for approximately 40% of elbow joint fractures. It is an intra-articular fracture, so the aim of treatment is anatomic reduction, stable fixation and early mobilization. Tension band wiring (TBW) may be a popular and widely practiced method using either single knot or two knots techniques. Now two knots TBW are widely accepted by AO foundation as well as various countries. But single knot technique is commonly practiced in Bangladesh. The present study was done to see the clinical, radiological and functional outcome of two knots Tension band wiring (TBW) in Mayo type IIA olecranon fracture. This observational study was carried out by the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh. A total of 32 patients with Mayo type IIA olecranon fractures were treated with two knots TBW, out of which 30 cases had completed at least 24 weeks of follow-up and analyzed for final functional outcome with Mayo Elbow Performance Score (MEPS). The mean age was  $32.58 \pm 14.21$  years and the male to female ratio was 2.6:1. The mean radiological union time was  $8.15 \pm 2.25$  weeks. In 6 (18.75%) cases, it took 6 weeks, in 18 (56.25%) cases, it took 8 weeks and in 8 (25.0%), it took 12 weeks. Complications were found in 21.9% of patients. At first follow-up after the operation showed that 21 (70.0%) had moderate pain and the final follow-up showed 21 (70.0%) had no pain. The mean arc of elbow motion at first follow-up and final follow-up were  $61.090 \pm 16.2340$  and  $122.820 \pm 15.2870$ , respectively. The mean functional score at 1st follow-up was  $6.75 \pm 5.63$  and the last follow-up was  $24.76 \pm 1.69$ . The mean total Mayo Elbow Performance Score (MEPS) scores at first and last follow-up were  $40.65 \pm 14.48$  and  $94.13 \pm 8.35$ , respectively. Excellent and good outcomes were found among 21 (70.0%) and 9 (30.0%) patients, respectively. Two knots TBW technique is safe regarding overall complication rate, pain status and excellent outcome.

## Introduction

Fractures of the proximal part of the ulna range in relation to the severity from simple fractures of the olecranon to complex fractures associated with the damaging effect to the structures which maintain the normal stabilizing capacity of the elbow.<sup>1,2</sup> Literature showed that the fractures of the olecranon account for up to 40% of all fractures implicated with the elbow joint<sup>3</sup> and 10% of all fractures occurred in the upper extremity. It is an intraarticular fracture, so the aim of treatment is anatomic reduction, stable fixation and early mobilization. There is various classification of systems used for olecranon fracture. Among them, the Mayo classification is the most useful classification

system in clinical practice. It not only describes fracture morphology but also includes fracture stability and, therefore, serves as a guide for planning of surgery. The simple displaced transverse intra-articular fractures are the most common, which account for up to 85% of all olecranon fractures falling into the Mayo type-II category.<sup>4-6</sup> These fractures usually occur due to standing height falls.<sup>7</sup>

The commonly used techniques adopted for the management of olecranon fractures include tension band wiring (TBW), plate, and intramedullary fixation.<sup>2,8</sup> Authors also stated that the tension band wiring (TBW) technique is widely used surgical approach involving the fixation of olecranon fractures.<sup>9</sup>



In a recent study, Fernandez et al<sup>10</sup> reported that tension band wiring and plates are the most widely used treatments for transverse displaced fractures of olecranon despite high rates of symptomatic hardware complications, subsequent implant removal and associated costs. The most common adverse outcomes complicating patients undergoing TBW are pain along with the urgency for hardware removal due to migration of the K-wires and prominence of the hardware.<sup>9,11</sup> The complications which have been reported in other studies comprise the loss of the range of motion, degenerative changes of the elbow joint, nerve and vascular injuries, non-unions, heterotopic ossification and infection.<sup>12-13</sup>

The treatment of olecranon fracture by TBW is economical and easier to perform. It converts the tensile force of the triceps into a dynamic compressive force at the fracture site.

Although the principle of TBW is somewhat consistent, there are few alternative techniques in Kirschner wire (K-wire) placements and stainless steel (SS) wire knot application. In our institution, it is customary to apply the tension band wiring (TBW) principle in treating the Mayo type IIA olecranon fractures by a single knot on figure-of-eight SS wire. But now, it is widely accepted by AO foundation as well as various countries, if the figure-of-eight wire is tensioned on both the ulnar and radial side simultaneously over two transcortically placed K-wires, it would create an equal compression across the fracture site and provide more stability than the use of a single knot.

Therefore, the present study aimed to evaluate the clinical, radiological and functional outcome of two knots tension band wiring (TBW) in Mayo type-IIA olecranon fracture.

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## Methods

This observational study was done on 32 patients at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh. Of these, 30 cases had been completed at least 24 weeks of follow-up. Patients with Mayo type II A (non-comminuted displaced stable) olecranon fractures, close fracture, fracture  $\leq$  3 weeks old and age  $\geq$  18 years were enrolled in this study. Patients with comminuted displaced olecranon fractures, open fractures, fracture  $>$ 3 weeks old and medically unfit for anaesthesia were excluded from the study.

After patient selection, they were evaluated pre-operatively and operation was done with two knots technique. Injection Ceftriaxone was given per-operatively followed by oral Cefixime and Flucloxacillin for 14 days. Patients were discharged from hospital at 2nd POD after removing drain. Proper history taking and clinical examination were performed. Pre-designed data collection sheet was used for documenting data collection of the patients.

The 1st follow-up was given at 14th POD to check any sign of infection and pain status. Cast was removed and active movement of elbow started. Stitches were removed on the same day. Next follow-ups were given in the 6th week, 8th week and 12th week after operation. During these follow-up sessions, the pain status, range of motion, and X-rays were assessed. This intensive follow up period was taken to assess the union status. Subsequent follow-ups were given in the 24th, 36th and finally 48th week after the operation. During these sessions, ROM of the elbow was measured and X-ray was done.

Assessment of any late complications was also done. Improvement was noted. Mayo Elbow Performance Score (MEPS) was measured during each follow-up period.<sup>14</sup> Those who could not complete at least 24 weeks of follow-up were excluded from the functional outcome evaluation.

The patient was placed in the lateral position with the elbow flexed over a side rest. A posterior midline skin incision was made that ran posteriorly from the supracondylar region to some extent 4 or 5 cm distal to the fracture. The fracture was reduced by extending the elbow. A pointed reduction clamp was allowed to use to hold the reduction. Approximately 40 mm distal from the fracture line and 5 mm from the posterior cortex, a hole was made through the ulna with a 2.0 mm drill bit.

An 18-gauge SS wire was prepared by making a loop approximately one-third along its length. The shorter segment of the wire was inserted by the drilled hole. With the help of drill guide two 1.8 mm K-wires were introduced through the head of the olecranon directed towards the anterior cortex, passing as close as possible to the joint. Both cortices were drilled. Just after drilling the anterior cortex, the K-wires were drilled back about 1cm. This was necessary because the proximal bent ends of the K-wires would finally be hammered into the bone and the distal ends of the K-wires should not protrude into the anterior soft tissues.

The pointed reduction forceps were removed. The long SS wire segment (bearing the loop) was passed in a figure-of-eight configuration beneath the triceps tendon around the protruding ends of the K-wires. It was ensured that the loop and wire twist did not lie too close to the wire hole in order to avoid unnecessary tension at the wire hole. Both loops (medial and lateral sides) were tightened at the same time and in the same direction in order to achieve equal tension on both arms of the wire. Excessive tensioning, especially in osteopenic bone, was avoided. With the help of a plier, bending iron and forceps, the proximal end of the K-wires was bent approximately 180 degrees. The K-wires were sinking their curved ends into the bone in order to prevent backing out and skin irritation. The joint was manipulated prior to closing for ensuring the fracture stability and range of motion, including supination-pronation.



Figure - 1: Pre-operative (a) and post-operative (b) X-ray

**Results**

Out of 32 cases, 23 (71.9%) were male and 9 (28.1%) were female. The mean age was 32.58±14.21 years and 20 (62.5%) patients belonged to 18-33 years of age. Among them 7 (21.9%) were students, 10 (31.3%) were service holders, 5 (15.5%) were housewives, 7 (21.9%) were businessman and the rest 3 (9.4%) were manual workers. Motor vehicle accidents accounted for 18 (56.3%) cases which was the most common cause of injury. Other causes were falling from height 9 (28.1%) and falling on slippery ground 5(15.5%) in descending order. Left-sided and right-sided injuries were 14 (43.8%) and 18 (56.2%), respectively. The mean duration between fracture and operation was 7.29±4.88 days, varying from 1 to 15 days. The mean duration of hospital stay was 6.38±3.69 days, varying from 2 days to 15 days.(Table - I)

Table-I			
Baseline characteristics of the study population (n=32)			
Characteristics		Frequency	Percentage
Gender	Male	23	71.9
	Female	9	28.1
Mean Age (years)		32.58±14.21	
Occupation	Students	7	21.9
	Service holder	10	31.3
	Housewives	5	15.5
	Businessman	7	21.9
	Manual workers	3	9.4
Mechanism of Injury	MVA	18	56.3
	FFH	9	28.1
	FSG	5	15.6
Side of Injury	Left	14	43.7
	Right	18	56.3
Mean duration between fracture and operation		7.29±4.88	
Mean hospital stay		6.38±3.69	

MVA=Motor vehicle accident, FFH=Fall from height, FSG= Fall on slippery ground

The mean radiological union time was 8.15±2.25 weeks. In 6 (18.75%) cases, it took 6 weeks, in 18 (56.25%) cases, it took 8 weeks and in 8 (25.0%) it took 12 weeks (Table - II).

Table-II		
Distribution of cases according to radiological union time (in week) (N=32)		
Radiological union time (in week)	Frequency	Percentage
6	6	18.75
8	18	56.25
12	8	25.00
24	0	0.00
Mean ±SD	8.15±2.25	

Among 32 cases, 25 (78.1%) had no complications but the rest 4 (12.5%) had elbow stiffness, 2 (6.3%) had symptomatic hardware and 1 (3.1%) had wound infection (Table- III).

Table-III		
Distribution of cases according to complications of the cases (N=32)		
Complication	Frequency	Percentage
No Complications	25	78.1
Complications	7	21.9
Elbow stiffness	4	12.5
Symptomatic hardware	2	6.3
Wound infection	1	3.1
Delayed union	0	0.00
Pin migration	0	0.00

At first follow-up, out of 30 cases, moderate pain had 21(70.0%) and severe pain had 9(30.0%). At the last follow-up, 9(30.0%) had mild pain and 21(70.0%) had no pain (Table - IV).

Table-IV		
Distribution of patients according to pain status (N=30)		
Pain status	Frequency	Percentage
At first follow up (At 2 weeks)		
Moderate	21	70.00
Severe	9	30.00
At last follow up (At 24 weeks)		
Mild	9	30.00
None	21	70.00

The mean functional score according to MEPS during 1st follow-up and the last follow-up were 6.75±5.63 and 24.76±1.69, respectively. (Table V)

Table-V		
Functional score of affected elbow according to MEPS (N=30)		
Time	Mean	SD
At 1st follow up	6.75	5.63
At final follow up	24.76	1.69

The final outcome during the last follow-up was assessed with MEPS tool. Out of 30 cases, 21 (70.0%) were excellent and the remaining 9 (30.0%) were good. (Table -VI)

Table-V		
Final outcome according to MEPS (N=30)		
Final outcome	Frequency	Percentage
Excellent	21	70.00
Good	9	30.00

## Discussion

The goal of surgical treatment for an olecranon fracture is to restore both the articular surface and the mechanism of elbow extension and allow early mobilization to reduce the stiffness of elbow. The spectrum of management choices accessible or available is a consequence of the actual fact that no explicit mode of treatment is universally applied to the varied array of fracture patterns encountered. But tension band wiring (TBW) has been generally accepted as the standard treatment for displaced olecranon fractures. It was hypothesized that, TBW with two knots would allow more anatomical reduction due

to equal compression on both side; give rigid fixation and subsequent early mobilization.

Claessen et al<sup>15</sup> in their study, showed the mean age of their transverse olecranon fracture case was 34 years varying from 19 to 72 years, which is comparable with the present study. But in a study conducted by Duckworth et al<sup>4</sup>, the mean age was 57±23.3 years, which is higher than the findings of the present study. In this study, motor vehicle accident (MVA) was the main cause of injury, which usually occur at young age. In contrast, fracture in osteoporotic bone in females is caused due to falling on the ground and occurs at an older age. The cases in this study had a younger age. Male was predominant in this study, which is similar to Claessen et al<sup>15</sup> study, where they found male and female were 65.0% and 35%, respectively. Duckworth et al<sup>4</sup>, in their study, concluded that high-energy injuries such as sports or motor vehicle accidents (MVA) occurred in significantly younger patients than those who sustained their fractures following a low-energy fall (p<0.001). In this context, this study showed that motor vehicle accidents (MVA) accounted for 27 (50%) cases, the most common cause.

Many studies done in western countries showed the mean injury to operation time was lowering when compared to the present study. In the series of Ali et al<sup>16</sup> the mean duration was 2.5 days ranging from 1 to 8 days. Two causes were identified for this delay. First was delay to come at the hospital and the second was delay in the hospital to get OT schedule.

Duckworth et al<sup>17</sup>, in their study, found that the median time to union was 12 weeks varying from 6 to 52 weeks. Again, in the series of Tankshali et al<sup>18</sup> they achieved 100% union rate at the end of 6 months. Average union time as determined by post-operative X-rays was 8 weeks which was similar to the findings of the present study.

According to Beacher and Edwards<sup>6</sup> the most common complication after fixation of olecranon fractures is symptomatic hardware issues. The elbow lacks an ample soft-tissue envelope compared to other joints. As a result, the risk of infection and wound problems would be taken seriously. If a postoperative wound becomes erythematous or dehisces, aggressive measures should be taken. Other complications like osteoarthritis, wire failure or elbow instability was not observed in the present study due to shorter follow-up period.

In this study it was observed that at the first follow up after operation, out of 30 cases, 21 (70.0%) had moderate pain and 9 (30.0%) had severe pain. At the last follow-up, mild and no pain was observed among 9 (30.0%) and 21 (70.0%) patients, respectively, showing pain relief among most patients.

The mean arc of motion of elbow at the first follow-up was 61.090 ± 16.2340 and at the last follow-up was 122.820 ±

15.2870. Regarding the arc of motion of elbow Bailey et al<sup>19</sup> observed the mean flexion was  $128.5^{\circ} \pm 6.60$ . Koslowsky et al<sup>20</sup> found the mean flexion was 135.40 after one year of follow-up. Van der Linden et al<sup>13</sup> showed significant differences in flexion in the short-and long-term outcomes.

In this study, the functional ability of the affected elbow was evaluated with MEPS.<sup>14</sup> The mean functional score at 1st and at the last follow-up were  $6.75 \pm 5.63$  and  $24.76 \pm 1.69$ , respectively. In this study, it was observed that the mean total MEPS score at 1st and the last follow-up were  $40.65 \pm 14.48$  and  $94.13 \pm 8.35$ , respectively. In the series of Duckworth et al<sup>17</sup>, they found that the overall mean MEPS was 93, varying from 40 to 100, where they followed up to one year. Van der Linden et al<sup>13</sup> got a mean MEPI score  $93 \pm 12$  after a short-term follow-up. These results are consistent with the present study. Functional outcome was measured in 30 cases as 2 cases lost follow-up during the study period. Excellent outcome was found in 21 (70.0%), good outcome in 9 (30.0%) patients and no poor outcome was observed. In the series of Duckworth et al<sup>17</sup>, in the final outcome, 93.0% achieved an excellent/good outcome. Three patients had a fair outcome and one poor, which is comparable with the present study.

## Conclusion

The procedure was safe regarding the overall complication rate, pain status and excellent outcome. This study has some limitations, which include a small sample size, only one study center, a short duration of study period and follow-up time. The sample was taken by purposive sampling, so there was a chance of personal biasness. In conclusion, two knots TBW techniques can be applied in treating Mayo type IIA fracture. To endorse this procedure, a multi-centric long-term study with a large series should be done.

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