Original research article

Olecranon Plating Vs Tension Band Wiring in Two Part Displaced Olecranon Fractures; A Prospective Comparative Study of Functional Outcomes.

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ABSTRACT

Introduction: This study compares two of the widely used procedures for olecranon fracture fixation in attempt to find a conclusive data and form a treatment protocol.

Material and Method: It is a single-blinded, prospective randomized study performed at single centre, aims to compare the outcomes of tension band wiring and plating for the isolated two part olecranon fracture fixation. 40 patients with mean age of 32y (range 22 to 45) were included in the study and randomized to either TBW (n=20) or plate fixation (n=20) group and were evaluated at 4 weeks, 12 weeks, 6 months and 12 months, post-operatively.

Results: Patients were assessed using DASH (Disabilities of Arm, Shoulder and Hand) score and Visual Analogue Score (VAS) at final follow-up at one year. DASH scores were comparable among two groups, Range of movement were satisfactory in both groups, four patients in TBW group complained of implant protrusion through skin and irritation during elbow movement, those patients were re-operated for loosening of implant and implant irritation. One patient in Plate group complained of painful range of movement and joint stiffness. Mean Union time was comparable in both groups. (6-8 weeks). Overall complication rates were higher in TBW group.

Conclusion: Although fracture union time and range of movement was almost similar in both groups, TBW group patients reported complications more often, mostly because of implant irritation and impingement.

MeSH terms: Olecranon plating, tension bend wiring, DASH Score, Impingement, VAS score, metal prominence.

Introduction

The aim of this single-centre, prospective randomized study was to compare the results of tension-band wire (TBW) and locking plate fixation for simple two part and displaced fractures of the olecranon only. Olecranon fracture fixation is a common orthopedic

procedure in routine practice. Olecranon plating and tension band wiring both have their own advantages and disadvantages and both have been used by orthopedic surgeons as per their choice and preferences. This study compares two of the widely used procedures for two-part olecranon fracture fixation in attempt to find a conclusive data and form a treatment protocol.

Tension bend wiring is easy to perform and requires usage of image intensifier to locate the k wires and keep them away from the elbow joint but the post-op complications of implant impingement and painful restricted range of movement is cumbersome while in the plate fixation the implant impingement is rare and movements are achieved without much discomfort.

Tension bend wiring neutralizes the tension at the fracture site and convert it to the compressive force so that the fracture remains opposed and reduced even with the movements, which ultimately promotes fracture healing without much interference. TBW fixation is gold standard for simple two-part fractures but for oblique pattern and fractures associated with coronoid fractures and dislocation or comminuted fractures of olecranon the Tension bend wiring is not a very strong and stable implant and anatomical locking plate offers better stability and strength to the olecranon fracture fixation.

The complication rate was more following TBW fixation and was due to impingement of wires and a higher rate of implant removal in symptomatic patients. TBW group patients required re-surgery for wire removal whereas plating group of patients accepted and tolerated the implant quite well.

Another factor which is important to mention is that tension bend wiring is a low-cost procedure while locking plate fixation is comparatively an expensive procedure, cost factor may be considerable in low-income countries like India, Africa. Which may prejudice the decision of choosing implant by the surgeons and patients.

Methods:

We performed a prospective randomized trial involving 40 patients who were ≥20 to <65 years of age and had an isolated, two-part, displaced fracture of the olecranon. Patients were grouped to either TBW (n = 20) or plate fixation (n = 20) and were evaluated at 4 weeks, 12 weeks 6 months and 12 months following surgery. The outcome measured with the DASH score [(1)] (Disabilities of the Arm, Shoulder and Hand) and Visual Analogue Score (VAS)[(2)] at 1 year.

ILLIUSTRATION OF TBW K-WIRE CASE

Pre op post-op

FIG. 01 showing pre-operative & post-operative radiographs of olecranon fracture fixed with TBW-k wire.

EVALUATION OF ROM POST-OPERATIVELY IN TBW-K WIRE

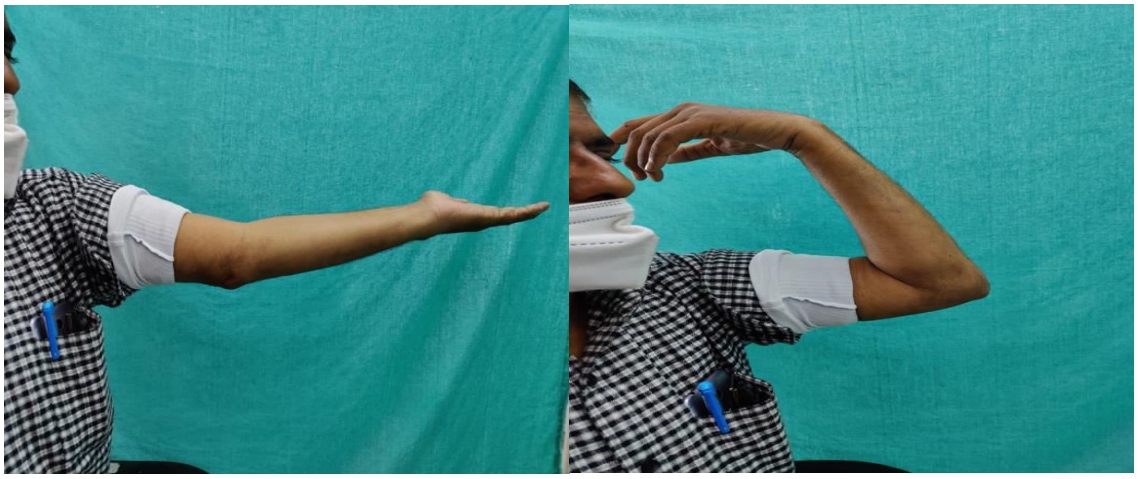

Fig. 02 showing clinical picture of post -operative patient with TBW fixation having restricted ROM.

POST-OP COMPLICATION IN TBW FIXATION

Fig.03 showing post-op complication i.e. impingement of k wire causing bursitis with painful & restricted ROM.

ILLUSTRATION OF OLECRANON PLATING CASE

Pre-operative **Post-op**

FIG. 04 showing pre-operative & post-operative radiographs of olecranon fracture fixed with LCP.

INTRA-OP PHOTOGRAPHS SHOWING REDUCTION TECHNIQUE

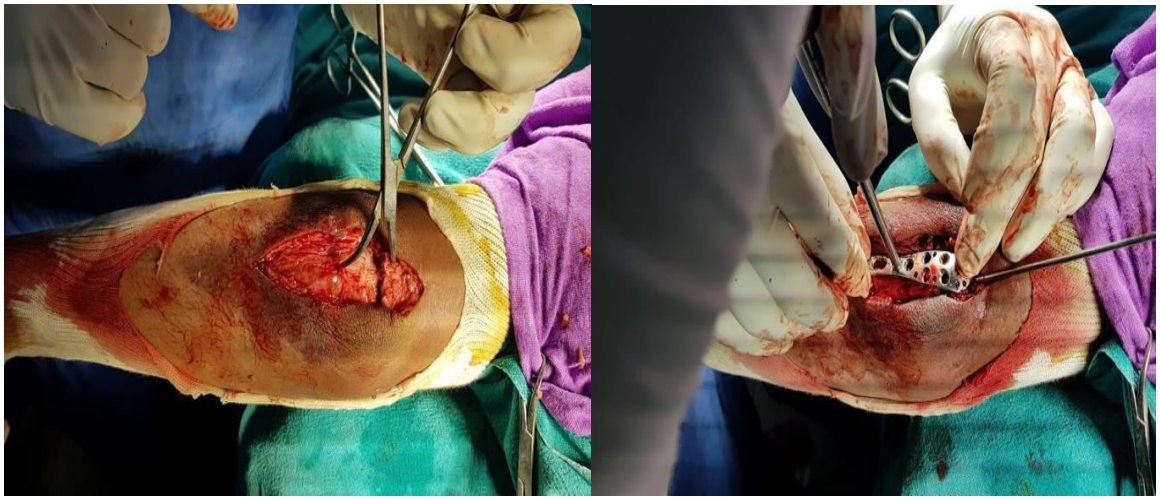

FIG. 05 showing intra-op reduction technique with LCP fixation.

EVALUATION OF ROM POST-OPERATIVELY IN LCP FIXATION PATIENT

Fig. 06 showing clinical picture of post -operative patient with LCP fixation.

Statistical analysis

Descriptive statistics included computation of percentages, means and standard deviations. The unpaired t-test and chi-square test were used for quantitative data comparison of all clinical indicators. Level of significance was set at $P \leq 0.05$.

Results:

The baseline demographic and fracture characteristics of the 2 groups were comparable, except for age, which was lower in the TBW group. Both the groups were evaluated based on DASH and VAS scores. Good improvement was observed in the DASH score over the 1-year period following surgery ($p < 0.001$). At 1 year, the DASH score for the TBW group (5) did not differ significantly from that of the plate group (3) ($p = 0.314$). Complication rates were higher in the TBW group (63% vs 38%; $p = 0.042$), predominantly because of a higher rates of implant removal in symptomatic patients (50.0% vs 21%; $p = 0.021$). 3 patients developed infection in TBW group, none in the plate group.

DASH wise comparison of the study: DASH score was showed statistically significant difference in each time interval. TBW showed higher DASH score than LCP group.

TBW showed lower range of movement than LCP group at 4th week. All kind of range of movement were showed statistically significant difference.

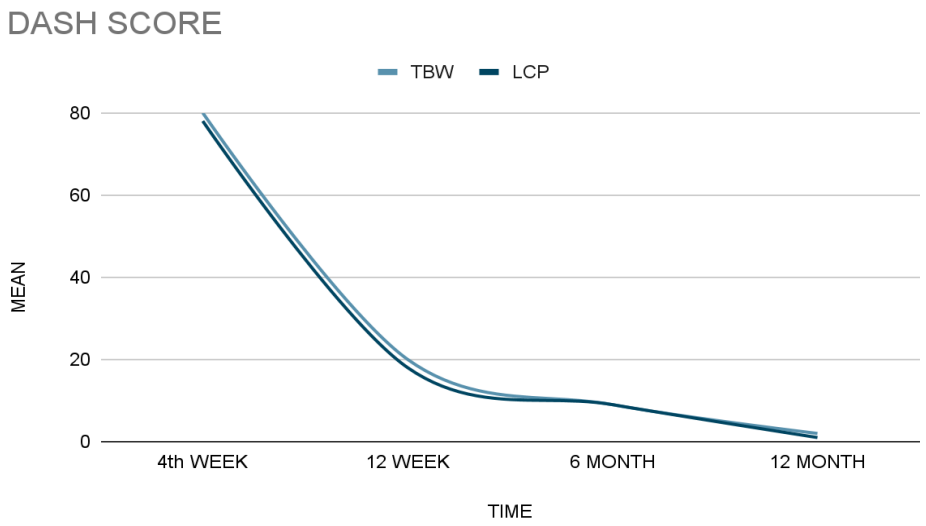

Table 1: Range of movement-wise comparison of the study at 4th -12th week

FOLLOW UP AT		4TH WEEK	12TH WEEK	6 MONTH	12 MONTH
FLEXION	TBW	110	145	148	148
	LCP	128.35	149.5	150	150
EXTENSION	TBW	66.5	5	5	5
	LCP	18.9	6.89	2	0
SUPINATION	TBW	45.25	78.5	80	82
	LCP	59.5	79.5	82.5	83.5
PRONATION	TBW	37	78.25	79.5	83
	LCP	58.25	79	82	84

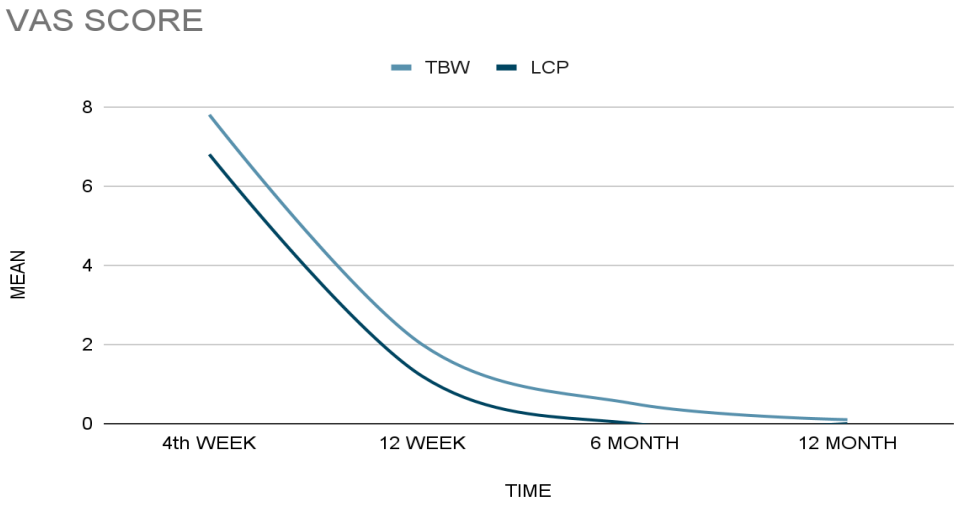

Table 2: time taken for union wise comparison of the study.

	Time taken for union	

			8 weeks	12 weeks	TOTAL
GROUP	TBW	N	6	14	20
		%	15%	35%	100%
	LCP	N	8	12	20
		%	20%	30%	100%

Mean ± SD=10.6 ± 1.93weeks.
Time taken for union in TBW group was 8 weeks in 6 cases (15%) and 12 weeks in 14 cases (35%).
In LCP group it was 8 weeks in (20%) and 12 weeks in 12 cases (30%).
List of complications occurred in our study-

- Surgical site infection was the only complication occurred in 3 patients of TBW K-wire group for which revision surgery was done.
- There was no case of Metal prominence in both the group.
- There was no case of fixation failure in both the group.
- There was no case of delayed union in both the group.

Discussion

The main aim of the treatment of fracture is not only achieving union but to preserve the optimum function of the adjacent soft tissues and joints.

TBW of transverse olecranon fractures is considered a simple procedure; however, as Schneider et al [(3)] demonstrated, the TBW method is associated with numerous pitfalls. In their review of 233 patients treated with TBW, they found that over 40% of the procedures had imperfections and concluded that TBW is not as simple as perceived by clinicians.
Hume and Wiss [(4)] performed the prospective randomized trial comparing TBW (n = 19) and plate fixation (n = 22) for displaced olecranon fractures. it was found that the overall clinical outcome was far superior in the plate-fixation group, with 86% obtaining a good result compared with 47% in the TBW group.

Similarly, Villanueva (2006)[(5)] et al reported on a series of 37 patients treated with TBW for an olecranon fracture. Hardware removal was necessary in 17 patients (46%). in comparison, only 2 of 18 patients(11%)required hardware removal in locked plate fixation group.
Immediate active mobilization with limited resistance would put considerably less distracting force on the proximal olecranon compared with the chair lift-off test, and routine immobilization to protect the fracture reduction may be unnecessary. No statistically significant difference was observed following the cyclic test mimicking a chair lift-off test using both arms by Midtgaard K (2020) et al[(6)].

Regarding migration of K wires the study explains the reason of high rate of k-wire migration may be the position of the wires in relation to the axis of the ulna. Some authors prefer to place the wires down the long axis of the ulna in order to prevent nerve and vessel injury. Mullett (2000) et al[(7)] could demonstrate that the rate of k-wire migration was three times lower when the wire penetrated the anterior cortex of the ulna as recommended by the AO. However, Chalidis et al[(8)] did not find a significant difference in k-wire migration with regard to anterior cortex penetration. The present study supports the data by Mullett et al[(7)]. In all patients, both k-wires perforated the anterior ulnar cortex and wire migration was only observed in one patient

Wiegand et al (2012)[9] 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. In a study by Wolfgang et al (1987)[10] 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.

In the study, functional outcome was found that In TBW group, 10 (50%) cases had excellent results with 5 cases (25%) had good and fair results each. In plating groups, 11 (55%) cases had excellent results, 4 (20%) cases had good results and 5 (25%) cases had fair results. The findings of the study are consistent with the findings of Schliemann B et al (2014)[11] who showed that 92% patients operated with plate osteosynthesis achieved a good to excellent results in comparison to 77% patients treated with TBW. Chalidis BE et al (2008)[8] reported good to excellent results in 85.5 % patients treated with TBW. Konig et al (1990)[12] found 60 % excellent and good results with plate osteosynthesis of comminuted fracture of the olecranon. Hume and Wiss et al (1992)[4] showed 79% good and fair results with TBW and 91% good and fair results with plate fixation. In study conducted by Mahoviya M (2021) et al[13], In group A (plate fixation), as per MEPS 40% cases had excellent results, 33% cases had good, 20% cases had fair and 7% of the cases had poor results. In group B (TBW) as per MEPS 27% cases had excellent results, 33% cases had well, 33% cases had fair and 7% of the cases had poor results

A primary **limitation of the study** was the lack of blinding of both the surgeon and the patient. Randomized controlled trials with larger sample size are required to further clarify these strengths and outcomes of tension band wiring and plate fixation in treatment of olecranon fractures.

Conclusion

Among active patients with a simple isolated, displaced fracture of the olecranon, not much difference was found between TBW and plate fixation in the clinical outcome at 1 year following surgery.

We also conclude that both plate/tension band wiring are equally effective for management of olecranon fracture. However, the plate has slight advantage over TBW K-wire in terms of early mobilization and less complications like metal prominence and Superficial Infection.
Considering all the distinct advantages of plate osteosynthesis for fractures of the olecranon over tbw k wire fixation the olecranon plate for simple and comminuted fractures can be the choice of implant.

References

1. Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand) [corrected]. The Upper Extremity Collaborative Group (UECG). Am J Ind Med. 1996 Jun;29(6):602-8
2. Freyd M. The graphic rating scale. *J Educ Psychol.* 1923;43:83–102. doi: 10.1037/h0074329. [CrossRef] [Google Scholar]
3. Schneider MM, Nowak TE, Bastian L, Katthagen JC, Isenberg J, Rommens PM, et al. Tension band wiring in olecranon fractures: the myth of technical simplicity and osteosynthetical perfection. Int Orthop 2014;38:847-55
4. Hume MC, Wiss DA. Olecranon fractures: a clinical and radiographic comparison of tension band wiring and plate fixation. Clin Orthop Relat Res. 1992;285:229–235

5. Villanueva P, Osorio F, Commessatti M, Sanchez- Sotelo J. Tension-band wiring for olecranon fractures: analysis of risk factors for failure. J Shoulder Elbow Surg 2006;15:351-356
6. Midtgaard K, Søreide E, Brattgjerd J, Moatshe G et al. Biomechanical comparison of tension band wiring and plate fixation with locking screws in transverse olecranon fractures. J Shoulder Elbow Surg 2020;29:1242–1248
7. Mullett JH, Shannon F, noel J, Lawlor G, Lee TC et al. k-wire position in tension band wiring of the olecranon – a comparison of two techniques. Injury 2000;31:427-431.
8. Chalidis BE, Sachinis NC, Samoladas EP, Dimitriou CG, Pournaras JD. Is tension band wiring technique the "gold standard" for the treatment of olecranon fractures? A long term functional outcome study. J Orthop Surg Res. 2008;22;3:9.
9. Wiegand L, Bernstein J, Ahn J. Fractures in Brief: Olecranon Fractures. Clin Orthop Relat Res. 2012; 470(12): 3637–3641.
10. Wolfgang G, Burke F, Bush D, Parenti J, Perry J, LaFollette B, Lillmars S. Surgical treatment of displaced olecranon fractures by tension band wiring technique. Clin Orthop Relat Res. 1987;(224):192-204.
11. Schliemann B, Raschke MJ, Groene P, et al. Comparison of tension band wiring and precontoured locking compression plate fixation in Mayo type IIA olecranon fractures. Acta Orthop Belg. 2014;80:106–11.
12. König S, Kilga M, Kwasny O. Results of plate osteosynthesis in comminuted fracture of the olecranon. Unfallchirurg. 1990;93(5):216-20
13. Mahoviya M, Choudhari P, Patel D, Choyal A. Comparative study of tension band wiring and pre contoured locking compression plate fixation in olecranon fractures in adults. Int J Res Orthop 2021;7:750-4