

Original Research Article

Comparative study of tension band wiring and pre contoured locking compression plate fixation in olecranon fractures in adults

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ABSTRACT

Background: Olecranon fractures are about 10% of all proximal forearm fractures. Mostly intra articular fractures, require anatomical reduction and internal fixation for satisfactory clinical outcomes. The most commonly used techniques are still tension band wiring (TBW) and plate fixation (PF). The aim of the current study is to discuss whether TBW or PF technique of internal fixation is better in the treatment of olecranon fractures.

Methods: This is a comparative study including 30 adult patients of olecranon fracture classified by Mayo classification and operated upon by tension band plating (group A) and tension band wiring (group B) at Department of Orthopaedics, Sri Aurobindo Medical College and PG Institute, Indore. All operated cases between the period of January 2018 to August 2019 with follow up of 1 year were assessed on the basis of functional outcome using Mayo elbow performance score (MEPS).

Results: The MEPS, 73% of the patients in group A achieved a good to excellent results in comparison to 60% in group B. no significant differences between the two groups could be detected regarding the clinical and radiographic outcome.

Conclusions: Both TBW and PF interventions had treatment benefit in OFs. The current study reveals that there are no significant differences in MEPS, improvement rate and ROM between TBW and PF for OFs. More high-quality studies are required to further confirm our results as most of the cases included in study belonged to Mayo type IIA category.

Keywords: Olecranon fracture, Tension band wiring, Plate fixation, Comparative study

INTRODUCTION

Olecranon fractures are about 10 % of all proximal forearm fractures.¹ Mostly intra articular fractures, require anatomical reduction and internal fixation for satisfactory clinical outcomes.^{2,3}

Anatomically the olecranon process is a large, curved eminence comprising of the proximal and posterior part of the ulna. It lies subcutaneously which makes it more vulnerable to injury. Together with coronoid process it forms greater sigmoid notch which articulates with trochlea. This provides motion only in the sagittal plane along with stability to the elbow joint. Triceps tendon is

inserted into olecranon after covering the capsule of elbow joint. Most common mechanism of injury is direct trauma as falling on the back of the elbow or direct impact at the posterior surface of the elbow or upper part of forearm causing comminution of the olecranon. Degree of comminution depends on severity of trauma.⁴ Patient are classified on the basis of Mayo classification which is based on the fracture's degree of stability, displacement and comminution.⁵ Due to intra-articular extension of fractures, anatomical reduction and early mobilization should be achieved in every case.

All olecranon fractures are intra articular fractures and therefore treated operatively in order to restore congruency

of the joint surface, prevent posttraumatic degeneration and to regain absolute stability. Various surgical techniques have been described to treat olecranon fractures.⁵⁻⁷ Tension band wire fixation (TBW), originally described by Weber and Vasey, is the most common technique particularly in non-comminuted fractures.⁸ In recent years, precontoured locking plates have been developed. These plate offer superior fixation strength particularly in osteoporotic bones due to the fixed angle construct. Good results have been reported but there is little evidence regarding its superiority in comparison to other fixation techniques.⁹

METHODS

This was a hospital based prospective study conducted on patients admitted in Orthopaedics Department of Sri Aurobindo Medical College and PG Institute, Indore. This is a comparative study including 30 adult patients of olecranon fracture classified by Mayo classification including 15 patients operated by tension band plating (group A) and 15 patients operated by tension band wiring (group B) which were selected by odd and even method. All operated cases were between January 2018 to August 2019 with follow up of 1 year were assessed on the basis of functional outcome.

Criteria for selection of patients

Inclusion criteria

The study included patients with age (above 18 years) of either sex and patients with all closed and isolated olecranon fractures.

Exclusion criteria

The study excluded patients with open fractures, pathological fractures, poor soft tissue condition, and concomitant elbow injuries.

Immediately on arrival of the patient, all patients managed as per advanced trauma life support (ATLS) protocols. Elbow immobilized in an above elbow crammer wire. A detailed history taken from the pt. about the duration and mechanism of injury. Detailed clinical examination both local and systemic was done and findings were recorded preoperatively. Standard X-ray in anteroposterior and lateral views were taken for the confirmation of diagnosis and also to know the type of fracture as per the Mayo classification of olecranon fractures.

Clinical examination included RoM using a goniometer, elbow stability tests and neurologic examination. A validated scoring systems was used to determine the functional outcome, which is The Mayo elbow performance score (MEPS).¹⁰ Radiographic examination included AP and lateral views of the elbow in order to detect non-unions, inadequacy or loss of reduction, heterotopic ossifications and signs of posttraumatic

arthritis. Furthermore, complications such as nerve injury, infections and hardware-related complications were noted. Written consent to use their data was obtained from all patients prior to the follow-up examination.

Table 1: Mayo classification of olecranon fractures.

Type	Classification
Type 1	Undisplaced fractures
Type IA	Non comminuted
Type IB	Comminuted
Type II	Fractures with 3 mm displacement, intact collateral ligaments, and preserved forearm humerus relationship
Type IIA	Non comminuted
Type IIB	Comminuted
Type III	Fractures with a disruption in the relationship between the forearm and the humerus, constituting a fracture dislocation
Type IIIA	Non comminuted
Type IIIB	Comminuted

Table 2: MEPS.

Parameter	Score
Section 1 pain intensity	45
None	45
Mild	30
Moderate	15
Severe	0
Section 2 motion	20
Arc of motion greater than 100 degree	20
Arc of motion between 50 and 100 degree	15
Arc of motion less than 50 degree	5
Section 3 stability	10
Stable	10
Moderately unstable	5
Grossly unstable	0
Section 4 function	25
Can comb hair	5
Can eat	5
Can perform hygiene	5
Can wear shirt	5
Can do shoe	5
Total	100

Table 3: Interpretation of MEPS.

Score	Interpretation
Score greater than 90	Excellent
Score 75-89	Good
Score 60-74	Fair
Score below 60	Poor

At each follow up visit, clinical parameters (pain, surgical wound, swelling, range of movement, any complication) and radiological parameter (maintenance of reduction, union) were assessed.

Final assessment was done at 12 months using the MEPS.

RESULTS

The study consisted of 30 cases which were equally divided into two groups according to type of surgery. Among 30 cases, 24 cases belonged to Mayo type IIA category and rest 6 cases belonged to Mayo type IIB category. All the 6 cases with comminution were treated with plating.

Table 4: Distribution of olecranon fractures according to Mayo classification in two groups.

Mayo classification	Group A	Group B
Type IA	0	0
Type IB	0	0
Type IIA	9 (60%)	15 (100%)
Type IIB	6 (40%)	0
Type IIIA	0	0
Type IIIB	0	0

Group A (locking compression plating)

In our study, majority of the patients were male (80%), most of the patients in both group were in the age group of 21- 52 years with mean age of 48.6 years. According to Mayo classification system, most common type of fracture was type 2 non-comminuted fracture (60%). Radiological union was seen at 6 weeks in 2 (13.3%) cases, 3 months in 11 (73.3%) cases, 6 months in 2 (13.3%) case, hence mean union time is 12.8 weeks. One patient required plate removal because of implant impingement and one case had superficial infection which resolved completely with oral antibiotics and one case had elbow joint stiffness. There were no cases of nonunion or malunion, implant failure, implant breakage or loosening in the present study. All 15 patients achieved fracture union in 6 months follow up period. As per MEPS, 40% cases had excellent results, 33% cases had good, 20% cases had fair and 7% of the cases had poor results respectively.

Table 5: Results of the MEPS with regard to the surgical procedure.

Grading	Group A		Group B	
	No. of cases	Percentage (%)	No. of cases	Percentage (%)
Excellent (score greater than 90)	6	40	4	27
Good (score 75-89)	5	33	5	33
Fair (score 60-74)	3	20	5	33
Poor (score below 60)	1	7	1	7
Total	15	100	15	100

Group B (tension band wiring)

In patients treated with tension band wiring, majority of the patients were male (73.3%). Patients in this group were younger as compared to group A with mean age of 38.6 years. According to Mayo classification system, all cases belonged to type 2 non-comminuted fracture. Radiological union was seen at 6 weeks in 1 (26.6%) cases, 3 months in 10 (67%) cases, and 6 months in 4 (27%) case. Therefore, mean union time is 14.8 weeks. 6 patients had the implant removed after a mean of 10 months. Main reasons for removal were painful irritations and expected improvement in range of motion after removal due to prior impingement of the k-wires in the fossa olecrani of the humerus. 2 patients suffered from ongoing local pain after implant removal. One patient presented with slight elbow stiffness at follow-up, although the impinging implant was removed.

As per MEPS, 27% cases had excellent results, 33% cases had well, 33% cases had fair and 7% of the cases had poor results respectively.

MEPS

Section 1: pain intensity

In our study 11 (73%) patients of group A and 9 (60%) patients of group B had no pain whereas 4 (27%) patients of group A and 6 (40%) patients of group B had mild pain.

Section 2: range of motion

In our series 12 (80%) patients of group A and 13 (87%) patients of group B had an arc of motion greater than 100 degrees, 3 (22%) patients of group A and 2 (13%) patients of group B had arc of motion between 50-100 degrees.

Section 3: stability

All fracture were stable after fixation.

Section 4: functional evaluation

2 patient of group A and 2 patients of group B were unable to comb their hair and 1 patient of group B were unable to close the button of shirt.

Table 6: Complications.

Complication	Group A (LCP)	Group B (TBW)
Implant irritation (with subsequent removal)	1	6
K-wire migration	-	0
Infection	1	0
Haematoma	1	0
Hardware failure	0	0
Elbow stiffness	1	2
Radioulnar synostosis	0	0

DISCUSSION

In our study mean age of patients treated by TBW is less than that of plating, which is 38.6 years and 40.8 years respectively. Similarly, in a study done by Schliemann et al mean age of patients with TBW was 38.1 years and mean age of patients with plating was 48.6 years.¹¹ Male patients included in our study outnumbered females by 4:1 in plating group and 11:4 in TBW group which different from studies done in Germany. This might be because Indian males tend to get into more road traffic accidents than Indian females. Also, we have included only those patients in our study who came for follow up for at least 1 year.

Our study showed union in 12.8 weeks among olecranon fractures treated with plate fixation and 14.8 weeks in TBW. In 1992, Hume and Wiss and in 1993 Fan et al studied cases of tension band wiring and reported that union was achieved in about 14 weeks. Erturer et al in his study on results of open reduction and plate osteosynthesis in comminuted fracture of the olecranon reported union in 17 weeks (4.4 months).¹²

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 respectively. A study done by Kakkar reported that all 22 patients achieved fracture union in 6 months follow up period.¹³ As per MEPS 54.54% cases had excellent results, 31.81% cases had good, 9.09% cases had fair and 4.54% of the cases had poor results respectively. MEPS in patients of tension band wiring is not significantly different from patients treated with plate fixation.

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. Aher in his study, reported that as per MEPS 60% cases had excellent results, 26.6% cases had good, 6.67% cases had fair and 6.67% of the cases had poor results respectively.¹⁴

In 6 cases out of 15 cases of TBW, implant removal was done. Villanueva et al reported on a series of 37 patients treated with TBW for an olecranon fracture.¹⁵ Hardware

removal was necessary in 17 patients (46%) in 3 cases, skin breakdown had developed at the time of removal.

All comminuted displaced fractures in our study was treated by plate fixation. In the management of intra articular fractures like fractures of the olecranon, a perfect anatomical reduction of the fragments to obtain articular congruity and rigid fixation of the fragments is of utmost importance, if early movements are to be instituted to prevent complications like traumatic arthritis and joint stiffness.^{16,17} Due to subcutaneous nature of the proximal ulna, hardware prominence is common which causes discomfort to the patient, and is a reason to necessitate its removal. Considering the high frequency of implant irritations, Chalidis et al raised the question if TBW is still the "gold standard" in the treatment of olecranon fractures in their series, 53 of 62 patients (85.5%) achieved a good to excellent MEPS at a long-time follow-up.¹⁸ Catalano et al described in an anatomic study a safe angle between the k-wire axis and the long axis of the ulna of 20° to 30° on the lateral view of the elbow.¹⁹ Taking the clinical and radiographic outcome as well as complications and procedure related costs into account, the only disadvantage of the TBW in the treatment of olecranon fractures is the high revision rate due to implant-related complications. Therefore, a proper surgical technique is mandatory. K-wires must be bent approximately 180° and advanced into the tip of the olecranon in order to bury them securely under the soft tissue of the triceps muscle insertion site. However, only those patients were included in the study who sustained an isolated olecranon fracture with no previous injury to the same extremity.

There were some limitation in our study. Not all the types of elbow fracture were included in our study. Further studies required to strengthen our conclusion.

CONCLUSION

Both TBW and plate fixation interventions had treatment benefit in Olecranon fractures. The current study reveals that there are no significant differences in MEPS, improvement rate and ROM between TBW and plate fixation for Olecranon fractures. Due to the less complications, we recommend the PF approach as the optimum choice for Olecranon fractures. More high-quality studies are required to further confirm our results.

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