

A Comparative Study on Management of Olecranon Fracture Using Tension Band Wiring and Olecranon Hook Plate

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Abstract:

Objective: To compare the results of tension band wiring (TBW) v/s Olecranon hook plate fixation in management of fracture olecranon in terms of time taken for fracture union and clinical, functional and radiological outcome.

Methods: 30 patients suffering from olecranon fracture were enrolled and study was carried out in Department of Orthopaedics, Guru Nanak Dev Hospital and College, Amritsar.

Results: It was observed that among the cases mean age was 42.4 years. The study reported more number of males than females. The subjects were categorized into 2 groups. In both the groups, fractures on right side were involved more than left side. The road side accident was the commonest mode of injury to cause fracture. In both groups most common fracture type was type IIA (50%). Majority of the cases 19 (63.3%) were operated within 24 hours. 4 (13%) cases associated with fracture of femur bone required hemodynamic stabilization/surgery on priority basis. Other complications entails fracture in shaft femur and inter-trochantric femur. Mean MEPS in group A was 86.9 and in group B was 89.1.

Conclusion: It was found that tension band wiring and plate fixation are equally effective in management of displaced olecranon fractures.

Keywords: Tension band wiring, fracture olecranon, Mayo Elbow Performance Score, Olecranon hook plate fixation, fracture union.

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Introduction

The olecranon is an important constituent of the elbow joint. It works with the coronoid process of the ulna, distal humerus, radial head and ligament structure of the elbow joint to maintain the stability of the elbow joint. The olecranon is the proximal articular portion of the ulna. Along with the coronoid process, it forms the greater sigmoid (semilunar) notch which articulates with the humerus to provide flexion and extension of the elbow.

Olecranon fractures are relatively common injuries, accounting for approximately 10% of upper extremity fractures in adults. [1] Fractures of the olecranon are a relatively common injury in adults; its subcutaneous location leaves it vulnerable to injury from a direct blow.

Most common cause of fracture of olecranon is road side accident. [2] These fractures may result from a direct blow to the proximal ulna, or

indirectly, via the forceful contraction of the triceps against resistance (typically, during a fall onto an outstretched hand).

The incidence of olecranon fractures has been quoted in one study from Sweden to be 10.8 per 100,000 adult individuals per year, with an incidence of 11.5 per 100,000 adult individuals per year in patients older than 16 years of age. [3] Patients typically present with elbow pain and swelling following a fall. If the fracture is displaced there may be marked deformity at the elbow with a palpable gap.

The hallmark of an olecranon fracture is the inability to extend the elbow against gravity. Conservative management often leads to prolonged immobilization with associated elbow stiffness and higher incidence of non-union, especially in displaced fractures. Operative management has gained popularity. [4] So, the

present study was conducted to evaluate and compare the results of management of olecranon fracture with TBW and olecranon hook plate.

Materials and methods:

The present study was conducted on 30 patients suffering from olecranon fracture presenting to OPD/Emergency of orthopaedics in the Department of Orthopaedics, Guru Nanak Dev Hospital and College, Amritsar. Patients were included after approval from the Ethical committee. An informed and written consent was taken from the patient before inclusion in the study.

Inclusion Criteria: Age (above 18 years), either sex or all closed fractures.

Exclusion Criteria: Patients with comorbid conditions preventing surgical intervention, patients with more than 3 weeks duration of injury, patients with immature skeleton and patients with

local tissue condition making the surgery inadvisable. Cases were classified according to MAYO classification. Patients were admitted in the emergency and OPD Department and were subjected to clinical examination. Patients were examined with respect to the injuries and special attention was given to circulation and neurological status of the limb. Radiographic evaluation of the affected side was done at the time of injury with the antero-posterior and lateral views. Primary treatment in the form of antibiotics, analgesics, immunization against tetanus, intravenous fluid, thorough wound debridement and antiseptic dressing in case of open fracture, and splinting was done. Routine investigations of blood and urine were carried out. A thorough clinical examination was done regarding the general condition of the patient and any associated systemic disease was ruled out.



Figure 1: A lateral radiographs demonstrating a displaced comminuted fracture of the olecranon

Classification: A simple classification of fractures of adult olecranon was proposed by Colton [21] and used as a basis for making recommendations about treatment as follows:

1. Nondisplaced or displacement <2mm.
2. Displaced fractures:

- a) Avulsion fractures.
- b) Oblique fractures.
- c) Comminuted fractures.
- d) Fracture Dislocations.

Mayo classification system:

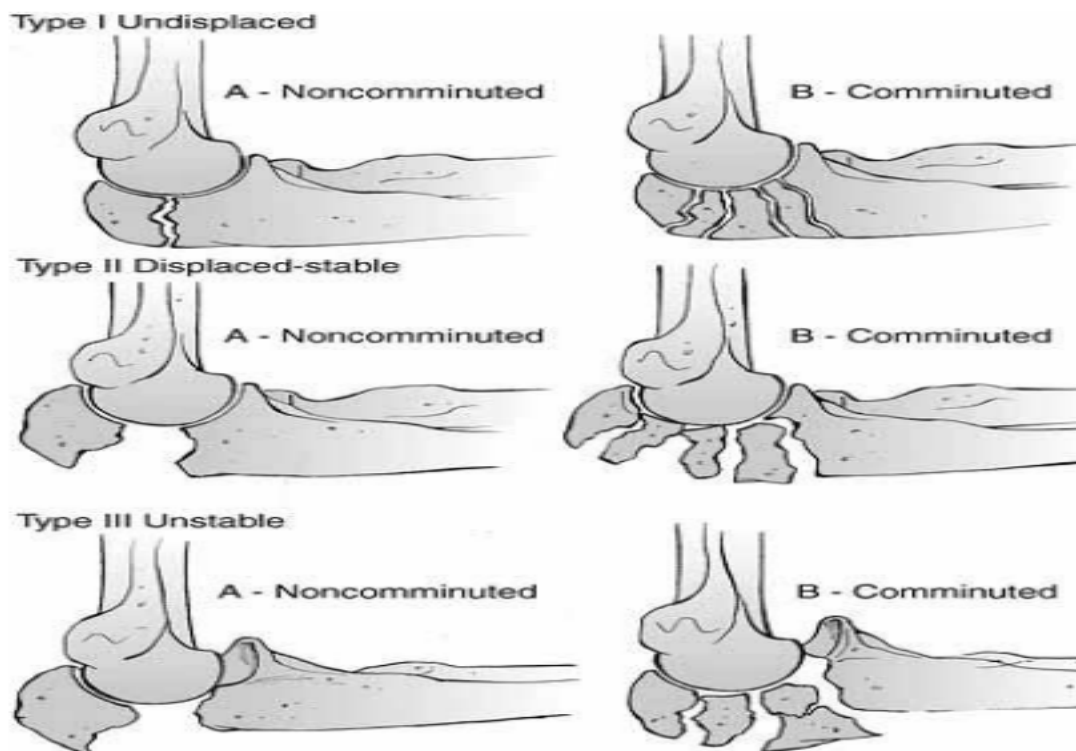


Figure 2:

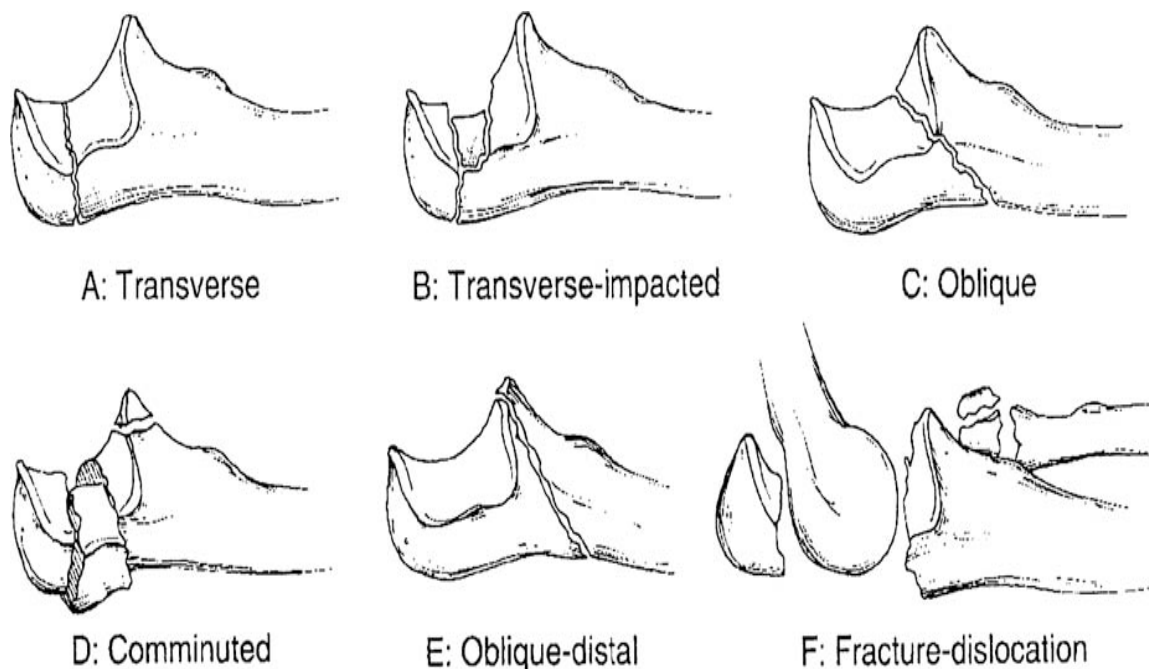


Figure 3:

Surgical techniques include Tension Band Wiring and Olecranon Hook Plate.

Follow up:

Patients on discharge were advised to report for follow up after 6 weeks and 12 weeks and thereafter every 3 months. The result was assessed 3 months after the procedure. At follow up, a detailed clinical examination was done and patient

was assessed subjectively for the symptoms like pain, swelling, restriction of joint motion. On clinical examination, swelling of the joint, tenderness, movements of the elbow joint, prominence of head of cancellous screw, nutrition and power of the muscles acting on the joint were noted. Patients were instructed to carry out physiotherapy in the form of active flexion extension and pronation supination without

loading. Check X-ray AP/lateral view, CT scan were taken if required. When final X-ray shows union, implant was removed.

Statistical analysis:

Results were analysed using SPSS version 21.0. Nominal variables were expressed as Mean± Standard Deviation, frequency and percentage was analyzed using Chi-square test. Continuous variables were expressed as mean and standard deviation was analyzed using t-test. A p value less than 0.05 were taken as statistically significant and p value less than 0.01 was taken as highly significant.

Results:

The present study was conducted on 30 consecutive cases of fracture of the olecranon admitted in the Orthopedic Ward at Guru Nanak Dev Hospital and College, Amritsar.

The subjects were categorized into groups: Group A- comprised of 15 cases which were treated by Tension band wiring and Group B- comprised of 15 cases treated with open reduction internal fixation 3.5 mm hook plate. In the present study, majority of the cases were in age group 31-40 years [13 (43.33%)] and the mean age was 42.4 years (Figure 1).

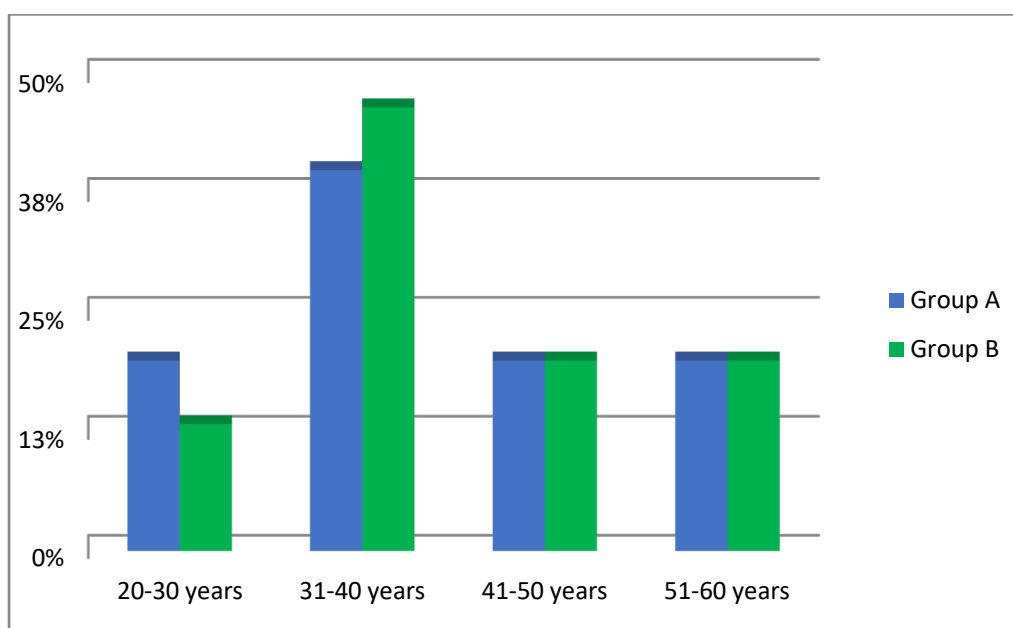


Figure 4: Demographic Profile (Age) [N=30]

Out of total patients, there were 25 (83.33%) males and 5 (16.7%) females. The male to female ratio was found to be 5.0:1 (p-value 0.74).

In our study, in Group A, right side was involved in 9 (60%) and in remaining 6 (40%) patients, left side was involved. In Group B, 11 (73.33%)

patients had right side involved and in remaining 4 (26.66%) patients left side was involved.

The road side accident was the commonest mode of injury to cause fracture of the olecranon in both groups. It constituted 19 (63.33%) cases out of 30 cases.

Table 1: Distribution of patients based on mayo classification (n=30)

MAYO classification	Group A		Group B		Total		P value
	No. of cases	%age	No. of cases	%age	No. of cases	%age	
IA	3	20	1	6.7	4	13.3	0.91
IB	2	13.3	2	13.3	4	13.3	0.91
IIA	7	46.7	8	53.33	15	50.0	0.84
IIIA	3	20	4	26.6	7	23.3	0.95
Total	15	100	15	100	30	100	

Table 1 showed fracture which was classified according to MAYO classification. In group A, 46.7% of cases and in group B, 53.3% of cases were of MAYO's type IIA. So, in both groups most common fracture type in study population was type IIA (50%). It was also observed that out of 30

cases, 19 (63.3%) cases were operated within 24 hours, 6 (20%) operated within 1-3 days because of bruising and swelling at elbow and rest 5 (16.7%) cases were operated within 4-7days. Out of 30 cases, 4 (13%) of cases were associated with fracture of femur bone required hemodynamic stabi-

lization/surgery on priority basis and it delayed the surgery of olecranon fracture by 3-5 days. In this study, 6.67% were the cases of fracture in shaft femur, 6.67% in inter-trochantric femur, 6.67% were of fracture in both bone leg and no associated injury seen in 73.33% cases in group A. In group B, 6.67% of fracture was seen in shaft femur, 93.33% of the cases showed no fracture in inter-trochantric femur or both bones in legs or associated injuries. The first method, undoubtedly was having significant shorter duration (p value= 0.021) when compared to second method of fixation with same type of fracture i.e IA/IB/IIA/IIIA. Apart

from the fact that there were very less chances of proud implant as olecranon is subcutaneous bone in its location. The union rate was excellent in our series of cases in both the groups but it was remarkably higher in group A when compared to group B (56.7% : 40%). It is evident that though the number of cases were more in group A when compared to group B but the infection was superficial in group A and did not hinder the progress of union. The union was delayed in group B due to need of repeated debridement of the wound and in group A due to wire migration.

Table 2: Assessment of cost-effectiveness

Cost of implant (Rupees)	Approximate cost	Mean	Standard deviation	p-value
Group A	500- 1000	766.6	258.1	.001
Group B	5000-7000	6066.6	1032.7	

Table 2: Needless to say that tension band wiring of MAYO's type IA/IB/IIA/IIIA fractures was much cost-effective when compared to hook plate fixation of similar kind of fracture in our series, having a significant p value < 0.05. In present study, 60% of cases in group A and 66.6% of cases

in group B had excellent results. In group A, 40% of cases and in group B, 26.7% of cases had good results.

In group A, no case had fair result. In group B, 3.33% of cases had fair results. No poor results were seen in either of the groups.

Table 3: Assessment of MEPS score

MEPS Score	Mean	SD	p-value
Group A	86.9	4.7	0.62
Group B	89.1	5.2	

In this study, mean MEPS in group A was 86.9 and group B was 89.1. There was no significant difference between two modalities (p value 0.62) (Table 3).



Figure 5: Pre-operative X-Ray of MAYO Type II A



Figure 6: Post- Operative X-Ray of MAYO Type II A treated with Tension band wiring



Figure 7: Pre-operative X-Ray of MAYO Type II B



Figure 8: Post-Operative X-Ray of MAYO Type II B treated with tension band wiring



Figure 9: Pre-Operative X-Ray of MAYO Type II A

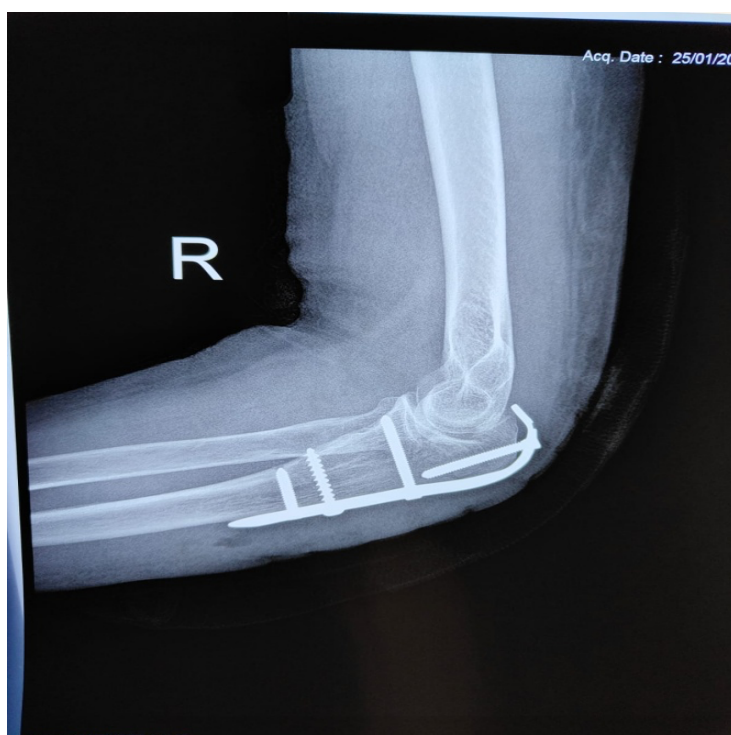


Figure 9: Post-Operative X-Ray of MAYO Type II A treated with Olecranon hook plate

Discussion:

Olecranon fractures are common upper extremity injuries, affecting adults of both sexes. These fractures are caused by violent injury like motor vehicle accident, a fall or assault and accounts for about 10% of the fractures around the elbow. Open reduction and internal fixation are the standard treatment for displaced intra-articular fractures. Two main modalities of treatment of olecranon fracture are tension band wiring and plate fixation. [5] In

the present study, mean age of the patients in group A (41.26 years) was greater than the average age of the patients in group B (43.53 years) but the difference was not statistically significant (p value >0.05). The overall mean age of the patients was 42.4 years.

The findings of our study are in accordance with the study conducted by Caglar C et al [6], Ring et al [7] and Mann HS et al [8] who reported mean age of the patients as 42.3 years, 38 years and 43.7

years respectively. This may be due to the fact that patients of this age group are more involved in active life and hence are more exposed to road side trauma, industrial accident and fight.

In this study, males outnumbered female patients with the ratio of 5:1. Ring et al also detected 82% of male preponderance in a similar study. Mann HS et al [8] and Cagler C et al [6] also reported that males outnumbered females with fracture olecranon in their studies. The male preponderance can be due to bone growth patterns and gender differences in physical activity (i.e. sports) and risk-taking. In present study, right side involvement was more than the left side. Among all patients, right side (66.6%) was more commonly involved. In similar studies conducted by Mann HS et al [8], Khanna G and Sohal HS2, right side was more commonly involved. This increase in incidence of right side may probably be because of more use of dominant site as protective limb during road side accident and direct below.

When the mode of injury was observed, we found that road side accident was the commonest mode of injury to cause fracture of olecranon in both the groups which constituted 66.66% of the cases followed by sports injury, assault and RTA. In similar studies conducted by Mann H.S et al [8], Barhua et al [9] and Horne et al [10], commonest mode of injury associated with fracture olecranon was road traffic accident. In a similar study done by Nieto H et al [11] on 163 cases of olecranon fracture most common mode of injury was road side accident. In present study, fracture was classified according to MAYO classification. Most common fracture type in our study population was type IIA (50%). A similar study conducted by Gathen M et al [12] also detected MAYO type IIA as the most common fracture type (52%). Cantoure M et al [13], in a similar study, also detected that most common fracture type according to MAYO classification was type IIA (64.2%). In this study, we also observed that the duration of surgery was significantly higher in group B as compared to group A. The average duration of surgery in Group A was 39 minutes and in group B was 56 minutes. Qi hong et al [14] also observed that the average operative time was 96.7 minutes in TBW and 104.9 minutes in plate fixation. Amini Michael H. et al [15] also performed the same study in 2016 which showed that operative time was significantly less for tension band group than plating group 55 & 85 minutes respectively.

In present study, 17 (56.7%) cases of both the groups were united in 12 weeks followed by 12 (40%) cases which were united in 18 weeks and 1 (3.33%) case was united in 24 weeks in group B. The mean duration of radiological union in group A was 13.2 weeks and in group B was 13.86 weeks. No statistically significant difference was found

between two groups in mean duration of radiological union. There was no incidence of deep infection in group A where the fractures were fixed with tension band wiring. The cases of superficial infection in group A were readily controlled by IV antibiotics for 6 weeks whereas the deep infections in group B of one case required debridement and antiseptic dressing along with parenteral antibiotics which eventually delayed the union. Hume and Wiss et al (1992) [16] also showed in their study that radiographic union occurred within 8 to 24 weeks in 95% of patients with average healing time of 12 weeks. The average union time in this study was also 13.3 weeks i.e. 3 months. Fan et al (1993) [17] reported bony union at 14 weeks. In a study conducted by Roel Langshong et al (2013) [18] clinical union was seen at 12 weeks in all cases. Radiological cortical bridging was seen at 12 weeks post-operatively. Macko et al (1985) [19] reported radiological union in all the cases at 12 weeks.

In our study, Group A when compared to Group B, the infection were superficial and did not hinder the progress of union. While the union was delayed in group B due to need of repeated debridement of the wound. One explanation of the 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 et al [20] 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.

In a study done by Mann HS et al [8] also, the complications were encountered in 11 (36.7%) cases. Group A reported higher number of complications as compared to group B. Group A had 8 (72.7%) cases with complications and group B had 3 (10%) cases with complications. Superficial infection occurred in 3 (10%) cases, 2 (13.3) cases in group A and 1 (6.7%) case were in group B, which was treated with I/V antibiotics and surgical debridement. In a study conducted by Byron E Chalidis et al (2008) [21], wound infection developed in 4 patients (6.5%).

When the cost-effectiveness was assessed, it was found that the cost of implant was 7.8 times higher in group B than group A. But medicinal costs are same in both the groups as both were done under brachial block. Jesse BS et al [22], Amini Michael H et al [15], in a similar study also observed that cost of TBW is significantly less when compared with plate fixation upon initial implantation. Specifically, tension band surgery is 39% of the mean direct cost of plate fixation. This financial difference resulted mainly from implant charges. The overall tension band fixation is half the cost of plate fixation. In present study, excellent results

were obtained among both groups except only 1 case which showed fair result and had deep infection which required debridement and antiseptic dressing along with intravenous antibiotic which eventually delayed the union. Hongfei Qi et al, in their study reported that the MEPS showed excellent results in 19 cases in the TBW group. [14] Mann HS et al [8] also in their study reported that 66.7% patients had excellent results with 23.3% having good results, 10% had fair results and no implant failure was seen. The difference was statistically not significant (p value-0.71) but comparable. The findings of the study are consistent with the findings of Schliemann B et al [23] (2014) who showed that 92% patients operated with plate osteosynthesis achieved good to excellent results in comparison to 77% patients treated with TBW.

In this study, mean MEPS score in group A was 88 and in group B was 89 and these showed no significant difference in final outcome of both groups with p value of 0.62. Amini Michael H et al [14], in a similar study with 10 patients in each group also detected that there was no significant difference in both groups with mean MEPS of 97 & 95 respectively for group A and group B. Tarallo L et al in a similar study in 2013 with 78 patients also showed that there was no significant difference in both groups with mean MEPS of 88 & 91 respectively for group A and group B. [15] Qi Hongfei et al [14], did a similar study in 2022 and observed that there was no significant difference in both groups and same results were also seen by Gathen M et al [12]. In a similar study by Schliemann B et al [23], there was no significance found between both groups according to MPES score.

Conclusion

It was concluded that tension band wiring and plate fixation are equally effective in management of displaced olecranon fractures. Tension band wiring, which is relied on the principle of posterior tensile forces to articular compressive forces, has gained widespread acceptance for the surgical treatment of olecranon fractures. It has the advantages of lesser surgery time, early functional recovery and radiological union, lesser use of hardware and early return to function. However, olecranon hook plate provides both angular and axial stability has a comparable functional and radiological outcome when compared with tension band wiring and especially useful in osteoporotic bone. Though, both these methods have a comparable functional and radiological outcome, the advantage which we observe regarding tension band wiring were lesser duration of surgery, early post-operative rehabilitation, early return to function and cost effectiveness which is very important factor in our government tertiary setup where most of the patients have low socio-economic status.

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