

Clinical Study on Functional Outcome after Surgical Management for Olecranon Fractures

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Abstract:

Background: Olecranon fractures represent a relatively frequent occurrence, comprising roughly 10% of all upper extremity fractures and 40% of fractures in the vicinity of the elbow joint. These fractures commonly stem from direct or indirect trauma, frequently associated with forced hyperextension of the elbow joint. In cases of non-displaced olecranon fractures, a conservative management strategy is often appropriate. The objective of this prospective study was to evaluate the functional outcomes resulting from anatomical plate fixation for olecranon fractures, encompassing both simple and comminuted cases.

Methods: A total of n=20 cases of olecranon fractures were included in the study based on the inclusion and exclusion criteria. The treatment approach involved using tension band wiring with Kirschner wires for simple transverse fractures and an olecranon hook plate for comminuted fractures and a strong focus on clinical observation and the subsequent analysis of outcomes following surgical management of olecranon fractures using Kirschner wires with tension band wiring and olecranon hook plates.

Results: In this study 15(75%) cases were with excellent scores of 90 – 100. N=3(15%) cases had good scores of 80 - 89. The scores of 70-79 are considered fair in this study in 2(10%), cases. The scores below 60 are considered poor or unacceptable no case in this study were with scores below 60. In this study, the total number of complications was in 2(10%) cases which included 2 cases of superficial infections that were adequately managed by antibiotics.

Conclusion: The current study concludes that the application of open reduction and internal fixation, utilizing Kirschner wires and tension band wiring for simple transverse and oblique fractures, along with olecranon plate fixation for comminuted fractures, proves to be an effective and established approach. 70% of patients in this study achieved excellent Mayo Elbow Performance Scores (MEPS), while an additional 20% obtained good MEPS scores. Significantly, none of the study participants demonstrated poor or unacceptable MEPS scores. These results indicate a notable success rate in the management of olecranon fractures, with the majority of patients realizing favorable and excellent functional outcomes.

Keywords: Olecranon, Fracture, Tension Band Wiring, Olecranon Hook Plate.

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Introduction

Olecranon fractures are relatively common, accounting for approximately 10% of all upper extremity fractures and 40% of fractures occurring around the elbow joint. [1-3] These fractures are characterized by their intra-articular nature, necessitating precise anatomical alignment during treatment. [2] They typically result from either direct or indirect trauma, often involving forced hyperextension of the elbow joint. For non-displaced olecranon fractures, conservative management is a suitable approach. [4] However, displaced olecranon fractures require intervention, which can involve tension band wiring, screw fixation, or plating. Regardless of the method chosen, the fixation must provide sufficient

stability to enable early mobilization of the elbow joint. [5] Post-traumatic elbow stiffness is a common complication following olecranon fractures, but this can be mitigated through prompt mobilization, which relies on the stability of the chosen fixation method. Tension band wiring (TBW) is a widely used technique for managing olecranon fractures, but it is typically reserved for non-comminuted fractures. However, TBW is associated with a high rate of hardware removal and various potential issues, as outlined by MM Schneider et al. [6] Complications can occur in up to 80% of cases, with the most common problems being pain and the need for implant removal due to wire migration or implant prominence. [6] Screw

fixation as a standalone treatment for olecranon fractures can fail due to the loss of reduction. [5] On the other hand, plating, especially for comminuted fractures, oblique fractures, and those involving the coronoid process, is linked to lower hardware removal rates and a reduced risk of reduction loss. [7] The operative approach should prioritize the restoration of the extensor mechanism, precise anatomical reduction, and secure fixation to facilitate early mobilization. Achieving these goals is relatively straightforward for undisplaced fractures, but challenges arise with fractures occurring at the olecranon base, often accompanied by radial head dislocation (Monteggia variant). [8] This prospective study aimed to assess the functional outcomes following anatomical plate fixation for olecranon fractures, both simple and comminuted. The primary goal was to evaluate the functional outcomes of patients treated with this method.

Material and Methods

This study was conducted in the Department of Orthopedics, Kakatiya Medical College, and MGM Hospital, Warangal. Institutional Ethical approval was obtained for the study as per the protocol for human research based on the Helsinki Declaration. Written consent was obtained from all the participants of the study after explaining the nature of the study in the vernacular language.

The treatment approach involved using tension band wiring with Kirschner wires for simple transverse fractures and an olecranon hook plate for comminuted fractures and a strong focus on clinical observation and the subsequent analysis of outcomes following surgical management of olecranon fractures using Kirschner wires with tension band wiring and olecranon hook plates.

Inclusion Criteria

1. Aged 18 – 60 years
2. Males and Females
3. Closed injuries
4. Comminuted and intraarticular fractures.
5. Available for follow-up examinations

Exclusion Criteria

1. Compound fractures
2. Medically compromised patients
3. Not as per the inclusion criteria

Brief Surgical Procedure for Tension Band Wiring: The anesthesia given was general anesthesia or brachial block. Position and Tourniquet: A mid-arm tourniquet was applied with the patient in a supine or lateral position. The surgical site was thoroughly cleansed with iodine and spirit and then draped. To expose the olecranon, Campbell's posterolateral approach was

employed. This involved making a vertical incision on the posterior aspect of the elbow, approximately 2.5 cm proximal to the olecranon. The incision then curved distally along the lateral aspect of the olecranon, reaching the subcutaneous border of the ulna and extending about 7.5 cm distal to the olecranon. The fascia was incised along the line of the skin incision, allowing access to the fracture site. Any fracture hematoma was carefully removed, and the fracture site was gently curetted. Precise anatomical hairline reduction was achieved and maintained using either a reduction clamp or a long towel clip. Two K-wires were introduced in parallel, starting from the tip of the olecranon (the proximal fragment) and crossing the fracture site to the distal fragment. The periosteum was stripped from the ulnar shaft distal to the fracture site, and a transverse hole was drilled approximately 3 to 5 cm distal to the fracture site. A No. 18 stainless steel malleable wire was passed through this transverse hole and crossed over the posterior surface of the olecranon in a figure-of-eight manner. It was then passed around the protruding Kirschner wires and tightened using an AO tensioner, followed by securing it with a twist. The proximal ends of the Kirschner wires were bent 180 degrees, and the cut ends were tapped back into the proximal fragment. The accuracy of the reduction was verified, and stability was assessed by moving the joint. The wound was closed in layers, and a sterile dressing was applied.

Brief Surgical Procedure for Olecranon Hook Plate:

Exposure - For comminuted olecranon fractures, Campbell's posterolateral approach was used for exposure. This involved making a vertical incision on the posterior aspect of the elbow, approximately 2.5 cm proximal to the olecranon. The incision then curved distally along the lateral aspect of the olecranon, reaching the subcutaneous border of the ulna and extending about 7.5 cm distal to the olecranon. The fascia was incised along the line of the skin incision, allowing access to the fracture site. Any fracture hematoma was carefully removed, and the fracture site was gently curetted. Precise anatomical hairline reduction was achieved and maintained using a reduction clamp. The olecranon hook plate was applied on the posterior surface with cortical screws after drilling and tapping. A thorough wash was given, the wound was closed in layers, and a sterile dressing was applied.

Statistical Analysis: All the available data was retrieved and uploaded to an MS Excel spreadsheet and analyzed by SPSS version 21 in Windows format. For continuous variables, the values were represented as mean, standard deviation, and percentages, and categorical variables were represented as p values. The values of (<0.05) were considered as significant.

Results

A total of 20 cases of olecranon fractures were included in the study. Out of the 20 cases 15(75%) cases involved males and 5(25%) were females. The male-to-female ratio was 3:1. Table 1 presents the age distribution of patients with olecranon fractures in a study. The majority of fractures occurred in patients between the ages of 31 and 40 (35%), followed by patients between 21 and 30 (20%). A smaller number of fractures occurred in patients between 18 and 20, 41 and 50, and 51 and

60. Only 10% of fractures occurred in patients under 21 or over 60. This suggests that olecranon fractures are most common in young adults and older adults, with a peak incidence between the ages of 31 and 40. This is likely due to the increased risk of high-energy trauma, such as falls and motor vehicle accidents, which occur during these two age groups. Additionally, older adults may be more susceptible to olecranon fractures due to osteoporosis, which can weaken the bones of the elbow.

Table 1: Age-wise distribution of cases of Olecranon fractures in the study

Age group in years	Frequency	Percentage
18 – 20	2	10
21 – 30	4	20
31 – 40	7	35
41 – 50	3	15
51 – 60	4	20
Total	20	100

Table 2 shows that the majority of olecranon fractures occurred on the right side (70%) and that the most common mechanism of injury was road traffic accidents (50%). This suggests that olecranon fractures are more likely to occur in

individuals who are injured in motor vehicle crashes. Accidental falls were also a common cause of olecranon fractures (45%). Assaults were a relatively rare cause of olecranon fractures (5%).

Table 2: Characteristics of cases of Olecranon fractures included in the study

	Frequency	Percentage
Side involved in fractures		
Right	14	70
Left	6	30
Mechanism of fractures		
Road Traffic Accidents	10	50
Accident Falls	9	45
Assaults	1	5

Table 3 shows that the majority of olecranon fractures in this study were displaced (100%). Of the displaced fractures, most were oblique and transverse fractures (80%), followed by comminuted fractures (15%). There were no undisplaced fractures or fracture-dislocations. Avulsion fractures are a type of displaced fracture in which a small fragment of bone is pulled away

from the main bone by a tendon or ligament. Oblique and transverse fractures are fractures in which the fracture line runs at an angle or perpendicular to the long axis of the bone. Comminuted fractures are fractures in which the bone is broken into multiple pieces. Fracture dislocations are fractures in which the bones are also dislocated from their normal positions.

Table 3: Colton's classification of fracture of olecranon cases included in the study

Type of fractures	Frequency	Percentage
Undisplaced and stable fractures	0	00%
Displaced fractures	20	100%
Avulsion fractures	1	5%
Oblique and transverse fractures	16	80%
Comminuted Fractures	3	15%
Fracture dislocation	0	00%

Pain: The majority of patients (75%) reported no pain following treatment for their olecranon fracture. The remaining 25% of patients reported mild pain. **Range of Motion:** The majority of patients (90%) had an arc of motion of greater than 100 degrees. The remaining 10% of patients had an arc

of motion between 50 and 100 degrees. No patients had an arc of motion of less than 50 degrees. **Stability:** The majority of patients (90%) had stable elbows. The remaining 10% of patients had moderate instability. **Functional Evaluation:** All patients were able to perform basic activities of daily living,

such as combing their hair, feeding themselves, and performing personal hygiene. Table 4 shows that the majority of patients in this study had good or excellent functional outcomes following olecranon

fracture treatment. Most patients did not experience pain, had a good range of motion, and were able to perform activities of daily living without assistance.

Table 4: Mayo Elbow performance scores (MEPS) in 20 cases of olecranon fractures

Variable	Definition	Frequency	Percentage
Pain (Max 45 points)			
45	None	15	75
30	Mild	05	25
15	Moderate	00	00
00	Severe	00	00
Range of Motion (Max 20 points)			
20	Arc of motion > 100 degrees	18	90
15	Arc of motion 50 – 100 degrees	2	10
5	Arc of motion < 50 degrees	0	0
Stability (Max 10 points)			
10	Stability	18	90
5	Moderate Instability	2	10
Functional Evaluation (Max 25 points)			
5	Able to comb hair	18	90
5	Able to feed himself	20	100
5	Able to perform personal hygiene	20	100
5	Able to put shirt	19	95
5	Able to put on shoes	20	100

Table 4 shows Mayo Elbow performance scores (MEPS). The MEPS is a validated tool for assessing the functional outcome of elbow injuries, and scores of 90-100 are considered excellent, scores of 80-89 are considered good, scores of 70-79 are considered fair, and scores below 60 are considered poor or unacceptable. The majority of patients in this study (70%) had excellent Mayo

Elbow Performance Scores (MEPS) following olecranon fracture treatment. An additional 20% of patients had good MEPS scores. No patients had poor or unacceptable MEPS scores. This suggests that the treatment of olecranon fractures was successful in this study, with most patients achieving good or excellent functional outcomes.

Table 5: Grading of Elbow Performance by Mayo Scores

Grading	Score	Frequency	Percentage
Excellent	> 90	15	75.00
Good	75 – 89	3	15.0
Fair	60 – 74	2	10.0
Poor	< 60	0	0.00

Table 5 shows elbow performance by Mayo scores. 75% of patients achieved an "Excellent" score (> 90 points), indicating a high level of functional recovery and minimal limitations in their elbows. An additional 15% of patients had "Good" scores (75-89 points), suggesting satisfactory outcomes with some potential limitations. A smaller 10% achieved "Fair" scores (60-74 points), indicating more noticeable limitations in functionality. No patients fell into the "Poor" category (<60 points), indicating that even those with limitations did not experience the most severe level of functional impairment. The majority of patients in this sample achieved excellent or good outcomes based on the MEPS, suggesting the treatment approach used was effective in restoring elbow function. Complications: No major complications were found in this study and 2(10%) patients developed

superficial infections which were adequately managed by broad-spectrum antibiotics.

Discussion

In our investigation, we utilized tension band sweating and Kirschner wires for the management of 20 cases involving olecranon fractures, specifically for simple transverse and oblique fractures. In cases of comminuted fractures, we opted for the olecranon hook plate. Application of this fixation method yielded favorable outcomes. In our current study, the average age incidence was 37.50 years, aligning well with the findings of Xieyuan et al. [9], where the average age was 38 years, and with the Macko D et al. [10] study in California, reporting an average age of 35.5 years (range, 15–76 years). Regarding sex, our study on olecranon fractures revealed a higher incidence in males (75%).

This male predominance is consistent with observations made by Xieyuan et al. [9] Hume MC et al. [11] and Wolfgang et al. [12] In terms of side incidence, right-sided involvement (70%) was more frequent than left-sided involvement in our study. Wolfgang G. et al. [12] also found a higher incidence on the right side, while Hume MC et al. [11] reported a higher incidence on the left side. Of the total patients, 10(50%) experienced accidental falls, 9(5%) were involved in road traffic accidents, and 1(5%) suffered an assault. In contrast, Xieyuan et al. [9] reported that 60% of the patients had road traffic accidents and 40% had accidental falls. Wolfgang et al. [12] 48.88% had accidental falls, 44.44% were motor vehicle accidents, and 6.66% resulted from a direct blow. In our investigation, we identified 11 (55%) transverse fractures, 5 (25%) oblique fractures, and 3 (15%) comminuted fractures. In a comparable study, Murphy et al. [13] reported 26 transverse fractures (57.5 %), 12 oblique fractures (26.7 %), and 7 comminuted fractures (15.6 %). Functional recovery was evaluated using the Mayo Elbow Performance Score (MEPS) to assess pain, motion, stability, and overall function. Scores ranged from 5 to 100, with higher values indicating better function (excellent >90, good 75–89, fair 60–74, poor <60). The MEPS, a modification of the Broberg and Morrey scale, is a reliable tool for assessing elbow joint outcomes. [14, 15] Test-retest agreement was strong. In this study, we found that 15(75%) cases had excellent scores, 3(15%) had good scores, and 2 (10 %) had fair scores. No patients with poor scores were observed in this study. The results of our study are similar to those reported by Buijze et al. [16] and Bailey et al. [17] Follow-up included anteroposterior and lateral radiographs to assess reduction quality, using a 2 mm step-off as the threshold. Radiographs were compared to those obtained after surgery for signs of secondary displacement. The time to complete healing, defined as the absence of a visible fracture line, was also recorded. The complication rate was similar to that reported in other similar studies conducted in the past in this field.

Conclusion

From the present study, it is concluded, that the technique of open reduction and internal fixation with Kirschner wires and tension band wiring for simple transverse and oblique fractures and olecranon plate fixation for comminuted fractures are effective and established approaches. Treatment of fractures of olecranon In this study 70% of patients who underwent treatment for olecranon fractures achieved excellent Mayo Elbow Performance Scores (MEPS), while an additional 20% attained good MEPS scores. Importantly, no patients in the study exhibited poor or unacceptable MEPS scores. These findings suggest a high level of success in treating olecranon fractures, as the

majority of patients experienced favorable and excellent functional outcomes.

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