ORIGINAL RESEARCH

Surgical Management of Olecranon Fractures: A Clinical Study Emphasizing the Pros and Cons of Different Techniques, Alongside an Evaluation of Joint Stability and Motion

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ABSTRACT

Background:Surgical intervention has become increasingly popular and is now considered a crucial approach to management. Early engagement in active mobilization following the surgical procedure plays a key role in swiftly restoring normal function. This proactive and timely mobilization is instrumental in promoting rapid fracture union and preventing issues with the surrounding tissues.**Methods**:In a study involving 46 participants of both genders, comminuted fractures were addressed using an olecranon hook plate, while simple transverse fractures were treated with tension band wiring using K-wire. The outcomes of the study were evaluated three months after the surgical procedures. During the follow-up visits, a comprehensive clinical examination was performed for all subjects to assess muscle power associated with the treated joint, prominence of cancellous screw heads, elbow joint mobility, tenderness, and joint swelling. Additionally, joint movement, limitations, swelling, and pain were thoroughly examined during the recall visits.**Results**:According to Mayo Elbow Performance scores, the study revealed excellent outcomes with scores exceeding 90 in 69.56% (n=32) of the participants. A good result was observed in 13.04% (n=6) of the subjects, while fair results were noted in 17.39% (n=8). Notably, no poor results were observed in any subject. In terms of complications, 73.91% (n=34) of the participants experienced no issues. Symptomatic metal prominence was noted in 13.04% (n=6), superficial infection in 8.69% (n=4), and implant loosening was the least common complication, observed in only 4.34% (n=2) of the study subjects.**Conclusion**:In conclusion, the current study affirms that the treatment approaches employed for Olecranon fractures, utilizing the Olecranon hook plate for comminuted fractures and tension band with K-wire for simple transverse fractures with open reduction and internal fixation, prove to be effective modalities with minimal drawbacks.

Keywords: Olecranon fracture, olecranon hook plate, Tension band wiring, simple transverse olecranonfracture, comminuted fracture

INTRODUCTION

Among the prevalent orthopaedic injuries requiring emergency attention, the Olecranon fracture stands out as one of the most commonly reported. The Olecranon process fracture of the ulna is typically attributed to various factors, including assault, falls, and motor vehicle accidents.In cases of displaced fractures, the recommended approach involves open reduction and internal fixation. This surgical intervention is designed to restore normal elbow function and ensure the anatomical realignment of the articular surface, facilitating optimal recovery.[1] On the other hand, for non-displaced fractures, a conservative management strategy is often employed. This entails initial immobilization for a brief period, followed by a gradual increase in the range of motion to promote healing.The paramount goals in the fixation and management of Olecranon fractures are to achieve successful fracture union and restore elbow function. This includes the restoration of both extension and flexion capabilities, while ensuring desirable stability in the affected joint. The comprehensive approach aims not only to address the immediate concerns related to the fracture but also to promote long-term functionality and stability for the patient's elbow joint.In the past, the go-to approach for managing Olecranon fractures involved the application of plaster casts and closed reduction. However, this method

presented heightened mortality and morbidity risks due to complications arising from prolonged immobilization in treated individuals. In response to these challenges, surgical intervention has emerged as a preferred and crucial management strategy.

The shift towards surgical solutions is motivated by the desire to mitigate complications associated with extended immobilization.[2] Early active mobilization, post-surgery, plays a pivotal role in swiftly restoring normal function. This proactive and early mobilization not only facilitates rapid fracture union but also serves to prevent complications arising from tissue immobilization.For simple transverse fractures, achieving early motion with minimal stiffness is paramount. This is effectively realized through stable internal fixation, with a tension band playing a crucial role. Notably, when considering the tension band technique, superior outcomes are observed when utilizing K-wire in the AO tension band technique. This preference is attributed to the K-wire's enhanced resistance to shearing forces, resulting in improved clinical outcomes.[3] The conversion of tensile force to compressive force in this technique contributes to the overall success of the treatment, ensuring better stability and functionality for the patient.In the context of managing comminuted fractures, oblique fractures, and distal fractures involving the coronoid process, plate fixation emerges as the most suitable treatment modality for fracture management. Specifically, for non-united comminuted fractures, dorsal application of an Olecranon hook plate is considered the most appropriate management method. Both plate fixation and tension band wiring are deemed acceptable, contingent upon the fracture type and the clinical situation at hand. However, there is a noticeable scarcity of data in the literature regarding the comparative analysis of these two techniques.In response to this gap in knowledge, the present study was undertaken with the primary objective of clinically assessing the outcomes following surgical treatment of Olecranon fractures. The study differentiated its approach based on the fracture type, utilizing plate fixation for comminuted fractures and tension band wiring for simple transverse fractures. The evaluation encompassed an in-depth analysis of the advantages and disadvantages associated with each procedure, shedding light on factors such as stability and elbow joint motion post-surgical management of Olecranon fractures.[4] Through this investigation, the aim is to contribute valuable insights into the efficacy and nuances of these surgical techniques, ultimately guiding future clinical decisions in the management of Olecranon fractures.

MATERIALS AND METHODS

The aim of the current clinical study was to comprehensively evaluate the clinical outcomes resulting from surgical interventions for Olecranon fractures, employing plate fixation for comminuted fractures and tension band wiring with K-wire for simple transverse fractures. The study encompassed a total of 46 participants of both genders, selected based on the presence of either simple transverse or comminuted fractures of the Olecranon within the defined study period.Upon inclusion in the study, subjects underwent an initial phase of management involving appropriate pain relief techniques, coupled with the immobilization of the fracture. Subsequently, following a thorough pre-anaesthetic assessment, the subjects proceeded to undergo the specified surgical procedures. A detailed examination of trauma and injury history was meticulously conducted for all participants, with equal emphasis placed on associated injuries. Various parameters, including swelling, pain severity, external wound characteristics, and active joint movements (both extension and flexion), were carefully documented.A comprehensive local and general examination followed, supported by routine urine and blood investigations encompassing parameters such as hemoglobin levels, bleeding and clotting time, erythrocyte sedimentation rate (ESR), white blood cell (WBC) counts, fasting blood sugar, viral markers, electrocardiogram (ECG), blood grouping, and urine analysis for sugar and albumin. The selection of treatment modality—specifically the utilization of K-wire (Krishner wire)—was based on considerations such as age, degree of comminution, and the extent of damage to the articular surface. Surgical intervention was withheld for older individuals and those with associated surgical risks.

Surgical exposure of the fractures was achieved through Campbell’s posterolateral approach. Simple transverse fractures were meticulously approximated and managed with two K-wires, while comminuted fractures were addressed using an Olecranon hook plate.[5] This detailed methodology reflects a thorough and systematic approach to the surgical management of Olecranon fractures in the study population.Following the surgical procedures, the postoperative care of the subjects involved a regimen of appropriate antibiotics and analgesics administered over a span of 5 days. During the initial postoperative period, the treated arm was maintained in an elevated position, with finger movements initiated on the first day and elbow movement commenced on the third day postoperatively. Limbs, excluding those with comminuted fractures, were mobilized starting from the third postoperative day. Comminuted fractures remained immobilized for a duration of 2 weeks, specifically in a 90-degree flexion.

Subsequent follow-up appointments were scheduled at 6 weeks and 12 weeks, with subsequent visits every 3 months. Subjects were advised to undergo physiotherapy without loading, focusing on exercises for pronation-supination and flexion-extension.[6] The study results were systematically assessed at the 3-month postoperative mark using the Mayo Elbow Performance Score.During recall visits, a thorough clinical examination was conducted for each subject, encompassing evaluations of muscle power related to

the treated joint, prominence of cancellous screw heads, elbow joint movement, tenderness, and the presence of joint swelling. Parameters such as joint movement, restrictions, swelling, and pain were consistently evaluated during these recall visits. Implants were removed upon radiographic confirmation of joint fusion. The duration from surgery to the resumption of normal work activities was also documented.The collected data underwent meticulous evaluation and analysis, with the results expressed in terms of percentages and numerical values. This comprehensive approach ensures a thorough understanding of the postoperative outcomes and aids in formulating insights into the efficacy of the surgical interventions employed in the study.

RESULTS

The primary objective of this clinical study was to assess the clinical outcomes associated with the surgical management of Olecranon fractures. The study specifically focused on two distinct surgical approaches: plate fixation for comminuted fractures and tension band wiring with K-wire for simple transverse fractures of the Olecranon. A total of 46 subjects, encompassing both genders, were included in the study. Comminuted fractures were addressed using an olecranon hook plate, while tension band wiring with K-wire was employed for the management of simple transverse fractures.The demographic characteristics of the study participants are detailed in Table 1, providing essential information about the composition of the subject population. This comprehensive assessment of the subjects' demographic profiles lays the foundation for understanding the diverse factors that may influence the outcomes of surgical interventions for Olecranon fractures. The inclusion of both genders ensures a representative sample, contributing to the generalizability of the study findings.

By employing a combination of specific surgical techniques tailored to the nature of the Olecranon fractures, the study aimed to contribute valuable insights into the efficacy of these approaches. The utilization of an olecranon hook plate for comminuted fractures and tension band wiring with K-wire for simple transverse fractures reflects the nuanced and individualized strategies employed in orthopedic practice.In summary, this study not only sought to evaluate the clinical outcomes of different surgical interventions for Olecranon fractures but also considered the demographic diversity of the study participants. The findings from this research endeavor have the potential to inform clinical decision-making and enhance the understanding of optimal approaches for managing Olecranon fractures based on their specific characteristics.

Table 1: Demographic and disease characteristics of the study subjects

Characteristic	Number (n)
Age range (years)	
<30	12
31-40	14
41-50	8
51-60	12
Gender	
Males	30
Females	16
Fracture side	
Left	14
Right	30
Fracture cause	
Direct fall	18
Road Traffic accident	26
Assault	2
Fracture type	
Comminuted	10
Oblique and transverse	34
Avulsion	2
Associated Injuries	4
Injury to surgery time within 10 days	46
Union duration (months)	
Non-union	0
<4	30
4-6	16
6-12	0

The study subjects, with an average age of 33.4±2.68 years and a broad age range spanning from 18 to 60 years, presented a diverse demographic composition. The highest concentration of participants fell within the age bracket of 31-40 years, constituting 30.43% (n=14) of the study cohort. Gender distribution revealed that 65.21% (n=30) were male, while 34.78% (n=16) were female. Fractures exhibited an asymmetric distribution, with 30.43% (n=14) occurring on the left side and 65.21% (n=30) on the right side.The etiology of fractures displayed variability, with falls, road traffic accidents, and assaults accounting for 39.13% (n=18), 56.52% (n=26), and 4.34% (n=2) of the cases, respectively. The spectrum of fracture types included comminuted fractures in 21.73% (n=10) of subjects, while oblique and transverse fractures constituted the majority at 73.91% (n=34), and avulsion fractures were observed in 4.34% (n=2) of cases. Associated injuries were documented in 8.69% (n=4) of subjects.

The timeline from injury to surgery was uniform across all subjects, occurring within 2-10 days. The duration of union varied, with 65.21% (n=30) experiencing union in less than 4 months, and 34.78% (n=16) achieving union in the 4-6 months range. Importantly, the study reported no instances of non-union.The evaluation of pain, range of motion, stability, and functional outcomes, utilizing Mayo Elbow Performance scores, yielded promising results.[7] A significant majority of study subjects, constituting 69.56% (n=32), achieved excellent outcomes with scores exceeding 90. Good results were noted in 13.04% (n=6) of cases, while fair outcomes were observed in 17.39% (n=8) of subjects. Notably, the absence of poor results underscores the overall positive functional outcomes following the surgical intervention.In summary, this comprehensive expansion provides detailed insights into the demographic characteristics, fracture profiles, and outcomes of individuals undergoing surgical treatment for Olecranon fractures. The favorable Mayo Elbow Performance scores underscore the efficacy of the selected surgical interventions in attaining positive functional outcomes among the study participants.

Table 2: Demerits/ Complications following surgery in the study subjects

Complication Encountered	Percentage (%)	Number (n)
None	73.91	34
Symptomatic metal prominence	13.04	6
Superficial infection	8.69	4
Implant Loosening	4.34	2

DISCUSSION

The present study, with a robust sample size of 46 subjects, aimed to investigate the clinical outcomes following surgical interventions for Olecranon fractures. The study encompassed individuals of diverse ages and both genders, highlighting the inclusivity of the research design.[8] Two distinct surgical approaches were employed based on the fracture type: comminuted fractures were addressed using an olecranon hook plate, while simple transverse fractures were treated with tension band wiring utilizing K-wire fixation.The demographic profile of the study subjects was characterized by a mean age of 33.4±2.68 years, ranging from 18 to 60 years. Within this spectrum, individuals aged 31-40 years constituted the largest subgroup, representing 30.43% (n=14) of the study population. Gender distribution indicated a majority of male participants, accounting for 65.21% (n=30), with the remaining 34.78% (n=16) being female.Fracture characteristics demonstrated an even distribution between the left and right sides, with 30.43% (n=14) and 65.21% (n=30) prevalence, respectively. The diverse etiology of fractures included falls (39.13%, n=18), road traffic accidents (56.52%, n=26), and assault (4.34%, n=2). Distinct fracture types were observed, with comminuted fractures in 21.73% (n=10) of cases, oblique and transverse fractures in the majority at 73.91% (n=34), and avulsion fractures in 4.34% (n=2). Associated injuries were documented in 8.69% (n=4) of subjects.The interval from injury to surgery was consistent across all subjects, occurring within 2-10 days, reflecting a prompt medical response.[9] Union duration demonstrated variability, with 65.21% (n=30) achieving union in less than 4 months and 34.78% (n=16) within the 4-6 months range. Notably, the absence of non-union cases underscored the success of the surgical interventions in promoting fracture healing.This study's demographics bear notable resemblance to those examined by Boyer MI et al in 2003 and Gordon MJ et al in 2006, enhancing the external validity and generalizability of the findings. The detailed exploration of patient characteristics, fracture types, and surgical outcomes contributes to a comprehensive understanding of Olecranon fracture management, catering to a diverse population.

The comprehensive evaluation of the surgical outcomes for Olecranon fractures in the present study utilized the Mayo Elbow Performance scores, providing a nuanced understanding of pain management, range of motion, stability, and overall functional recovery. The noteworthy finding that 69.56% (n=64) of study subjects achieved excellent outcomes, marked by scores surpassing 90, reflects a high degree of success in the employed surgical interventions. Additionally, 13.04% (n=12) attained good results, and 17.39% (n=16) fell within the fair category, indicating an overall positive trend in patient outcomes. The absence of poor results further underscores the effectiveness of the procedures.These

results align with the outcomes reported by Chaldis BE et al and Inam M et al[10], reinforcing the acceptability of tension band wiring with K-wire and Olecranon hook plate as viable and successful approaches in managing Olecranon fractures.The study's meticulous exploration of complications and demerits associated with the surgical procedures further enhances its clinical relevance. The majority of subjects, 73.91% (n=34), experienced no complications, indicating a favorable safety profile. Symptomatic metal prominence affected 13.04% (n=6) of study subjects, while superficial infection and implant loosening occurred in 8.69% (n=4) and 4.34% (n=2) of subjects, respectively. The relatively low incidence of complications suggests the overall safety and efficacy of the evaluated procedures.

These findings resonate with studies by Rommens PM et al and Tejwani NC et al[11], where similar complications and demerits were observed in Olecranon fracture treatments involving olecranon hook plates and tension band wiring with K-wire. The consistency in outcomes across these studies underscores the reliability of the employed surgical techniques and emphasizes their efficacy in managing Olecranon fractures while maintaining a relatively low risk of complications.

CONCLUSION

In conclusion, the present study provides valuable insights into the management of Olecranon fractures, highlighting the efficacy of employing an Olecranon hook plate for comminuted fractures and tension band wiring with K-wire for simple transverse fractures through open reduction and internal fixation. The observed outcomes suggest that these treatment modalities are effective with minimal associated demerits.However, it's essential to acknowledge the study's limitations, including a relatively short follow-up period, a modest sample size, and potential biases related to the geographic area of the study population. To draw more robust and generalizable conclusions, future research endeavors should consider incorporating larger sample sizes and extended follow-up durations. This would contribute to a more comprehensive understanding of the long-term outcomes and potential complications associated with the evaluated treatment modalities, further enhancing the evidence base for clinical decision-making in Olecranon fracture management.

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