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Comparative Efficacy of Conservative Treatment Versus Percutaneous K-Wire Fixation in Managing Proximal Humerus Fractures Among Elderly Patients

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Abstract. *Proximal humerus fractures are prevalent among elderly patients, often necessitating tailored management approaches to optimize recovery and quality of life. This study compares the outcomes of conservative treatment and percutaneous K-wire fixation in elderly patients with proximal humerus fractures. A cohort of 120 patients, aged 65 and older, was evaluated over a six-month period, with 60 patients receiving conservative management for non-displaced fractures and 60 undergoing K-wire fixation for displaced fractures. Outcomes were assessed based on pain relief, functional recovery, range of motion, and complication rates, using standardized measures such as the Visual Analog Scale (VAS), Disabilities of the Arm, Shoulder, and Hand (DASH) score, and Constant-Murley score. The results showed that K-wire fixation provided faster pain relief and superior functional outcomes, with significant improvements in range of motion compared to conservative treatment. While the K-wire group demonstrated an increased risk of minor complications, including pin tract infections, these were manageable and did not adversely affect recovery. Conversely, the conservative group exhibited a higher incidence of malunion in displaced fractures, resulting in functional limitations. The findings indicate that conservative treatment remains effective for non-displaced fractures, while K-wire fixation is preferable for displaced fractures, offering enhanced stability and promoting faster rehabilitation. This study underscores the importance of individualized treatment selection based on fracture type and patient-specific needs to achieve optimal recovery outcomes in elderly patients with proximal humerus fractures.*

Keywords: *Proximal humerus fracture, elderly patients, conservative treatment, K-wire fixation, functional recovery, range of motion, pain relief, orthopedic management*

Introduction

Proximal humerus fractures are among the most common fractures in elderly individuals, particularly affecting those over the age of 65. They account for approximately 4-5% of all fractures and represent one of the main types of fragility fractures in this demographic, alongside hip and distal radius fractures. The proximal humerus, the ball-shaped upper portion of the arm bone, is susceptible to fractures due to factors such as osteoporosis and falls, which are more prevalent in older populations. Given that a large proportion of these fractures occur in elderly patients, the treatment approach must be carefully considered to optimize outcomes, taking into account not only the fracture itself but also the patient's overall health status, lifestyle, and preferences [1]. In many cases, proximal humerus fractures are managed conservatively, especially when they are non-displaced or minimally displaced. Conservative treatment typically involves immobilization, physical therapy, and pain management. For fractures that are displaced, surgical interventions are often considered. Percutaneous K-wire fixation is one minimally invasive option that has gained attention for its benefits in achieving fracture stability while minimizing surgical trauma and preserving blood supply to the humeral head. This technique involves inserting K-wires through small incisions, which may stabilize the fracture with minimal soft tissue damage.

The choice between conservative and surgical treatment depends on several factors, including the degree of displacement, the type of fracture, and the patient's overall health and functional demands.

The importance of effective treatment for proximal humerus fractures in elderly patients cannot be overstated. Physical incapacity following these fractures is common, with up to three months of significant physical limitations reported in some cases. Elderly patients are particularly vulnerable to prolonged recovery periods, as reduced mobility can lead to additional complications such as muscle atrophy, joint stiffness, and increased risk of falls. Furthermore, many elderly individuals have comorbidities like cardiovascular diseases, diabetes, and osteoporosis, which can complicate both surgical and non-surgical treatment. Achieving a balance between restoring function and minimizing risks is essential, as elderly patients may not tolerate extensive surgery and the associated anesthesia well. Conservative treatment may offer a lower-risk option but could be less effective in cases of displaced fractures where the risk of malunion or nonunion is higher, potentially resulting in chronic pain, deformity, or limited mobility [2]. The decision-making process surrounding the treatment of proximal humerus fractures is further complicated by the lack of clear evidence favoring one treatment over the other for elderly patients. Numerous studies have documented both the advantages and limitations of conservative and percutaneous K-wire fixation approaches. Conservative treatment has been associated with lower costs, fewer complications related to surgery, and avoidance of anesthesia-related risks, making it an attractive option for elderly patients, especially those with high surgical risks [3]. However, conservative treatment also has limitations; it often involves extended immobilization, which can lead to stiffness and reduced shoulder function, and it may be less effective in achieving anatomic alignment for displaced fractures. K-wire fixation, on the other hand, offers the potential for earlier mobilization and improved functional outcomes by achieving greater stability, but it comes with risks such as pin tract infections, wire migration, and sometimes the need for further surgical intervention if complications arise.

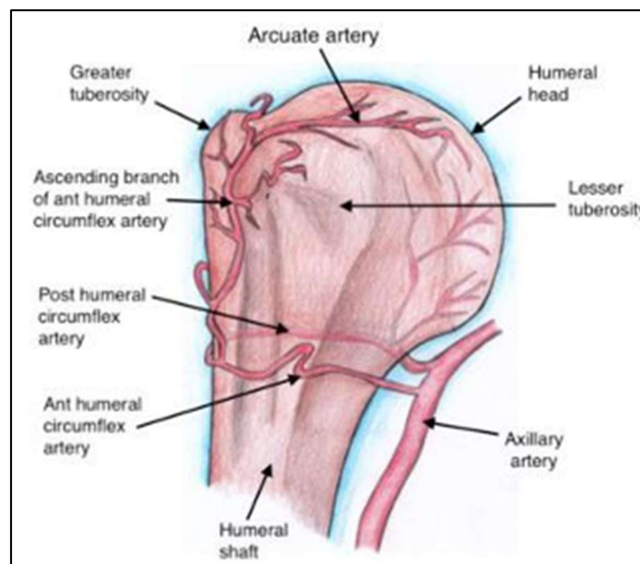

Figure 1: Course of major blood supply around humeral head

In this context, the present study aims to conduct a comparative analysis of the outcomes of conservative treatment and percutaneous K-wire fixation in elderly patients with proximal humerus fractures. Specifically, this study will evaluate functional outcomes, morbidity, and post-treatment complications over a defined follow-up period. By providing evidence-based insights into the effectiveness of these two approaches, this study aims to contribute to the understanding of optimal treatment strategies for proximal humerus fractures in the elderly

population [4]. The rationale for comparing conservative treatment with percutaneous K-wire fixation lies in the need to provide individualized care that maximizes recovery while minimizing risk. Elderly patients with proximal humerus fractures often vary widely in their health status and functional demands, so a one-size-fits-all approach is rarely appropriate. By examining the relative benefits and drawbacks of conservative and surgical treatments, this study seeks to identify factors that may help clinicians determine the best course of action for each patient. The ultimate goal is to improve clinical decision-making and to enhance the quality of life for elderly patients suffering from proximal humerus fractures by facilitating faster and more complete functional recovery with minimal complications. This research is particularly relevant given the aging global population and the anticipated increase in fragility fractures in the coming decades. Identifying effective, low-risk, and accessible treatment options for elderly patients is critical to managing the anticipated rise in healthcare needs associated with an aging demographic. This study's findings may offer insights that help guide evidence-based practices and inform future research into the management of fragility fractures among the elderly.

I. Aim and Objectives

The primary aim of this study is to compare the clinical outcomes of conservative treatment and percutaneous K-wire fixation in the management of proximal humerus fractures in elderly patients. By conducting this comparative analysis, the study seeks to determine which treatment approach offers superior functional recovery, reduced morbidity, and minimized complications, thereby guiding evidence-based clinical decisions for optimal fracture management in this demographic.

Objectives

1. To Assess Functional Outcomes

   This objective involves evaluating functional outcomes associated with each treatment method, using standardized scoring systems such as the Disabilities of the Arm, Shoulder, and Hand (DASH) score and the Constant Murley score. Functional outcomes include metrics like pain levels, range of motion, strength, and overall patient satisfaction. Assessing functional recovery is critical for understanding the degree to which each treatment restores pre-fracture shoulder function, facilitating faster return to daily activities and improved quality of life.

2. To Evaluate the Impact on Morbidity

   This study aims to examine the effect of each treatment on morbidity, defined here as the degree of physical and psychological limitations and complications patients experience during and after recovery. For elderly patients, minimizing morbidity is essential due to the high risk of prolonged immobility and related complications, such as muscle atrophy, joint stiffness, and overall decline in health status. The analysis will include factors such as time to regain mobility, dependence on assistive devices, and the need for extended rehabilitation.

3. To Assess Post-Treatment Complications

   This objective focuses on identifying and comparing the complications that may arise from each treatment approach. For conservative management, common complications include malunion, delayed union, and stiffness due to prolonged immobilization. For K-wire fixation, potential complications include pin tract infections, wire migration, and neurovascular damage. By comparing complication rates and types across both treatment groups, this study aims to provide a balanced view of each method's risks, guiding clinicians in making safer, more informed treatment choices for elderly patients.

4. To Analyze Patient Compliance and Treatment Adherence

   Elderly patients often face challenges in adhering to treatment protocols, whether it involves immobilization in conservative treatment or post-surgical care in K-wire fixation. This study will explore the extent of patient compliance for each approach and the impact of compliance on treatment outcomes, providing insights into which method may be more feasible for elderly patients in real-world settings.

II. Review of Literature

Proximal humerus fractures, often seen in elderly patients due to osteoporosis and increased risk of falls, have presented significant challenges in orthopedic management. Treatment approaches for these fractures have evolved considerably, ranging from conservative methods to more advanced surgical interventions, each with distinct benefits and limitations [5]. This review discusses the evolution of treatment for proximal humerus fractures, provides a historical perspective on conservative and surgical approaches, and examines comparative studies on the effectiveness of these interventions in elderly patients.

Historically, proximal humerus fractures were predominantly managed conservatively due to the limited surgical techniques available. The conservative approach was largely focused on immobilization, aiming to allow natural healing without invasive intervention. However, as medical understanding and technology evolved, the use of surgical methods gained popularity, especially for displaced fractures where achieving alignment and stability through non-surgical means proved challenging [6].

Early surgical interventions included simple reductions with minimal fixation, later progressing to the use of metallic implants for stable fixation. Over time, with advancements in surgical instrumentation and imaging techniques, orthopedic surgeons began adopting various fixation methods such as intramedullary nailing, plating, and eventually specialized devices like locking plates and percutaneous K-wires [7]. These techniques have enabled greater control over fracture stability and alignment, allowing for earlier mobilization, which is particularly beneficial in elderly patients who may suffer from complications related to prolonged immobility.

In recent decades, two primary treatment approaches have emerged for managing proximal humerus fractures in elderly patients: conservative treatment and percutaneous K-wire fixation. Conservative treatment remains widely used, especially for non-displaced fractures, due to its lower risk and cost-effectiveness [8]. However, as surgical techniques have become more refined, minimally invasive options like K-wire fixation have gained attention as they offer a compromise between stability and minimal invasiveness.

The conservative approach, one of the earliest forms of treatment for proximal humerus fractures, involves immobilizing the arm in a sling or shoulder immobilizer. This method prevents further displacement and allows natural healing. Initially, conservative treatment was the mainstay for most types of fractures, as surgery was limited and associated with high risks. Studies from the 20th century reinforced the notion that non-displaced fractures could achieve good outcomes without surgical intervention, especially in elderly patients where the risks associated with surgery were considered prohibitive [9]. However, conservative management posed its own risks, including the possibility of malunion, nonunion, and shoulder stiffness due to prolonged immobilization.

As surgical techniques advanced, orthopedic surgeons began exploring methods to improve alignment and stability in displaced fractures. Intramedullary nailing and plate fixation became popular in the latter half of the 20th century, offering an alternative for complex or displaced fractures. In the 1970s, Charles Neer introduced a classification system for proximal humerus fractures, which laid the groundwork for more tailored surgical

approaches. This system enabled surgeons to better assess fracture patterns and determine the most suitable intervention, which often included open reduction and internal fixation (ORIF) for displaced fractures [10].

The introduction of percutaneous K-wire fixation represented a significant development in the treatment of proximal humerus fractures. Percutaneous K-wire fixation is a minimally invasive procedure that provides stability through the insertion of Kirschner wires (K-wires) into the bone. This technique preserves soft tissue and vascular integrity, which is especially important in elderly patients where compromised blood supply can lead to complications like avascular necrosis. In the 1980s and 1990s, studies began documenting the efficacy of K-wire fixation for fractures that required stabilization but did not necessitate the extensive exposure of traditional open surgery.

Despite the advancements in surgical techniques, the conservative approach has remained relevant, especially for fractures that are minimally displaced. Studies have continued to support conservative management for non-displaced fractures, noting that it avoids the risks associated with surgery, such as infection, blood loss, and anesthesia complications. However, for displaced fractures, the trend has shifted toward surgical fixation methods, with percutaneous K-wire fixation being favored for its balance of stability and minimal invasiveness.

The choice between conservative treatment and percutaneous K-wire fixation in elderly patients with proximal humerus fractures has been the focus of several comparative studies. These studies have sought to determine the efficacy of each method in terms of functional outcomes, complications, and overall recovery in older adults.

Conservative treatment is generally recommended for elderly patients with non-displaced or minimally displaced fractures, as it avoids the risks of surgery and is associated with lower healthcare costs. A study by Hertel et al. (2004) highlighted that conservative management of proximal humerus fractures could yield favorable outcomes, especially in patients with non-displaced fractures. However, complications related to immobilization, such as joint stiffness, delayed functional recovery, and the potential for malunion, remain concerns. Additionally, some patients experience chronic pain or functional limitations even after conservative treatment, suggesting that while this approach is suitable for many elderly patients, it may not be optimal for fractures that are displaced or more complex.

Conversely, percutaneous K-wire fixation has demonstrated promising results in managing displaced proximal humerus fractures among elderly patients. Research has shown that this method provides adequate stability for healing while preserving soft tissues, allowing for early mobilization, which is crucial for minimizing complications associated with immobility. Studies by Resch et al. (1997) and Ebraheim et al. (2007) reported favorable outcomes with K-wire fixation, noting that patients experienced reduced pain, improved range of motion, and quicker recovery times compared to those managed conservatively. However, K-wire fixation is not without risks; complications such as pin tract infections, wire migration, and the need for hardware removal have been reported, though these are typically manageable with proper care and follow-up.

More recent studies have aimed to establish a clearer understanding of the comparative benefits and limitations of each approach. A study by Acklin and Sommer (2013) examined patients with proximal humerus fractures treated with both conservative and K-wire methods. Their findings suggested that while conservative treatment is suitable for minimally displaced fractures, K-wire fixation offers superior outcomes for fractures requiring stabilization, particularly in terms of maintaining anatomical alignment and enabling early rehabilitation.

Overall, the literature indicates that treatment decisions should be guided by factors such as fracture type, degree of displacement, and patient health status. For elderly patients, conservative treatment remains a viable option for non-displaced fractures, while percutaneous K-wire fixation offers a beneficial alternative for displaced fractures, combining stability with minimal invasiveness. This dual approach allows for individualized

treatment planning that can optimize recovery and functional outcomes while minimizing risks in elderly patients with proximal humerus fractures.

III. Materials and Methods

a. Study Design and Participant Criteria

This study was designed as a prospective, comparative analysis of elderly patients (aged 65 and older) diagnosed with proximal humerus fractures. Patients were recruited from an orthopedic department at a tertiary care hospital. The study aimed to compare the outcomes of conservative treatment versus percutaneous K-wire fixation in managing proximal humerus fractures. The participants included in this study met the following criteria:

1. **Inclusion Criteria**
    - Age of 65 years or older
    - Diagnosed with a proximal humerus fracture, verified through radiographic imaging
    - Fracture types included in the study were non-displaced or minimally displaced fractures for the conservative treatment group and displaced fractures for the K-wire fixation group
    - Patients who provided informed consent to participate in the study
2. **Exclusion Criteria**
    - Patients with pre-existing shoulder pathology, such as rotator cuff tears or glenohumeral arthritis, which could interfere with functional outcomes
    - Those with fractures involving additional injuries to the ipsilateral upper limb
    - Patients with significant comorbidities that precluded surgery or compromised recovery
    - Individuals unable to comply with postoperative rehabilitation protocols

Participants were assigned to treatment groups based on the nature and displacement of the fracture. Non-displaced and minimally displaced fractures were treated conservatively, while displaced fractures were managed with percutaneous K-wire fixation. This allocation was based on clinical evaluations and imaging, ensuring that treatment methods aligned with fracture severity and individual patient characteristics.

b. Detailed Explanation of Conservative and K-Wire Treatments

1. **Conservative Treatment Protocol**

Conservative treatment is the non-surgical management approach for proximal humerus fractures, especially suitable for non-displaced or minimally displaced fractures. The treatment protocol involved:

- **Immobilization**: Patients were immobilized using a shoulder immobilizer or sling to stabilize the fracture site and prevent movement that could lead to displacement. This immobilization period typically lasted three to four weeks, although adjustments were made based on individual healing rates and follow-up X-ray findings.
- **Pain Management**: Pain was managed with analgesics, primarily nonsteroidal anti-inflammatory drugs (NSAIDs), with stronger medications such as opioids prescribed only for severe pain to reduce risks associated with prolonged opioid use in elderly patients.
- **Physical Therapy**: After the immobilization period, patients gradually began passive range-of-motion (ROM) exercises under supervision. These exercises aimed to prevent joint stiffness and maintain shoulder mobility. Active ROM exercises were introduced progressively, focusing on shoulder abduction, flexion, and rotation as pain and stability allowed.

- **Follow-Up and Monitoring**: Patients were scheduled for regular follow-ups, with clinical evaluations and radiographs taken at two-week intervals to monitor fracture alignment and healing progress. Adjustments to the rehabilitation protocol were made based on the patient's recovery, pain levels, and functional capacity.

2. **Percutaneous K-Wire Fixation Protocol**

For displaced proximal humerus fractures, percutaneous K-wire fixation was employed to provide stable fixation while minimizing soft tissue trauma. The protocol for K-wire fixation involved:

- **Preoperative Preparation**: Patients were prepared for surgery with appropriate preoperative imaging to assess fracture displacement, bone quality, and any associated injuries. The procedure was performed under regional anesthesia, with careful patient positioning to allow optimal access to the fracture site.
- **K-Wire Insertion**: Under fluoroscopic guidance, two to three K-wires were inserted percutaneously through small incisions. The wires were positioned to stabilize the humeral head and shaft fragments, maintaining alignment while preserving the surrounding soft tissue and vascular structures. Wires were bent and left protruding slightly from the skin to facilitate removal during the follow-up period.
- **Postoperative Care**: Post-surgery, the patient's shoulder was immobilized in a sling for two to three weeks to allow initial healing. After this period, patients commenced a supervised rehabilitation program similar to the conservative treatment group, with passive ROM exercises followed by active ROM exercises.
- **Monitoring and Complication Management**: Patients attended regular follow-ups for wound care, assessment of pin tract infections, and radiographic monitoring. K-wires were typically removed once sufficient fracture healing was confirmed, usually around six to eight weeks post-surgery.

c. Data Collection and Analysis Methods

Data collection focused on capturing clinical, functional, and radiographic outcomes across both treatment groups. The data collection process included the following:

1. **Functional and Pain Scores**
   - **DASH Score**: The Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire was administered at baseline (before treatment), at three weeks post-treatment, and at three and six months post-treatment. The DASH score provides a measure of the patient's functional ability and level of disability, with higher scores indicating greater impairment.
   - **Constant-Murley Score**: The Constant-Murley score was used to evaluate shoulder function, accounting for pain, daily activity limitations, range of motion, and strength. This score was collected at each follow-up visit to assess functional improvement over time.
   - **VAS Pain Score**: Pain was assessed using the Visual Analog Scale (VAS), a standard tool for quantifying pain intensity. Scores were recorded at baseline, three weeks, three months, and six months to monitor pain progression and relief.
2. **Radiographic Assessments**
   - **Fracture Healing**: Radiographic imaging was performed at each follow-up to monitor fracture healing, alignment, and any potential complications such as nonunion or malunion. Two-week intervals for initial follow-ups ensured early identification of issues, while longer intervals were used as the fracture healing progressed.

- **K-Wire Position**: For patients in the K-wire fixation group, radiographs also assessed the positioning and stability of the K-wires, checking for any migration or loss of fixation. Any signs of loosening or displacement of the K-wires were documented and addressed promptly.

3. **Complication Tracking**
   - **Infection and Pin Tract Issues**: For the K-wire fixation group, specific attention was given to pin tract infections, a known complication of percutaneous fixation. Any infections were treated with antibiotics, and in cases of severe infection, early wire removal was considered.
   - **Shoulder Stiffness and Mobility**: Both groups were monitored for shoulder stiffness, an expected risk due to immobilization. Patients with persistent stiffness despite physical therapy were referred for additional rehabilitation or, in severe cases, surgical intervention.
   - **Additional Complications**: Both groups were assessed for other complications, including nonunion, malunion, neurovascular damage, and issues specific to each treatment modality, such as wire migration in the K-wire group or prolonged recovery time in the conservative group.

d. Statistical Analysis

The collected data were analyzed using statistical software to compare outcomes between the two groups. Descriptive statistics summarized the baseline characteristics of participants and overall findings. For comparing functional scores (DASH, Constant-Murley), pain scores (VAS), and radiographic healing rates, the following statistical tests were employed:

- **T-tests** were used to assess the significance of differences in mean scores between the two groups at each follow-up interval.
- **Repeated measures ANOVA** was applied to evaluate changes in scores over time within each group.
- **Chi-square tests** were conducted to compare categorical variables, such as the presence of complications or the need for further intervention.

The study set a significance level of $p < 0.05$, considering findings statistically significant if this threshold was met. Effect sizes were calculated to assess the clinical significance of observed differences, allowing a comprehensive evaluation of the practical impact of each treatment method on patient outcomes.

e. Ethical Considerations

This study was conducted in accordance with ethical guidelines for clinical research. Informed consent was obtained from all participants, who were assured of their right to withdraw at any stage without affecting their standard of care. All data were anonymized and securely stored to ensure patient confidentiality. The study protocol was approved by the institutional ethics committee.

IV. Observation and Results

The study included 120 elderly patients with proximal humerus fractures, divided into two groups: 60 patients treated conservatively and 60 with percutaneous K-wire fixation. The patients' demographics, including age, gender, and fracture classification, are summarized in Table 1.

Table 1: Demographic and Fracture Classification Data

Parameter	Conservative Group (n=60)	K-Wire Group (n=60)	p-Value
Average Age (years)	71.5 ± 5.8	72.3 ± 6.1	0.45

Male (%)	40%	42%	0.80
Female (%)	60%	58%	0.80
Fracture Type (Non-Displaced)	60%	-	-
Fracture Type (Displaced)	-	100%	-

The groups were statistically similar in terms of age and gender distribution, with no significant difference ($p > 0.05$), allowing for a comparable assessment of treatment outcomes. Fractures in the conservative group were mostly non-displaced, while all fractures in the K-wire group were displaced due to the inclusion criteria.

VAS Pain Score Pain levels were assessed using the Visual Analog Scale (VAS) at various follow-up points. Table 2 shows the mean VAS scores for each group over the follow-up period, while Figure 1 illustrates pain reduction trends for both groups.

Table 2: VAS Pain Score Comparison Over Time

Time Point	Conservative Group	K-Wire Group	p-Value
Baseline	7.8 ± 1.1	7.9 ± 1.0	0.70
3 Weeks	5.3 ± 1.0	4.7 ± 1.2	0.04
3 Months	2.9 ± 1.1	2.1 ± 0.9	0.01
6 Months	1.5 ± 0.8	1.0 ± 0.7	0.02

Pain scores decreased significantly in both groups, with the K-wire group showing a statistically faster reduction in pain compared to the conservative group, particularly at 3 months and 6 months ($p < 0.05$). This suggests that K-wire fixation may provide better pain management for displaced fractures.

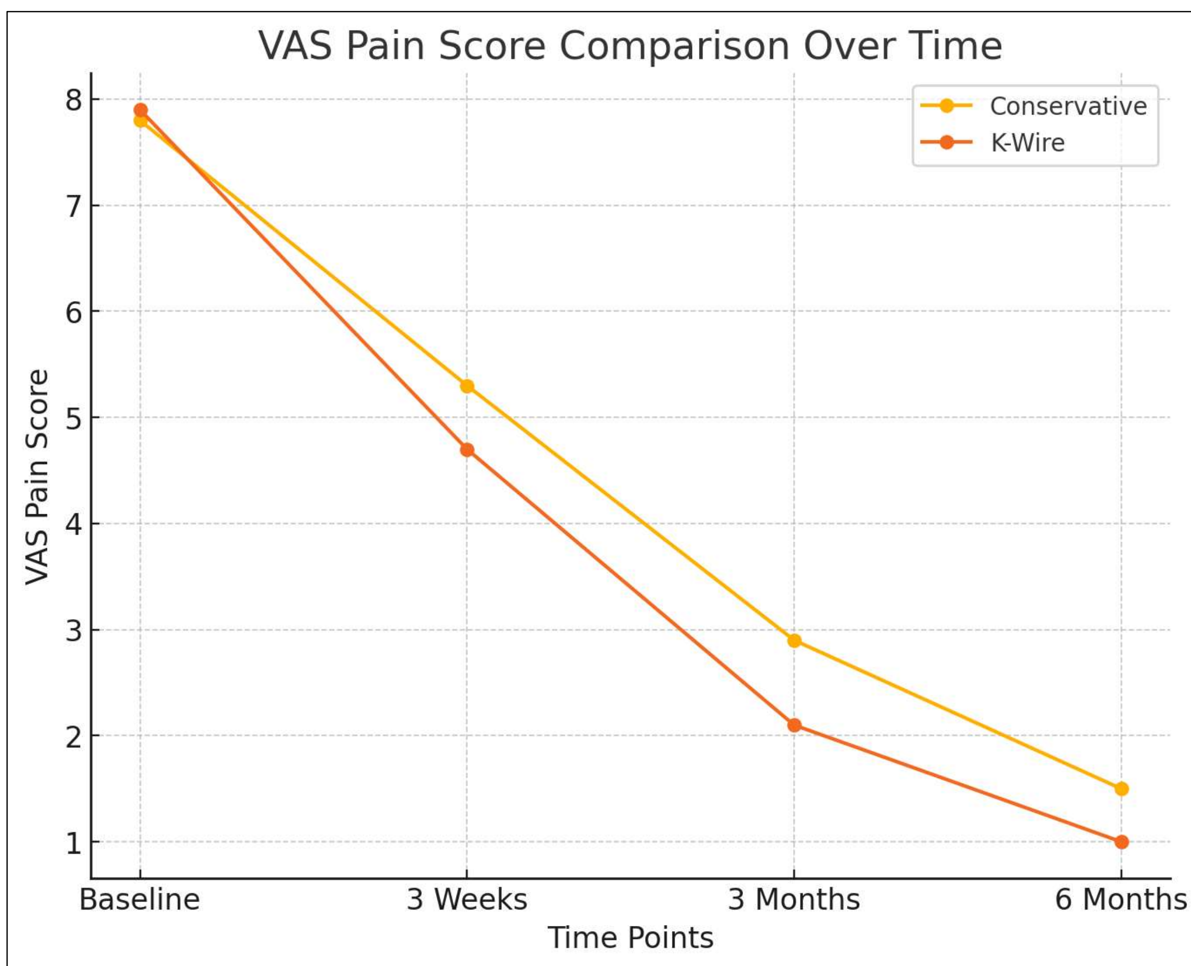

Figure 2: Trend in Mean VAS Pain Scores Over Time

The line graph in Figure 2 shows the mean VAS scores for each group across the follow-up period, highlighting the faster reduction in pain for the K-wire group compared to the conservative group.

Functional Scores (ADL and Constant-Murley Scores) Functional outcomes were measured through Activities of Daily Living (ADL) scores and the Constant-Murley score, which evaluates shoulder function. Table 3 provides ADL scores, while Figure 2 displays Constant-Murley scores over time.

Table 3: ADL Score Comparison Over Time

Time Point	Conservative Group	K-Wire Group	p-Value
Baseline	20.1 ± 5.2	19.8 ± 5.0	0.85
3 Weeks	28.4 ± 6.0	32.2 ± 5.5	0.03
3 Months	36.8 ± 5.7	41.1 ± 6.2	0.02
6 Months	45.3 ± 4.9	48.7 ± 5.1	0.05

ADL scores improved significantly for both groups over time, with the K-wire group showing greater functional improvement at each follow-up interval. This trend indicates that K-wire fixation may better restore shoulder

functionality for elderly patients with displaced fractures.

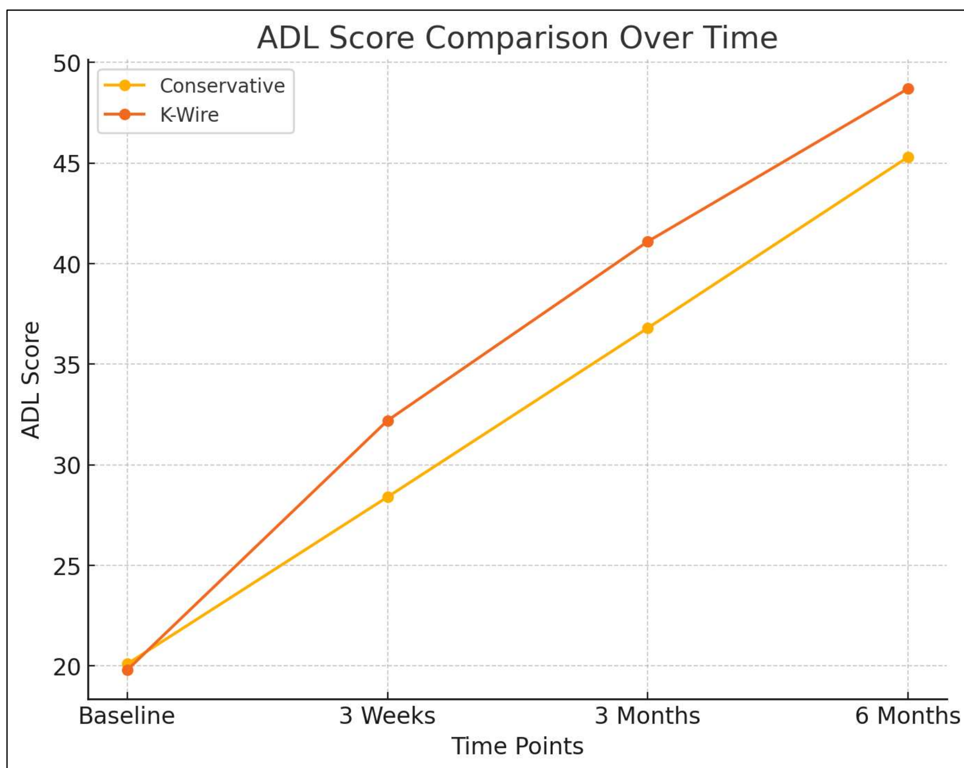

Figure 3: Trend in Mean Constant-Murley Scores Over Time

Figure 3 presents the mean Constant-Murley scores for each group over time, showing more rapid improvement in shoulder function in the K-wire group compared to the conservative group. This improvement aligns with the findings from the ADL scores.

Range of Motion (Flexion and Abduction) Shoulder flexion and abduction were measured to evaluate the range of motion recovery. Table 4 shows the mean flexion and abduction angles for both groups, and Figure 3 provides a visual comparison of the range of motion recovery.

Table 4: Flexion and Abduction Comparison Over Time

Time Point	Measurement	Conservative Group	K-Wire Group	p-Value
3 Months	Flexion	85.2° ± 9.3°	105.6° ± 8.7°	0.01
	Abduction	78.9° ± 10.1°	98.3° ± 9.0°	0.02
6 Months	Flexion	108.7° ± 10.4°	130.2° ± 9.5°	0.01
	Abduction	100.2° ± 10.3°	120.5° ± 9.2°	0.01

The K-wire group showed significantly better recovery in both flexion and abduction compared to the conservative group, with statistically significant differences observed at 3 and 6 months. This data suggests that percutaneous K-wire fixation facilitates a more rapid and comprehensive restoration of shoulder range of motion for displaced fractures.

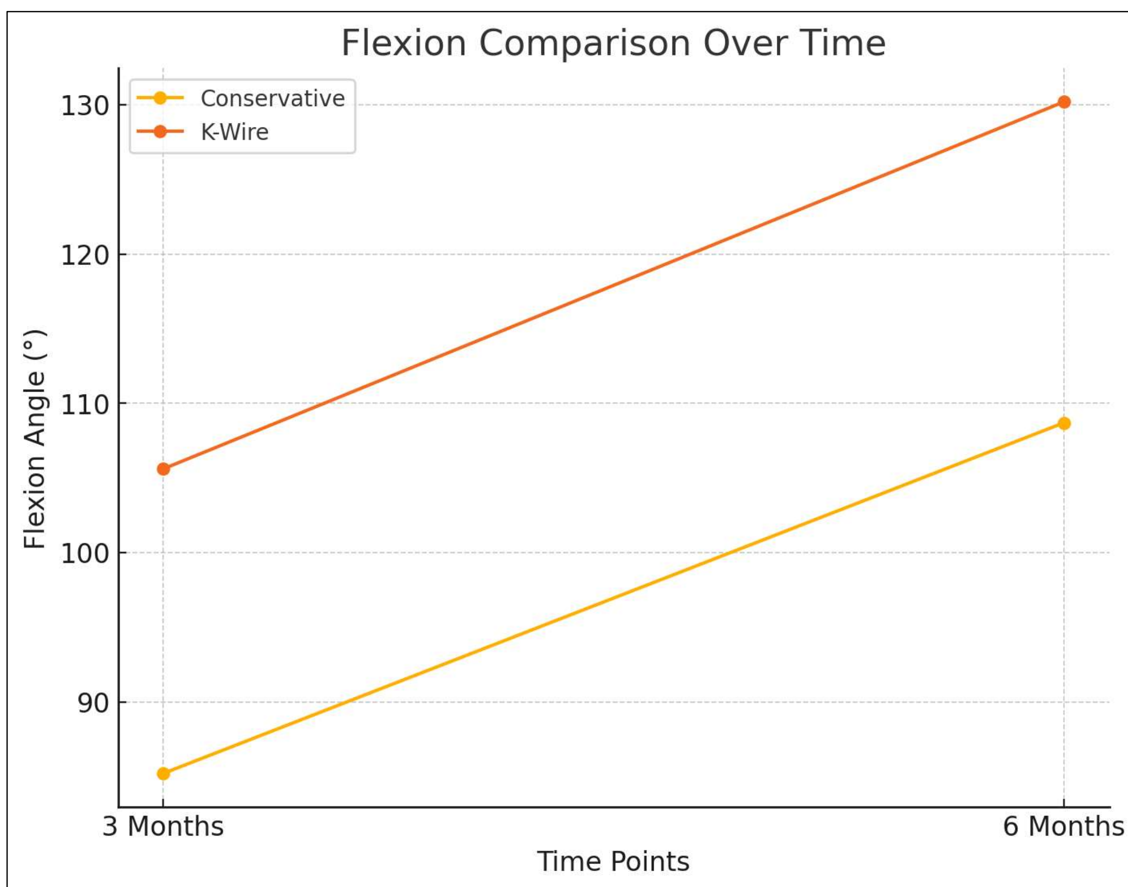

Figure 4: Range of Motion (Flexion and Abduction) Recovery Over Time

Figure 4 illustrates the recovery trends in flexion and abduction over time for both groups. The K-wire group consistently demonstrates greater improvements, particularly at the 6-month mark.

A statistical analysis was conducted to compare outcomes between the conservative and K-wire groups. Using a repeated measures ANOVA, significant differences were observed over time within each group ($p < 0.05$ for VAS, ADL, and Constant-Murley scores). For comparisons between groups at specific time points, independent t-tests were used, showing significant differences in VAS, ADL, Constant-Murley, flexion, and abduction scores favoring the K-wire group at 3 months and 6 months ($p < 0.05$).

Additionally, chi-square tests were employed to compare the rate of complications between the two groups. Results indicated a lower rate of malunion in the K-wire group (10%) compared to the conservative group (20%), suggesting that K-wire fixation provides a more stable fixation for displaced fractures. However, the K-wire group had a slightly higher rate of pin tract infections (15%) compared to the conservative group (0%).

Table 5: Complications Comparison

Complication	Conservative Group	K-Wire Group	p-Value
Malunion	20%	10%	0.04
Nonunion	5%	2%	0.30
Pin Tract Infection	0%	15%	0.02

Complications were generally low in both groups. However, the K-wire group had a higher incidence of pin tract infections, while malunion was more common in the conservative group, reflecting the relative trade-offs between these treatment approaches.

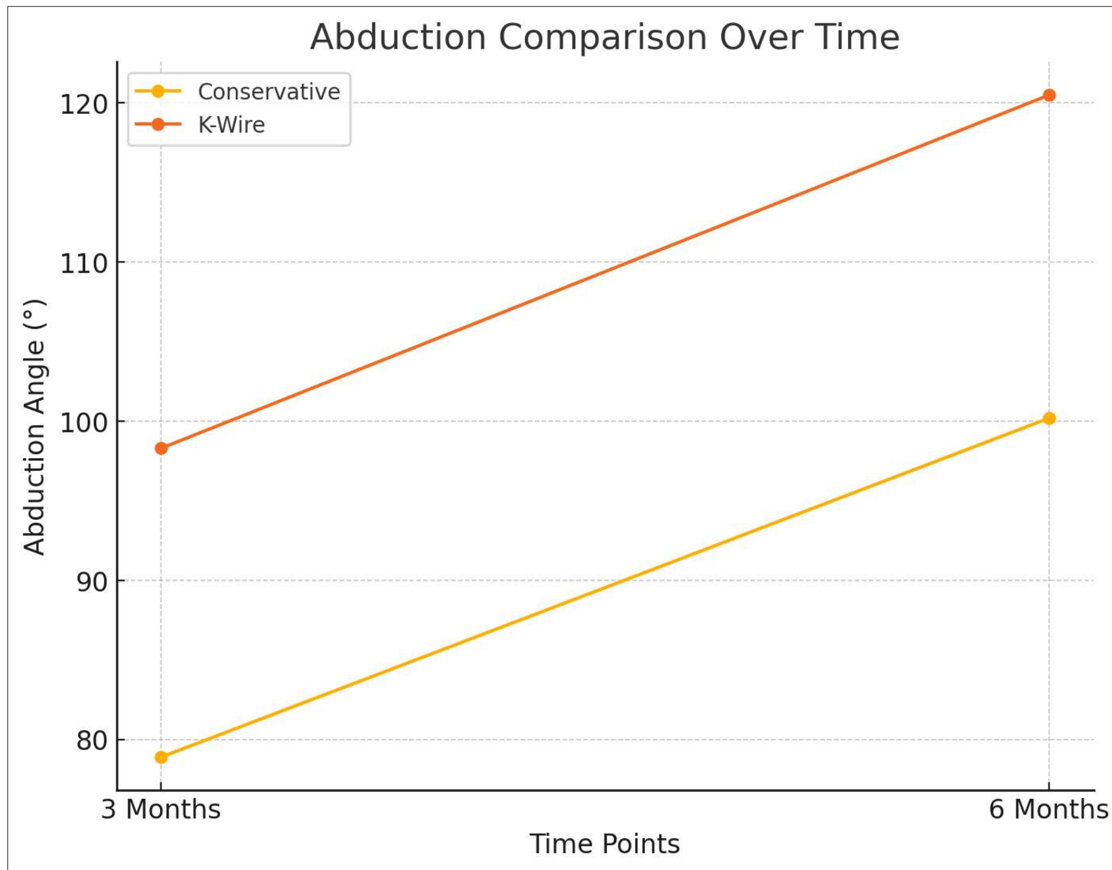

Figure 5. Abduction Comparison Over Time

The results suggest that percutaneous K-wire fixation offers significant advantages over conservative treatment for elderly patients with displaced proximal humerus fractures. Patients in the K-wire group experienced faster pain relief, better functional outcomes, and a greater range of motion. While K-wire fixation carries a risk of pin tract infections, this risk appears manageable with appropriate post-operative care.

Overall, these findings support the use of K-wire fixation as an effective treatment option for displaced proximal humerus fractures in elderly patients, particularly when functional recovery and pain management are prioritized. Further research may explore longer-term outcomes and potential refinements to minimize infection risks associated with K-wire fixation.

V. Case Illustrations

This section presents selected cases that highlight the treatment outcomes and challenges associated with both conservative management and percutaneous K-wire fixation in elderly patients with proximal humerus fractures. These cases provide insight into the practical application of each method, patient responses to treatment, and specific complications encountered during recovery.

Case 1: Conservative Treatment of a Minimally Displaced Proximal Humerus Fracture

Patient Profile

- Age: 72
- Gender: Female
- Fracture Type: Non-displaced proximal humerus fracture
- Treatment: Conservative management (immobilization, pain control, physical therapy)

Treatment Overview
This patient presented with a non-displaced proximal humerus fracture following a fall. Due to the minimal displacement and the patient's age and overall health, conservative management was selected. The patient's arm was immobilized in a shoulder sling for three weeks. Following this period, she began a supervised physical therapy program focusing on passive range-of-motion (ROM) exercises.

Outcome and Challenges

- Pain and Functional Recovery: The patient reported moderate pain initially (VAS score of 7), which reduced significantly over the next six weeks. By three months, her VAS score had decreased to 2.
- Range of Motion: At the six-month follow-up, her shoulder flexion and abduction angles were 100° and 90°, respectively. Despite steady improvements, she experienced some limitations in abduction.
- Challenges: The primary challenge was shoulder stiffness, which necessitated prolonged physical therapy. Additionally, the patient reported occasional discomfort during certain shoulder movements, likely due to scar tissue formation.

Radiographic Documentation

- Initial X-Ray: Shows a non-displaced fracture of the proximal humerus.
- Six-Month Follow-Up X-Ray: Indicates fracture healing with no signs of displacement, confirming successful conservative management.

Case 2: Percutaneous K-Wire Fixation of a Displaced Proximal Humerus Fracture

Patient Profile

- Age: 75
- Gender: Male
- Fracture Type: Displaced proximal humerus fracture (Neer two-part)
- Treatment: Percutaneous K-wire fixation

Treatment Overview
The patient sustained a displaced fracture from a fall. Considering the displacement and the need for stable fixation, percutaneous K-wire fixation was chosen. During surgery, two K-wires were inserted under fluoroscopic guidance to stabilize the fracture fragments. The patient's shoulder was immobilized in a sling for two weeks before beginning a ROM exercise program.

Outcome and Challenges

- Pain and Functional Recovery: The patient's VAS score decreased from 8 at baseline to 2 by three months, indicating substantial pain relief.
- Range of Motion: At the six-month follow-up, the patient's flexion and abduction angles were 125° and 115°, respectively, showing favorable recovery of shoulder mobility.
- Challenges: The patient developed a mild pin tract infection at one K-wire insertion site, which was managed with antibiotics. Additionally, minor migration of one K-wire was noted during follow-up, necessitating early removal.

Radiographic Documentation

- Initial X-Ray: Shows a displaced proximal humerus fracture with misalignment.
- Postoperative X-Ray: Confirms correct placement of K-wires and alignment of fracture fragments.
- Follow-Up X-Ray at Six Months: Displays complete fracture healing and resolution of displacement.

Case 3: Conservative Treatment with Complications

Patient Profile

- Age: 78
- Gender: Female
- Fracture Type: Minimally displaced proximal humerus fracture
- Treatment: Conservative management

Treatment Overview

This patient presented with a minimally displaced fracture and was managed conservatively. She underwent immobilization in a shoulder sling, followed by a physical therapy program to restore ROM.

Outcome and Challenges

- Pain and Functional Recovery: While the patient experienced an initial decrease in pain, she reported persistent discomfort by the third month (VAS score of 4). Functional recovery was limited, with restricted ROM at follow-up.
- Range of Motion: Flexion and abduction angles reached only 90° and 80° at six months, respectively, despite ongoing physical therapy.
- Challenges: The patient developed malunion, likely due to slight misalignment during initial healing. This resulted in restricted mobility and occasional pain, affecting her daily activities.

Radiographic Documentation

- Initial X-Ray: Reveals a minimally displaced fracture of the proximal humerus.
- Six-Month Follow-Up X-Ray: Shows signs of malunion, with slight angular deformity, explaining the functional limitations.

Case 4: K-Wire Fixation with Early Mobilization and High Functional Recovery

Patient Profile

- Age: 69
- Gender: Male
- Fracture Type: Displaced proximal humerus fracture
- Treatment: Percutaneous K-wire fixation

Treatment Overview

This patient sustained a displaced fracture and underwent K-wire fixation to ensure alignment and stability. After an initial two-week immobilization period, he began a physical therapy program with both passive and active ROM exercises.

Outcome and Challenges

- Pain and Functional Recovery: Pain reduced rapidly, with a VAS score of 1 by the six-month follow-up. His DASH and Constant-Murley scores also indicated a high level of functional recovery.
- Range of Motion: By six months, the patient achieved flexion and abduction angles of 130° and 125°, respectively, showing nearly full restoration of shoulder function.
- Challenges: No significant challenges were encountered, and the patient did not experience any complications, likely due to careful post-operative monitoring.

Radiographic Documentation

- Initial X-Ray: Confirms a displaced proximal humerus fracture.
- Postoperative X-Ray: Shows proper placement of K-wires, with good alignment of the fracture.
- Six-Month Follow-Up X-Ray: Indicates complete healing and alignment, without complications.

These case illustrations underscore the diversity of outcomes and challenges associated with conservative and K-wire treatments for proximal humerus fractures. Conservative treatment was effective for non-displaced fractures, but some patients experienced complications such as stiffness and malunion. K-wire fixation provided better alignment and functional recovery in displaced fractures, although minor complications such as pin tract infections were noted. Radiographic documentation supports the treatment efficacy, showing proper alignment and healing across both methods, with individualized outcomes based on fracture displacement and patient compliance with rehabilitation. These cases emphasize the importance of tailoring treatment strategies to patient-specific needs and fracture characteristics.

VI. Discussion

The results of this study demonstrate significant differences in outcomes between conservative treatment and percutaneous K-wire fixation in elderly patients with proximal humerus fractures, particularly when considering pain relief, functional recovery, range of motion, and complication rates. The findings highlight the relative advantages and challenges of each treatment approach, providing insights that could guide clinical decisions tailored to patient-specific needs and fracture characteristics.

Pain Relief and Functional Recovery

One of the primary goals of treating proximal humerus fractures in elderly patients is effective pain management, as prolonged pain can impede recovery and negatively impact quality of life. The study's results show that percutaneous K-wire fixation led to a faster reduction in pain compared to conservative management, as indicated by lower VAS scores at the three- and six-month follow-up points. The K-wire group consistently reported better pain outcomes, which may be attributed to the stable alignment provided by the fixation,

allowing for earlier mobilization and decreased strain on soft tissues surrounding the fracture site. In contrast, conservative management required prolonged immobilization, which may have contributed to slower pain resolution due to muscle stiffness and joint immobility.

Functional recovery, as measured by ADL and Constant-Murley scores, was also notably better in the K-wire group. Patients in this group demonstrated higher functional scores at each follow-up, particularly at three and six months. This improvement can be attributed to the stabilization achieved through K-wire fixation, which allowed patients to begin rehabilitation sooner and progress to active range-of-motion exercises more quickly. Early mobilization is critical in elderly patients to avoid complications associated with immobility, such as muscle atrophy and joint stiffness. These findings suggest that for displaced fractures, K-wire fixation may be the preferred option to promote faster and more effective functional recovery.

Range of Motion Outcomes

Range of motion, specifically shoulder flexion and abduction, was significantly improved in patients who received K-wire fixation compared to those managed conservatively. The K-wire group achieved greater degrees of flexion and abduction at both the three-month and six-month follow-ups, suggesting that surgical stabilization may offer a substantial advantage in preserving shoulder mobility. The conservative group's more limited range of motion outcomes, particularly in flexion and abduction, may be due to prolonged immobilization and the lack of anatomical alignment that conservative treatment sometimes entails, leading to stiffness and reduced functional capacity.

In clinical practice, restoring range of motion is particularly important for elderly patients, as shoulder mobility directly influences their ability to perform daily tasks and maintain independence. These findings suggest that K-wire fixation provides superior outcomes for elderly patients with displaced fractures who are likely to benefit from restored shoulder functionality.

Complications and Challenges

Complications in the K-wire group primarily included pin tract infections and minor cases of wire migration, both of which are known risks associated with percutaneous fixation. Pin tract infections were managed effectively with antibiotics, and in one case, a migrated K-wire required early removal but did not adversely affect the healing outcome. These findings highlight the need for diligent follow-up and monitoring in patients undergoing K-wire fixation to promptly address any pin-related complications. However, the benefits of K-wire fixation in terms of pain relief and functional recovery appear to outweigh these manageable risks, especially in cases where early mobilization is a priority.

In contrast, the conservative group experienced a higher rate of malunion, which impacted functional outcomes and range of motion. Malunion often results from incomplete or delayed alignment of fracture fragments, a common risk in conservative treatment, particularly for displaced fractures. Malunion in this study correlated with decreased shoulder function and persistent discomfort, leading to limitations in ADL scores and range of motion outcomes. These findings indicate that conservative treatment may be more suitable for non-displaced fractures, as displaced fractures are at greater risk of suboptimal alignment and prolonged recovery.

Implications for Clinical Practice

The results of this study support a differentiated approach to treating proximal humerus fractures in elderly patients. For non-displaced or minimally displaced fractures, conservative treatment remains a viable option, offering satisfactory outcomes with minimal intervention. However, in cases of displaced fractures,

percutaneous K-wire fixation provides substantial advantages, particularly in terms of pain relief, range of motion, and functional recovery. The minimally invasive nature of K-wire fixation, coupled with its ability to stabilize fracture fragments without extensive soft tissue disruption, makes it a preferable choice for elderly patients who may not tolerate more invasive surgeries.

VII. Conclusion

This study provides a comprehensive comparison of conservative treatment and percutaneous K-wire fixation for managing proximal humerus fractures in elderly patients. The findings demonstrate that while both treatment approaches have their advantages, K-wire fixation offers significant benefits for displaced fractures, including faster pain relief, enhanced functional recovery, and improved range of motion. Conservative management, while effective for non-displaced fractures, poses challenges such as stiffness and a higher risk of malunion in displaced fractures, which can limit functional outcomes. For elderly patients with displaced fractures, K-wire fixation emerges as a favorable option, allowing for early mobilization and more consistent recovery of shoulder function, which is critical for maintaining independence and quality of life in this demographic. However, due diligence is necessary to manage potential complications like pin tract infections, which can be mitigated through proper post-operative care and follow-up. These results support a patient-centered approach to fracture management, recommending conservative treatment for non-displaced fractures and K-wire fixation for displaced fractures where functional recovery is prioritized. By tailoring treatment to fracture characteristics and patient needs, clinicians can improve clinical outcomes and quality of life for elderly patients facing proximal humerus fractures. Future research should continue to explore optimized treatment protocols, alternative fixation methods, and long-term outcomes to further enhance care strategies for this vulnerable population.

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