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Prospective study of functional outcome of K wire fixation for proximal humerus fracture in adults

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Abstract: Background: Proximal humerus fractures are one of the most common fractures of the upper limb in older individuals and can be managed by multiple modalities, from ORIF to K-wire fixation, and can even be managed conservatively.
Materials and Methodology: Thirty patients with proximal humerus fractures were treated with K-wire fixation at a tertiary care center and followed up for six months to evaluate the functional outcome using the Neer scoring system.
Results: The patients who underwent K-wire fixation had a significant functional outcome in terms of range of motion, pain relief, and anatomical reduction.
Conclusion: K-wire fixation is a simpler, less invasive, and less time-consuming surgical modality of treatment with a favorable functional outcome for proximal humerus fractures.

Keywords: Proximal humerus fracture; K wire fixation.

1. Introduction

Proximal humerus fractures are one of the most common fractures in the skeleton, accounting for approximately 4-5% of all fractures [1,2]. The incidence of these fractures is more common in the elderly due to osteoporosis and decreased bone density. However, they can also occur in younger age groups following high-velocity trauma [3,4].

Approximately 3% of physeal fractures occur through the proximal humerus [4]. Proximal humerus fractures account for over 75% of humerus fractures in patients over the age of 40, and after age 50, women have a much higher incidence than men, especially after menopause, representing the typical characteristic of an osteoporotic fracture [5]. Up to 85% of all proximal humerus fractures are one-part (non-displaced or minimally displaced) fractures, while 15% to 20% of all proximal humerus fractures are classified as displaced [6,7].

In 90% of cases, fractures result from low-energy trauma such as falling from standing height. Other causes include direct blows to the shoulder, fracture dislocation secondary to epileptic fits or electrical shock.

The symptoms and signs associated with proximal humerus fractures can be quite variable, but they most often correlate with the degree of fracture displacement and comminution. Pain, especially with any attempts at shoulder motion, is almost always present. Inspection of the shoulder usually reveals swelling and ecchymosis. The ecchymosis that develops may extend distal to the arm and forearm or even to the chest and breast area. Palpation of the shoulder will usually reveal tenderness about the proximal humerus. Crepitus may be evident with motion of the fracture fragments [8]. Essential to the clinical evaluation of the patient with a proximal humerus fracture is a complete neurovascular examination of the involved upper extremity. Associated axillary artery and brachial plexus injuries have been reported, especially with fractures displaced medial to the coracoid process. About 20% incidence of nerve injury is reported [9].

Conservative treatment is generally accepted for minimally displaced fractures, which account for 80% of all fractures, with good reported functional outcomes [10]. Surgery is considered for displaced and unstable fractures. The aim of surgical fixation is to achieve a stable anatomical construct that allows pain-free early mobilization, bony union, and early return to activities. Fixation can be achieved through plate fixation,

intramedullary devices, or percutaneously using K-wires. For displaced and severely comminuted fractures, joint replacement could also be offered in the form of hemiarthroplasty or reverse shoulder replacement [5,6].

There are multiple variables that can influence the choice between conservative and operative treatment of such fractures, such as the pattern of fracture, patient's age, level of activity, and age of the patient. Therapeutic options include conservative treatment, open reduction and internal fixation (ORIF), joint replacement, and percutaneous fixation [11]. Good clinical outcomes range from 92% for ORIF, 87.6% for percutaneous K-wire fixation, to 87% for conservative treatment [12].

Among all, K-wire fixation provides stable fixation of the fractures, with low blood loss, less invasiveness, and affordability for poor and medium-income group patients. The benefit of this technique is that, firstly, it is less invasive, and the integrity of skin and tissues is respected [13]. Secondly, this is cost-effective as compared to plate fixation. Thirdly, less chances of injuring adjacent neurovascular structures [14]. Lastly, the common problem of screw cut out is not an issue in this technique. Although this fixation method has many advantages, still there are some complications as well like any surgical procedure [15,16]. Most common complications which can happen are k-wire related. Firstly, k-wire migration can happen. Secondly, the pin site infection is a known complication [17].

2. Materials and Methods

2.1. Source of Data

The study was conducted at the Departments of Orthopedics (Outpatient Department, Emergency Service, and Indoor Patient Department) at the Government Medical College and Tertiary Care Center.

2.2. Study Population

The study included patients with proximal humerus fractures who attended the Departments of Orthopedics (Outpatient Department, Emergency Service, and Indoor Patient Department) at the Government Medical College and Tertiary Care Center from July 2020 to December 2022.

2.3. Study Design

This was a prospective observational study.

2.4. Sample Size

The study included 30 patients.

2.5. Screening Procedure and Format

The screening procedure included a detailed medical history, physical examination, and appropriate investigations.

2.6. Inclusion Criteria

The study included patients who were 18 years or older, had radiologically diagnosed proximal humerus fractures, and provided informed consent to participate in the study.

2.7. Exclusion Criteria

Patients under 18 years of age, those with open fractures in Gustilo-Anderson Type III B and C, those who refused to provide informed consent, and those with significant comorbidities were excluded from the study.

2.8. Study Procedure

Patients who met the inclusion criteria were included in the study. All patients who were admitted to the orthopedics department at the Government Hospital were treated with informed consent from the patients and their relatives.

2.9. Pre-operative Procedure

The patients were treated with emergency analgesics and provided with a USI Brace or Arm strapping for the affected limb. Preoperative investigations, including Hb, CBC, LFT, KFT, Blood Group, Chest X-ray, and X-ray of the affected shoulder (AP and Lateral views), were performed. The fractures were classified using Radiological NEER's classification. Pre-anesthetic evaluation was performed, and informed consent was obtained for both surgical procedure and participation in the study.

2.10. Follow-up Procedure

The patients were assessed during follow-up at the 15th day, after 1, 3, 6, 9 months, and after 1 year using the Neer's Scoring System.

2.11. Statistical Analysis

The data was entered into a Windows Excel format, and the statistical package SPSS software was used to obtain frequency tables and measures of central tendency (mean) and dispersion (standard deviation). Outcome variables with a p-value less than 0.05 were selected, and cross-tabulation was performed to determine the strength and direction of the association between outcome variables. The Chi-square test was used to check statistical associations between outcome variables and covariates.

2.12. Ethical Clearance

This study was conducted after obtaining proper permission from the ethical committee.

3. Results

We observed 30 patients of proximal humerus fractures attending the Departments Orthopedics (Out Patient Department, Emergency Service & Indoor Patient) Department at Government Medical College & Tertiary care center for management with k wire, see Figures 1-5.

Figure 1. Patient positioning

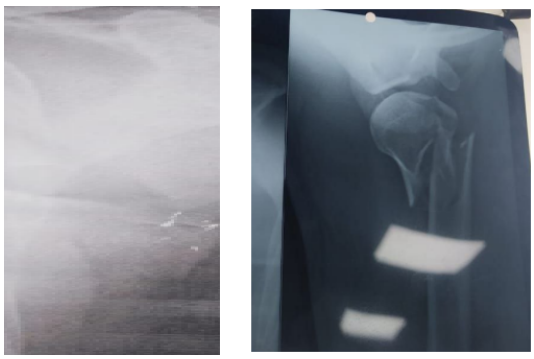

Figure 2. 51 years old 4 part proximal humerus fracture with head split

Figure 3. Patient 2 post operative with cross k wires

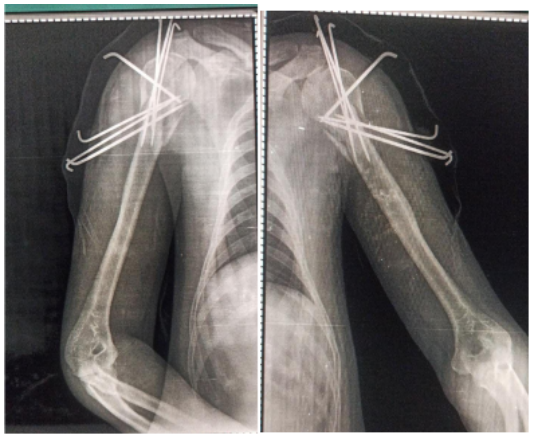

Figure 4. Patient 2 at 2 months follow up

Figure 5. Patient 2, Range of motion at 8 weeks follow up

4. Discussion

Among the 30 study participants with proximal humerus fractures, 17 (57%) were male while 13 (43%) were female. In a study by Chugh *et al.*, [18], an overall male predominance was observed with 70% males and a male to female ratio of 2.33:1.

In the present study, see Table 1, the maximum of 12 (40%) patients were in the 41 to 50 years age group, followed by 10 (33%) patients in the 51 to 60 years age group. 5 (17%) patients were in the 31 to 40 60 years age group, while 3 (10%) patients were above 60 years of age. The mean age in the present study was 49.37 $\pm$ 8.536. *Chugh et al.*, [18] mentioned in their study that the mean age of the total study group was 61.7 years.

Table 1. Distribution of study subjects according to age

Age	Frequency	Percentage (%)
18 to 30	0	0
31 to 40	5	17
41 to 50	12	40
51 to 60	10	33
>60	3	10
Total	30	100

Among all study subjects, see Table 2, 15 (50%) were injured in road traffic accidents, 9 (30%) patients were injured by self-fall, while 6 (20%) patients were injured by physical assault. Chugh *et al.*, [18] observed in their study that the most common mode of injury was a fall (60%), followed by road traffic accidents (40%). In a study by Rose *et al.*, [22], 80% of cases of proximal humerus fracture were caused by a minor fall in patients aged above 40 years and especially in osteoporotic females. Herbert Resch *et al.*, [19] reported that among 27 patients with three-part and four-part fractures, 24 patients had a history of high-energy trauma.

Table 2. Distribution of study subjects according to Neers type of fracture

Neers type of fracture	Frequency	Percentage (%)
1 part	3	10
2 part	5	17
3 part	7	23
4 part	15	50
Total	30	100

We distributed study subjects according to Neer's classification of the type of fracture and found that 1-part study subjects were 3 (10%), 2-part study subjects were 5 (17%), 3-part study subjects were 7 (23%), and 4-part study subjects were 15 (50%). In a study by Bozkurt *et al.*, [23], 2-part patients were 6, 3-part were 9, and 4-part patients were 1. Chugh et al., [18] observed in their study that 7 patients had a 1-part fracture, 7 had a 2-part fracture, 6 had a 3-part fracture, and 5 had a 4-part fracture.

Blood loss during surgery, see Table 3, was 15 to 20 ml in 19 (63) patients, 20 to 25 ml in 3 (10) patients, 25 to 30 ml in 1 (3) patient, and 30 to 40 ml in 7 (23) patients. Akel *et al.*, [20] observed in their study that the mean blood loss was less than 5 cc. Varyani *et al.*, [21] mentioned in their study that K-wire fixation of such fractures provides stable fixation, low cost, minimal blood loss, and early discharge from the hospital.

Table 3. Distribution of study subjects according to blood loss while operating

Blood loss (ml)	Frequency	Percentage (%)
15 to 20	19	63
20 to 25	3	10
25 to 30	1	3
30 to 40	7	23
Total	30	100

Our study has demonstrated that among the study participants, a NEER score of 61-70 was observed in 1 patient at 1 month, in none of the patients at 3 months, and none of the patients at 6 months. A NEER score of 71-80 was observed in 1 patient at 1 month, 1 patient at 3 months, and 1 patient at 6 months. A NEER score of 81-90 was observed in 24 patients at 1 month, 15 patients at 3 months, and 14 patients at 6 months. A NEER score of 91-100 was observed in 4 patients at 1 month, 14 patients at 3 months, and 15 patients at 6 months. Another study conducted by Magovern *et al.*, [22] found that percutaneous fixation yields good constant scores like NEER scores with surgery and relatively few complications, with better functional scores.

In terms of the duration required for clinical union, see Table 4 the distribution of study subjects was as follows: 4 weeks in 7 (23%) patients, 5 weeks in 5 (17%) patients, 6 weeks in 13 (43%) patients, and 7 weeks in 5 (17%) patients. Baldev *et al.*, [23] stated that out of all patients, four patients had pin site infection, four patients had mal-union, one patient had non-union, and no patients had avascular necrosis of the humeral head. Akel Y *et al.*, [20] found that one patient had pin tract infection (patient with three parts fracture). Another one had delayed union after 5 months and the last had decreased range of motion after 3 and 6 months.

Table 4. Distribution of study subjects according to duration for clinical union (weeks)

Duration for clinical union (weeks)	Frequency	Percentage (%)
4	7	23
5	5	17
6	13	43
7	5	17
Total	30	100

Closed K-wire fixation of proximal humerus fractures has shown encouraging results both clinically and radiologically. However, it also has certain disadvantages, such as requiring shoulder immobilization for 6-8 weeks, pin tract infection, and common pin loosening and backout after 6-8 weeks as the fracture begins to unite. Being a cancellous bone, the humerus tends to collapse a little during the healing process.

Compared to other treatment modalities, closed K-wire fixation yields favorable outcomes in terms of range of motion. With regular, good, and supervised physiotherapy, near-normal range of motion can be achieved, and only a few patients experience a terminal 10 to 15 degrees of loss of abduction.

For patients who are financially unable to afford plates, K-wires are the treatment of choice, provided that the patient adheres to strict shoulder immobilization. The distribution of study subjects according to NEER score at 1, 3, 6 months is presented in Figure 6 and the distribution of study subjects according to complications and Neers type of part fracture is presented in Figure 7.

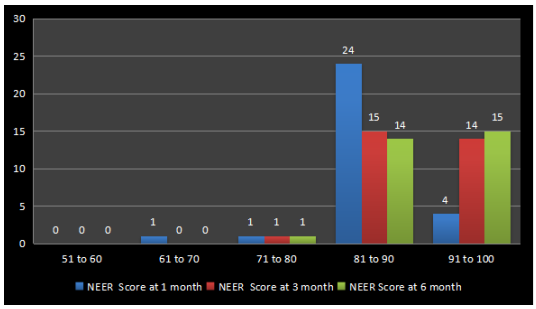

Figure 6. Distribution of study subjects according to NEER score at 1, 3, 6 months

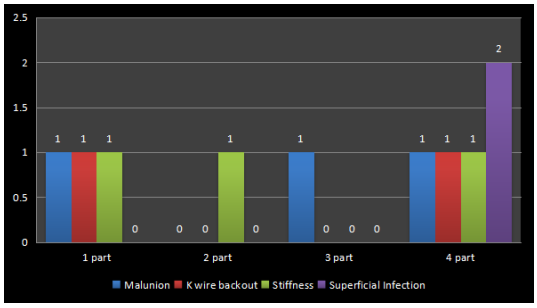

Figure 7. Distribution of study subjects according to complications and Neers type of part fracture

5. Conclusion

The use of K-wires with threaded tips can prevent migration, but they may be difficult to remove after fracture union. Technical errors such as placing pins too close together, which may fix only a portion of the head fragment, and inserting a K-wire too close to the fracture site, which can cause further fragmentation of the metaphysis, are the most common.

In cases of three-part fractures with greater tuberosity displacement, closed reduction may be challenging, and anatomical reduction may not be possible, necessitating open reduction with K-wires or screw fixation. Percutaneous fixation with multiple K-wires has shown good functional outcomes and early fracture union. In elderly patients with comminuted proximal humerus fractures, percutaneous K-wire fixation is an effective treatment option.

K-wire fixation is preferred as it requires less intra-operative time, less blood loss, less trauma to soft tissues, and lower costs. However, it does require C-arm control. Because elderly patients often have medical comorbidities, and their fitness for anesthesia may be in question, K-wire fixation is a preferred option.

In summary, closed reduction and K-wire fixation is an easy, reliable, safe, and reproducible method of managing proximal humerus fractures.

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Conflicts of Interest: "Authors declare that they do not have any competing interests."

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