Management of Three and Four Parts Proximal Humeral Fractures in Elderly Using PHILOS Plate Fixation versus Percutaneous Pinning

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Abstract

Background: Proximal humerus fractures are frequent in elderly cases, with treatment options ranging from conservative management to surgical fixation.

Aim: This research aimed to compare and evaluate the functional and radiological results of three- and four-part proximal humerus fractures treated with PHILOS plate fixation versus percutaneous K-wire pinning in elderly patients.

Patients and Methods: Randomized comparative prospective research was performed on 40 cases aged over 50 years with displaced three- or four-part proximal humerus fractures, classified into 2 groups. Group I (number=twenty) underwent PHILOS plate fixation, and Group II (number=twenty) underwent K-wire pinning. Data on surgical parameters, complications, and functional outcomes were collected over a six-month follow-up period.

Results: Both groups achieved fracture union, with mean times of 16 weeks for Group I and 14 weeks for Group II. Insignificant variance was discovered in range of motion, strength, or complications between the groups. However, Group I showed significantly better activity of daily living scores and lower postoperative VAS pain scores. Complications were more frequent in Group II, including implant loosening and delayed union. Overall, 70% of Group I achieved excellent outcomes, compared to 35% in Group II ($p < 0.05$).

Conclusion: PHILOS plate fixation offers superior functional outcomes and fewer complications compared to K-wire pinning for proximal humerus fractures in elderly cases, making it a preferred option for complex fractures.

Keywords: PHILOS plate, Proximal humerus fracture, Functional outcomes, K-wire pinning, Surgical fixation

Introduction

Proximal humerus fractures are most frequently observed in elderly people after a low-energy fall **[1]**. Proximal humerus fractures are predominantly managed conservatively, with the expectation that the fracture will heal and the case will restore function in the shoulder **[2]**. The majority of

proximal humerus fractures are minimally displaced, low-energy osteoporotic injuries that are effectively managed with conservative therapy. However, for individuals with moderate to severe displacement, the ideal therapy for the case remains inadequately defined. The therapy algorithm has persistently advanced. Advances were made in the design, technology, and procedures for surgical fixation. Moreover, cases are now experiencing increased longevity and engaging in more active lifestyles. Their expectations for outcomes have altered, and utilizing chronological age to classify these fractures is becoming increasingly irrelevant **[3]**.

The introduction of "locking plates" for the proximal humerus has provided a novel approach to the therapy of fractures, particularly those involving 3 or 4 parts, which present increased technical challenges in fixation **[4]**. The mechanical benefit theory of "locking plates" claims that adequate stability is attained without contact between the bone and plate, which could be required using conventional plates **[5]**. This stability is achieved through locking screws, resulting in improved outcomes in porous bones **[6]**.

This study aimed to evaluate and compare functional as well as radiological outcomes of the management of three- and four-part proximal humeral fractures using open reduction internal fixation by the Proximal Humerus Internal Locking System (PHILOS) versus closed reduction percutaneous pinning in elderly patients.

Patients and methods

This was randomized comparative prospective research performed on forty cases above 50 years old with three- and four-part proximal humerus fractures at the Orthopedic Department in Beni-Suef University Hospital and the Orthopedic Department in Beni-Suef Specialized Hospital. **Patients were divided into two groups: Group I:** twenty cases underwent percutaneous pinning management, and **Group II**: twenty cases underwent internal fixation by locked plate.

Inclusion criteria: Patients presenting with displaced proximal humerus fractures, 3 and 4 parts regarding Neer's classification, and cases above 50 years old.

Exclusion criteria: One- and two-part fractures regarding Neer's classification, cases less than 50 years of age, pathological fractures, compound fractures of the humerus, and patients who refused to be included in the study.

Methods

All cases have been exposed to the following:

Preoperative assessment involved history-taking, involving personal details such as the patient's full name, age, gender, occupation, and hand dominance. This was followed by a review of presenting symptoms and past medical history, which addressed comorbidities, chronic diseases, the time elapsed since the current fracture, pre-injury functional level, history of malignancy, previous fragility fractures, and prior surgeries. Clinical examination included a general assessment and a local examination comprising inspection and neurovascular evaluation. This involved assessing the axillary and peripheral nerves, axillary artery pulsations, distal circulation, elbow and wrist movements, and hand sensation. In the emergency room, after examination and resuscitation, primary management was provided, including irrigation of lacerated skin with saline and antiseptic solution, sterile dressing, and application of an arm sling. Cases with chronic disease or several traumas were further evaluated by specialists and scheduled for surgery as needed. Radiological evaluation involved X-rays in anteroposterior, lateral, and axillary views, supplemented by computed tomography for detailed imaging.

Preoperative investigations: Laboratory investigations, including CBC, coagulation profile in the form of PT, PC, and INR; kidney function tests (urea, creatinine); liver function tests (SGPT and SGOT). ECG and chest X-ray were done.

Operative Techniques

Patients were positioned in a beach-chair posture for surgery, and either PHILOS plates or smooth K-wires were utilized for fixation. For PHILOS plate fixation, a deltopectoral method has been utilized with an eight to ten centimeters incision along the deltopectoral groove. The cephalic vein was retracted, and the internervous plane located among the pectoralis and deltoid major was determined. The subscapularis was incised following external rotation to access the fracture site. Hematoma clearance and tagging of the rotator cuff preceded the challenging anatomic head decrease, which aligned the humeral head to the shaft calcar and surrounding tuberosities. Provisional fixation with K-wires was verified under an image intensifier, and the PHILOS plate was secured approximately five to eight millimeters distal to the greater tuberosity and 2–4 millimeters posterior to the bicipital groove. Screws have been inserted into the humeral head and diaphysis with care to avoid intra-articular penetration, followed by suturing and meticulous closure. For K-wire fixation, reduction was achieved via traction, manipulation, and arm abduction under imaging guidance. Pins were inserted in a triangular configuration to stabilize fragments, bent near the skin to prevent migration. Final fixation was verified with imaging, ensuring fracture alignment and stability.

Postoperative stage

Postoperatively, all patients were monitored for vital signs, neurovascular status, and abnormal bleeding and were kept in an arm pouch for two weeks with standardized pain management protocols. Antibiotic treatment included parenteral 3rd-generation cephalosporins every 12 hours for three days, followed by oral antibiotics for two weeks after discharge. Postoperative AP and lateral X-rays were performed on day one, and wounds were dressed on day two before discharge. Patients were advised to seek immediate medical attention for signs of infection, excessive bleeding, or medication intolerance. For PHILOS patients, early home exercises, including pendulum and Codman exercises, were initiated around day 10, with gradual progression of motion. For K-wire patients, the sling was worn almost continuously for 4-6 weeks, with passive shoulder motion starting in the second week and active motion delayed until fracture union. Follow-ups occurred every two weeks for suture removal, then at one, three, and six months to evaluate pain, function, range of motion, and radiographic healing. Radiographs assessed union, nonunion, avascular necrosis, implant stability, and complications, with K-wires removed after confirmed fracture union. Physical therapy was prescribed as needed based on individual progress.

Results

Table 1 shows that 23 patients were males; 11 of them were in group I (55%), while 12 of them were in group II (60%). 17 patients were females; 9 of them were in group I (45%), while 8 of them were in group II (40%). The mean age was 68.19 ± 7.53 in group I, while it was 67.72 ± 8.14 in group II.

Table 2 shows Neer's classification of fractures in both groups. 15 patients have three-part fractures; 8 of them are in group I, while 7 of them are in group II. 25 patients have four-part fractures; 12 of them are in group I, while 13 of them are in group II.

Table 3 demonstrates that a significant variance is discovered among both examined groups according to postoperative and follow-up VAS for group I.

Table 4 demonstrates that a significant variance was discovered among both examined groups according to the activity of daily living score for group I. However, there is insignificant variance among both studied groups according to strength and range of movement.
Table 5 shows that insignificant variance was discovered among both examined groups according to complications; however, complications were more frequent in Group II ($p < 0.05$).
Table 6 shows that significant variance was discovered among both examined groups according to the outcome p-value < 0.05.

Table (1): Baseline characteristic of both examined groups

Variable		**Group I (PHILOS)** (number=20)	**Group II (K-wires)** (number =20)	**t / χ^2**	**P**
Age (years) Mean ± Standard Deviation		68.19 ± 7.53	67.72 ± 8.14	.190	.851
Sex	Male	11 (55%)	12 (60%)	.102	.749
	Female	9 (45%)	8 (40%)		
BMI (kg/m^2) Mean ± SD		26.82 ± 3.77	26.33 ± 3.85	.407	.687

Table (2): Neer's classification between both examined groups

	Group I (PHILOS) (number=20)	**Group II (K-wires)** (number=20)	**χ^2**	**P**	**Total**
Three-part fracture	8 (40%)	7 (35%)	.107	.744	15
Four-part fracture	12 (60%)	13 (65%)			25
Total	20	20			

Table (3): VAS distribution between both examined groups

	Group I (PHILOS) (number =20)	**Group II (K-wires)** (number =20)	**T**	**P**
Preoperative Mean ± Standard Deviation	8.23 ± 0.846	8.17 ± 0.823	.227	.821
Immediate postoperative Mean ± SD	3.79 ± 0.902	3.18 ± 0.875	**2.17**	**.036**
Three months follow up Mean ± SD	1.65 ± 0.633	1.23 ± 0.578	**2.19**	**.035**
P-value	**<0.001**	**<0.001**		

Table (4): Clinical characteristics postoperatively between both examined groups

2	**Group I (PHILOS)** (number=20)	**Group II (K-wires)** (number=20)	**T**	**p**

Activity of daily living score Mean ± SD	18.46 ± 1.85	17.39 ± 1.54	**2.1**	**.047**
Strength Mean ± SD	23.15 ± 3.62	21.58 ± 2.84	1.53	.135
Range of movement Mean ± SD	34.54 ± 3.88	32.78 ± 2.91	1.62	.113

Table (5): Complications between both examined groups

	Group I (PHILOS) (number=20)	**Group II (K-wires)** (number =20)	χ^2	**p**
Infection	2 (10%)	1 (5%)	.360	.548
Decrease ROM	0	1 (5%)	1.03	.313
Delayed union	1 (5%)	3 (15%)	1.11	.293
Implant loosening	2 (10%)	6 (30%)	2.5	.114
Avascular necrosis	0	1 (5%)	1.03	.313

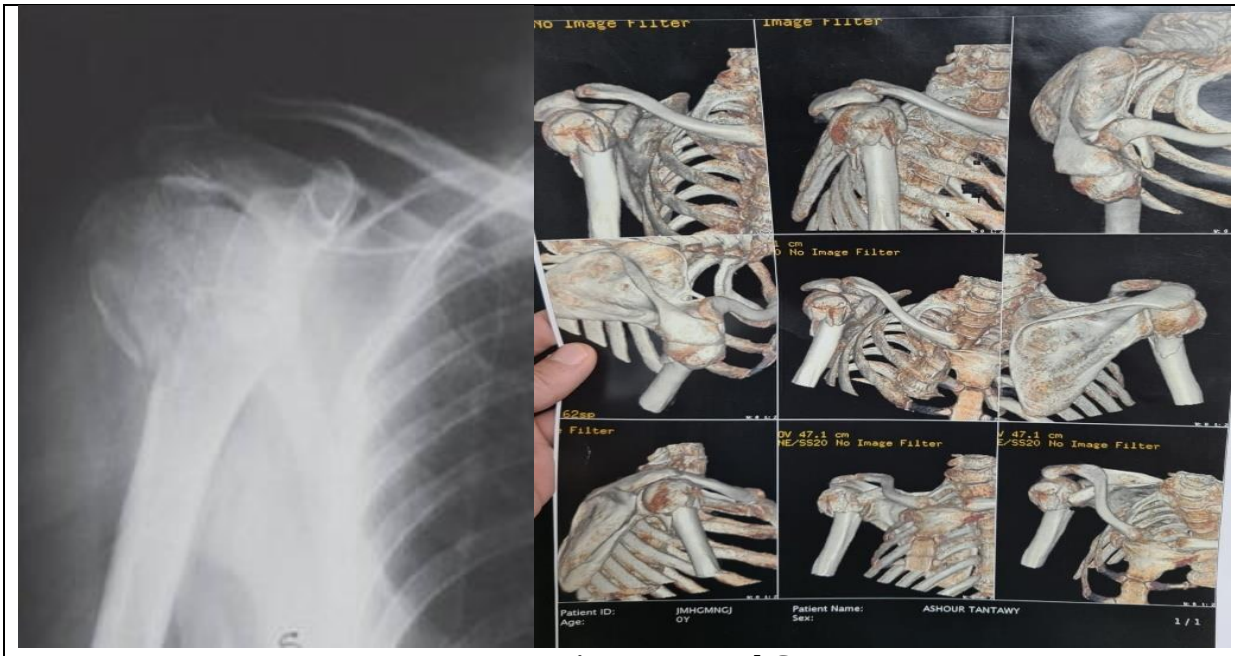
Table (6): Outcome between both examined groups

	Group I (PHILOS) (number =20)	**Group II (K-wires)** (number =20)	χ^2	**p**
Excellent	14 (70%)	7 (35%)	7.22	**.065**
Good	5 (25%)	6 (30%)		
Fair	1 (5%)	4 (20%)		
Poor	0	3 (15%)		

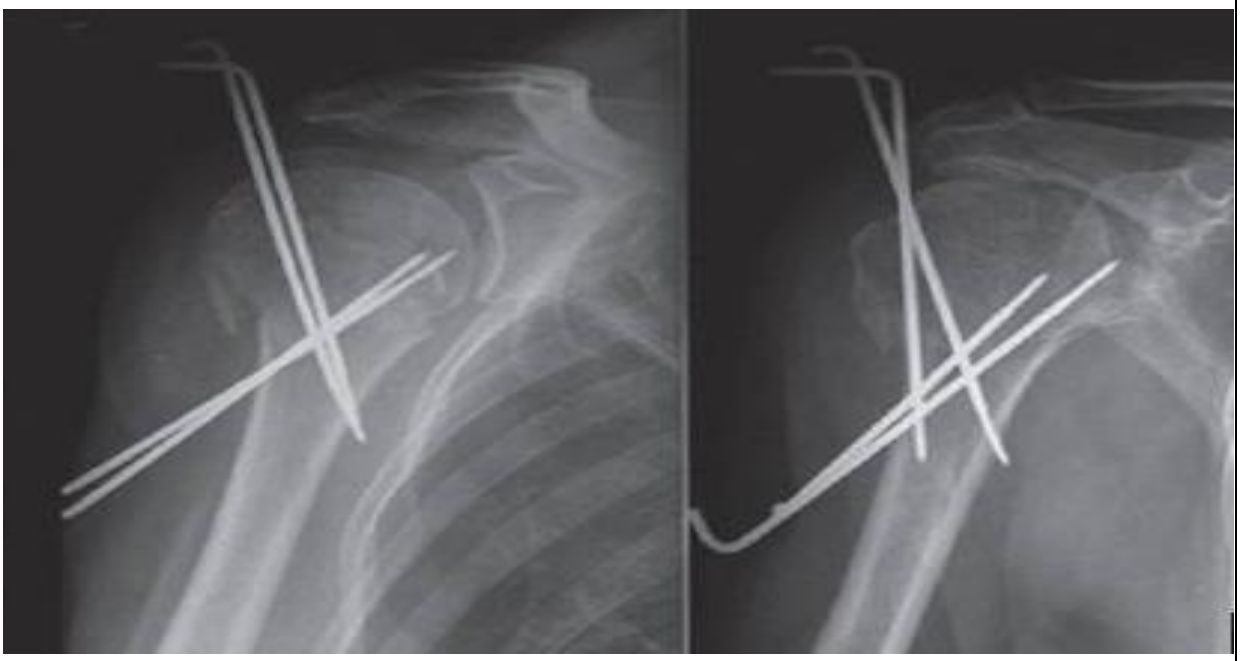
Case presentation

Case One: A sixty-year-old man case presented with a proximal humerus fracture on the right side following a fall. He underwent surgical fixation using K-wires on the third day post-trauma. The procedure, completed in 20 minutes with 75 seconds of fluoroscopic imaging, was uneventful,

with no reported difficulties. Postoperative X-rays confirmed satisfactory fracture reduction, proper K-wire positioning, and good bone quality. The patient experienced no complications during the six-month monitoring period. Fracture union has been achieved in 14 weeks, and the range of motion in the affected shoulder was comparable to the contralateral side.



Preoperative X-ray and CT



Immediate postoperative X-rays

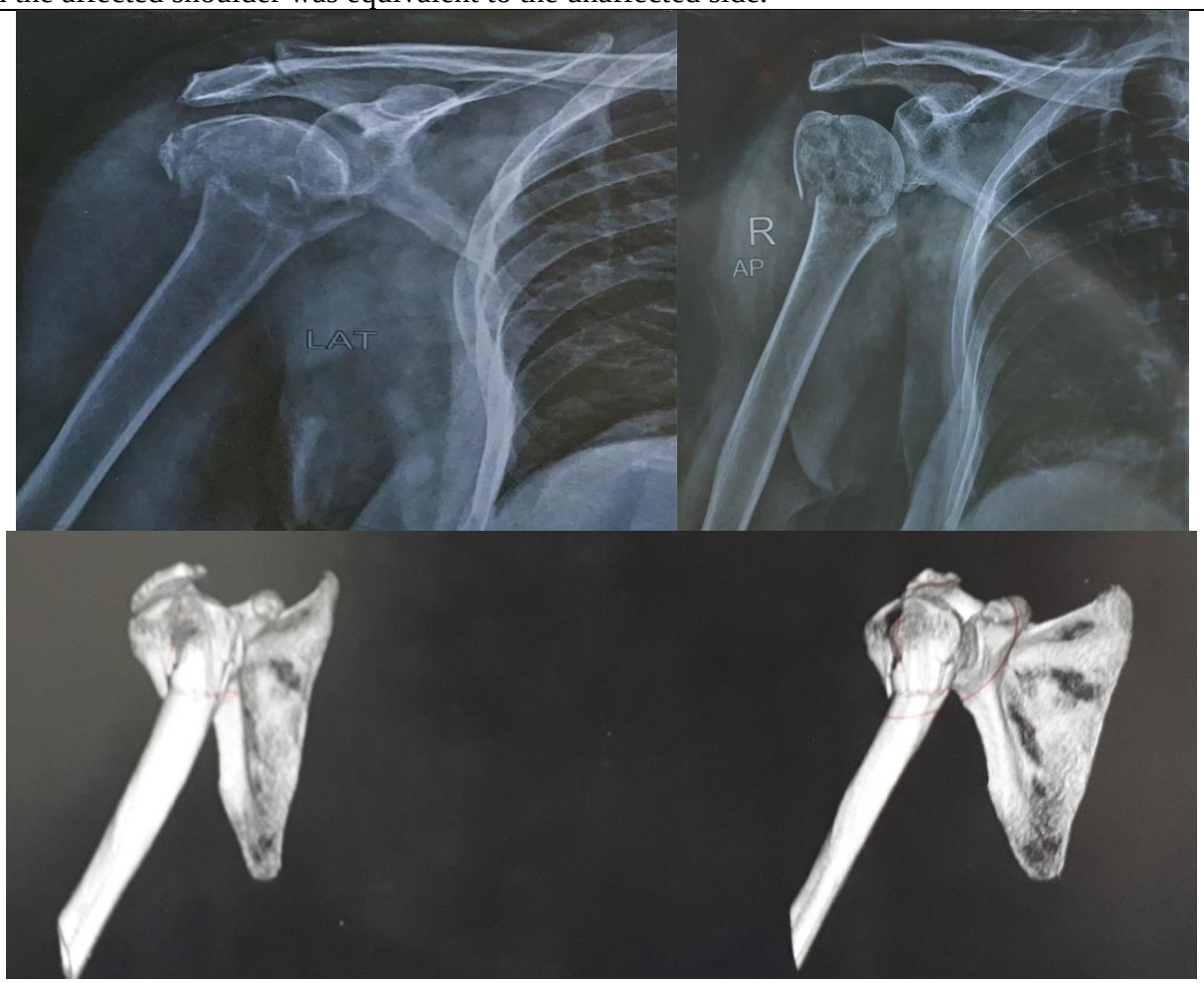
Follow up X-rays showing union after K-wires removal after 14 weeks.

Clinical images showing range of motion after K-wires removal.

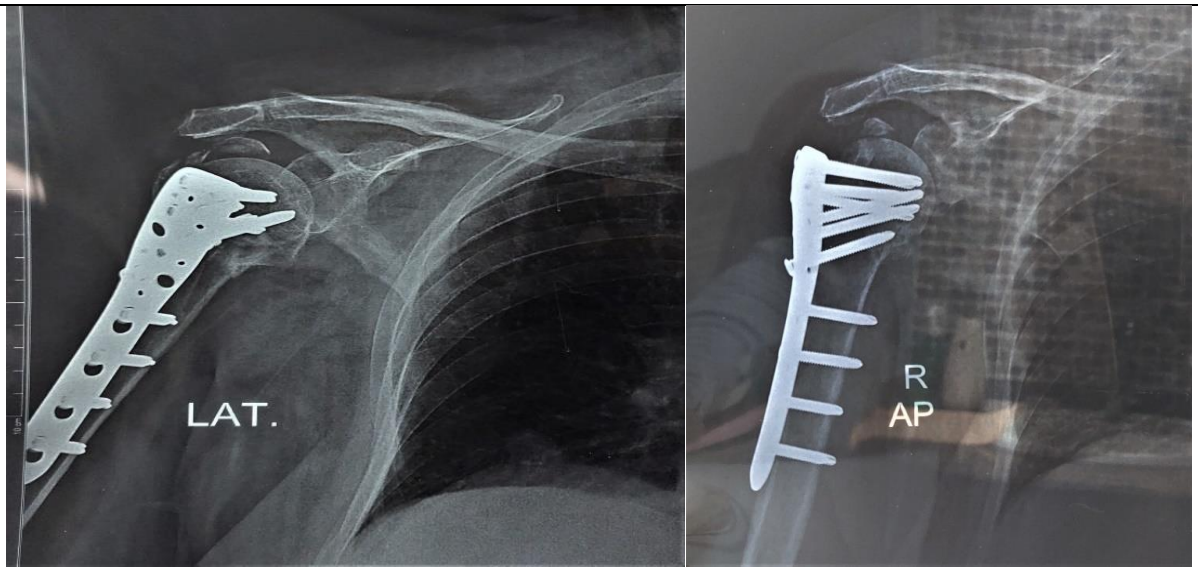
Figure (1): Shows case One

Case Two: A 52-year-old female case sustained a proximal humerus fracture on her right side following a fall and underwent surgical fixation with a PHILOS plate on the fourth day post-

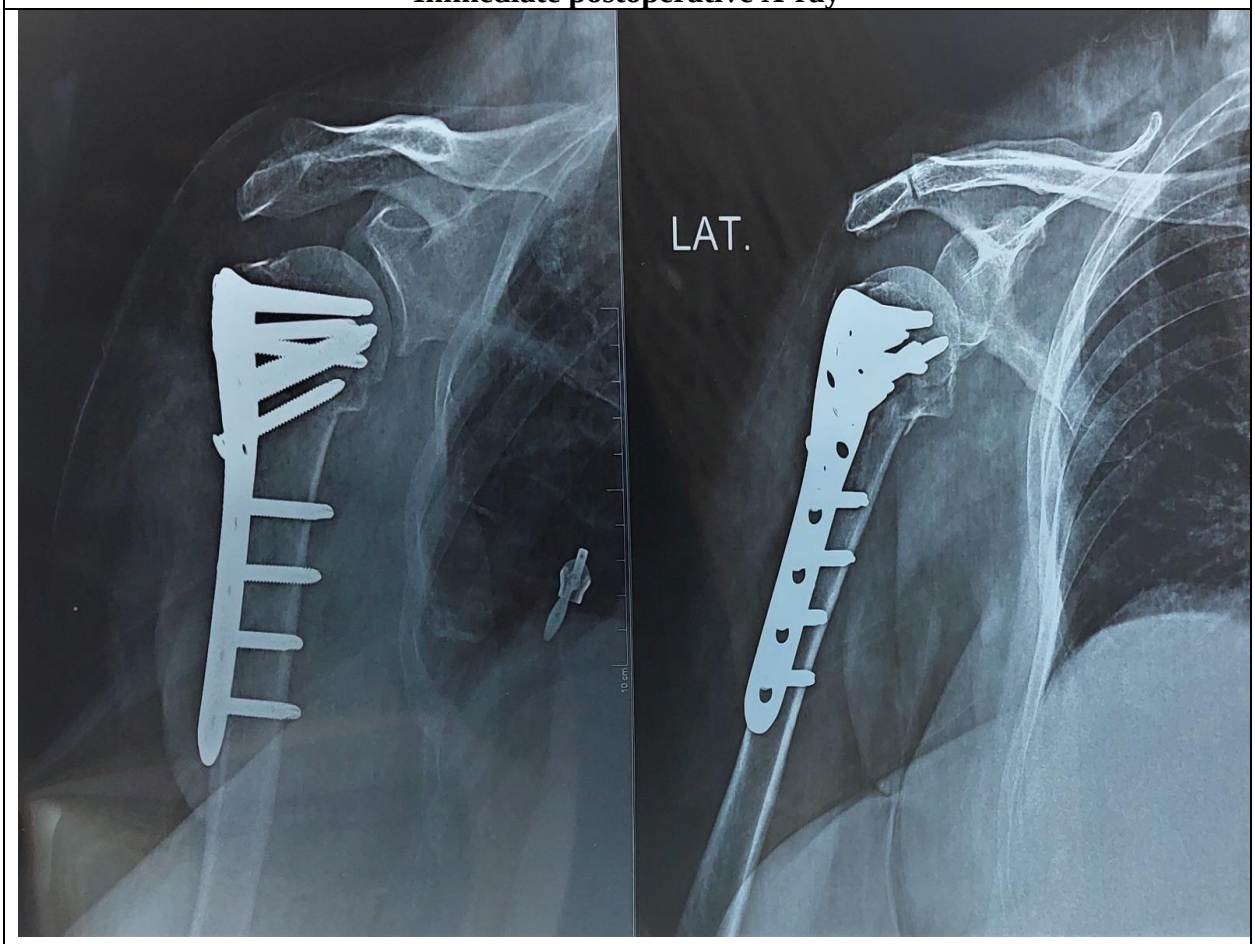
trauma. The procedure lasted 45 minutes, with 60 seconds of fluoroscopic imaging, and was completed without difficulties. Postoperative X-rays confirmed satisfactory fracture reduction, proper plate and screw positioning, and good bone quality. Over a 6-month follow-up period, no complications were reported. Fracture union was achieved in 16 weeks, and the range of motion in the affected shoulder was equivalent to the unaffected side.



Preoperative X-rays and CT



Immediate postoperative X-ray



Follow up X-rays demonstrating union

Clinical images demonstrating range of motion

Figure Two: Shows case Two

Discussion

Osteoporosis is frequently associated with proximal humerus fractures, which are exceedingly prevalent. The frequency of it is on the rise as the human people age. The annual frequency of proximal humerus fractures was as much as 2.48/1000, according to a current epidemiological survey. The Neer categorization indicates that two-part fractures are frequent in twenty-eight percent of cases, with a mean age of seventy-two years and a preponderance of cases over the age of fifty. Despite the fact that a few investigations have compared the outcomes of intramedullary pinning, plate fixation, and percutaneous fixation, no consensus was established **[7, 8]**.

The main results of this study were as follows:

A statistically insignificant variance was discovered as regards age, gender, and BMI of both groups.

Our outcomes have been supported by research of **Repetto I. et al. [9],** as they stated that twenty-two cases underwent closed decrease and internal fixation (CRIF) utilizing the pinning method with Kirschner wires, nineteen cases underwent open decrease and internal fixation (ORIF) utilizing locked compression plates, twenty-four cases underwent hemiarthroplasty (HA), and twenty-seven cases underwent reverse shoulder arthroplasty (RSA). Demographic data was similar among both examined groups.

The present study demonstrated that statistically insignificant variance was discovered as regards Neer's classification of fractures in both groups; the majority of them were four-part fractures.

Our results were in line with the study of **Repetto I. et al. [9],** as they reported that the data was collected from ninety-two cases who were admitted to our hospital for complex humeral fractures. The cases had twenty-one 3-part fractures, eleven head-splitting fractures, thirty-seven percent four-part fractures, and twenty-three fracture-dislocations. A statistically insignificant variance was observed among the examined groups.

Also, in **Akel Y. et al. [10],** research was performed on twenty cases (M=7, F=13) in the elderly group with two components (ten cases) and three components (ten cases) proximal humerus

fractures regarding Neer's categorization were randomly assigned to either (group 1), which underwent open reduction and internal fixation with a PHILOS plate, or (group 2), which underwent percutaneous K-wire fixation. The examined groups were showing statistically insignificant variances regarding Neer's categorization.

In the study in our hands, a significant difference is discovered among both studied groups as regards postoperative VAS. A significant difference is discovered among both examined groups according to the activity of daily living score. However, there is insignificant variance among both examined groups according to strength and range of movement.

Our outcomes have been supported by research of **Repetto I. et al. [9],** as they stated that at the ending of the monitoring period, statistically insignificant variance was observed among the treatment groups in regards to postoperative range of motion (p-value > 0.05). However, the statistical analysis indicated that reverse shoulder arthroplasty performed more effectively in terms of abduction than hemiarthroplasty (p-value < 0.05).

In the study of **Ortmaier R. et al. [11]** Group 1 demonstrated significantly worse mean abduction (109.7° versus 133.7°; p-value < 0.01) and anterior flexion (128.3° versus 145.7°; p-value < 0.01). The VAS pain score was significantly reduced in group 2 compared to group 1 (1.2 versus 2.4; p-value < 0.01). The mean surgery time of the two groups was significantly different (117.3 versus 72.1, p-value < 0.01).

Our outcomes demonstrated that there was insignificant variance among both examined groups according to complications (infection, decreased ROM, delayed union, implant loosening, and AVN), which were more frequent in Group II. insignificant variance among both examined groups according to outcome; the majority of group I were excellent, whereas the majority of group II were either good or fair.

While, in the study of **Akel Y. et al. [8]**, both groups didn't suffer from any significant intraoperative complications. Four cases in group (1) and three cases in group (2) experienced complications following surgery. In group 1, one case, who was diabetic and sixty-two years old, developed a superficial wound infection. He was administered IV antibiotics following the collection of culture and sensitivity reports, as well as repeated dressings. Additionally, one case with a three-part fracture experienced delayed union following five months. Another case experienced non-union and implant failure, which was managed through the removal of the plate and bone graft. Following three and six months, the final cases experienced a reduction in their range of motion. In group 2, one case (who had a 3-part fracture) was given therapy with daily dressings and antibiotics due to a pin tract infection. Other cases experienced delayed union following five months, while the final case experienced a reduction in range of motion following three and six months. In group 1, more than eighty percent of the cases achieved excellent or excellent results regarding the UCLA score system. This method enabled them to achieve a decrease in all cases. In the second group, more than eighty percent of cases achieved excellent and good results as measured by the UCLA score, which additionally included case satisfaction, active forward flexion, and pain.

Furthermore, **Baldev and Sumit [12]** conducted a study on the functional outcomes of cases who were treated with k-wire fixation. Twenty cases with two- and three-part fractures comprised the research group. The cases' least follow-up period was twelve months. K-wire fixation was utilized for managing all 3-part and 2-part fractures. Of the total number of cases, four experienced pin site infection, four developed malunion, one developed nonunion, and none developed avascular necrosis of the humeral head. The average constant score in his research was 73.65%. Of this

group, ten percent had an excellent functional result, fifty-five percent had a good functional result, twenty percent had a moderate result, and fifteen percent had a poor outcome.

Conclusion

PHILOS plate fixation offers superior functional outcomes and fewer complications compared to K-wire pinning for proximal humerus fractures in elderly cases, making it a preferred option for complex fractures.

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