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Evaluation of Result of Percutaneous Fixation Proximal Humerus Fracture in Adults in Zagazig University Hospitals

Abdelsalam Eid, Osam Mohamed Metwally,
Hany Mohamed Abdelfattah Bakr, Mohammed Saad Amer Daw
Department of Orthopedic Surgery, Faculty of Medicine, Zagazig University, Egypt
***Corresponding author:** Mohammed Saad Amer Daw, **E-Mail:** Dr.alferjani@gmail.com, **Mobile:** (+20) 01025923883

ABSTRACT

Background: Percutaneous pinning is a minimally invasive treatment with a limited number of applications for fractures of the proximal humerus.

Objective: to assess whether closed reduction with percutaneous pinning gives sufficient stability to allow early active range of motion and eventual bone healing in the proximal humerus.

Patients and Methods: 18 patients with age above 18 years with closed proximal humeral fracture in adults at Zagazig University Hospital by closed reduction and percutaneous pinning by K-wire were the subject of our study. Percutaneous K-wire fixation was used to treat the patients. We followed up patients and evaluated our results at 1, 3 then 6 months according to constant score (CS).

Results: The radiographic union of all but one of the patients occurred by 12 weeks. Intraoperatively, there were no serious issues, eighteen patients had superficial (mild) pin tract infection (100%), One patient had delayed union (5.6%), the last patient had pin loosening (5.6%), and no patient had nonunion or avascular necrosis (AVN). The average Constant-Murley score was 81.

Conclusion: By using a closed reduction with percutaneous pinning (CRP) to stabilise fractures of two and three parts, the advantages of minimum soft tissue invasiveness and less blood loss can be achieved.

Keywords: Percutaneous Fixation, Proximal Humerus.

INTRODUCTION

Proximal humerus fractures, which account for 4% to 5% of all fractures, are common[(1)]. Patients over the age of 60 account for 71% of all proximal humerus fractures, a startlingly high number. Elderly populations may have a 7:1 male to female ratio, which is higher than the average ratio of 3:1[(2)].

Falling on an outstretched arm in an elderly patient with osteoporotic bone is the most common cause of proximal humerus fractures. There is a risk of fracturing the humerus if the humeral head hits the glenoid or the acromion directly [(3)]. Traumatic events like vehicle accidents or falls from great heights are less likely to cause fractures in younger persons. Muscle spasms brought on by an electric shock or seizure are an uncommon cause [(4)].

While the majority of these fractures can be stabilized without surgery, 15–20 percent will require it due to their instability or displacement [(5)]. Open reduction and internal fixation procedures can be employed to treat these fractures. While anatomical reduction and stable fixation are the primary benefits of open reduction and internal fixation, there are several drawbacks, including increased joint stiffness, implant failure, an increased infection rate, and an increased risk of humeral heave avascular necrosis [(6)].

While less invasive, closed reduction and percutaneous fixation with straight wires have the potential for insecure fixation, reduction deterioration, and wire migration [(7)]. Closing reduction and percutaneous pinning (CRPP) was first described by Bohler in 1962, but has garnered increasing attention in the literature in recent years [(8)].

Only a few conditions call for the use of percutaneous pinning, a minimally invasive procedure with few potential applications. A 3- or 4-part proximal humerus fracture with appropriate bone stock can be accepted. This technique minimizes scarring at the scapulohumeral contact and reduces the risk of vascular compromise, postoperative pain, operating time, and blood loss. 70% of the time, two-part fracture patterns can yield good results [(8)].

It was the goal of this work to assess whether closed reduction with percutaneous pinning gives sufficient stability to allow early active range of motion and eventual bone healing in the proximal humerus.

PATIENTS AND METHODS

Eighteen patients with age above 18 years with closed proximal humeral fracture in adult at Zagazig University Hospital by closed reduction and percutaneous pinning by K-wire were the subject of our study. Percutaneous K-wire fixation was used to treat the patients.

Ethical consent:

Zagazig University's Research Ethics Committee approved the study as long as all participants' parents signed informed consent forms and submitted them to Zagazig University (ZU-IRB#6853). We adhered to the Helsinki Declaration, the ethical guideline of the World Health Organization for human trials.

Inclusion criteria: Patients of both genders presented with proximal humeral fractures, aged above 18 years, and in most cases, the proximal humerus fracture is operated on within two to seven days after the injury.

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Exclusion criteria: Medial calcar fractures with extensive comminution of the fracture (allowing for varus displacement), fractures with delayed presentation (after 2 weeks), patient before skeletal maturity, and infection.

All Patients were subjected to:

History: The patient's age, sex, gender, occupation, mechanism of trauma.

Clinical examination: General and local examination was done after stabilization, as well as neurovascular examination.

Laboratory evaluation: All patients underwent preoperative laboratory tests, including a complete blood count, random blood glucose, a bleeding profile, and liver and kidney function tests

Radiological Evaluation: The purpose of the preoperative radiological assessment was to: Determine the fracture type, understand the fracture pattern, and exclude associated fractures or dislocations.

Plain radiography: Each patient had radiographs obtained from the anteroposterior (AP), axillary, and lateral scapular (Y) viewpoints as part of a shoulder trauma series.

Value of CT: Using this test, you can determine whether or not the glenoid rim has fractured and the degree of articular involvement is present.

Surgical approach: Percutaneous Kirschner-wire pinning was used in all cases of closure reduction with pinning. Only longitudinal traction force was applied to the upper extremity after the arm and shoulder have been draped freely to allow for fracture reduction. Direct pressure or manipulation of the fracture site were avoided. The humerus shaft's posterior sagging due to gravity was addressed with prudence. Image intensifier's C-arm was employed instead of a humerus rotation to verify realignment. K-wires were used as joysticks to fine-tune the reduction. Wires with a nonthreaded tip and a diameter of 2.5 mm were the most common (also known as pins). There were four wires in total: a reduction pin, an antirotating pin, a stabilization pin, and a third and a fourth wire for support.

Reduction Pin: As a result, K-wires were inserted from the anterior, posterior and lateral sides to minimise head-shaft fragmentation. Additionally, the positions of these structures could vary depending on whether or not the sagittal plane is angulated. The 2.5 mm non-threaded K wire was inserted into the shaft of the humerus.

Anti-rotation Pin: The installation of a second pin balances off the loss of the first pin. To counteract rotation, the reduction and anti-rotation pins were positioned anterolaterally. The reduction and antirotation pins were extended to the midshaft level (Figure 1).

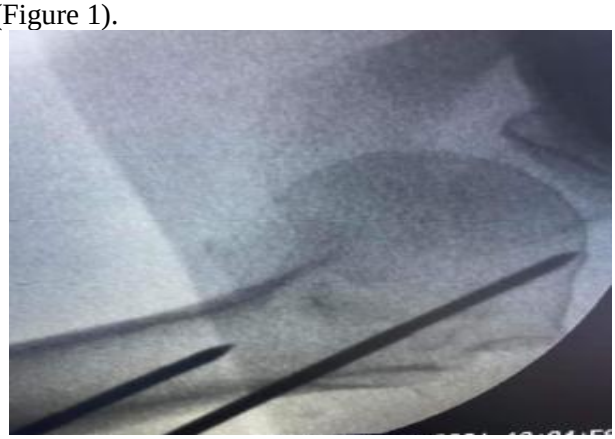


Figure (1): Anti-rotational pin.

Stabilizing Pins: Two pins were inserted into the fractured bone to reinforce it. In order to stabilize the fracture, these pins were inserted into the greater tuberosity and bore obliquely into the medial cortex (Figure 2).

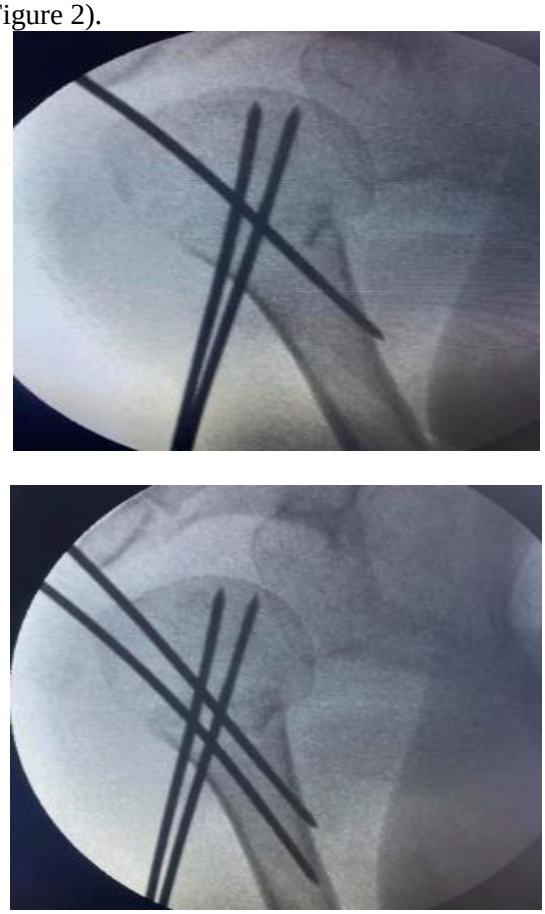


Figure (2): Stabilization pins.

Follow up: At 1, 3, and 6 weeks, clinical and radiographic examinations were done. Clinical evaluation was done using **Constant and Murley** [(9)] score. The Visual Analogue Scale (VAS) was used for pain assessment [(10)]**.** Range of motion and power also were assessed.

Radiological evaluation: In order to check for reduction, fixation, healing, and infection at 3 months, and 6 months after surgery, radiographs

taken from the anteroposterior and lateral sides were used to remove the pins, loosening and necrosis of bone.

Statistical analysis

SPSS version 23 was used for statistical analysis. Quantitative data were presented as mean, standard deviation (SD), median, and range and were compared by paired t-test. Qualitative data were presented as frequency and percentage. P value 0.05 was considered statistically significant. It was judged highly significant when the P value was <0.01.

RESULTS

The demographic data of the studied group are shown in table 1.

Table (1): Demographic data of the studied group

Parameters		**Mean± SD Median (Range)**	
Age		54.05±10.57 58.0 (37-67)	
		No.	**%**
Sex	Male	6	33.3
	Female	12	66.7
Mechanism of injury	Fall	11	61.1
	RTA	7	38.9
Side	Left	8	44.4
	Right	10	55.6
Total		**18**	**100.0**

Table (2) below shows the union time.

Table (2): Union time distribution among studied group

	Union Time
Mean± SD	10.72±1.99
Median (Range)	10.0 (8-16)

VAS significantly decreased from pre to one and 3 months **(Table 3).**

Table (3): VAS score distribution at different times among studied group

	Pre	**Post**	**3 Months**	**P**
VAS	8.22±0.54	3.27±0.95	1.33±0.58	<0.01**

Shoulder constant score component and total distribution at different times among studied group are shown in table 4.

Table (4): Shoulder constant score component and total distribution at different times among studied group

	Post 1 month	**At 3 months**	**P**
VAS post	3.27±0.95	1.33±0.58	<0.01**
Pain post	9.55±2.22	13.55±1.42	<0.01**
Activity of daily living score-post	12.55±1.50	17.55±1.61	<0.01**
Strength post	13.11±3.28	22.44±3.71	<0.01**
Range of movement-post	23.11±4.40	34.55±3.74	<0.01**
Total constant post	**58.33±9.64**	**88.11±8.71**	<0.01**

Eighteen patients experienced postoperative complications despite the absence of significant intraoperative complications **(Table 5).**

(1) Pin loosening: There was one patient had pin loosening two weeks postoperatively. At follow up the patient showed good response on CS score and gave a satisfactory result. The patient did not require any treatment, as the range of motion was acceptable**.**

(2) Pin tract infection: There was an infection in 18 patient's pin tract, and they were treated with daily medicines and bandages.

(3) Delayed union: One case had delayed union, patient number seven, male patients 54 years had delayed union after 5 months, at follow up showing poor results on CS score and the patient was not satisfactory.

(4) Stiffness: There was one patient had stiffness, case number twenty, female 55 years old diabetic had a four-part proximal humerus fracture, operated on fifth day and fixated by 4 K-wire at follow up showed poor result on CS score **(Table 5).**

Table (5): Complication distribution among studied group

		N	**%**
Pin tract infection	-VE	0	0
	+VE	18	100
Stiffness	-VE	17	94.4
	+VE	1	5.6
Delay union	-VE	17	94.4
	+VE	1	5.6
Re operate	-VE	17	94.4
	+VE	1	5.6
	Total	18	100.0

After three and six months, the results of postoperative follow-ups were evaluated using a consistent grading system. At the end of three months, 7 patients had great results, 9 patients had good results, and 2 patients had

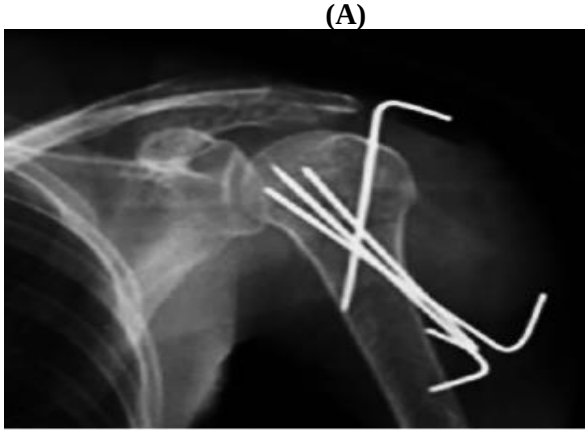
a fair result. 7. The results at the end of six months are shown in table 6.

Table (6): Outcome and satisfaction distribution among studied group after 6 months

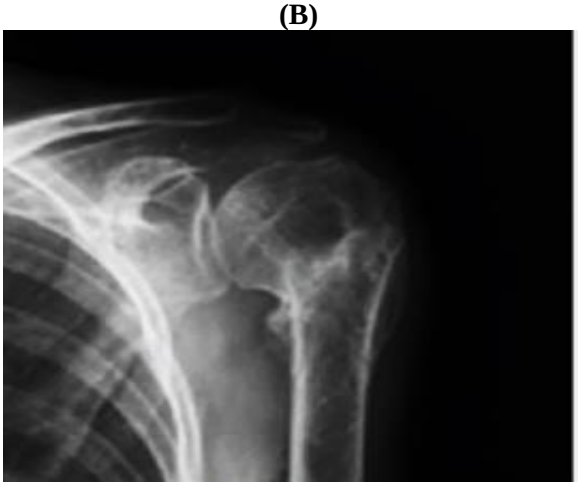
		N	%
Outcome	Excellent	11	61.1
	Good	5	27.8
	Fair	1	5.6
	Poor	1	5.6
Satisfaction	Not	2	11.1
	Satisfied	16	88.9
	Total	**18**	**100.0**

Figure 3 shows the X-ray of one patient.

(A)



(B)



(C)

Figure (3): A 63-year-old male patient form Faqous had a left three-parts proximal humeral fracture due to fall down on outstretched hand, taken pre-operation image the antroposterior view (A). There was no neurovascular injury or associated fracture. The patient was operated on the day after the day of injury, under general anesthesia. Patient was placed on beach chair closed reduction and percutaneous pining by 4 K –wires, analgesia and intravenous antibiotic were injected for patient. After three to four weeks of immobilization in a sling, passive range of motion and pendulum exercise were started as soon as discomfort and edema diminish. (B) Clinical and radiological evaluation was done after six months by using the CS, without complication. The patient had CS 94 % of the CS modified according to age and sex. The patient was graded as excellent result, and patient gave satisfactory result (C).

DISCUSSION

Predominantly, proximal fractures occur in the upper arm. Distal radius fractures are the second most prevalent in the upper limb. Oral and femoral fractures can be treated non-operatively or surgically using a variety of techniques (Open reduction and internal fixation (ORIF), percutaneous screw/pin fixation, hemiarthroplasty, and external fixation). In this region, high-energy traumas and simple falls in elderly people with osteoporosis are major contributors to fractures. As people age, their bones become more brittle and more likely to shatter [(11)].

According to Neer's recommendation, minimal dissection surgical procedures and strict fixation have been prioritised in order to preserve vascularity in the articular area. Using percutaneous fixation to close the reduction and preserve the vascularity of the humeral head allows for faster healing and more mobility of the injured tissue [(12)].

The patients in our study ranged in age from 37 to 67, with a mean age of 43.8 years. There was a 1:2 male-to-female ratio, with the females taking the lead. The right upper limb was more frequently implicated, with a ratio of 1.25:1. **Keener and colleagues** [(13)] found that 8 men and 19 women were reported in a ratio of 1:2.3. A ratio of 1: 0.58 resulted in 17 fractures in the right extremity and 10 in the left.

Except for one patient who had a delayed union, all patients in this study had radiographic union by 12 weeks, similar to **Kotb and colleagues** [(14)] who had one patient with delayed union, compared to **Seyhan and colleagues** [(12)]. By 12 weeks after surgery, all patients had achieved radiographic union and in the study of **Jaberg *et al.*** [(8)] there were two cases when patients who had closed reduction and percutaneous K-wire fixation for unstable proximal humeral fractures failed to heal.

There were no major intraoperative problems in our investigation. One patient had a delayed union (5.6%), and the last patient suffered pin loosening as a postoperative complication. There were 18 patients who had superficial (mild) pin tract infections (100 percent). No one had AVN or nonunion. **Vijay and colleagues** [(15)] also found no harm to the patient's

neurovascular system after the last follow-up in two of the patients who had pin tract infections. Restricted range of motion (ROM) stiff shoulder was seen in six patients, four patients also had malunion, and **Jaura and colleagues** [(11)] reported after a second closed reduction, percutaneous pinning was used to re-establish fixation in four patients, malunion was the cause of a negative outcome for only one of them. Pin-track infections and loosening occurred in four patients, one patient experienced severe infection, and two patients experienced non-union. Complete avascular necrosis with collapse of the humeral head developed in only two patients, and **Kotb and colleagues** [(14)] according to the assessment, there were three complications. Patients with pin tract infections required daily dressing and antibiotics, while one patient suffered a delay in union.

In our study, eleven patients (61.1%) had an excellent, five patients (27.8%) had good, one patient (5.6%) had fair and last patient (5.6%) had poor result according to the Constant-Murley scoring system, in the average constant score was 88.11. Compared to **Seyhan and colleagues**[(12)] 21 patients (58%) had great outcomes, 9 patients (25%) had acceptable results, and 6 patients (17%) had fair results, according to the survey data. Constant-Murley scores ranged from 0 to 100 (range, 78-100). **Fenichel and colleagues** [(7)] found 18 (36%), 17 (34%), 8 (16%) and 7 (14%), respectively, of the 50 individuals studied had outstanding results, decent results, and fair or poor results. The average Constant-Murley score was 81 (range, 60-100). **Akel and colleagues** [(16)] (percutaneous K-wire) found five outstanding, three good, and two bad results out of a total of ten patients in the study. **Sundar and Rai** [(17)] (percutaneous K-wire) in their study, the functional outcomes for 10% were excellent; for 55% it was good; for 20% it was moderate; and for the other 15% it was bad.

Magovern and Ramsey [(18)] found few risks and a higher functional outcome for percutaneous fixation, surgery was shown to be a good long-term option. **Matassi and colleagues** [(19)] found that proximal humerus fractures in older patients with severe comorbidities may be treated with percutaneous fixation treatment, especially in the case of significant critical health problems.

Our finding is in line with previous study [(7)] treating Neer's two- and three-part fractures of the proximal humerus with minimum pin fixation instead of traditional surgery.

CONCLUSION

The surgical management of displaced three and four parts fractures of the proximal humerus includes many options: CRPF, ORIF, IM nailing and transosseous sutures.

The results of our study show that displaced two- and three-part fractures can be stabilised using closed reduction and percutaneous pinning, with the advantages of low soft tissue invasiveness and less blood loss.

Percutaneous pinning is more important in elderly population as it allows rapid return to function except in severe osteoporosis or significant comminution.

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