

Outcome of percutaneous fixation and locked plates in proximal humerus fractures

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Abstract

Background

Several treatment modalities have been proposed depending upon the fracture pattern, patients' age, level of activity and, bone stock, amount of displacement of the fragments and associated medical co-morbidities: conservative treatment, open reduction and internal fixation (ORIF), percutaneous fixation.

Aim of the Work

The aim of the study is to compare the functional outcome of the closed reduction of proximal humerus fracture using kirshner (K_wires) fixation versus open reduction and internal fixation with proximal humeral internal locking system (PHILOS plate).

Patients and Methods

This study was performed on 40 patients from January 2017 to may 2018 with mean age 45 years old, range from 18 to 70 with 2, 3 and 4 part fractures according to Neer's classification [1,2], patient was randomized to either (group 1) includes 20 patients who were treated with open reduction and internal fixation and (group 2) who were treated by percutaneous K-wires fixation. Functional evaluation was done according to ULCA score [3], these cases were checked with standard X-rays and CT scan.

Results

The mean follow up of UCLA score[3] was 30 points (range from 26 to 34) points in (group 1) which is good results and 31 points (range from 27 to 35) points in (group 2) which is also good results. Values varied depending upon fracture type with worst values in 4 part fractures in each group.

Conclusion

each procedure having its advantages and drawbacks. We found that fixation with percutaneous K-wires presented an efficient treatment option with the advantages of minimal invasive technique and soft tissue dissection while PHILOS plate fixation provided stable fixation with minimal implant problems with ability to perform early range of motion exercises to achieve acceptable functional results.

Keywords

Proximal humeral fractures percutaneous fixation, PHILOS plate, Percutaneous K-wires.

Introduction

Fractures of the proximal humerus are relatively common representing 2-3 % of all fractures. Women were affected more than twice as frequently as men. The age and osteoporotic bone influence treatment options and clinical outcomes. 87% of fractures in adults results from falls from a standing height, the incidence of more complex fractures appear to increase with age[5].

Neer's classification evaluate the proximal humerus fractures in four parts as: the anatomical head, the greater tuberosity, lesser tuberosity and the surgical neck. Any translation more than 1 cm or angulation more than 45 degrees in any part of the humerus are

defined as a displacement[4].

The treatment of proximal humerus has been a subject of intense discussion with many treatment options including; conservative treatment, open reduction and internal fixation (ORIF), percutaneous fixation and joint replacement[6].

ORIF includes extensive surgical exposure and damage to vascular supply of bone fragments. It has advantage of anatomical reduction and early mobilization, on the other hand percutaneous fixation allows minimal soft tissue dissection so protects the blood supply to the fracture fragments which promotes rapid healing and minimizes the incidence of avascular necrosis[7,8].

Aim of the Work

The aim of the study is to compare the functional outcome of the proximal humerus fracture fixation using k-wires fixation versus locked plates (PHILOS plates).

Patients and Methods

Our study was prospective study to compare functional and radiological outcome between percutaneous fixation and locked anatomical plates in proximal humerus fractures this study was done between January 2017 and May 2018 in Fayoum University Hospital and Misr University for Science and Technology Hospital, it was conducted upon 40 patients (male: female is 21:19) with mean age of patients is 45 years (range from 18 to 70 years). According to Neer's classification of proximal humerus fractures; 10 patients had two parts, 19 patients had three parts, 11 patients had four parts. patients were randomized according to block randomization technique with 1:1 allocation ratio into two groups: (Group 1) who were treated by open reduction and internal fixation (ORIF) with PHILO'S plate and group 2 who were treated with percutaneous K-wire fixation with 20 patients in each group, functional evaluation was done according to UCLA[3] rating system, these cases were checked with standard X-rays and CT scan.

Inclusion criteria for both groups: According to neer's classification patients with two, three, four part fractures are included with age range from 18 to 70 years with exclusion of patients with open fractures and fracture dislocation.

in both groups, surgery was performed under general anesthesia beach-chair position with small sand bag under shoulder, all patients received a preoperative dose of intra venous antibiotics.

Group 1 (locked plate)

fracture was exposed with delto-pectoral approach and fracture fragments were relieved, definitive fixation with PHILOS plate was done with plate positioning lateral to biceptal groove sparing tendon of long head of biceps, the plate was placed at least 1 cm distal to upper end of greater tuberosity, range of motion of shoulder and impingement was checked on table, wound was closed in layers and suction drain was placed.

Post-operative regimen started at the second day post-operative with passive range of motion, sutures were removed after 12-15 days, active shoulder mobilization exercise started 4 to 6 weeks post-operative depend on the patient co-operation. Follow up at one week then every month for 6 months with standard antero-posterior, axillary and lateral radiographs for evaluation.

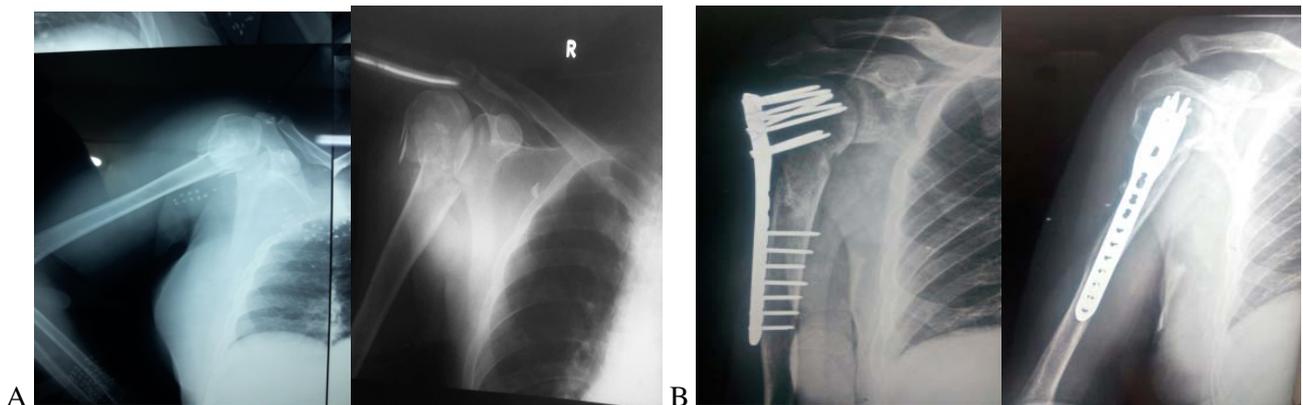


Fig. 1a: pre-operative radiograph of proximal humerus fracture in Group 1. **b:** post-operative AP and Lateral radiographs shows fixation with PHILOS plate.

Group 2 (percutaneous K-wires)

Reduction was achieved by manual traction and arm mobilization. Four or more K-wires under image intensifier were inserted depending on the number of fracture fragments, we described the first wire as the reduction pin, the second wire as anti-rotation pin, the

third and fourth as a stabilization pins, these two pins were inserted into the greater tuberosity to the medial cortex obliquely passing fracture line, care was taken to avoid injury of axially nerve, radial nerve and anterior humeral circumflux artery. The arm is immobilized in a sling for three to four weeks, passive range of motion and pendulum exercise are initiated as soon

as pain and swelling subsidence, clinical and radiographic evaluation were performed at 1,3 and 6 months where the reduction and anti-rotation pins are removed at 6 weeks when there is radiographic evi-

dence of union, more aggressive motion and rotational exercise are then applied to regain range of motion of shoulder at two months after surgery.



Fig. 2a: Pre-operative AP and Lateral radiographs of proximal humerus fracture in Group 2. **b:** Post-operative AP and lateral radiographs of fracture following K-wire fixation.

Results

Proximal humerus fracture is more common in fe-

males than males also more common on old age group. there are 13 patients with overhead activity. (Table1, 2)

Table 1: demographic characteristics of study groups

Variable	Group 1 (N=20)	Group 2 (N=20)
	N (%)	
<u>Age</u>		
18-30	4 (20.0)	4 (20.0)
31-50	6 (30.0)	6 (30.0)
51-70	10 (50.0)	10 (50.0)
<u>Sex</u>		
Male	8 (40.0)	13 (65.0)
Female	12 (60.0)	7 (35.0)
<u>Work</u>		
Over-head activity	6 (30.0)	7 (35.0)
Other work	12 (70.0)	13 (65.0)

Table 2: classification of fracture type according to neer's classification

Variable	Group 1 (N=20)	Group 2 (N=20)
	Mean ± SD	
Neer's classifications		
Tow part fracture	4 (20.0)	6 (30.0)
Three part fracture	6 (30.0)	13 (65.0)
Four part fracture	10 (50.0)	1 (5.0)

There were 10 patients (25%) with two-part fracture (4 in group 1 and 6 in group 2), and 19 patients (47.5%) with three-part fracture (6 in group 1 and 13 in group 2) and there are 11 patients (25.5%) with four part fracture (10 in group 1 and 1 in group 2) and in this fracture biceps tendon mainly frayed. (Table 3)

Table 3: Differences in intra operative data according to study groups

Variable	Group 1 (N=20)	Group 2 (N=20)	P-value
	Mean ± SD		
Time of surgery (hours)	1.65 ± 0.37	0.97 ± 0.50	<0.0001*
Time of IOP image (minutes)	1.42 ± 0.63	4.65 ± 0.93	<0.0001*
Length of skin incision (cm)	14.26 ± 2.23	-----	-----
Amount of blood loss (cm³)	392.50 ± 115.02	-----	-----

there was highly significant relation between both groups and time of surgery, time of intra operative image exposure and amount of blood loss

In (Group 1) mean operative time was 90 minutes (range from 70 to 110 min.) and average blood loss was 500 ml. (range from 300 to 700 ml)

Time of intra-operative imaging in (Group 1) ranged from 1 to 2 minutes while in (Group 2) ranged from 4 to 6 minutes.

In (Group 2) mean operative time was 40 minutes (range from 30 to 50 min.) and blood loss was less than 5 cc. (Table 4)

Table 4: post-operative complications

Variable	Group 1 (N=20)	Group 2 (N=20)
	N (%)	
Decrease ROM	1 (20.0%)	0 (0.0)
Delayed union	1 (20.0%)	1 (33.3)
Infection	1 (20.0%)	2 (66.7)
Implant failure	1 (20.0%)	0 (0.0)
Avascular necrosis	1 (20.0%)	0 (0.0)

Both groups received broad spectrum antibiotics postoperatively. There was no major complication intraoperatively in both groups. Postoperative complications were noted in 4 patients in (Group 1) and 3 patients in (Group 2).

In (Group 1) one patient had superficial infection; this patient was 62 years diabetic and was treated with intravenous antibiotics after obtaining culture and sensitivity reports, other patient had delayed union after 5 months (patient with four part fracture), another patient had im-

plant failure and non-union which was treated by removal of plate and bone grafting the last had decrease range of motion after 3 and 6 months we had also one case with avascular necrosis of humeral head (63 years old patient with 4 part fracture).

In (Group 2) two patients had pin tract infection (both of them had 3 part fracture) and they were treated with daily dressings and antibiotics, and another one had delayed union after 5 months. (Table 5)

Table 5: functional results according to UCLA score

Variable	Group 1 (N=20)	Group 2 (N=20)
	N (%)	
After 3 months		
Excellent	12 (60.0)	10 (50.0)
Good	5 (25.0)	9 (45.0)
Poor	3 (15.0)	1 (5.0)
After 6 months		
Excellent	13 (65.0)	18 (90.0)
Good	5 (25.0)	1 (5.0)
Poor	2 (10.0)	1 (5.0)

Patients were available for follow up on an average of 24 months (range from 20 to 28 months) post-operative follow up results according to UCLA scoring system, after 3 and 6 months; 12 patients had excellent result in Group 1 and 10 patients in Group 2 while good results were achieved in 5 patients in Group 1 and 9 patients in Group 2 and poor results in 3 Patients in Group 1 and 1 in Group 2.

After 6 months, excellent result was achieved in 14 patients in Group 1 and 16 patients in Group 2, while good results in 4 patients in Group 1 and 2 patients in Group 2, Poor results 2 in Group 1 and 1 in Group 2.

Discussion

In this study we examined a group of patients (40 patients) with displaced fracture of proximal humerus (2,3,4 parts) according to Neer's classification with mean age of 45 years. Patients were randomized to either (group 1) that was treated by open reduction and internal fixation with proximal humeral internal locking system (PHILOS) plate and (group 2) that was treated with percutaneous K- wire fixation. We analyzed our results and follow up patients at 1, 3

then 6 months according to UCLA score similar studies was done by sehyan *et al.*[9] and sehyan *et al.* [10]

In sehyan *et al.* study Thirty-six consecutive patients with proximal humerus fractures was fixed with K wires with mean age was 52 years, patients were followed up for an average of 38 months according to constant scoring system.

In Jura *et.* study was performed on 60 patients with proximal humerus fractures with mean age was 64 years in 30 patients (Group 1), who were treated by open reduction and internal fixation with Proximal Humeral Internal Locking System (PHILOS) plate and 30 patients (Group 2) who were treated with percutaneous K-wire fixation. Follow up at 1 week then every month for 6 months according to Visual Analogue Score (VAS) and Constant-Murley score [11].

In our study, In (Group 1) mean operative time was 90 minutes (range from 70 to 110 min.) and average blood loss was 500 ml. (range from 300 to 700 ml.) while In (Group 2) mean operative time was 40 minutes (range from 30 to 50 min.) and blood loss was less than 5 cc.

Intra-operative imaging timing in (Group 1) ranged from 1 to 2 minutes while in (Group 2) ranged from 4 to 6 minutes. Both groups received broad spectrum antibiotics postoperatively.

Jura et al. [12] stated that mean operation time was 100 minutes (range 80-120 minutes) in (Group 1) and 50 minutes (range 35-70 minutes) in (Group 2). In (Group 1) the average blood loss during surgery was 600 ml (range 400-1000 ml) whereas in (Group 2) it was 100 ml (range 70-160ml). Both groups received broad spectrum antibiotics postoperatively.

In our study, more than 85% of the patients had excellent and good outcomes according to UCLA score system in group 1. In group 2 of our study, more than 80% had also good and excellent result according to UCLA score with calculation active forward flexion, patient satisfaction and pain. We were able to obtain reduction in all cases by this technique except in 2 cases there is open reduction.

According to the Constant scoring system, Seyhan et al. stated that 21 patients (58%) had excellent, 9 patients (25%) had good, and 6 patients (17%) had fair results. The mean Constant-Murley score [12] was 93.4 (range, 78–100). All patients showed radiographic union by 12 weeks postoperatively

Jura et al. stated that mean Constant-Murley score was 84.6 points (range: 61-100) in Group 1 and 76.4 points (range:56-100 Group 2 at final follow up. Values varied depending upon the fracture type with the worst in 4 part fractures. Mean VAS Score was 2.6 (range:0-10) in Group 1 and 3.8 (range:0-10) in Group 2.

In our study, There were no major intraoperative complications in both groups. Postoperative complications were noted in 4 patients in group (1) and 3 patients in group (2).

In group (1) one patient had superficial wound infection this patient was 62 years diabetic and was treated with intravenous antibiotics after obtaining culture and sensitivity reports, repeated dressings and obtained other patient had delayed union after 5 months (patient with four part fracture) other patient had implant failure and non-union which was treated by removal of plate and bone graft the last had decrease range of motion after 3 and 6 months we also had one patient with AVN this patient was 63 years with with four part fracture this patient prepared for revision with arthroplasty, in our study we had 11 patients with four part fracture 10 in group (1) and 1 in group (2) we observed one case of AVN (9%) in patients with four part fractures which match with *Bogner et al.* [13] who reported in his study on 48

patients with three and four part fracture fixed by K-wires that implant failure and loss of reduction due K-wires migration was observed in 10% where AVN in 7.8% however these patients are older than 60 years. This percentage is less than incidence in literature which is upto 30% in four part fractures.

In group (2) we had 3 complications two patients had pin tract infection (both these patients were with 3 part fracture) and they were treated with daily dressings and antibiotics. And one had delayed union for 5 months.

Seyhan et al. reported that there was pin tract infection in 2 cases and resolved with oral antibiotics after the pin removal.

Jura et al. In Group 1 two patients had non-union (one patient with 3 part fracture and another with 4 part fracture), four patients had infection and two had avascular necrosis of the humerus head (both of them had 4 part fracture). Two patients had avascular necrosis of the head of humerus. In Group 2, six patients had pin tract infection, two patients had non-union (both of them had 3 part fracture), four patients had malunion (three patients with 2 part fracture and one patient with 3 part fracture) and two patients had K-wire loosening (both of them had 2 part fracture).

The most common technical error was placement of pins too close together so that only a portion of the head fragment was fixed. Another technical error was insertion of a Kirschner pin at a point so near the fracture site as to result in further fragmentation of metaphysis. There were no cases of deep infection, nonunion.

In group (2) reduction can't be achieved in closed manner and open reduction was done in 2 cases. closed reduction in three and four part fracture may be difficult as greater tuberosity displacement can't be easily reduced anatomically so some cases with three and four part fracture with greater tuberosity displacement need open reduction with K-wires or even screw fixation.

In our study rehabilitation in (group1) The first phase of physiotherapy was in the form of pendulum exercises that started on the first postoperative day and was continued till suture removal. Active-assisted exercises of the shoulder started at third week and continued for 6 weeks.. In the 4th week, active mobilization without weight was performed and, finally, in the 6th week full active mobilization began.

The second phase of physiotherapy, which started approximately 6 weeks after surgery. The third phase, the exercises generally began after 3 months and characterized by a program of progressive

strengthening and maintenance.

In (group 2) Postoperative Care include that The arm is immobilized in a sling for 3 to 4 weeks. Passive and pendulum exercises are initiated as soon as pain and swelling subside. Clinical and radiographic evaluations are performed at 1, 3, and 6 weeks. The reduction and antirotation pins are removed at 4 weeks. The stabilizing pins are removed at 6 weeks when there is radiographic evidence of union. More aggressive motion and rotation exercise are then instituted to regain the range of motion of the shoulder at 2 months after surgery.

Jura et al. [14] started passive range of motion (ROM) exercises on the second postoperative day in both groups then active shoulder mobilization exercises were started 4 to 6 weeks postoperatively depending on the patient's co-operation.

Seyhan et al. [15] believed that closed reduction using the joystick method of K-wires reduction and percutaneous fixation provided reasonable treatment. Despite being technically demanding, satisfactory realignment and sufficient fixation can be accomplished with meticulous radiographic assessment.

Magovern and Kenner [16] found good constant score with surgery and relatively few complications with better functional outcome for percutaneous fixation.

Massimo et al. [17,18] found that percutaneous fixation treatment may represent reasonable treatments for proximal humerus fractures in elderly patients affected by severe comorbidities contraindicating an open surgery specially in case of significant critical health conditions.

In a study conducted by *Fazal et al.* [19,20] it was seen that PHILOS plate fixation provided more anatomical reduction with minimal implant problems and enabled early range of motion exercises to achieve acceptable functional results.

Conclusion

We obtained satisfactory results in both groups, with each procedure having its advantages and drawbacks. We found that fixation with percutaneous K-wires presented an efficient treatment option with the advantages of minimal invasiveness of soft tissue and less blood loss while PHILOS plate fixation provided stable fixation with minimal implant problems and enabled early range of motion exercises to achieve acceptable functional results.

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