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Original Research Article

A comparative study to assess the effect of multiple Kirschner wiring versus plating in the management and functional outcome of proximal humerus fractures

Amit Chugh[1], Prakash Samant[2], Adnan Asif[3]*

[1]Lilavati Hospital and Research Centre, Mumbai, Maharashtra, India
[2]Dr. D. Y. Patil Hospital and Research Centre, Navi Mumbai, Maharashtra, India
[3]K. B. Bhabha Municipal General Hospital, Mumbai, Maharashtra, India

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***Correspondence:**
Dr. Adnan Asif,
E-mail: adnan.asif1092@gmail.com

ABSTRACT

Background: Proximal humerus fractures constitute 5% of all appendicular skeletal injuries and are mainly a menace of the elderly, after hip fractures and distal radial fractures. According to the NEER'S classification, the decision regarding the treatment of such fractures is dependent on whether the four anatomical segments of the proximal humerus are fractured or displaced.
Methods: A total of 50 patients admitted in orthopaedics ward satisfying the inclusion criteria were randomly divided in 2 groups with 25 patients in each group for PHILOS plating and Kirschner wiring management. Groups were compared with respect to their improvement in physical function, pain, quality of life, complications and re-operation rates.
Results: Out of the total 50 cases, 20% were type I, 22% type II, 36% were type III fractures while 22% were type IV fractures. Mean DASH questionnaire was comparable between two groups at 1 month after surgery (p=0.56). During immediate post-op period and at subsequent follow ups, DASH questionnaire was better in plating group as compared to K-wiring. At 3 months and 6 months follow up, functional outcome as calculated by DASH questionnaire was comparable between two groups (p=0.17 and 0.45). Excellent to good outcome was seen in all cases of either group. No difference was observed between study groups with respect to associated complications. K-wire loosening was observed in 2 cases (8%). Plating was associated with infections (8%) and screw break out (4%).
Conclusions: After comparing both the techniques, we recommend PHILOS plating for young adults and percutaneous K wire fixation for the elderly age group.

Keywords: Proximal humerus, PHILOS, Kirschner wire, DASH score

INTRODUCTION

Proximal humerus fractures constitute 5% of all appendicular skeletal injuries and are mainly a menace of the elderly.[1] Hence, most of these fractures (80%) are amenable to nonsurgical treatment either because they are undisplaced and stable or because elderly people tolerate minor deficiencies in reduction much better. It is the management of the remaining 20% displaced and unstable fractures that remains elusive to the surgeons. There is no dearth of options available for the fixation of these fractures, reflected from the fact that Sporer et al described 10 different methods for a single fracture type, but none of the techniques have proved to be ideal and consensus still seems far-fetched. The conservative management in the form of simple immobilization puts shoulder at the risk of stiffness and malunion, trans osseous suturing fails to provide a rigid construct, intramedullary nailing violates the rotator cuff predisposing to postoperative shoulder pain, open reduction and fixation with plates endangers the

neurovascular structures and increases the likelihood of osteonecrosis of humeral head, and even hemiarthroplasty in the hands of other surgeons has not been as rewarding as reported by Neer et al.[3]

A novel method of biological fixation by closed reduction and percutaneous pinning is actually an extrapolation of original Bohler's technique described in 1962 for epiphyseal fractures of proximal humerus.[15] Some minor complications and limitations of this technique are masked by the overwhelming advantage it offers, which are a rigid fixation without sacrificing soft tissues vascularity around head, lower rates of avascular necrosis, decreased scar formation, and better cosmesis.

The primary objective of this study was to evaluate and assess healing of proximal humerus fractures treated by Kirschner wiring or plating. The secondary objectives were 1) to evaluate the functional outcomes of patients with humerus fractures receiving either operative management, 2) to evaluate the number and types of complications associated with either operative treatment in patients with proximal humerus fractures and 3) To study the post-treatment range of motion at the affected region in the patients of humerus fractures.

METHOD

This prospective study was conducted in the department of orthopaedics at a tertiary level medical college and hospital, upon patients of either sex with proximal humerus fracture that presented to our hospital over a period of 18 months.

Following ethics committee approval, a prospective randomized study was conducted upon 50 patients who were diagnosed with proximal humerus fractures. The study was planned to assess the effect of operative management by either Kirschner wiring (K-wiring) or PHILOS (Proximal Humerus interlocking system) plating on pain relief and functional outcome in these patients. A detailed history was taken and relevant examinations and investigations as per the case record form were done. Patients and relatives were thoroughly explained regarding the nature of study and informed consent was taken from screened patients fitting inclusion and exclusion criteria.

Inclusion criteria was: (1) patients with proximal humerus fracture; (2) patient of either sex male/female; (3) age of 18 years and above; (4) isolated post traumatic fractures with no neurovascular deficit; (5) ready to sign on the consent form and ready to comply with the follow up schedules; and (6) patients with all laboratory investigations within normal limits and hemodynamically stable patients. The exclusion criteria was (1) patients with history of open fractures; (2) patients suffering from Charcot's joints; (3) patients having history of any surgical intervention in the affected shoulder in the last 12 months; (4) patients who have participated in another study in the last one month; and (5) patients who are diagnosed with pathological fractures.

Following the informed consent, along with proper preoperative evaluation and relevant investigations as per the case record form, the patients were randomly allocated to either of the two groups. Randomization was done using random number table generated from a computer software. The patients were randomly divided into 2 groups: 1) Group A (N=25): PHILOS plating treatment (Figure 3), and 2) group B (N=25): Kirschner wiring treatment (Figure 2). The patients in the wiring group underwent closed reduction and internal fixation with the help of percutaneous k wires and the patients in the plating group underwent open reduction by the conventional deltopectoral approach and fixation with a PHILOS plate.

Postoperatively, the arm was immobilized in a sling. The drain was removed on 2nd post-operative day. The time for commencement of shoulder rehabilitation was determined by stability of fixation, quality of bone, and compliance of patient. Passive ROM exercises (i.e., pendulums, passive forward elevation, external rotation) generally were begun on the first post-operative day provided that a stable reduction was achieved. Active ROM of the elbow, wrist and hand was also begun immediately after the surgery. The patient then progressed through a three-phase rehabilitation program consisting of passive assisted exercises early, active exercises starting at approximately 4 weeks post operatively and strengthening or resisted exercises beginning 3 months after surgery.

Early passive assisted exercises help to avoid adhesion formation. No limitation of exercises within the pain-free ROM was necessary during this time provided that bone stock was good and medial buttressing adequate. Shoulder strengthening andresistance exercises were initiated only after bony consolidation was confirmed on plain radiographs and adequate coordination of the extremity had been achieved. Standard AP, axillary, and scapular Y radiographic views were taken immediately after surgery. Routine follow-up radiographs were taken 1 month, 3 months and 6 months postoperatively to ensure that no pin had migrated, no loss of reduction has occurred, evidence of callus formation and consolidation of fracture.

Measurement data for the age, duration of surgery, blood loss, hospital stay and DASH (Disability of arm, shoulder and hand) (Figure 1) is expressed as means with standard deviation (SD). Categorical data and discrete data for gender, fracture type, side of fracture and mode of injury are expressed as numbers with percentages (proportions) for each category.

All data was entered into a Microsoft office excel (version 2016) in a spreadsheet which was prepared and validated for the data form. Data was entered and checked for errors and discrepancies. Data analysis was done using windows based 'MedCalc statistical software' version 19.0.3 (MedCalc software bvba, Ostend, Belgium;

http://www.medcalc.org; 2019). All measurement data were compared between the two groups (Plating vs K-wire) using independent sample t-test (unpaired). Categorical data is compared between the two groups for differences chi-square test A repeat measures Analysis of variance (ANOVA was done to analyse the effects of surgical method (Plating and K-wire) and time of assessment time (1, 3 and 6 months) for DASH. All testing was done using two-sided tests at alpha 0.05. Thus, the criteria for rejecting the null hypothesis was a $p<0.05$.

Please rate your ability to do the following activities in the last week.

1. Open a tight or new jar	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
2. Write	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
3. Turn a key	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
4. Prepare a meal	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
5. Push open a heavy door	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
6. Place an object on a shelf above your head	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
7. Do heavy household chores (eg wash walls, wash floors)	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
8. Garden or do yard work	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
9. Make a bed	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
10. Carry a shopping bag or briefcase	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
11. Carry a heavy object (over 10 lbs)	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
12. Change a lightbulb overhead	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
13. Wash or blow dry your hair	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
14. Wash your back	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
15. Put on a pullover sweater	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
16. Use a knife to cut food	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
17. Recreational activities which require little effort (eg cardplaying, knitting, etc)	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
18. Recreational activities in which you take some force or impact through your arm, shoulder or hand (eg golf, hammering, tennis, etc)	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
19. Recreational activities in which you move your arm freely (eg playing frisbee, badminton, etc)	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
20. Manage transportation needs (getting from one place to another)	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
21. Sexual activities	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
22. During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups?	Not at all	Slightly	Moderately	Quite a bit	Extremely
23. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	Not limited at all	Slightly limited	Moderately limited	Very limited	Unable
Please rate the severity of the following symptoms in the last week					
24. Arm, shoulder or hand pain	None	Mild	Moderate	Severe	Extreme
25. Arm, shoulder or hand pain when you performed any specific activity	None	Mild	Moderate	Severe	Extreme
26. Tingling (pins and needles) in your arm, shoulder or hand	None	Mild	Moderate	Severe	Extreme
27. Weakness in your arm, shoulder or hand	None	Mild	Moderate	Severe	Extreme
28. Stiffness in your arm, shoulder or hand	None	Mild	Moderate	Severe	Extreme
29. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand?	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	So much I can't sleep
30. I feel less capable, less confident or less useful because of my arm, shoulder or hand problem	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

Figure 1: DASH questionnaire.

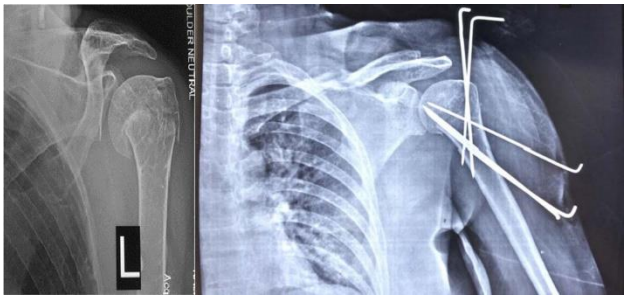

Figure 2: Pre and post-operative X-ray of a K wiring case.

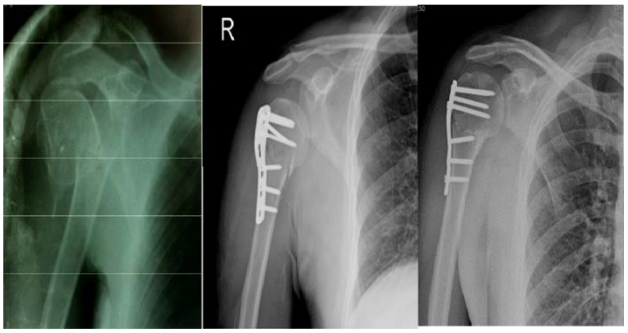

Figure 3: Pre and post-operative X-ray of a PHILOS plating case.

RESULTS

Age distribution of study groups was comparable with 58% cases being over 60 years of age and mean age of the total study group as 61.7 years. There was an overall male predominance was seen in study group with 70% males and male to female ratio of 2.33:1. Most common mode of injury was fall (60%) followed by road traffic accident (40%). Right sided was involved in 27 (54%) patients while left side was involved in 12 (46%) cases. Mean duration of hospital stay for plating was 11.7 days and for K-wiring was 3.4 days. Mean duration of surgery for plating was 86 minutes and for K-wiring was 31.8 minutes. Mean blood loss for plating was 92 ml and for K-wiring was 20 ml. Mean duration of antibiotic therapy for plating was 5 days and for K-wiring was 1 day.

The DASH score at 1 month post-operative was 71.26±3.74 for PHILOS plating and 71.99±4.93 with a p=0.56. The DASH score at 3 months post-operative was 35.38±3.05 for PHILOS plating and 36.98±4.81 with a p=0.17. The DASH score at 6 months post-operative was 13.04±4.44 with a range of 5.8-24.2 for PHILOS plating and 14.08±4.74 with a range of 6.7-22.5 and a p=0.45 (Table 1 and Figure 4).

Table 1: Comparison between PHILOS plating and K wire fixation groups.

Variables		PHILOS plating	K wiring	P value
Total participants		25	25	
Age (in years) (mean±SD) (range)		55.04±15.09 (22-75)	53.84±16.21 (19-81)	0.79
Sex (%)	Male (68)	17 (68)	17 (68)	1.0
	Female (32)	8 (32)	8 (32)	
Mode of injury (%)	Fall (60)	15 (60)	15 (60)	1.0
	RTA (40)	10 (40)	10 (40)	
Laterality (%)	Left (56)	13 (52)	15 (60)	0.57
	Right (44)	12 (48)	10 (40)	
Neer classification (%)	1 part (20)	3 (12)	7 (28)	0.11
	2 parts (22)	4 (16)	7 (28)	
	3 parts (36)	12 (48)	6 (24)	
	4 parts (22)	6 (24)	5 (20)	
Duration of hospital stay (in days) (men±SD) (range)		11.76±1.36 (10-14)	3.44±0.51 (3-4)	<0.0001
Duration of surgery (in minutes) (mean±SD) (range)		86.0±13.07 (70-110)	31.8±8.64 (20-45)	<0.0001
Blood loss (in ml) (mean±SD)		92.0±16.33	22.0±7.36	<0.0001
Duration of antibiotic therapy (in days)		5	1	
DASH score at 1 month (mean±SD) (range)		71.26±3.74 (65.8-78.7)	71.99±4.93 (61.3-79.3)	0.56
DASH score at 3 months (mean±SD) (range)		35.38±3.05 (30-42.5)	36.98±4.81 (30.8-45.8)	0.17
DASH score at 6 months (mean±SD) (range)		13.04±4.44 (5.8-24.2)	14.08±4.74 (6.7-22.5)	0.45
Complications		3	2	0.7

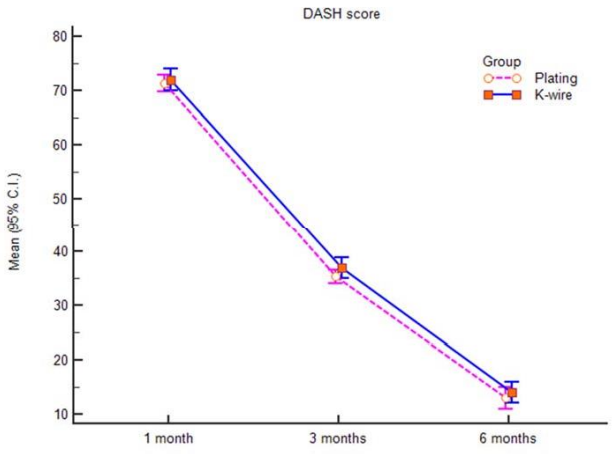

Figure 4: Line graph showing DASH score at 1-, 3- and 6-months pot operative.

There occurred 3 complications in the PHILOS plating group (2 infections and 1 screw backout) and 2 patients with complications in the wiring group (K wire loosening).

DISCUSSION

A hospital based comparative study was conducted to determine the outcome of plating vs K wiring treatment of proximal humerus fractures. A total of 50 patients admitted in orthopaedics ward satisfying the inclusion criteria were randomly divided in two groups with 25 patients in each group for plating vs K-wiring management. The groups were compared with respect to improvement in physical function, union and cosmesis.

Age distribution of study groups was comparable with 58% cases being over 60 years of age and mean age of the total study group as 61.7 years. Our findings are comparable to the study done by Gerber et al where the mean age of incidence was 64.9 years.[4] Other studies conducted by Fazal et al and Sameer Aggarwal et al also showed the mean age of incidence in accordance with our results i.e., 56 and 58.5 years respectively.[5,6] So, we concluded that proximal humerus fractures are more common in older age groups.

In the present study, overall male predominance was seen in study group with 70% males and male to female ratio of 2.33:1. This finding was in accordance to the study conducted by Gerber et al which showed a male: female incidence ratio of 1.26:1 and the study conducted by Sameer Aggarwal et al which showed a male: female ratio of 1.35:1.[4,6] This higher male ratio can be explained by a higher involvement of male in day-to-day activities in compare to female.

Most common mode of injury was fall (60%) followed by road traffic accident (40%). Our results are in concordance with MA Fazal et al who reported 21 cases (77.8%) of fall and 6 cases (22.2%) of RTA among 28 cases studied.[5] Sameer et al in their study of 47 patients of proximal humerus fracture observed that fall accounted for 55% of fracture, road side accident 42.5% and 1 fracture (2.5%) was caused by seizure.[6] Higher incidences of proximal humerus fractures following a fall in our study is in congruence with the finding of greater incidence in the relatively elderly age group.

At 6 month follow up, functional outcome as calculated by DASH score was comparable between two groups (p=0.45). Excellent to good outcome was seen in all groups. Zyto and colleagues reported mean constant score of 65 points and no complications with conservative treatment compared with surgical approach, resulting in mean value of 60 points and with complications (avascular necrosis, infection).[7,8] Magovern, Kenner, and Nho found good constant scores with surgery and relatively few complications, with better functional scores for percutaneous fixation.[9-10] Percutaneous fixation has its limitations of poor reduction of fracture fragments, pin tract infection and long period of recovery. But it has the advantages of less soft tissue stripping with less exposure, less blood loss and minimal invasiveness.

In a study conducted by Fazal et al it was seen that PHILOS plate fixation provided stable fixation with minimal implant problems and enabled early range of motion exercises to achieve acceptable functional results.[5] In the present study it was concluded that PHILOS plate provides an excellent stable construct even in multi fragmented osteoporotic proximal humerus fractures with the advantages of accurate reduction and early mobilisation. Fixation with percutaneous K-wires may - present an efficient treatment option for 2- or 3-part proximal humerus fractures with its advantages of minimal invasiveness and less soft tissue dissection. Better functional results were seen in patients treated with PHILOS plate than those treated with percutaneous K-wire fixation.

No difference was observed between study groups with respect to associated complications (p=0.7). K wire loosening, leading to a maluniting fracture was observed in 2 cases (8%) in wiring group as compared to none in plating group. Plating management was associated with infections in 2 cases (8%) and screw break out in 1 case (4%). Re-operation was required in 1 case in wiring group due to a maluniting fracture and in 1 case in plating group due to screw backout.

Olerud et al in a similar study of 3-part fracture observed re-operation requirement in 3 and 2 cases of surgical and non-surgical group respectively.[1] Olerud et al in another study on cases of 4-part fracture, observed 3 patients (10%) in the locking plate group displayed signs of AVN, 2 minor and 1 severe, compared to 2 patients (7%) in the non-operative group, both minor.[12] Kilian et al in a similar comparative study observed complications in 4 patients i.e., 2 cases each of both groups (10.6%).[13] Rangan et al in a similar study observed comparable complication rate (30 patients

in surgical group vs 23 patients in nonsurgical group; p-0.28) and secondary surgery rate (11 patients in both groups) in each group.[14]

CONCLUSION

A hospital based comparative study was conducted at department of orthopaedics of a tertiary level medical college and hospital. Proximal humerus fractures contribute 5 to 10% of fractures of the upper extremity. These fractures are most commonly seen in elderly age groups following trivial fall on the shoulder. Treatment analysed close reduction percutaneous K wiring vs open reduction and plating for proximal humerus fracture. Both the procedures have their merits and demerits. The study group of 25 patients who were treated with close reduction and percutaneous fixation with multiple K wires showed good functional outcomes and early fracture union. Duration of hospitalisation was not more than two days and they were followed up weekly for K wire dressing. In the other study group, open reduction and internal fixation was done by the deltopectoral approach. In this fixation, the soft tissue and musculature has to be taken adequate care of and the axillary nerve had to be identified and protected. This procedure was technically more demanding in majority of the cases.

After comparing both the techniques, we recommend PHILOS plating for young adults and percutaneous K wire fixation for the elderly age group.

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