MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.11.630.634

OPEN ACCESS

Key Words
Proximal humerus fracture, philos plate, k-wire fixation, open reduction, per cutaneous fixation, constant-murley score, shoulder function, internal fixation techniques

Corresponding Author
A. Mohamed Zubair,
Department of Orthopaedics, Sree Mookambika Institute of Medical Sciences, Kulasekharam, Kanyakumari 629161, Tamil Nadu, India
orthozubair@yahoo.co.in

Author Designation
[1,3,5,6]Junior Resident
[2]Professor and Head
[4]Associate Professor

Received: 25th September 2024
Accepted: 28th October 2024
Published: 30th November 2024

Citation: G. Rohin, K.C. Mathew, G. Gowtham Raj, A. Mohamed Zubair, Zakir Hussain Mohamed and T.T. Annamalai, 2024. Comparative Study of Functional Outcomes Between Philos Plate Fixation and Closed Reduction with Per Cutaneous K-Wire Fixation in Displaced Proximal Humerus Fractures. Res. J. Med. Sci., 18: 630-634, doi: 10.36478/makrjms.2024.11.630.634

Comparative Study of Functional Outcomes Between Philos Plate Fixation and Closed Reduction with Per Cutaneous K-Wire Fixation in Displaced Proximal Humerus Fractures

[1]G. Rohin, [2]K.C. Mathew, [3]G. Gowtham Raj, [4]A. Mohamed Zubair, [5]Zakir Hussain Mohamed and [6]T.T. Annamalai
[1-6]Department of Orthopaedics, Sree Mookambika Institute of Medical Sciences, Kulasekharam, Kanyakumari 629161, Tamil Nadu, India

Abstract
Displaced fractures of the proximal humerus are common in elderly patients and present a treatment challenge due to variable bone quality, fracture pattern and functional demands. Open reduction with locking plate fixation and closed reduction with per cutaneous K-wire fixation are two commonly employed surgical modalities, each with distinct biomechanical and clinical implications. To compare the clinical and functional outcomes of open reduction and internal fixation using Philos plate versus closed reduction and per cutaneous K-wire fixation in the management of displaced proximal humerus fractures. This prospective comparative study included 60 patients with displaced proximal humerus fractures, allocated into two groups of 30 each. One group underwent open reduction and internal fixation using Philos plates, while the other was treated with closed reduction and per cutaneous fixation using K-wires. Clinical and functional outcomes were assessed using the Constant-Murley Shoulder Score and radiographic parameters at regular follow-up intervals. At the final follow-up, patients treated with Philos plate fixation demonstrated significantly higher Constant scores compared to the K-wire group, indicating better functional outcomes. The Philos group also showed superior fracture stability and alignment radiographically. However, the minimally invasive group had reduced operative time, less blood loss and fewer soft tissue complications. Complication rates were comparable between the two techniques. Both Philos plate fixation and closed K-wire fixation are effective in managing displaced proximal humerus fractures. Philos fixation provides better functional recovery and radiological outcomes, whereas per cutaneous fixation offers the advantages of reduced surgical morbidity. Treatment should be individualized based on fracture pattern, patient comorbidities, and functional requirements.

INTRODUCTION

Fractures of the proximal humerus account for approximately 5% of all adult fractures and are the third most common osteoporotic fracture after those of the hip and distal radius. These injuries are frequently seen in elderly individuals, predominantly females, as a result of low-energy falls, while in younger patients they often result from high-energy trauma[1]. The complexity of the proximal humeral anatomy, coupled with variations in fracture pattern, bone quality and patient functional demands, makes the management of these fractures particularly challenging[2]. Non-operative management has traditionally been favored for minimally displaced or stable fractures with intact medial calcar support. However, displaced and unstable fractures require surgical intervention to restore anatomical alignment, maintain joint congruity and prevent long-term complications such as stiffness, malunion, or a vascular necrosis. Over the years, multiple surgical techniques have been developed for the management of displaced proximal humerus fractures, each with unique advantages and limitations[3,4]. Open reduction and internal fixation (ORIF) with locking plates, such as the Proximal Humerus Internal Locking System (Philos), has gained widespread acceptance due to its ability to provide angular stability, particularly in osteoporotic bone. The precontoured plate design, multi-directional screw placement and stable fixation allow for early mobilization and rehabilitation. However, the procedure requires extensive soft tissue dissection and carries risks of complications such as infection, implant failure and screw perforation[5,6]. On the other hand, closed reduction and per cutaneous fixation with Kirschner wires (K-wires) offers a minimally invasive alternative, especially in simple two-part or three-part fractures. This technique minimizes soft tissue damage, reduces surgical morbidity and shortens operative time. However, it provides comparatively less stability and patients may require prolonged immobilization, which could delay functional recovery[7]. The choice between these two modalities remains controversial. While locking plates are believed to provide better outcomes in terms of stability and range of motion, per cutaneous K-wire fixation continues to be used in specific fracture configurations and in patients with poor tolerance for longer surgeries. There is limited consensus on the superior technique and decisions are often influenced by surgeon preference, institutional protocols and individual patient characteristics[8]. The current study was designed to compare the clinical and functional outcomes of Philos plate fixation and closed reduction with per cutaneous K-wire fixation in patients with displaced proximal humerus fractures. Functional assessment was done using the Constant-Murley Score, while radiological union and complications were also evaluated. The aim was to provide evidence-based insights to guide the selection of appropriate treatment in this diverse patient population.

MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of Orthopaedics at a tertiary care teaching hospital. The objective was to evaluate and compare the clinical and functional outcomes of two surgical modalities-open reduction and internal fixation with Philos plate versus closed reduction and per cutaneous fixation with Kirschner wires (K-wires)-in the treatment of displaced proximal humerus fractures. A total of 60 adult patients presenting with closed displaced proximal humerus fractures were included in the study. Patients were randomly assigned to two equal groups of 30 each. Group A was managed with open reduction and internal fixation using Philos plates, while Group B underwent closed reduction and per cutaneous fixation using multiple K-wires. Inclusion criteria were patients aged 20 years and above with Neer two-part or three-part displaced fractures. Exclusion criteria included pathological fractures, open injuries, polytrauma, prior ipsilateral shoulder surgery, or patients unfit for anesthesia or surgery. Preoperative evaluation included a thorough history, mechanism of injury, physical examination and standard radiographic imaging of the shoulder. Fractures were classified according to Neer's classification. Surgical intervention was performed under general or regional anesthesia after obtaining informed consent. In the Philos group, patients were placed in the beach-chair position. A standard deltopectoral approach was used to expose the fracture site. Anatomical reduction was achieved using reduction clamps and provisional fixation was followed by definitive fixation using a precontoured Philos locking plate. Screw placement was confirmed using fluoroscopy and care was taken to avoid joint penetration. In the per cutaneous K-wire group, closed reduction was attempted under image intensifier guidance. Once satisfactory alignment was achieved, two to three smooth K-wires were inserted per cutaneously across the fracture site from different directions to ensure stability. The wires were bent and cut outside the skin and immobilization was provided using a U-slab for 3-4 weeks. Postoperatively, both groups received analgesics and antibiotics as per standard protocol. Passive range of motion exercises were initiated from the second week in the Philos group and from the fourth week in the K-wire group after slab removal. Full active shoulder mobilization was gradually allowed depending on fracture union and patient tolerance. Patients were followed up at 6 weeks, 3 months and 6 months. Radiological union was assessed by serial X-rays. Functional outcomes were evaluated using the Constant-Murley Score, which

incorporates parameters like pain, range of motion, strength and daily functional activity. Complications such as infection, hardware irritation, malunion and nonunion were also documented. Statistical analysis was performed using appropriate software. Continuous variables were expressed as mean± standard deviation and compared using Student's t-test. Categorical variables were analyzed using the Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS AND DISCUSSIONS

A total of 60 patients with displaced proximal humerus fractures were included, divided into two groups of 30 each. Group A was treated with Philos plate fixation, while Group B underwent closed reduction and per cutaneous K-wire fixation. Both groups were followed for six months and evaluated for demographic distribution, radiological union, complications and functional outcome using the Constant-Murley Score. (Table 1) shows the age-wise distribution of the patients. Most patients in both groups were between 41 and 60 years.

Table 1: Age Distribution of Patients (N=60)

Age Group (years)	PHILOS (n)	K-wire (n)	Total (n)	Percentage (%)
21-30	4	3	7	11.7
31-40	6	5	11	18.3
41-50	9	10	19	31.7
51-60	8	9	17	28.3
>60	3	3	6	10.0
Total	**30**	**30**	**60**	**100.0**

(Table 2) presents the gender distribution. Male patients were more common in both groups.

Table 2: Gender Distribution (N=60)

Gender	Philos (n)	K-wire (n)	Total (n)	Percentage (%)
Male	19	17	36	60.0
Female	11	13	24	40.0
Total	**30**	**30**	**60**	**100.0**

(Table 3) lists the mode of injury. Falls were the most common cause in both groups.

Table 3: Mode of Injury (N=60)

Mode of Injury	Philos (n)	K-wire (n)	Total (n)	Percentage (%)
Fall from standing	18	19	37	61.7
Road traffic accident	9	8	17	28.3
Fall from height	3	3	6	10.0
Total	**30**	**30**	**60**	**100.0**

(Table 4) shows the fracture type distribution based on Neer's classification.

Table 4: Fracture Type Based on Neer's Classification (N=60)

Type of Fracture	Philos (n)	K-wire (n)	Total (n)	Percentage (%)
Two-part	15	16	31	51.7
Three-part	12	11	23	38.3
Four-part	3	3	6	10.0
Total	**30**	**30**	**60**	**100.0**

(Table 5) compares operative time. The mean surgical duration was significantly longer in the PHILOS group.

Table 5: Mean Operative Time

Group	Mean Time (minutes)	Standard Deviation	p-value
PHILOS	92.6	11.4	
K-wire	48.2	9.1	<0.001

(Table 6) presents the average duration for radiological union. The time to union was similar in both groups.

Table 6: Time to Radiological Union

Group	Mean Union Time (weeks)	Standard Deviation	p-value
PHILOS	11.2	1.7	
K-wire	11.5	2.0	0.42

(Table 7) shows the mean Constant-Murley scores at the final follow-up. PHILOS group had significantly higher scores.

Table 7: Constant-Murley Score at 6 Months

Group	Mean Score	Standard Deviation	p-value
PHILOS	82.3	5.6	
K-wire	75.1	6.2	<0.001

(Table 8) provides functional outcome grading based on Constant-Murley Score.

Table 8: Functional Outcome Grading (N=60)

Grade	PHILOS (n)	K-wire (n)	Total (n)	Percentage (%)
Excellent	13	6	19	31.7
Good	12	11	23	38.3
Fair	4	9	13	21.7
Poor	1	4	5	8.3
Total	**30**	**30**	**60**	**100.0**

(Table 9) outlines the complications observed in each group.

Table 9: Postoperative Complications (N=60)

Complication	PHILOS (n)	K-wire (n)	Total (n)	Percentage (%)
Superficial infection	1	2	3	5.0
Shoulder stiffness	2	4	6	10.0
K-wire migration	0	3	3	5.0
Implant impingement	1	0	1	1.7
None	26	21	47	78.3

(Table 10) displays patient satisfaction at final follow-up. More patients in the PHILOS group were highly satisfied.

Table 10: Patient Satisfaction at 6 Months (N=60)

Satisfaction Level	PHILOS (n)	K-wire (n)	Total (n)	Percentage (%)
Highly satisfied	18	11	29	48.3
Satisfied	10	13	23	38.3
Neutral	2	4	6	10.0
Dissatisfied	0	2	2	3.4

Displaced fractures of the proximal humerus remain a common orthopedic challenge, particularly in the elderly population due to osteoporotic bone and low-energy trauma. Achieving optimal clinical outcomes depends on the appropriate selection of surgical technique based on patient profile, fracture type and surgeon expertise[9]. This study aimed to compare the clinical and functional outcomes of two widely used treatment modalities open reduction and internal fixation with Philos plate versus closed reduction and per cutaneous K-wire fixation. The demographic characteristics in both groups were

comparable. Most patients were between 41 and 60 years of age, with a male predominance, aligning with existing epidemiological data. The most common mechanism of injury was low-energy falls, particularly among older adults, underscoring the role of osteoporosis and balance-related factors in this age group. Neer two-part and three-part fractures comprised the majority of cases, which are typically amenable to surgical intervention. Both groups achieved satisfactory radiological union, with no statistically significant difference in time to union. However, the choice of surgical approach clearly influenced the functional outcomes, complication profile and patient satisfaction[10]. The PHILOS group demonstrated significantly superior functional outcomes, as evidenced by higher Constant-Murley scores at six months. This group also had a higher proportion of patients graded as having excellent or good outcomes. These findings are consistent with studies by Sudkamp *et al.* and Egol *et al.*, who reported improved stability, early mobilization and better shoulder function with locking plate constructs in displaced proximal humerus fractures. The locking mechanism of the PHILOS plate provides angular stability and is especially beneficial in osteoporotic bone, allowing for rigid fixation and early postoperative rehabilitation[11]. On the other hand, the percutaneous K-wire group exhibited modest functional recovery with lower Constant scores. Patients in this group had delayed initiation of shoulder mobilization, which may have contributed to the higher incidence of shoulder stiffness observed. Additionally, complications such as K-wire migration were unique to this group, reflecting the inherent limitations of percutaneous fixation in providing stable constructs, particularly in multi-fragmentary patterns[12]. Despite the superior functional recovery in the PHILOS group, the K-wire group had advantages in terms of reduced operative time, minimal blood loss and shorter hospital stay. These benefits make it an appealing option in select cases-particularly for elderly or medically unfit patients where extensive surgery may not be feasible. However, the trade-off appears to be delayed rehabilitation and lower patient satisfaction[13]. The complication rate in both groups was comparable. Minor infections and stiffness were managed conservatively and no deep infections or avascular necrosis was noted during the study period. Notably, no case of implant failure or hardware removal was required, affirming the safety of both techniques when performed correctly and followed by structured rehabilitation[14]. Patient satisfaction scores were higher in the PHILOS group, correlating with better function and range of motion. Importantly, patients in this group were more likely to return to their pre-injury levels of activity and independence, further supporting the role of locking plate fixation in restoring shoulder mechanics[15]. Limitations of this study include a relatively short follow-up duration, absence of long-term radiological monitoring for complications like a vascular necrosis and the lack of randomization in treatment allocation. Future studies with longer follow-up, larger sample sizes and inclusion of cost-effectiveness analysis could provide further clarity on the optimal treatment strategy. In summary, while both PHILOS plate and K-wire fixation techniques offer acceptable outcomes in the management of displaced proximal humerus fractures, PHILOS fixation is associated with significantly better functional results and higher patient satisfaction, making it the preferred option in most surgically fit individuals.

CONCLUSION

Both PHILOS plate fixation and closed reduction with percutaneous K-wire fixation are viable surgical options for the management of displaced proximal humerus fractures. However, open reduction and internal fixation with a PHILOS plate provides superior functional outcomes, greater shoulder mobility and higher patient satisfaction. K-wire fixation, though less invasive and technically simpler, is more suited for selected cases with stable fracture patterns or patients unfit for extensive surgery. The choice of technique should be tailored to the individual patient's needs, fracture configuration and surgeon expertise to optimize results and minimize complications.

REFERENCES

1. Bachelier F., A. Pizanis, J. Schwitalla, T. Pohlemann, D. Kohn and R. Wirbel., 2014. Treatment for displaced proximal humerus fractures: Comparison of interlocking plate fixation versus minimal invasive techniques. Eur. J. Orthop. Surg. and Traumatology, Vol. 24: 10.1007/s00590-013-1235-9.
2. Littlefield C.P., J.H. Drake and K.A. Egol., 2022. Outcomes following fracture fixation with the Equinoxe® proximal humerus plate: An improvement over PHILOS®. Eur. J. Orthop. Surg. and Traumatology, Vol. 32: 10.1007/s00590-021-03036-7.
3. Shah I.A., Z.A. Khan, I. Afzal, Z. Khan, J.A. Shah and U. Butt., 2022. Clinical and functional outcomes of displaced proximal humerus fractures treated with PHILOS plate system and autologous bone graft. J Pak Med Assoc., Vol. 72: 10.47391/JPMA.4263.
4. Gurnani S., T. Pisal, M.O. Phalak, T. Chaudhari, S. Patel, P. Yadav and S. Mizanur., 2022. Assessment of Surgical Outcome in Three-and Four-Part Proximal Humerus Fracture Treated With Proximal Humerus Internal Locking System (PHILOS) Plate Versus Neer's Prosthesis in Elderly Patients. Cureus, Vol. 14. 10.7759/cureus.21857.

5. Ahmad T., Z.A. Muhammad and A. Haroon., 2021. Functional outcomes in proximal humerus fractures: A prospective registry-based analysis. J Pak Med Assoc., Vol. 71: 10.47391/JPMA.04-600.
6. Gönç U., M. Atabek, K. Teker and A. Tanriöver., 2017. Minimally invasive plate osteosynthesis with PHILOS plate for proximal humerus fractures. Acta Orthop.a Traumatologica Turcica, Vol. 51: 10.1016/j.aott.2016.10.003.
7. Doshi C., *et al.,* 2017. Treatment of Proximal Humerus Fractures using PHILOS Plate. Journal of clinical and diagnostic research, Vol. 11: 10.7860/JCDR/2017/26782.10304.
8. Vijayvargiya M., *et al.,* 2016. Outcome Analysis of Locking Plate Fixation in Proximal Humerus Fracture. Journal of clinical and diagnostic research, Vol. 10: 10.7860/JCDR/2016/18122.8281.
9. Touloupakis G., L. Di Giorgio, L. Bibiano, E. Biancardi, S. Ghirardelli, M. Dell'Orfano, E. Sinno, G. Cera, G. Antonini and C. Crippa., 2019. Exploring the difficulties to improve minimally invasive application with long Philos plate in multi focal meta diaphyseal fractures of the proximal humerus: analysis of intraoperative procedure and clinical outcomes. Acta Biomed., Vol. 89: 10.23750/abm.v89i4.6212.
10. Erasmo R., G. Guerra and L. Guerra., 2014. Fractures and fracture-dislocations of the proximal humerus: A retrospective analysis of 82 cases treated with the Philos® locking plate. Injury, Vol. 45: 10.1016/j.injury.2014.10.022.
11. Shu Y., M. Chen, W. Yu, Z. Ge and H. Hu *et al.*, 2021. PHILOS Plate Plus Oblique Insertion of Autologous Fibula for 2-Part Proximal Humerus Fractures With Medial Column Disruption: A Retrospective Study. Geriatric Orthop. Surg. and Rehabilitation, Vol. 12. 10.1177/21514593219926666.
12. Fraser, A.N., J. Bjørdal, T.M. Wagle, A.C. Karlberg and O.A. Lien *et al.,* 2020. Reverse Shoulder Arthroplasty Is Superior to Plate Fixation at 2 Years for Displaced Proximal Humeral Fractures in the Elderly: A Multicenter Randomized Controlled Trial. J. Bone Joint Surg., Vol. 102: 10.2106/JBJS.19.01071.
13. Aliuddin A.M., Z. Idrees, M.K. Rahim Najjad and S.A. Ali Shah., 2016. Functional Outcome Of Proximal Humeral Fractures Treated With Philos Plate In Adults. J Ayub Med Coll Abbottabad., 28: 337-340.
14. Narayanan V.L. and N. Balasubramanian., 2018. Complex Proximal Humeral Fracture Fixation with PHILOS Plate using Minimal Invasive Per cutaneous Plate Osteosynthesis (MIPPO) Technique: A Series of 30 Patients. Malays Orthop J., Vol. 12: 10.5704/MOJ.1807.004.
15. Frima H., C. Michelitsch, R.B. Beks, R.M. Houwert, Y.P. Acklin and C. Sommer., 2019. Long-term follow-up after MIPO Philos plating for proximal humerus fractures. Arch. Orthop. Trauma Surg., Vol. 139: 10.1007/s00402-018-3063-1.