



Determining Functional Outcomes Following Proximal Humerus Interlocking System (Philos) Plating in Displaced Proximal Humerus Fractures: A Comprehensive Evaluation

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ABSTRACT:

Displaced fractures of the proximal humerus pose a significant challenge in orthopaedic practice, particularly in the aging population. The Proximal Humerus Interlocking System (PHILOS) plating has emerged as a promising surgical approach for managing these fractures. This study aims to evaluate the functional outcomes associated with PHILOS plating in displaced proximal humerus fractures.

The classification of fracture types was inconsistent and thus the selection of surgical approaches varied. Various surgical procedures have been performed, but the recent trend towards internal fixation has shifted to locking plates.

AIM AND OBJECTIVES

The current study is being conducted to evaluate the functional outcome and complications of displaced proximal humeral fractures treated with locking compression plates.

MATERIALS AND METHODS

The proposed study is prospective study centered in VINAYKA MISSION'S KIRUPANANDA VARIYER MEDICAL COLLEGE AND HOSPITAL, SALEM, TAMILNADU during the term between November 2020 to November 2022 over period of 2 years.

In the proposed study a minimum of 20 cases presenting with displaced proximal humerus fractures are evaluated clinically, radiologically and treated by ORIF with LOCKING COMPRESSION PLATES (PHILOS). functional outcomes were assessed with the use of NEER'S SHOULDER SCORE at the end of the study.

RESULTS

The study included 20 patients, with a predominance of males. Road traffic accidents (RTA) were identified as the most common cause of injury among young individuals, while falls at home were predominant among the elderly population. Fracture classification revealed a spectrum of injuries, including two-part, three-part, and four-part fractures of displaced Proximal humerus.

Introduction

Fractures of the proximal humerus represent a significant orthopaedic challenge due to their prevalence, particularly among the elderly, and the potential for substantial disability. As the incidence of these fractures continues to rise, fuelled by factors such as an aging population and increased rates of trauma, there is a pressing need to refine treatment approaches and optimize functional outcomes. This introduction provides an overview of the epidemiology,

classification, and treatment modalities for displaced proximal humerus fractures, leading to the rationale for evaluating the functional outcomes of the Proximal Humerus Interlocking System (PHILOS) plating in this context.

1.Epidemiology and Burden of Proximal Humerus Fractures

Fractures of the proximal humerus account for a significant proportion of all appendicular skeletal



injuries, approximately 5% according to epidemiological data. This incidence is notably higher among the elderly population, where osteoporosis and age-related changes in bone quality contribute to an increased risk of fracture. The aging demographic landscape, coupled with lifestyle factors and the rising incidence of trauma from various sources such as road traffic accidents and industrial mishaps, underscores the growing burden of proximal humerus fractures on healthcare systems worldwide.

2. Classification and Treatment Dilemmas

Historically, proximal humerus fractures have predominantly been managed non-surgically, with satisfactory functional outcomes reported in a majority of cases. However, approximately 15% to 20% of displaced fractures are associated with poor functional outcomes, especially when there is significant displacement or repeated fractures. The classification of these fractures has evolved over time, yet considerable controversy persists regarding the optimal treatment approach. Non-operative management remains a viable option for many patients, but surgical intervention is increasingly favoured, particularly for displaced fractures where anatomical reduction and stable fixation are paramount for successful outcomes.

3. Evolution of Surgical Techniques

Over the past few decades, a plethora of surgical techniques has emerged for the management of displaced proximal humerus fractures, reflecting the ongoing quest for improved outcomes. These techniques include trans osseous suturing, percutaneous fixation, tension band wiring, plating, intramedullary nailing, and arthroplasty, each with its unique advantages and limitations. Among these, plating techniques have gained prominence, offering the advantages of anatomical reduction, stable fixation, and early rehabilitation. The introduction of locking plates, such as the Proximal Humerus Interlocking System (PHILOS), has further revolutionized the surgical management of these fractures, provided enhanced stability and facilitated early mobilization.

4. Rationale for Evaluating Functional Outcomes with PHILOS Plating

The selection of an appropriate surgical technique for displaced proximal humerus fractures is crucial to achieving optimal functional outcomes and minimizing the risk of complications. Given its theoretical advantages, including anatomical fixation, angular stability, and early rehabilitation, PHILOS plating represents a promising option for this patient population. However, the existing literature on the functional outcomes following PHILOS plating in displaced proximal humerus fractures is varied and often limited by factors such as study design, patient selection, and outcome measures. A comprehensive evaluation of functional outcomes is thus warranted to provide valuable insights into the effectiveness of this surgical technique and guide clinical decision-making.

In light of these considerations, this dissertation aims to determine the functional outcomes following Proximal Humerus Interlocking System (PHILOS) plating in displaced proximal humerus fractures through a comprehensive evaluation. By synthesizing existing evidence, conducting a rigorous analysis, and elucidating the factors influencing functional recovery, this study seeks to contribute to the optimization of treatment strategies for this challenging orthopaedic condition.

Review of literature

Fractures of the proximal humerus have captivated the attention of medical practitioners for centuries, with Hippocrates marking the earliest known attempt at treatment through weight traction. However, the outcomes of such early interventions remain shrouded in mystery, indicative of the complexities inherent in managing these injuries. The historical narrative takes us through a series of milestones, including the pioneering surgical endeavours of LaMotte, Lane, Kocher, and Keen, each contributing to the evolving understanding of proximal humerus fractures.

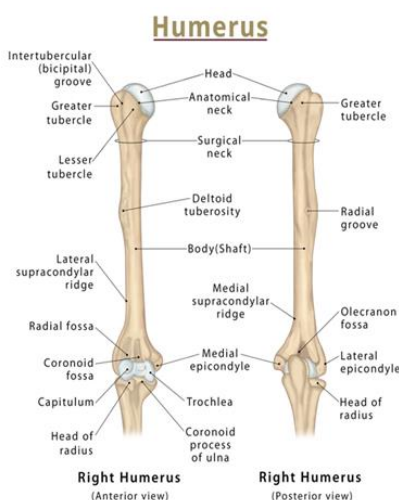


FIG 1 - ANATOMY OF PROXIMAL HUMERUS

The introduction of anatomical classifications by Kocher in 1896 aimed to enhance diagnostic precision and guide treatment decisions, laying the groundwork for subsequent advancements. Keen's groundbreaking open reduction of the greater tuberosity fracture in 1907 marked a significant departure from conservative management practices, paving the way for more invasive surgical techniques. The advent of immobilization methods proposed by Albee and Austin in the early 20th century offered additional options for fracture stabilization, albeit with varying degrees of success.

The mid-20th century witnessed a paradigm shift with Meyer advocating for open reduction and early mobilization to mitigate malunion risks and improve alignment. This era also saw the emergence of diverse fixation techniques, including the pioneering work of the ASIF group in popularizing osteosynthesis with plates and screws.

The seminal contributions of Dr. Charles S. Neer II in the 1970s, culminating in the development of a novel classification system and treatment algorithm, revolutionized the management of proximal humerus fractures. Neer's classification, based on anatomical considerations and clinical outcomes, provided a framework for individualized treatment strategies, guiding subsequent research and clinical practice.

Subsequent decades witnessed a flurry of biomechanical studies and clinical trials aimed at refining surgical techniques and optimizing implant designs. From the comparative biomechanical analyses of fixation methods by Koval et al. and the clinical evaluations of plate osteosynthesis by Hessman et al., to the advent of locking plates and intramedullary devices, each milestone has contributed to the ongoing quest for improved outcomes and reduced complications.

Recent multicentre studies by Brunner et al. and Paw Askar et al. have provided valuable insights into the real-world outcomes of modern fixation techniques, highlighting both the successes and challenges inherent in their application. Despite the strides made in surgical management, controversies persist regarding optimal treatment algorithms, complication rates, and functional outcomes, underscoring the need for continued research and evidence-based practice.

This study aims to build upon this rich historical tapestry and contribute to our understanding of proximal humerus fractures by evaluating the functional outcomes following Proximal Humerus Interlocking System (PHILOS) plating. By synthesizing historical insights with contemporary evidence, this study seeks to inform clinical decision-making and enhance patient care in this challenging orthopaedic domain.

Statistical Results (n=20)

**Table 1: Frequency and Percentage Analysis**

	Factors	Frequency	Percentage
Age	<i>20-30</i>	3	15
	<i>31-40</i>	7	35
	<i>41-50</i>	3	15
	<i>51-60</i>	5	25
	<i>61-70</i>	2	10
Sex	<i>Male</i>	14	70
	<i>Female</i>	6	30
Mode of Injury	<i>RTA</i>	11	55
	<i>FALL</i>	8	40
	<i>ASSUALT</i>	1	5
Type of fracture	<i>TWO PART</i>	11	55
	<i>THREE PART</i>	7	35
	<i>FOUR PART</i>	1	5
	<i>FRACTURE DISLOCATION</i>	1	5
Side affected	<i>Right</i>	12	60
	<i>Left</i>	8	40
Associated Injuries	<i>Colles's fracture</i>	2	10
	<i>Fracture ribs</i>	1	5
	<i>Both bone forearm</i>	1	5
	<i>Fracture clavicle</i>	1	5
	<i>Neurovascular leis ins (excluded)</i>	15	75
Time taken for fracture union	<i>10 weeks</i>	8	40
	<i>12 weeks</i>	6	30
	<i>14 weeks</i>	4	20
	<i>16 weeks</i>	2	10
Complications	<i>Shoulder stiffness</i>	3	15
	<i>Plate impingement</i>	2	10
	<i>Varus malunion</i>	1	5
	<i>Post op infection</i>	1	5
	<i>No complications</i>	13	65

AGE INCIDENCE

The mean age incidence in our analysed series of 20 patients ranging between 25 years to 70 years was 45 years, which is consistent with the age incidence in the

studies by Kenneth A. Egol et al,²⁹ 61 years old and mean Age incidence in study C. Gerber et al.,²³ was 44.9 years old.



In our series, 13 of 20 patients were under 50 years of age and the mean age incidence was 45 years in our series

Table 2: Age Incidence

STUDY	AVERAGE AGE (in years)
KENNETH A. EGOL et al ²⁹	61
GERBER C et al ²³	44.9
OUR STUDY	45

MODE OF INJURY

The most common form of injury seen in our series was a road traffic accident in 11 (55%), 8 (45%) patients with a history of falls and 01 (5%) with a history of assault. These observations are consistent with DOLFI HERSCVICI study in the literature showing 19 (47.5%) road accidents, 20 (50%) history of falls and 01 (2.5%)

history of assault among forty cases which studied²¹. In another study, 12 (75%) had a road accident and 04 (25%) had a history of falls in a series of 16 cases studied. The RTA rate was higher in our study because 8 out of 20 patients were under 40 years old. The most common fracture modality in young patients is RTA and, in the elderly, it is domestic fall, consistent with world literature.

Table 3: Mode of Injury

STUDY	RTA	FALL	ASSAULT
DOLFI HERSCVICI	19(47.5%)	20(50%)	1(2.5%)
KOJI YAMAMOTO	12(75%)	4(25%)	00
OUR STUDY	11(55%)	8(45%)	1(5%)

TYPE OF FRACTURE

The fracture type study in our series showed that 11 (55%) were 2-part fractures, 7 (35%) were 3-part fractures, 01 (5%) were 4-part fractures, and 01 (5%) were fractures dislocation. In studies performed by Rizwan Shahid et al.²⁸, out of a series of 50 patients

were studied, 11 (22%) were partial fractures, 21 (42%) were 3-part fractures and 18 (36%) is 4-parts fracture. In another study by MA Fazal et al.³², out of 27 cases, 13 (48%) were 2-part fractures, 12 (44.5%) were 3-part fractures and 2 (7.5%) were fractures 4 parts, showing that the rate of fracture type is almost consistent with studies in the literature.

Table 4: Type of Fracture

STUDY	2PART #	3 PART #	4 PART#	# DISLOCATION
RIZWAN SHAHID et al ²⁸	11(22%)	21(42%)	18(36%)	00
MA FAZAL et al ³²	13(48%)	12(45.5%)	02(7.5%)	00
OUR STUDY	11(55%)	7(35%)	01(5%)	1(5%)

COMPLICATIONS

Malunion occurred in ONE surgical neck case, a 4-part fracture in a 70-year-old man. It is related to anterior angular deformation and varus deformation, reducing

the neck shaft angle < 120°. It is possible that the communication of the underlying osteoporotic bone can be impacted into the fracture site after reduction leading to varus instability.



Post operative infection occurred in ONE case.

TWO patients had impingement of plate and limitation of abduction, it's a hardware-related complication and improper plate positioning may have led to impingement.

THREE patients suffered shoulder stiffness leading to undesirable outcomes, including two elderly patients. These results are also consistent with other studies.

Table 5: Complications

	RAMCHANDER SIWACH ²⁷	RICHARD JHAWKINS	OUR STUDY
Stiffness		0000	03
Post op Infection		0100	01
Plate impingement		0102	02
Mal union		0100	01
Non union	02	00	00
Avn		0202	00

COMPARISON

In our study, the final functional outcome was assessed by the NEER'S score. 5 (25%) of the 20 patients had an excellent outcome, 10 (50%) had a satisfactory outcome

and 5 (25%) had an unsatisfactory outcome. All unsatisfactory results were elderly patients and had complications. No patient in our study had failure. These results are also consistent with other studies.

Table 6: Comparison of ROL with current Study

STUDY	Excellent	Satisfactory	Unsatisfactory	Failure
AA MARTINEZ et al ³¹	13(22.4%)	36(62%)	08(13.8%)	1(1.7%)
RICHARD JHAWKINS	08(53.3%)	06(40%)	00	01(6.7%)
STUDYSERIES	05(25%)	10(50%)	5(25%)	00

Findings

Twenty patients with proximal humeral fractures were treated with open reduction and internal fixation with LOCKING COMPRESSION PLATES (PHILOS) to study surgical management of proximal humeral fractures and functional outcome of the shoulder during November 2020 to November 2022 at VINAYKA MISSIONS KIRUPANANDA VARIYER MEDICAL COLLEGE AND HOSPITAL, SALEM, TAMILNADU.

- In our studies, bimodal age incidence was observed with the highest incidence between 30 and 40 years of age in males due to RTA and another between 50 and 70 years of age in females due to domestic fall.
- Two-part and three-part fractures are common in young people between 20 and 40 years old and three-part fractures are more common in older patients.



- In our study, fractures on the right side were more frequent than on the left side.
- The average time taken for union in our study was 12 weeks.
- In our series, 3 patients developed shoulder stiffness after surgery, 2 patients had impingement and one patient had varus malformation and infection after surgery.
- In our study of 20 patients, 25% had excellent results, 50% had satisfactory results and 25% had unsatisfactory results.

The process of osteosynthesis with open reduction and internal fixation with LOCKING COMPRESSION PLATES has given good results in proximal humeral fractures.

Surgical management results in good functional outcome in proximal humeral fractures in adults aged between 20 to 40 with fewer complications. These patients responded better to the rehabilitation program than their older counterparts.

Conclusion

In conclusion, displaced proximal humeral fracture remains debatable and controversial topic in orthopedics. Clinically, obtaining appropriate radiological views, patient age and activity level are the keys to a pragmatic approach and appropriate surgical management of these complex fractures. The common injury mode of these fractures is fall on shoulder in the elderly patients and RTA in the young, anatomical reduction is important and determines the outcome of surgical treatment of these fractures, open reduction and internal fixation with a LOCKING COMPRESSION PLATES has given good results and is the implant of choice today.

The anatomically correct restoration of the articular surfaces and tuberosities seems to be more important for better functional outcomes. An adequate surgical technique will minimize complications and an active rehabilitation regimen (active physical therapy) will ensure the best possible outcome. The advantages of LCP are Stable internal fixation, early mobilization, Functional restoration of tuberosity can be achieved by indirect reduction of articular fragments using an image intensifier.

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