

Assessing Functional Outcome of PHILOS Plate Fixation in Proximal Humerus Fractures- A Prospective Study

Dr. Pankoj Kanti Mondol^{1*}, Dr. Md. Ziaur Rahman², Dr. Md. Mehedi Hasan³, Dr. Md. Sahidur Rahman Khan⁴, Dr. Sheikh Md. Sheikh Sadi⁵, Dr. Ananta Kumar Bhakta⁶, Dr. Md. Humayun Kabir⁷, Dr. Sabbir Ahmed⁸

¹Assistant Professor, Department of Orthopaedics Oncology & Musculoskeletal Tumor, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh

²Assistant Professor, Department of Hand & Microsurgery, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh

³Registrar, Department of Orthopaedics and Traumatology, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh

⁴Senior Consultant, Department of Orthopaedics and Traumatology, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh

⁵Assistant Registrar, Department of Orthopaedics and Traumatology, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh

⁶Registrar, Department of Orthopedic Surgery, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh

⁷Junior Consultant, Department of Orthopaedics and Traumatology, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh

⁸Junior Consultant, Department of Orthopaedics and Traumatology, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh

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*Corresponding author: Dr. Pankoj Kanti Mondol

Assistant Professor, Department of Orthopaedics Oncology & Musculoskeletal Tumor, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh

Abstract

Introduction: Despite the availability of numerous treatment options, managing unstable proximal humeral fractures remains a significant surgical challenge. Utilizing a PHILOS plate is an effective surgical technique for addressing these fractures. This approach provides stability and support to the fracture site, promoting proper healing and potentially improving patient outcomes. **Aim of the study:** The aim of this study was to assess the functional outcome of PHILOS plate fixation in proximal humerus fractures. **Methods:** This prospective study was conducted in the the Department of Orthopedic Surgery, National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Sher-e-Bangla Nagar, Dhaka, Bangladesh during the period from January 2009 to December 2010. A total of 80 patients aged over 18 years were included in the study. Patients with open, pathological and ipsilateral distal fractures in the same limb were excluded from the study. **Result:** The youngest and the oldest one were 23 and 78 years respectively. Majority of the patients were male and business was their main occupation. Fifty patients (62.5%) presented with 3-part fractures, ten (12.5%) with four-part fractures and twenty (25%) with fracture dislocation. The interval between injury and plate fixation was 18 days and minimum and maximum interval was 2 and 78 days respectively. Majority (92.5%) of the injury was caused by high-velocity accident. Evaluation of the outcome at 6 months showed that 62.5 percent of patients had good outcome, 25 percent patients had fair outcome. **Conclusion:** PHILOS plate fixation for proximal humeral fractures provides stable fixation and good functional outcomes, particularly in elderly patients.

Keywords: Proximal Humerus, Fracture, PHILOS plate, Constant score, Internal fixation.

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INTRODUCTION

Proximal humerus fractures are among the most frequently occurring fractures in the elderly population. They constitute approximately 4 - 5% of all fractures

experienced by older individuals (Lind *et al.*, 1989). These fractures are more prevalent in older patients, primarily because the spongy or cancellous bone in the humeral neck becomes weaker with age and is further

compromised by conditions such as osteoporosis (Kannus *et al.*, 2000). In younger patients, these fractures often result from high-energy trauma and tend to be more severe with greater displacement. Some patients may also experience associated dislocations. However, many of these fractures are stable and can typically be managed conservatively without surgical intervention (Duralde XA and Leddy LR, 2009). The rising incidence of high-velocity trauma has led to more complex fracture patterns in the proximal humerus. Managing these fractures remains challenging due to several factors: the numerous muscle attachments in the area, the weakened bone typical in elderly patients, and the limited space available for implant fixation. Unstable and displaced fractures pose particularly high morbidity risks, especially among older patients.

The surgical treatment of proximal humerus fractures continues to present significant challenges. Achieving precise reduction and stable fixation of these fractures remains a technically demanding task in shoulder surgery. The advent of new implants has introduced further debate and controversy regarding the optimal methods for achieving stable fixation. The Neer system is widely utilized for classifying proximal humeral fractures, focusing on the displacement or angulation of the four main segments of the proximal humerus (Neer, 1970). These segments include the anatomical head, the greater and lesser tuberosities, and the proximal shaft, delineated based on the epiphyseal line (Codman, 1934). This classification system easily accommodates associated anterior or posterior dislocations of the humeral head, providing a comprehensive framework for understanding and categorizing these fractures. In recent decades, various techniques have been employed in the treatment of proximal humeral fractures. Conservative treatment is generally favored for undisplaced fractures, but managing displaced fractures, particularly three- and four-part fractures, remains a subject of ongoing scientific debate. Numerous implants have been developed and studied, yet the lack of conclusive outcomes underscores the complexity in determining the optimal approach (Korkmaz *et al.*, 2008). The primary treatment objective for proximal humeral fractures is achieving a pain-free shoulder with full functional recovery. Various methods have been employed to achieve this, including Kirschner wire fixation, suture fixation, external fixation, tension band fixation, rush pin fixation, intramedullary nailing, and prosthetic replacement with plating. Recent advancements in fracture fixation technology have introduced fixed angled locked plates that offer angular stability under load. Biomechanical studies indicate that these implants can withstand physiological loads in osteoporotic bone, suggesting they could serve as an alternative to hemiarthroplasty (Solberg *et al.*, 2009). The aim of this study was to examine the functional outcome of PHILOS plate fixation in proximal humerus fractures.

Objectives

The objective of the study was to assess the functional outcome of PHILOS plate fixation in proximal humerus fractures.

METHODOLOGY & MATERIALS

This was a prospective study and was conducted in the Department of Orthopedic Surgery National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Sher-e-Bangla Nagar, Dhaka, Bangladesh during the period from January 2009 to December 2010. A total of 80 cases of patients of diagnosed displaced fractures of the proximal humerus of both male and female were included in the study.

➤ Inclusion criteria:

- Patients with closed displaced three or four-part fractures and fracture dislocations
- Age above 18 years
- The patients who are mentally fit and physically alert (ASA-group 1-3)
- Patients without any neurological deficit

➤ Exclusion criteria:

- Open fracture
- Pathological fracture
- Previous shoulder surgery
- Chronic shoulder pain
- Ipsilateral upper limb fractures

A standardized semi-structured data collection sheet was utilized for gathering essential information through face-to-face interviews. Relevant medical reports were also reviewed to supplement the data collection process. A semi-structured questionnaire, developed in English, was used to guide the interviews, focusing on selected variables aligned with specific research objectives. Additionally, desired variables were extracted from admission records, history sheets, and other pertinent medical documents. Data integrity was maintained through immediate verification following interviews and the review of necessary investigation reports, ensuring accuracy and completeness in the collected data. The demographic characteristics of the patients studied were age, sex and occupation. Mechanism of injury, affected limb and clinical presentation were recorded. Radiological types of fracture (impacted/nonimpacted, two-part, three-part, four-part) and fracture dislocations were evaluated. Post operative complaints in the form of pain and restricted movement of shoulder and activities of daily living were addressed. Final outcome evaluation at the end of six months was done following Constant Murley shoulder score. In each case, a comprehensive approach was taken, starting with a detailed medical history, thorough clinical examination, and relevant investigations. Standard procedures included obtaining X-rays of the affected shoulder (both anteroposterior and lateral views), as well as conducting routine tests such as complete blood count, random blood sugar, and serum

creatinine. Patients with associated conditions such as hypertension, diabetes mellitus, pulmonary issues, or concurrent injuries received appropriate management tailored to their specific needs. Once the patient's overall health stabilized, surgical intervention was scheduled.

Before each operation, intravenous antibiotics were administered as a preventive measure. On average, surgery was performed within three weeks from the time of injury, aiming to optimize outcomes while minimizing risks associated with delayed treatment. After the surgery, patients underwent outpatient follow-up for six months, scheduled at three-week intervals. During these visits, patients were required to bring check X-rays of the affected shoulder for review. Each follow-up session included a thorough evaluation comprising medical history, clinical examination, and radiographic assessment. Data collection during follow-up involved

structured interviews using predefined interview schedules and standardized investigation formats.

Patients were given full autonomy to participate in the study and informed written consent was obtained.

Statistical Analysis: All data were recorded systematically in preformed data collection form and quantitative data was expressed as mean and standard deviation and qualitative data was expressed as frequency distribution and percentage. Statistical analysis was carried out by using Statistical analysis was done by using SPSS (Statistical Package for Social Science) Version 11.5for windows. Ethical clearance was obtained from the ethical committee to perform the investigation and study.

RESULT

Table 1: Demographic characteristics of the respondents

Characteristics	Frequency	Percentage	
Age in years	20-29	20	25
	30-39	15	18.75
	40-49	15	18.75
	50-59	20	25
	60-69	0	0
	70-79	10	12.5
Gender	Male	60	75
	Female	20	25
Occupation	Student	10	12.5
	Business	35	43.75
	Driver	15	18.75
	Worker	7	8.75
	Farmer	2	2.5
	Housewife	4	5
	Service	7	8.75

Table 1 shows that out of 80 patients in 20-29 and 50-59 age groups, each representing 25% of cases. The 30-39 and 40-49 age groups each account for 18.75% of fractures. Notably, there are no reported cases in the 60-69 age group, while the 70-79 age group comprises 12.5% of the cases. On the other hand, Vast

majority (75%) of the patients were male and the rest (25%) female. Also shows that occupation, business was the main occupation (43.75%). However, a significant number of patients were drivers (18.75%). The rest were students (12.5%), service holders (8.75%), workers (8.75%) and housewives (5%) and farmers (2.5%).

Table 2: Clinical Characteristics of the respondent

Characteristics	Frequency	Percentage	
Affected limb side	Right	15	18.75
	Left	65	81.25
Type of fracture pattern	3-part fracture	50	62.5
	4-part fracture	10	12.5
	Fracture Dislocation	20	25
Time interval (plate fixation)	<3 weeks	72	90
	>3 weeks	8	10
Mechanism of injury	High Velocity Injury	74	92.5
	Low Velocity Injury	6	7.5
Pain Type	No	20	25
	Mild	45	56.25
	Moderate	15	18.75

Table 2 shows that clinical characteristics of the respondent. Of the 80 patients, 81.25% presented with left sided proximal humeral fracture and 18.75% with right side fractures. The most common type of fracture pattern is the 3-part fracture, accounting for 62.5% of cases, 12.5% with four-part fractures and 25% with fracture dislocations. In 90 percent cases proximal humeral locking plate was fixed within 3 weeks of occurrence of fracture while in the rest (10%) of cases, fixation was done after 3 weeks of the fracture. The mean

interval between injury and nail fixation was 18 days and the minimum and maximum intervals were 2 and 78 days respectively. Vast majority (92.5%) of injuries were caused by high velocity trauma i.e.; road traffic accident and fall from height and only one (7.5%) was of low velocity injury i.e.; due to simple fall. At six months follow up, only 15 (18.75%) patients complained of moderate pain, 20 (25%) patients had no pain at all and 45 (56.25%) patients had only mild pain.

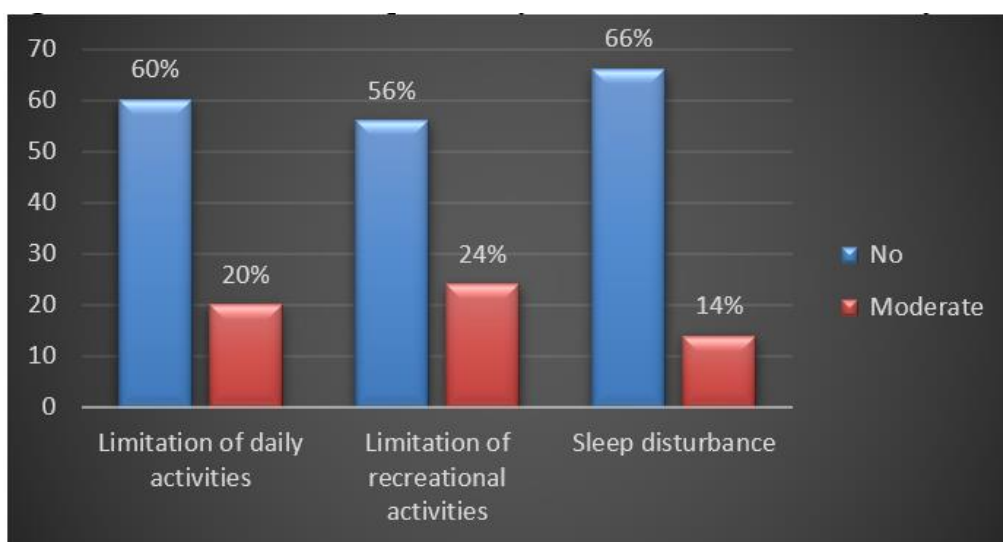


Figure 1: Distribution of the patients by limitation of activities of daily living

Figure 1 shows that patients by limitation of activities of daily living. On the final follow up at 6 months, (60%) patients had no limitation of daily activities whereas (20%) patients had moderate limitation of daily activities. (56%) patients had no

limitation of recreational activities and (24%) patients had moderate limitations. (66%) patients had no sleep disturbance but (14%) patients complained of some sleep disturbance due to pain.

Table 3: Distribution of patients according to range of movement

Range of movement	Frequency	Percentage
Flexion movement (range of motion)		
61 ⁰ -90 ⁰	10	12.5
91 ⁰ -120 ⁰	20	25
121 ⁰ -150 ⁰	50	62.5
Abduction movement (range of motion)		
61 ⁰ -90 ⁰	13	16.25
91 ⁰ -120 ⁰	60	75
121 ⁰ -150 ⁰	7	8.75
Rotatory movement		
Hand above head and elbow forward	46	57.5
Hand behind head and elbow forward	7	8.75
Hand above head and elbow backward	7	8.75
Hand behind head and elbow backward	20	25
Internal rotatory movement		
D12	10	12.5
waist	50	62.5
SI joint	5	6.25
Buttock	10	12.5
Thigh	5	6.25

Table 3 shows that distribution of patients according to range of movement. According to the Constant scoring criteria the forward flexion of shoulder was 61°-90° in (12.5%) patients, 91°-120° in (25%) patients and 121°-150° in (62.5%) patients. According to the constant scoring criteria the abduction of shoulder was 61°-90° in (16.25%) patients, 91°-120° in (75%) patients and 121°-150° in (8.75%) patients. According to Constant score criteria (57.5%) patients can externally

rotate their shoulder with hand above head and elbow forward, (25%) patients can do it hard behind head and elbow backward, (8.75%) each can do it either with hand behind head and elbow forward or hand above and elbow backward. According to Constant scoring criteria the dorsum of the hand reaches D12 vertebra in (12.5%) patients, waist in (62.5%) patients, sacroiliac joint in (6.25%) patient, buttock in (12.5%) patients and thigh in (6.25%) patient.

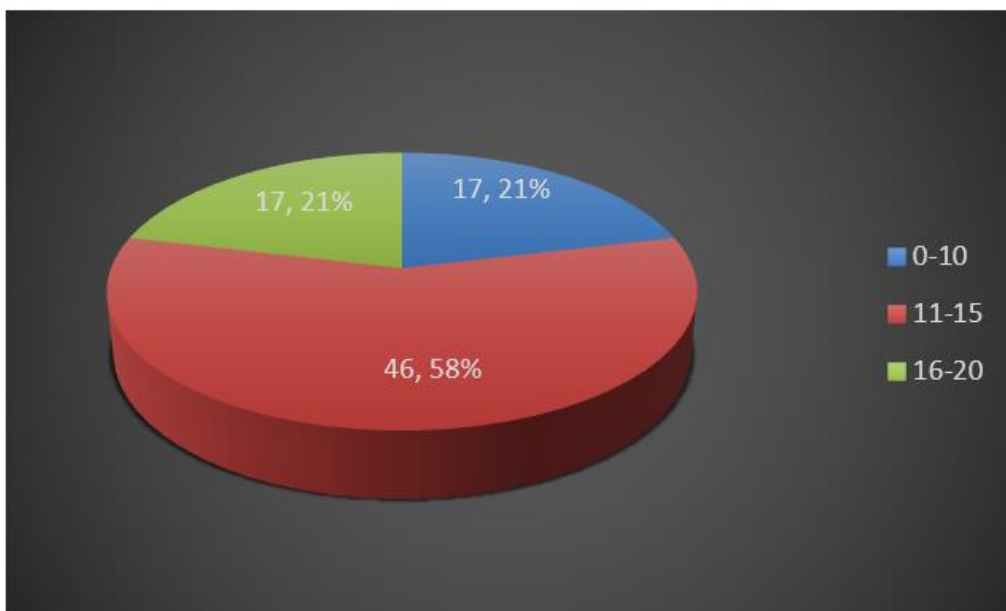


Figure 2: Distribution of patients according to power of shoulder

Figure 2 shows that patients according to power of shoulder. According to Constant scoring criteria power was measured with a spring balance with an average record from five pulls against a measured weight

and expressed in Kilograms. (21%) patients had a power of not more than 10 kg. 7 (58%) patients had a power in between 11 to 15 kg., and 4(21%) patients had a power in between 16 to 20 kg.

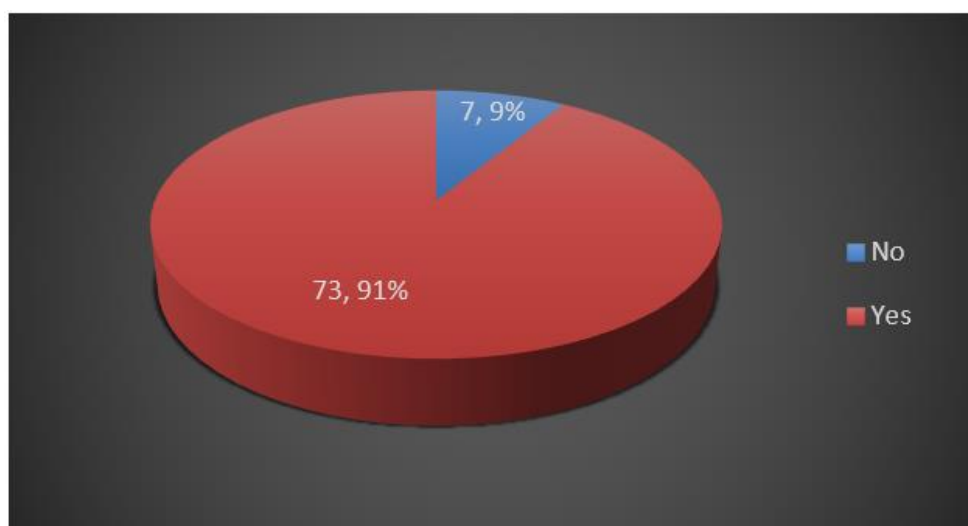


Figure 3: Distraction of patients according to status of fracture union

Figure 2 shows that patients according to status of fracture union. At final follow up (91%) patients

showed union of the fracture and in (9%) patient union was delayed.

Table 4: Outcome of the respondents

Outcome		Frequency	Percentage
Constant score grading	Good	50	62.5
	Fair	20	25
	Poor	10	12.5
Follow-up	Satisfactory	70	87.5
	Unsatisfactory	10	12.5

Table 4 shows that outcome of the respondents. The outcome of the patients was graded according to Constant score criteria as good (>70) in (62.5%) patients, Fair (56-70) in (25%) patients and poor (0-55) in (12.5%) patients. On the other hand, Constant score was treated as satisfactory group and the poor grade was treated as unsatisfactory group. 80% patients were in the satisfactory group and only 20% patients were in unsatisfactory group.

DISCUSSION

Proximal humeral fractures are a relatively common issue seen in hospital emergency departments. There has been a growing inclination towards conservative treatment for many of these fractures, relying on natural healing processes. However, managing displaced proximal humeral fractures remains challenging. According to Neer's classification, displacement is characterized by greater than 45 degrees of angulation or 1 cm of separation between individual fracture parts. The results of our current study indicate that with the youngest and oldest patients being 23 and 78 years old, respectively. The majority (75%) of the patients were male, and the predominant occupation was business. In contrast, Ishaq and colleagues reported an average age of 41.21 years for proximal humeral fractures in their study, with the youngest and oldest patients aged 20 and 58 years, respectively. These findings suggest that proximal humeral fractures in our country predominantly affect individuals in early middle age. However, studies by Young and Wallace (1985) and Hintermann *et al.*, (2000) indicate that fractures of the proximal humerus tend to affect relatively older individuals. The younger group typically consists of individuals who sustain proximal humeral fractures due to high-energy mechanisms of injury, often related to trauma such as road traffic accidents. These patients are typically active and younger earners within their families. In contrast, older patients often present with fractures in osteoporotic bone, where even minor trauma can result in comminuted fractures. In our current series, a significant majority (92.5%) of proximal humeral fractures resulted from high-energy trauma, contrasting with only 7.5% caused by falls, notably in a 78-year-old patient. In a study by Court-Brown and colleagues (2001), 90.5% of fractures were attributed to simple falls, with 4% due to road traffic accidents, 3.2% from falls from height, and 1.6% from direct blows. The higher incidence of proximal humeral fractures from road traffic accidents in our country is often attributed to insufficient knowledge of traffic regulations among drivers, many of whom are illiterate and reluctant to follow traffic rules.

In our series, the mean age of 41.53 years indicates a predominance of younger individuals affected by proximal humeral fractures, which correlates with the high incidence of high-energy trauma. The patient distribution was predominantly male (80%) and female (20%). In contrast, Young and Wallace (1985) reported a higher mean age of 66 years (range 40 to 86 years), with a majority of female patients (73.6%) and fewer male patients (27.4%). This difference in age distribution suggests that proximal humeral fractures occur at a younger age in our study compared to Western populations, possibly influenced by differences in average life expectancy and demographic factors between regions. In the study by Hintermann *et al.*, (2000), the mean age of patients was notably higher at 72 years, with a predominantly female distribution (78.57%) compared to males (21.43%). This age disparity likely reflects similar factors mentioned earlier, such as differences in life expectancy and societal roles. In our country, traditional gender roles may contribute to the demographic differences observed in proximal humeral fractures, where males, often the primary earners and more exposed to external risks like road traffic accidents, are more frequently affected. Interestingly, in our series, two out of the three female patients were well-educated working women, indicating a potential shift in societal dynamics and occupational hazards contributing to these injuries. In the present series, the left side was more affected (81.25%) than the right (18.75%). In a series by Hintermann *et al.*, (2000), the right side (57%) was more affected than the left side (43%). Whereas, in this series by Young and Wallace (1985), right and left humerus was almost equally affected. The cause of left side involvement is probably due to unpreparedness following high velocity injury in most of the cases. In our current series, the diagnosis of proximal humeral fractures was primarily based on clinical examination and radiological assessment, including anteroposterior and lateral views of the affected shoulder. All cases involved displaced three or four-part fractures, some of which were also associated with dislocation of the humeral head. Treatment consisted of open reduction and internal fixation using proximal humeral locking plates. Post-operatively, patients were immobilized with a long arm back slab for two weeks until suture removal. Pendular exercises were initiated as early as the second week to promote shoulder mobility and prevent stiffness. Physiotherapy played a crucial role in the early recovery of patients and was closely supervised to optimize functional outcomes. In the series by Hintermann *et al.*, (2000), displaced proximal humeral fractures were managed using a

modified hip blade plate. Their one-year follow-up revealed a satisfactory outcome in 65.85% of cases and an unsatisfactory outcome in 34.15% of cases. Neer (1970) experienced 86% satisfactory results with a suture tension band technique, Stableforth (1984) reported 100% satisfactory results with a similar technique. Jaberg *et al.*, (1992) reported 95% fracture union with closed reduction and percutaneous pinning but noted pin tract infection in 7% cases. Kristiansen and Christiansen (1986) reported only 45% satisfactory results using an AO T plate for 3-part fractures. In our current series, the proximal humeral locking plate yielded satisfactory outcomes in 87.5% of cases and unsatisfactory outcomes in 12.5%.

Limitations of the study

Our study was a single center study. In our study, there was small sample size. The study was conducted at a short term follow up and short period of time. Long term follow up might have improved the functional outcome. The study was not randomized and the total number of patients in the study was small.

CONCLUSION

This study focused on assessing the functional outcomes following surgical treatment of proximal humerus fractures using PHILOS plates. It emphasized the integral role of postoperative physiotherapy in rehabilitating patients to achieve optimal results. The findings underscored that internal fixation with PHILOS plates can consistently yield reliable functional outcomes when applied correctly. This approach was deemed a suitable surgical option for managing proximal humeral fractures providing a good functional outcome.

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