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Original Research Article

# Clinical Outcomes of Early Versus Delayed Surgical Fixation in Proximal Humerus Fractures

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**Abstract**

**Background:** Proximal humerus fractures are prevalent injuries, especially in the elderly patients, displaced fractures often need operative stabilization. When the surgery should be performed is still a debatable issue, and there is no consensus to whether early or delayed intervention is better.

**Methods:** This prospective comparative study was conducted from August 2023 to August 2025 in the Department of Orthopaedics, PMCH. 70 patients with Neer two-, three- and four-part proximal humerus fractures were recruited and assigned to Early Fixation group (surgery within the first 72 h, n=35) or Delayed Fixation group (surgery later than 72 h, n=35). All the patients were treated with open reduction and internal fixation by a PHILOS plate. Functional results were evaluated according to Constant-Murley Score and DASH Score. Pain was assessed with the Visual Analog Scale (VAS) and radiological union on serial radiographs. Statistical analysis was conducted in SPSS $p < 0.05$ indicated statistical significance.

**Results:** The average Constant-Murley score at one year was significantly higher among patients in the Early Fixation Group (82.6 ± 8.4) than among those in the Delayed Fixation Group (74.2 ± 9.6) ($p = 0.001$). Mean DASH was significantly lower in the early group (18.5 ± 6.8) compared to the delayed group (26.9 ± 7.5) ($p = 0.002$). For the mean time for radiographic union, it was shorter in the early period (12.4 ± 2.1) than in the late period (14.1 ± 2.8), with a difference reaching a statistically significant level ($p = 0.01$). The total complication rate was 14.3% in the early and 28.6% in the delayed group. The average time of hospitalization was significantly shorter in the early group (6.2 ± 1.4 days) compared to the delayed group (9.5 ± 2.3 days) ($p < 0.001$).

**Conclusion:** Early surgical fixation of proximal humerus fractures is associated with improved functional outcomes, faster radiological union, lower complication rate and shorter hospitalisation when compared with delayed treatment.

**Keywords:** Constant-Murley Score, DASH Score, Delayed Fixation, Early Surgical Fixation, PHILOS Plate, Proximal Humerus Fracture.

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## Introduction

Proximal humerus fractures are one of the most frequent upper limb injuries, accounting for 4–6% of all adult fractures [1]. They are the third most common fracture among the elderly population, after hip and distal radius fractures. Proximal humerus fractures have become more common throughout the world, mainly as a result of age-related diseases with due consideration to the increased number of elderly people and osteoporosis [2]. For the elderly people, only minor trauma such as a fall from standing height can lead to fracture, in part due to low bone mineral density. Injuries of the proximal humerus in younger subjects are not connected with low-energy trauma, road traffic accident, sport injury and fall from a height being implicated. Accordingly, the epidemiology demonstrates a bimodal distribution: A group of elderly osteoporotic patients and a second one with younger patients suffering from high-energy mechanisms [3]. The mechanism of injury is critical in defining the fracture pattern, as well as both its displacement and associated soft tissue disruption. In osteoporotic bone, low-energy injuries tend to result in impacted or minimally displaced fractures while high-energy trauma tends to lead to complex, displaced and comminuted fractures in younger

individuals [4]. Concomitant injuries, including shoulder dislocation, neurovascular compromise, and soft tissue swelling are more frequent in cases of high-energy trauma. These differences have a major impact on decisions of treatment and prognosis.

The Neer classification continues to be the most prevalent method of classifying proximal humerus fractures. It characterizes fractures as the amount of displacement in the four segments: humeral head, greater tuberosity, lesser tuberosity, and humeral shaft [5]. A fracture fragment is presumed to be displaced if there is more than 1 cm of separation or greater than 45 degrees of angulation, by Neer's judgment. Fractures are, therefore, classified as one-part, two-part, three-part or four-part fractures [6]. This categorization aids in fracture morphology comprehension as well as for when planning treatment and the prognosis.

Conservative treatment can be considered in many of the undisplaced fractures, but displaced two-part, three-part and four-part fractures and those with greater than 45 degrees of varus displacement, fracture-dislocations and high demand individuals require operative intervention [7,8]. Open reduction and internal fixation (ORIF) with locking compression plates, especially PHILOS plates, is a commonly used technique for stable fixation of fractures, which are often associated with osteoporosis. The fundamental principles of surgical management include anatomic reduction, stable fixation, early mobilization in a pain-free environment and the functional recovery of the shoulder [9].

The time for surgery is crucial to the outcome. The early surgical intervention is thought to aid in the ease of reduction, decrease soft tissue contracture, reduce edema-related complications and contribute to an early rehabilitation [10]. Late fixation could lead to greater technical challenge, higher risk for stiffness and longer pain duration, while complication rate will probably be raised [11,12].

However, not all patients will have surgery soon after diagnosis because medical comorbidities, late presentation in patients with ample time for preoperative treatment or logistical reasons may cause surgery to be postponed. However, with improvements in surgical procedure and implants, the optimal timing of surgery for proximal humeral fractures is still controversial. Although a number of case series have advocated better functional outcomes with early intervention, there are others do not show any difference in the outcome when surgery is done within a permissible delay period. Limited data are available from single-centre studies in tertiary care centre like PMCH especially for a regional population. This literature gap underscores the lack of comparative analysis for early versus late surgical fixation.

**Objective**

- To compare the clinical and functional results of early versus delayed surgical fixation for proximal humeral fractures at PMCH.
- To evaluate the postoperative functional scores (Constant-Murley Score and DASH Score) of early versus delayed fixation.

**Materials and Methods**

**Study Design:** This study was designed as a prospective comparative study to assess and compare the clinical & functional results of early and delayed surgical fixation in proximal humerus fractures. Eligible patients were consecutively assigned to the two groups according to the timing of surgical treatment. The purpose of the study was to evaluate outcomes using standardized clinical, functional and radiological parameters in a well-defined follow-up.

**Study Setting:** The study was conducted at the Department of Orthopaedics, PMCH, a tertiary care hospital, approximately serving a population with a varying spectrum of injury. The institution is equipped with dedicated orthopedic trauma care and services and advanced surgical facilities, which guarantee standardization in operative techniques and postoperative management.

**Study Duration:** The study duration was 2 years, from August 2023 to August 2025. During this time frame eligible patients with proximal humerus fractures were studied, surgically treated, and followed at intervals for assessment of outcome.

**Sample Size:** A total of 70 patients were screened for this study. The patients were equally randomized in two groups of 35 patients each. The Early Fixation Group was found to consist of patients who underwent surgical fixation less than 72 hours after injury, and the Delayed Fixation Group was for those operated over 72 hours after the event.

**Inclusion Criteria**

- Patients aged 18 years or older with closed proximal humerus fractures, Neer two-part, three-part, or four-part.
- Patients who are fit for surgery under anesthesia.
- Patients who signed informed consent information.

**Exclusion Criteria**

- Conservative or pathological fracture of the proximal humerus.
- Polytraumatized patients with life-threatening injuries requiring late stabilization.

- History of prior surgery to the shoulder on the same side.

**Group Definition:** Patients were divided into 2 groups according to the time of surgery. The Early Fixation Group consisted of those patients who received open reduction and internal fixation within 72 hours of the injury. The patients who were operated after 72 hours from the time of injury comprised the delayed fixation group. The timing was guided by presentation, medical optimization and logistics.

**Surgical Technique:** ORIF were employed in all the patients with PHILOS plate. All patients were treated with the standard deltopectoral approach. After satisfactory exposure, the fracture fragments were anatomically reduced under fluoroscopic control and fixed with locking screws, that secures stable construct in an osteoporotic bone in particular. During surgery, great care was taken to maintain soft tissue attachments and to preserve blood supply to the humeral head. The injured limb was postoperatively immobilized in an arm sling, with a standardized rehabilitation program. The child started performed passive range of motion exercises as tolerated, followed by active-assisted and active exercises under supervision.

**Outcome Measures:** Both Constant-Murley Score and Disabilities of the Arm, Shoulder, and Hand (DASH) Score were employed for the evaluation of functional results at follow-up. VAS was used to assess pain. Radiographic union was evaluated using standard anteroposterior and lateral shoulder radiographs at 6 weeks, 3 months, and 6 months after surgery. Union was characterized by the presence of bridging callus and absence of fracture line tenderness. Postoperative infectious complications, humeral head avascular necrosis (AVN), mechanical failure, malunion and loss of shoulder motion were recorded and compared between the two groups.

**Follow-up:** All patients were followed up at 6 weeks, 3 months, 6 months, and one year following surgery. At these visits, clinical examination, functional scoring and pain score assessment and radiological evaluation was carried out.

**Statistical Analysis:** The collected were analyzed by SPSS software. Continuous data were presented as mean and standard deviation, categorical data as frequency and percentage. Mean differences between groups were compared using an independent t-test and categorical variables with a Chi-square test. $P < 0.05$ was considered to be statistically significant.

## Results

A total of 70 patients with proximal humerus fracture were analysed, 35 in the Early Fixation Group and 35 in the Delayed Fixation Group. All patients received at least one year of follow-up and were ultimately analyzed.

**Demographic Profile:** The average age of the Early Fixation Group was 52.4 ± 14.2 years and that for the Delayed Fixation Group was 54.1 ± 13.6, with no statistically significant difference ($p > 0.05$). Patients were all over 50 years of age in both groups. In the early group, there were 22 males and 13 females, in the delayed group, 20 males and 15 females. RTA was the most frequent mode of injury in younger patients, followed by fall from height, but insignificant falls were common in the elderly.

**Table 1: Demographic Characteristics**

| Variable | Early Fixation (n=35) | Delayed Fixation (n=35) |
|---|---|---|
| Mean Age (years) | 52.4 ± 14.2 | 54.1 ± 13.6 |
| Male | 22 (62.9%) | 20 (57.1%) |
| Female | 13 (37.1%) | 15 (42.9%) |
| RTA | 18 (51.4%) | 16 (45.7%) |
| Fall | 17 (48.6%) | 19 (54.3%) |

**Fracture Type Distribution:** According to Neer classification, two-part fractures were most common in both groups, followed by three-part and four-part fractures. The distribution of fracture types between groups was comparable and statistically insignificant.

**Table 2: Neer Classification Distribution**

| Fracture Type | Early (n=35) | Delayed (n=35) | p-value |
|---|---|---|---|
| 2-Part | 16 (45.7%) | 15 (42.9%) | 0.89 |
| 3-Part | 12 (34.3%) | 13 (37.1%) | |
| 4-Part | 7 (20.0%) | 7 (20.0%) | |

**Functional Outcomes:** The Early Fixation Group showed superior functional results at 1-year follow-up. The average Constant-Murley Score was 82.6 ± 8.4 in the early group vs. 74.2 ± 9.6 in the delayed group ($p = 0.001$). The average DASH score was also significantly less (better function) between the early and delayed groups (18.5 ± 6.8 vs 26.9 ± 7.5, p =.002).

**Table 3: Functional Outcome Comparison**

| Outcome Measure | Early Fixation | Delayed Fixation | p-value |
|---|---|---|---|
| Constant Score | 82.6 ± 8.4 | 74.2 ± 9.6 | 0.001 |
| DASH Score | 18.5 ± 6.8 | 26.9 ± 7.5 | 0.002 |

**Radiological Union:** Mean time to radiological union was 12.4 ± 2.1 weeks and 14.1 ± 2.8 weeks in Early Fixation Group and Delayed Fixation Group respectively, that is a statistically significant difference ($p = 0.01$). The earlier the surgery, the shorter of the healing time.

**Complications:** The overall incidence of complication was less in the Early Fixation Group (14.3%) as compared with Delayed Fixation Group (28.6%). Shoulder stiffness and superficial infections occurred more frequently in the delayed group. There was one case of avascular necrosis in the delayed group.

**Table 4**: **Postoperative Complications**

| Complication | Early (n=35) | Delayed (n=35) |
|---|---|---|
| Infection | 1 (2.9%) | 2 (5.7%) |
| AVN | 0 | 1 (2.9%) |
| Implant Failure | 1 (2.9%) | 2 (5.7%) |
| Shoulder Stiffness | 3 (8.6%) | 5 (14.3%) |
| Total | 5 (14.3%) | 10 (28.6%) |

**Hospital Stay Duration:** The average hospitalization time in the Early Fixation Group was much less than that of Delayed-fixation Group (6.2 ± 1.4 vs 9.5 ± 2.3 days, $p < 0.001$), suggesting that early treatment can accelerate rehabilitation and reduce hospitalization period clearly.

## Discussion

The current prospective comparative study analyzed the clinical and functional outcomes between early and delayed surgical fixation of proximal humerus fractures at PMCH. The results showed that early surgical fixation (early fixation surgical treatment performed within 72 hours after the injury) provided better functional outcomes, a significantly earlier radiological union, a lower percentage of complications and fewer days in the hospital than delayed fixation. The mean Constant-Murley score was statistically significantly higher and the DASH score statistically significant lower in the early fixation group, meaning better shoulder function and less disability. The time to radiological union was also shorter in the early group, which can be interpreted as timely surgery improves fracture healing and functional outcomes.

**Biological and Mechanical Rationale for Early Fixation:** The improved results seen in the early fixation group can be logically attributed to both biological and mechanical reasons. Early intervention permits anatomical reduction before the soft-tissue edema, fibrosis and muscle contracture becomes substantial. Fewer inflammatory changes and improved tissue planes can also provide better reduction of fracture fragments, as well as proper alignment and stability. An immediately mechanically stable fixation allows for early mobilization and, hence, avoids stiffness of the joint with better functional outcome. Moreover, achieving early stabilization preserves vasculature integrity of the fracture site and reduces humeral head blood supply disruption, which may in turn decrease avascular necrosis risk. Early mobilization as well promotes the circulation of synovial fluid circulation, contributing to improved cartilage nutrition and shoulder function.

**Comparison with Previous Studies:** The results of the present study are similar to those of several previous reports which have highlighted the advantages of early surgical treatment for proximal humeral fractures [13].

Several authors have found that when an operation is carried out during the early-post injury period, these patients achieve better functional scores and acquire fewer complications. Similar to our results, earlier research has shown better constant scores and less stiffness in patients who had been early fixed. On the other hand, no significant difference was found in other studies with surgery within a short-delayed window, indicating that different thresholds may apply [14]. Nevertheless, most reports agree that, if treatment is delayed for an extended period, it also heightens the technical difficulty and worsens outcomes as noted in our study.

**Complications in the Delayed Group:** Several reasons might lead to the increased complication rate of delayed fixation group. Late surgical intervention leads to exacerbated soft tissue swelling, hematoma organized and fast callus formation that results in a difficult anatomical reduction [15]. Poor alignment can lead to the malunion and implant complications, recessive shoulder stiffness and atrophy. Sometimes the cause of an immobilized and stiffened shoulder with muscle atrophy is not easily corroborated from

history alone. In the present series, shoulder stiffness and implant-related complications were significantly higher in the delayed group supporting these arguments.

**Strengths of the Study:** One of the strength points of this study is that it is prospective with an even sample distribution between groups and then standardized surgical material pertaining to PHILOS plating. Standardized rehabilitation programs and regular follow-up visits increased the robustness of outcome evaluation. These data could be associated to validated functional scores (e.g. Constant-Murley and DASH scores) adds validity to results.

**Limitations:** The study also has some limitations. The study was performed at a single tertiary care center and may not be generalizable. The fact that the current study was limited to comparison and included only 70 patients can also provide a limitation for our results as small sample. Secondly, the long-term follow-up could bring us more information of late complications like femoral head necrosis and post-traumatic arthritis. Large multicentric studies are therefore indicated to confirm these findings.

## Conclusion

In the current prospective comparative study, early surgical fixation of proximal humerus fractures is shown to provide better clinical and functional results than delayed fixation. Patients treated by surgery less than 72 hours after injury showed significantly better Constant-Murley outcomes and lower DASH scores, indicating functional results and decreased disabilities of their injured shoulder. Early fixation was also correlated with early radiological union and less incidence of postoperative complications like shoulder stiffness, infection, and implant-related problems. In addition, the length of stay was significantly shorter early fixation group that suggested faster recovery and less burden on medical resources. These results underscore the role of early surgical management in influencing outcome.

According to the findings of this study, early surgical intervention should be performed, when medically and functionally possible, in cases of displaced proximal humerus fractures to promote functional recovery and reduce complications.

**Recommendations:** According to this study, early surgical stabilization of the displaced proximal humerus fractures is advocated as long as patients are medically fit. Early intervention leads to better anatomical reduction and early motion with good functional recovery. Greater multicentric studies and longer follow-up being needed to confirm these findings and increase the general applicability.

A standardized, structured post-operative rehabilitation protocol is also necessary to optimize functional outcomes and to guarantee that patients achieve similar recovery in different healthcare settings.

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