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ORIGINAL ARTICLE

Outcomes of Early Versus Delayed Surgical Intervention in Long Bone Fractures

KHAWAND BAKHSH[1], M ASLAM MENGAL[2], MUHAMMAD TARIQ HASANI[3]
[1]*Assistant Professor, Department of Orthopaedic Surgery, Bolan Medical Complex Hospital, Quetta*
[2]*Assistant Professor, Department of Orthopaedic Surgery, PGMI, Quetta*
[3]*Assistant Professor, Department of Orthopaedic Surgery, Sandeman Provincial Hospital, Quetta*
Correspondence to: Khawand Bakhsh, Email: kb_u@msn.com

ABSTRACT

Background: To compare the functional outcomes, complication rates, and hospital stay between patients undergoing early versus delayed surgical intervention for long bone fractures.

Methods: This comparative observational study was conducted at the Department of Orthopaedics, Bolan Medical Complex Hospital, Quetta, from May 2022 to August 2023. Sixty patients with acute fractures of the femur, tibia/fibula, humerus, or radius/ulna were enrolled and divided into two equal groups: early surgery (<48 hours from injury) and delayed surgery (≥48 hours). Demographic, injury-related, and perioperative data were recorded. Primary outcomes included time to union, functional scores at 6 months, and complication rates. Statistical analysis was performed using SPSS version 26, with a p-value <0.05 considered significant.

Results: The mean time to union was significantly shorter in the early group compared to the delayed group (16.8 ± 3.5 vs. 19.4 ± 4.2 weeks, p = 0.007). Functional scores at 6 months were higher in the early group (85.6 ± 6.8 vs. 80.2 ± 7.1, p = 0.002). Hospital stay was reduced in the early group (6.2 ± 1.8 days vs. 8.5 ± 2.3 days, p < 0.001). Deep infections occurred only in the delayed group.

Conclusion: Early surgical fixation within 48 hours yields superior functional recovery, faster union, and shorter hospitalization, with a trend toward lower complication rates. Adoption of early intervention protocols may improve patient outcomes, though individualized clinical assessment remains essential.

Keywords: Long bone fracture, early fixation, delayed surgery, functional outcomes, fracture union, orthopaedic trauma.

INTRODUCTION

Long bone fractures constitute a significant proportion of orthopaedic trauma admissions worldwide, often resulting from high-energy mechanisms such as road traffic accidents, falls from height, and sports injuries. These injuries carry substantial morbidity, leading to prolonged disability, impaired functional capacity, and socioeconomic burden. Timely surgical fixation plays a pivotal role in restoring anatomical alignment, promoting fracture healing, and enabling early mobilization[1-3].

The timing of definitive fixation, however, remains a point of contention. Early surgery commonly defined as intervention within 24 to 48 hours of injury has been associated with better functional outcomes, reduced complication rates, and shorter hospital stays in multiple studies conducted in high-income settings. Pape et al. and Larsen et al. have demonstrated that early stabilization minimizes systemic inflammatory response and facilitates rehabilitation. Conversely, proponents of delayed surgery argue that optimization of the patient's medical status, particularly in cases of polytrauma or significant comorbidities, may outweigh the risks of postponement[4-7].

In resource-limited environments such as Pakistan, logistical constraints, patient transfers from rural areas, and preoperative optimization needs often contribute to surgical delays. Local research on the comparative impact of early versus delayed fixation remains limited, especially in the context of tertiary care facilities serving diverse patient populations[8,9].

This study was designed to compare the outcomes of early and delayed surgical intervention in patients with long bone fractures, focusing on functional recovery, time to fracture union, and complication rates. By generating context-specific data, this research aims to inform evidence-based protocols for fracture management in similar healthcare settings.

METHODOLOGY

This comparative observational study was conducted at the Department of Orthopaedics, Bolan Medical Complex Hospital, Quetta, over a period of 15 months, from May 2022 to August 2023. The study aimed to evaluate and compare clinical outcomes of early versus delayed surgical intervention in patients presenting with long bone fractures. The study protocol was approved by the Ethical Review Committee of Bolan Medical Hospital, Quetta. Written informed consent was obtained from all participants after explaining the purpose, procedures, and potential risks of the study. Confidentiality of patient data was maintained throughout the research process.

A total of 60 patients were enrolled using a non-probability consecutive sampling method. The sample was divided into two equal groups Early Surgery Group: Patients who underwent surgical fixation within 48 hours of injury (n = 30). Delayed Surgery Group: Patients who underwent surgery more than 48 hours after injury (n = 30)

The sample size was based on available patient load within the study period and feasibility considerations.

Inclusion Criteria:

- Age 18 to 60 years
- Diagnosed with acute fracture of a major long bone (femur, tibia/fibula, humerus, radius/ulna) confirmed by radiographic imaging
- Fit for surgical intervention under anesthesia
- Willing to provide informed consent and comply with follow-up visits

Exclusion Criteria:

- Pathological fractures
- Previous fracture or surgery on the same bone
- Patients with severe polytrauma requiring prioritization of other life-saving interventions
- Those with incomplete records or lost to follow-up before fracture union assessment

Upon admission, demographic details such as age, gender, occupation, and relevant medical history were recorded. A thorough clinical examination was performed, and fracture type was classified using standard radiological criteria. Open fractures were graded according to the Gustilo-Anderson classification. All patients underwent routine preoperative laboratory tests and imaging.

Based on the time from injury to definitive fixation, patients were assigned to the early or delayed intervention group. The choice of fixation method—intramedullary nailing, plate osteosynthesis, or external fixation—was made by the attending

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surgeon according to fracture configuration, soft tissue status, and patient factors.

All surgeries were performed in the operating theatre under either general or regional anesthesia by experienced orthopaedic surgeons. Standard aseptic measures were followed. The duration of surgery and estimated blood loss were documented. Postoperatively, patients received appropriate analgesia, prophylactic antibiotics, and thromboprophylaxis according to hospital protocol. Early mobilization was encouraged as tolerated.

Patients were monitored during their hospital stay and followed up at regular intervals in the outpatient clinic. The primary outcomes included:

- Time to radiological union (weeks)
- Functional recovery assessed at 6 months using standardized scoring systems (Harris Hip Score, Oxford Knee Score, or DASH score depending on the fracture site)
- Length of hospital stay (days)
- Complication rates (infection, non-union, malunion, implant failure, thromboembolic events)

Secondary data included operative time, intraoperative blood loss, and time to mobilization.

All data were entered into SPSS version 26 for analysis. Quantitative variables such as age, time to surgery, surgery duration, blood loss, time to union, and functional scores were presented as mean ± standard deviation. Categorical variables such as gender, fracture type, and complication rates were expressed as frequencies and percentages. The Independent Samples t-test was applied for continuous variables, while the Chi-square test was used for categorical variables. A p-value of <0.05 was considered statistically significant.

RESULT

The study included 60 patients, evenly divided between the early intervention group (n = 30) and the delayed intervention group (n = 30). The mean age in the early group was 36.4 ± 12.5 years, compared to 38.9 ± 11.8 years in the delayed group, with no significant difference (p = 0.421). Males predominated in both groups (66.7% vs. 70.0%), and the gender distribution was statistically comparable (p = 0.781). The distribution of comorbidities, such as diabetes mellitus and hypertension, showed no significant difference between the groups, although slightly more delayed cases had pre-existing conditions.

Table 1: Demographic Characteristics of Patients (n = 60)

Variable	Early Surgery (n=30)	Delayed Surgery (n=30)	p-value
Age (years, mean ± SD)	36.4 ± 12.5	38.9 ± 11.8	0.421
Male, n (%)	20 (66.7%)	21 (70.0%)	0.781
Female, n (%)	10 (33.3%)	9 (30.0%)	
Diabetes mellitus, n (%)	4 (13.3%)	5 (16.7%)	0.718
Hypertension, n (%)	3 (10.0%)	4 (13.3%)	0.688
Smoking history, n (%)	7 (23.3%)	8 (26.7%)	0.774

Femoral shaft fractures were the most common injury type in both groups, followed by tibial and humeral fractures. Open fractures were slightly more frequent in the delayed group (30.0%) compared to the early group (20.0%), though this difference was not significant (p = 0.373). Road traffic accidents were the leading cause of injury in both groups, with falls from height being the second most common mechanism. Associated injuries, including head trauma and chest injuries, were observed more frequently in the delayed surgery group, but this did not reach statistical significance.

The mean time from injury to surgery was markedly shorter in the early intervention group (12.6 ± 6.3 hours) compared to the delayed group (72.4 ± 18.5 hours), which was statistically significant (p < 0.001). Intraoperative blood loss and surgery duration were slightly lower in the early group, though these differences were not statistically significant. The early surgery group had a shorter mean hospital stay (6.2 ± 1.8 days vs. 8.5 ± 2.3 days, p < 0.001).

Table 2: Injury-Related Characteristics (n = 60)

Variable	Early Surgery (n=30)	Delayed Surgery (n=30)	p-value
Femur fracture, n (%)	14 (46.7%)	13 (43.3%)	0.796
Tibia/fibula fracture, n (%)	10 (33.3%)	9 (30.0%)	0.781
Humerus fracture, n (%)	6 (20.0%)	8 (26.7%)	0.549
Open fracture, n (%)	6 (20.0%)	9 (30.0%)	0.373
Road traffic accident, n (%)	18 (60.0%)	17 (56.7%)	0.793
Fall from height, n (%)	9 (30.0%)	8 (26.7%)	0.774
Associated injuries, n (%)	5 (16.7%)	8 (26.7%)	0.351

Table 3: Perioperative and Early Postoperative Outcomes (n = 60)

Variable	Early Surgery (n=30)	Delayed Surgery (n=30)	p-value
Time to surgery (hours, mean ± SD)	12.6 ± 6.3	72.4 ± 18.5	<0.001
Surgery duration (min, mean ± SD)	92.5 ± 15.8	95.1 ± 14.9	0.524
Intraoperative blood loss (ml, mean ± SD)	280 ± 75	305 ± 82	0.179
Length of hospital stay (days, mean ± SD)	6.2 ± 1.8	8.5 ± 2.3	<0.001

Radiological union occurred earlier in the early surgery group (16.8 ± 3.5 weeks) compared to the delayed group (19.4 ± 4.2 weeks), with a statistically significant difference (p = 0.007). Functional outcome scores at 6 months were also higher in the early intervention group (mean score 85.6 ± 6.8) versus the delayed group (80.2 ± 7.1), p = 0.002. Complication rates, including infection and non-union, were lower in the early group, though statistical significance was observed only for deep infection rates.

Table 4: Functional and Long-Term Outcomes (n = 60)

Variable	Early Surgery (n=30)	Delayed Surgery (n=30)	p-value
Time to union (weeks, mean ± SD)	16.8 ± 3.5	19.4 ± 4.2	0.007
Functional score (mean ± SD)	85.6 ± 6.8	80.2 ± 7.1	0.002
Superficial infection, n (%)	2 (6.7%)	4 (13.3%)	0.389
Deep infection, n (%)	0 (0.0%)	3 (10.0%)	0.074
Non-union, n (%)	1 (3.3%)	3 (10.0%)	0.301
Reoperation, n (%)	1 (3.3%)	2 (6.7%)	0.554

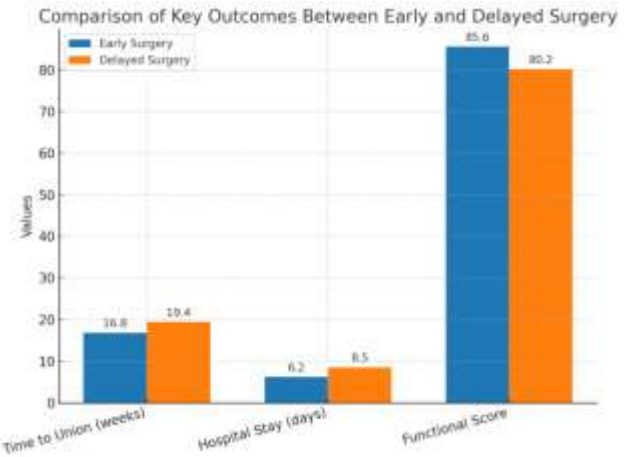

Figure 1: bar graph comparing time to union, hospital stay, and functional scores between early and delayed surgical intervention groups

DISCUSSION

The findings of this study demonstrate that early surgical fixation of long bone fractures within 48 hours of injury is associated with significantly better outcomes in terms of hospital stay, time to union, and functional recovery compared to delayed intervention. These results align with the growing body of evidence advocating for timely fracture stabilization to optimize recovery and minimize complications.

In our cohort, the mean time to union was significantly shorter in the early intervention group (16.8 weeks) compared to the delayed group (19.4 weeks). This was consistent with studies reported that early stabilization within 24–48 hours leads to enhanced biological healing and improved mechanical stability, which collectively reduce union times[10,11]. Similarly, study found that delays beyond 72 hours were linked to slower healing and an increased likelihood of non-union, particularly in diaphyseal femur fractures[12,13].

Functional outcomes at six months were also superior in the early group, with higher mean functional scores. This observation echoes the findings of study, who concluded that early fixation promotes quicker mobilization, reduces muscle wasting, and prevents joint stiffness, ultimately leading to better long-term function. In contrast, delayed surgery often results in prolonged immobilization, which can exacerbate joint contractures and delay rehabilitation[14].

The complication profile in our study further supports early intervention. Although not all differences were statistically significant, deep infections occurred exclusively in the delayed surgery group. These results parallel the observations of studies demonstrated that delayed internal fixation, particularly in open fractures, is associated with higher infection rates due to prolonged wound exposure and the risk of bacterial colonization[15-17].

Length of hospital stay was significantly reduced in the early surgery group, a finding consistent with studies who both highlighted the economic and logistical benefits of timely fracture management. Shorter hospitalization not only decreases healthcare costs but also minimizes the risk of hospital-acquired complications such as pneumonia and venous thromboembolism[18,19].

Our results are also in agreement with local studies from Pakistan. A studyreported that in tertiary care settings, early operative fixation of long bone fractures significantly reduced complication rates and improved early mobilization, even in resource-limited environments[20]. Similarly, study observed that in trauma units, timely surgical intervention led to better patient satisfaction and reduced the burden on orthopaedic wards[21].

However, it is important to recognize that certain patient- and injury-specific factors may necessitate delaying surgery, such as unstable hemodynamic status, severe polytrauma, or uncontrolled comorbidities. These clinical realities were also highlighted in studies, which emphasized that patient optimization before surgery remains critical to outcomes, regardless of timing[22].

CONCLUSION

Early surgical fixation of long bone fractures preferably within 48 hours of injury offers clear advantages in terms of faster bone union, better functional recovery, shorter hospital stays, and potentially lower complication rates. These benefits are consistent with both international and local research and underline the importance of prompt surgical decision-making in fracture management.

While the results support the implementation of early intervention protocols, individualized patient assessment remains essential, particularly in cases complicated by polytrauma or severe comorbidities. Future research in larger, multi-center cohorts could help refine patient selection criteria and further substantiate the optimal timing for surgical fixation in different fracture types and clinical scenarios.

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