

Association between Time to Surgical Intervention and Functional Outcomes in Patients with Hip Fractures: A Prospective Observational Study

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ABSTRACT

Background: Hip fractures are associated with significant morbidity, mortality, and functional disability, particularly among elderly patients. The timing of surgical intervention is an important potentially modifiable factor influencing postoperative recovery. This study aimed to evaluate the association between surgical timing and functional outcomes in patients with hip fractures. **Materials and Methods:** This prospective observational study included 110 patients with hip fractures, categorized into Group A (early surgery, ≤ 48 hours; $n=55$) and Group B (delayed surgery, >48 hours; $n=55$). Demographic characteristics, fracture patterns, surgical procedures, perioperative parameters, and postoperative complications were assessed. Functional outcomes were evaluated using the Harris Hip Score (HHS) at six weeks, three months, and six months. Statistical significance was considered at $p<0.05$. **Results:** The mean injury-to-surgery interval was significantly shorter in Group A than Group B (30.2 ± 9.4 versus 76.8 ± 19.6 hours; $p<0.001$). Early surgery was associated with faster postoperative mobilization (29.4 ± 8.6 versus 39.8 ± 11.2 hours) and shorter hospitalization (6.8 ± 2.1 versus 9.4 ± 3.2 days). At six months, mean HHS was significantly higher in Group A (85.4 ± 7.9) compared with Group B (76.2 ± 9.4 ; $p<0.001$). Excellent or good functional outcomes were observed in 78.2% versus 50.9% of patients, respectively. Postoperative complications occurred in 9.1% and 27.3% of patients, respectively. **Conclusion:** Early surgical intervention was associated with improved functional recovery, earlier mobilization, shorter hospitalization, and fewer postoperative complications. Timely surgical management may contribute to better outcomes following hip fractures.

Keywords: Hip Fracture; Surgical Timing; Early Surgery; Delayed Surgery; Harris Hip Score; Functional Outcomes; Postoperative Complications.

INTRODUCTION

Hip fractures represent a major global public health concern, particularly among the elderly population, owing to their increasing incidence, associated morbidity, mortality, and substantial socioeconomic burden. With increasing life expectancy and the growing prevalence of osteoporosis, the incidence of fragility-related hip fractures is expected to rise considerably in the coming decades [1–3]. These fractures are frequently associated with prolonged hospitalization, reduced mobility, loss of functional independence, and diminished quality of life. Surgical management remains

the mainstay of treatment, aiming to achieve fracture stabilization, relieve pain, facilitate early mobilization, minimize complications, and restore pre-fracture functional status.

The timing of surgical intervention has emerged as an important potentially modifiable factor influencing postoperative outcomes. Early surgical management is generally recommended to reduce complications associated with prolonged immobilization, including deep vein thrombosis, pulmonary embolism, pneumonia, pressure ulcers, and muscle deconditioning. Several studies have demonstrated an association between

delayed surgery and increased postoperative morbidity, mortality, and hospital stay, supporting surgical intervention within 24–48 hours of hospital admission when medically appropriate [4–7]. However, although the relationship between surgical delay and postoperative complications has been extensively investigated, its influence on functional recovery remains less clearly established.

In routine clinical practice, surgical timing is commonly calculated from hospital admission rather than the actual time of injury. Consequently, delays occurring between fracture onset and hospital presentation may be overlooked, despite their potential influence on postoperative recovery [8]. Such delays may result from geographical barriers, referral pathways, medical optimization, and limited availability of specialized orthopaedic services. Evaluating the total interval between injury and definitive surgical intervention may therefore provide a more comprehensive understanding of its association with functional outcomes.

Functional recovery following hip fracture surgery is a multifactorial process influenced by age, pre-existing comorbidities, fracture characteristics, baseline mobility, surgical technique, and postoperative rehabilitation [9,10]. Standardized functional assessment tools, including the Harris Hip Score and mobility assessment scales, provide objective measures of postoperative recovery. Although previous observational studies and randomized controlled trials have investigated the association between surgical timing and functional outcomes, their findings remain inconsistent because of differences in study populations, definitions of surgical delay, follow-up duration, and adjustment for potential confounding factors [11–15].

Therefore, further prospective investigation is warranted to clarify the association between surgical timing and postoperative functional recovery. The present prospective observational study aims to evaluate the association between the interval from injury to surgical intervention and functional outcomes in patients with hip fractures. The findings may provide clinically relevant evidence to guide surgical prioritization, optimize perioperative management, and improve rehabilitation strategies, ultimately contributing to better functional recovery and quality of life among patients undergoing hip fracture surgery.

MATERIALS AND METHODS

Study Design

The present study was designed as a hospital-based, prospective observational study to evaluate the association between time to surgical intervention and postoperative functional outcomes in patients with hip fractures. Patients were prospectively enrolled and followed up to assess functional recovery, postoperative

complications, and the influence of surgical timing on clinical outcomes.

Study Setting

The study was conducted in the Department of Orthopaedics at a tertiary care teaching hospital. Patients diagnosed with hip fractures and undergoing surgical intervention were recruited from the orthopaedic inpatient department and emergency services.

Study Duration

The study was conducted over a period of 18 months, which included patient recruitment, clinical assessment, surgical management, postoperative follow-up, data collection, and statistical analysis.

Study Population

The study population comprised adult patients aged 18 years and above who were diagnosed with hip fractures, including femoral neck and intertrochanteric fractures, and underwent surgical management during the study period.

Sample Size

A total of 110 patients with hip fractures who fulfilled the eligibility criteria were included in the study. All eligible patients presenting during the study period were considered for recruitment until the required sample size was achieved.

Sampling Technique

A consecutive sampling technique was employed. Patients meeting the inclusion criteria were enrolled after obtaining written informed consent. The study was observational, and the timing of surgical intervention was determined by routine clinical considerations rather than investigator allocation.

Eligibility Criteria

Inclusion Criteria

1. Patients aged 18 years and above.
2. Patients diagnosed with femoral neck or intertrochanteric fractures.
3. Patients who underwent surgical management of hip fractures.
4. Patients with a documented history of the time of injury and time of surgical intervention.
5. Patients willing to participate and provide written informed consent.
6. Patients available for scheduled postoperative follow-up.

Exclusion Criteria

1. Patients with pathological fractures secondary to malignancy.

2. Patients with periprosthetic hip fractures.
3. Patients with associated major injuries significantly affecting mobility or rehabilitation.
4. Patients with pre-existing severe neurological or musculoskeletal disorders that substantially impaired walking ability.
5. Patients who were managed conservatively.
6. Patients who declined consent to participate.

Study Procedure

Patient Recruitment and Baseline Assessment

A total of 110 eligible patients diagnosed with hip fractures were enrolled. Detailed clinical histories were obtained, including demographic characteristics, mechanism of injury, time of injury, time of hospital admission, medical comorbidities, and pre-injury mobility status.

A comprehensive clinical examination was performed, including general physical examination, assessment of the affected limb, neurovascular examination, and evaluation of associated injuries. Relevant laboratory investigations and preoperative assessments were performed according to institutional protocols.

Radiological Assessment

All patients underwent standard anteroposterior radiographs of the pelvis with both hips and additional radiographic views as clinically indicated. Fractures were classified according to their anatomical location and relevant classification systems.

Femoral neck fractures were assessed using the Garden classification, while intertrochanteric fractures were classified using an appropriate radiological classification system. Additional imaging was performed when required for diagnostic clarification and surgical planning.

Assessment of Time to Surgical Intervention

The interval between the occurrence of injury and definitive surgical intervention was recorded for each patient. Surgical timing was calculated in hours using the documented time of injury and the time of commencement of surgery.

Three intervals were assessed:

- Injury-to-admission interval: Time between the occurrence of injury and hospital admission.
- Admission-to-surgery interval: Time between hospital admission and commencement of surgical intervention.
- Injury-to-surgery interval: Total time between injury and commencement of surgical intervention.

For comparative analysis, patients were categorized into two groups according to the total injury-to-surgery interval:

Group A (Early Surgery): Patients who underwent surgical intervention within 48 hours of injury.

Group B (Delayed Surgery): Patients who underwent surgical intervention more than 48 hours after injury.

The reasons for surgical delay, including delayed presentation, medical optimization, diagnostic evaluation, and operating theatre availability, were documented wherever applicable.

Surgical Management

All patients underwent surgical treatment according to fracture characteristics, patient age, bone quality, functional requirements, and the treating surgeon's clinical judgment.

Surgical procedures included internal fixation using appropriate implants, hemiarthroplasty, or total hip arthroplasty, depending on the fracture pattern and clinical indications.

All procedures were performed under spinal or general anaesthesia according to anaesthetic assessment. Standard perioperative antibiotic prophylaxis, thromboprophylaxis, and postoperative monitoring were provided according to institutional protocols.

Postoperative Management and Rehabilitation

Following surgery, patients received standard postoperative care, including analgesia, wound management, prevention of thromboembolic complications, and physiotherapy.

Early mobilization was encouraged according to patient tolerance, fracture stability, surgical procedure, and the operating surgeon's recommendations. Rehabilitation included assisted ambulation, strengthening exercises, joint range-of-motion exercises, and gait training.

The time to first postoperative mobilization, duration of hospital stay, and postoperative complications were recorded.

Functional Outcome Assessment

Functional outcomes were assessed using the Harris Hip Score (HHS), which evaluated pain, functional capacity, absence of deformity, and range of motion.

The Harris Hip Score ranged from 0 to 100, with higher scores indicating better hip function.

Harris Hip Score	Functional outcome
90–100	Excellent
80–89	Good
70–79	Fair
Below 70	Poor

Functional assessment was performed at scheduled postoperative follow-up visits at 6 weeks, 3 months, and 6 months.

At each visit, patients were evaluated for pain, walking ability, requirement for walking aids, activities of daily living, and overall hip function. Functional scores were

recorded and compared between the early and delayed surgery groups.

Outcome Measures

Primary Outcome

The primary outcome was the association between the injury-to-surgery interval and postoperative functional recovery, assessed using the Harris Hip Score at 6 months.

Secondary Outcomes

Secondary outcomes included:

- 1. Comparison of Harris Hip Scores between early and delayed surgery groups at 6 weeks, 3 months, and 6 months.
- 2. Association between surgical timing and postoperative mobilization.
- 3. Comparison of duration of hospital stay between the two groups.
- 4. Incidence of postoperative complications, including wound infection, deep vein thrombosis, pneumonia, and pressure ulcers.
- 5. Association of age, fracture type, comorbidities, and pre-injury mobility with functional outcomes.
- 6. Relationship between injury-to-admission and admission-to-surgery intervals and postoperative functional recovery.

Data Collection

Data were collected using a predesigned structured case record form. Demographic details, clinical characteristics, fracture classification, surgical procedure, time intervals, postoperative complications, and follow-up functional scores were documented.

RESULTS

The present study included a total of 110 patients with hip fractures, who were divided into two groups based on the timing of surgical intervention: Group A (early surgery, n=55) and Group B (delayed surgery, n=55). Demographic characteristics, fracture patterns, surgical procedures, perioperative recovery, functional outcomes, and postoperative complications were compared between the two groups.

Table 1. Comparison of Demographic and Baseline Clinical Characteristics Between Early and Delayed Surgery Groups (N = 110)

Parameter	Group A: Early (n=55)	Group B: Delayed (n=55)	p-value
Age (years), Mean ± SD	66.8 ± 10.4	68.2 ± 11.1	0.496
Age group, n (%)			
18–40 years	3 (5.5)	2 (3.6)	—
41–60 years	13 (23.6)	11 (20.0)	—
61–80 years	32 (58.2)	33 (60.0)	—
>80 years	7 (12.7)	9 (16.4)	—
Sex, n (%)			
Male	29 (52.7)	27 (49.1)	0.702
Female	26 (47.3)	28 (50.9)	
Affected side, n (%)			
Right	30 (54.5)	28 (50.9)	0.702

All collected information was entered into a computerized database and checked for completeness and consistency before

Statistical Analysis.

Data were entered into Microsoft Excel and analyzed using SPSS 27 statistical software. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, depending on the distribution of data. Categorical variables were presented as frequencies and percentages.

The Shapiro–Wilk test was used to assess the normality of continuous variables. Comparisons between the early and delayed surgery groups were performed using the independent-samples Student's t-test for normally distributed variables and the Mann–Whitney U test for non-normally distributed variables.

Categorical variables were compared using the Chi-square test or Fisher's exact test, as SPSS27. Functional outcomes at different postoperative follow-up intervals were evaluated using suitable repeated-measures statistical methods.

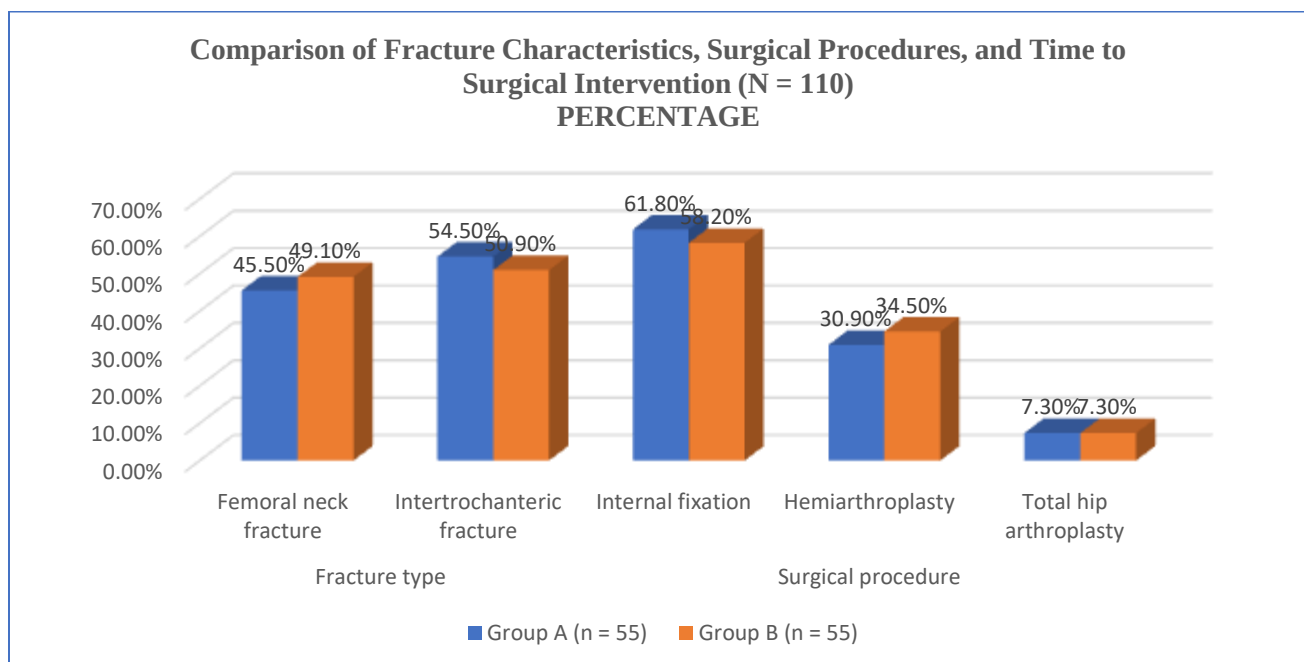
Pearson's or Spearman's correlation analysis was performed to assess the relationship between surgical delay and functional outcome scores. Multivariable linear regression analysis was used to evaluate the association between injury-to-surgery interval and 6-month Harris Hip Score after adjustment for relevant confounding variables, including age, sex, fracture type, comorbidities, baseline mobility, and surgical procedure. A p-value less than 0.05 was considered statistically significant.

Left	25 (45.5)	27 (49.1)	
Mode of injury, n (%)			
Low-energy fall	43 (78.2)	45 (81.8)	—
Road traffic accident	9 (16.4)	7 (12.7)	—
Other trauma	3 (5.5)	3 (5.5)	—
Comorbidities, n (%)			
Diabetes mellitus	15 (27.3)	17 (30.9)	0.675
Hypertension	22 (40.0)	24 (43.6)	0.699
Cardiovascular disease	7 (12.7)	9 (16.4)	0.588

As shown in Table 1, the mean age of patients was 66.8 ± 10.4 years in Group A and 68.2 ± 11.1 years in Group B, with no statistically significant difference ($p=0.496$). The majority of patients belonged to the 61–80-year age group in both groups (58.2% and 60.0%, respectively). Male patients constituted 52.7% of Group A and 49.1% of Group B ($p=0.702$). Right-sided fractures were observed in 54.5% and 50.9% of patients, respectively ($p=0.702$). Low-energy falls were the most common mode of injury, accounting for 78.2% and 81.8% of cases. Hypertension was the most frequent comorbidity (40.0% versus 43.6%), followed by diabetes mellitus (27.3% versus 30.9%) and cardiovascular disease (12.7% versus 16.4%). None of the evaluated baseline characteristics showed a statistically significant difference between the groups, indicating comparable demographic and clinical profiles.

Table 2. Comparison of Fracture Characteristics, Surgical Procedures, and Time to Surgical Intervention (N = 110)

Parameter	Group A (n=55)	Group B (n=55)	p-value
Fracture type, n (%)			0.701
Femoral neck fracture	25 (45.5)	27 (49.1)	
Intertrochanteric fracture	30 (54.5)	28 (50.9)	
Surgical procedure, n (%)			
Internal fixation	34 (61.8)	32 (58.2)	—
Hemiarthroplasty	17 (30.9)	19 (34.5)	—
Total hip arthroplasty	4 (7.3)	4 (7.3)	—
Time intervals (hours), Mean $\pm$ SD			
Injury to admission	6.8 ± 3.4	18.6 ± 9.2	<0.001
Admission to surgery	23.4 ± 8.6	58.2 ± 16.4	<0.001
Injury to surgery	30.2 ± 9.4	76.8 ± 19.6	<0.001



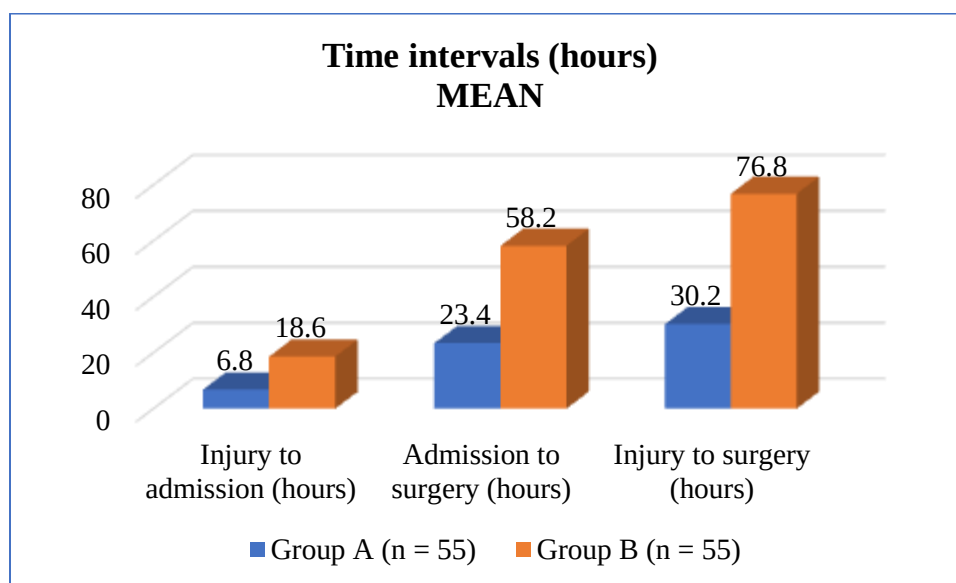


Figure 1 Comparison of Fracture Characteristics, Surgical Procedures, and Time to Surgical Intervention (N = 110)

Table 2 and Figure 1 present the comparison of fracture characteristics, surgical procedures, and time intervals between the two groups. Intertrochanteric fractures were observed in 54.5% of Group A and 50.9% of Group B, whereas femoral neck fractures accounted for 45.5% and 49.1%, respectively ($p=0.701$). Internal fixation was the most frequently performed procedure in both groups (61.8% versus 58.2%), followed by hemiarthroplasty (30.9% versus 34.5%) and total hip arthroplasty (7.3% in each group). The mean injury-to-admission interval was significantly shorter in Group A than Group B (6.8 ± 3.4 versus 18.6 ± 9.2 hours; $p<0.001$). Similarly, the mean admission-to-surgery interval was 23.4 ± 8.6 hours in Group A compared with 58.2 ± 16.4 hours in Group B ($p<0.001$). The total injury-to-surgery interval was also significantly shorter in Group A (30.2 ± 9.4 versus 76.8 ± 19.6 hours; $p<0.001$).

Table 3. Comparison of Perioperative Recovery Parameters Between Early and Delayed Surgery Groups (N = 110)

Parameter	Group A (n=55)	Group B (n=55)	p-value
Duration of surgery (minutes), Mean $\pm$ SD	84.6 $\pm$ 18.2	87.3 $\pm$ 19.4	0.453
Time to first mobilization (hours), Mean $\pm$ SD	29.4 $\pm$ 8.6	39.8 $\pm$ 11.2	<0.001
Hospital stay (days), Mean $\pm$ SD	6.8 $\pm$ 2.1	9.4 $\pm$ 3.2	<0.001
Mobilization within 48 hours after surgery, n (%)			
Yes	46 (83.6)	35 (63.6)	0.017
No	9 (16.4)	20 (36.4)	
Walking aid at discharge, n (%)			
Walker	39 (70.9)	43 (78.2)	—
Crutches	10 (18.2)	8 (14.5)	—
Independent walking	6 (10.9)	4 (7.3)	—

As demonstrated in Table 3, the mean duration of surgery was comparable between Group A and Group B (84.6 ± 18.2 versus 87.3 ± 19.4 minutes; $p=0.453$). However, patients undergoing early surgery demonstrated significantly faster postoperative recovery. The mean time to first mobilization was 29.4 ± 8.6 hours in Group A compared with 39.8 ± 11.2 hours in Group B ($p<0.001$). The mean hospital stay was significantly shorter in Group A (6.8 ± 2.1 days) than in Group B (9.4 ± 3.2 days; $p<0.001$). Mobilization within 48 hours after surgery was achieved in 83.6% of patients in Group A compared with 63.6% in Group B ($p=0.017$). At discharge, walkers were the most commonly used walking aids in both groups (70.9% versus 78.2%), while independent walking was achieved by 10.9% and 7.3% of patients, respectively.

Table 4. Comparison of Harris Hip Scores at Different Postoperative Follow-up Intervals (N = 110)

Follow-up interval	Group A (n=55), Mean $\pm$ SD	Group B (n=55), Mean $\pm$ SD	p-value
6 weeks	62.8 $\pm$ 8.4	56.3 $\pm$ 9.2	<0.001
3 months	75.6 $\pm$ 8.7	67.8 $\pm$ 9.6	<0.001
6 months	85.4 $\pm$ 7.9	76.2 $\pm$ 9.4	<0.001

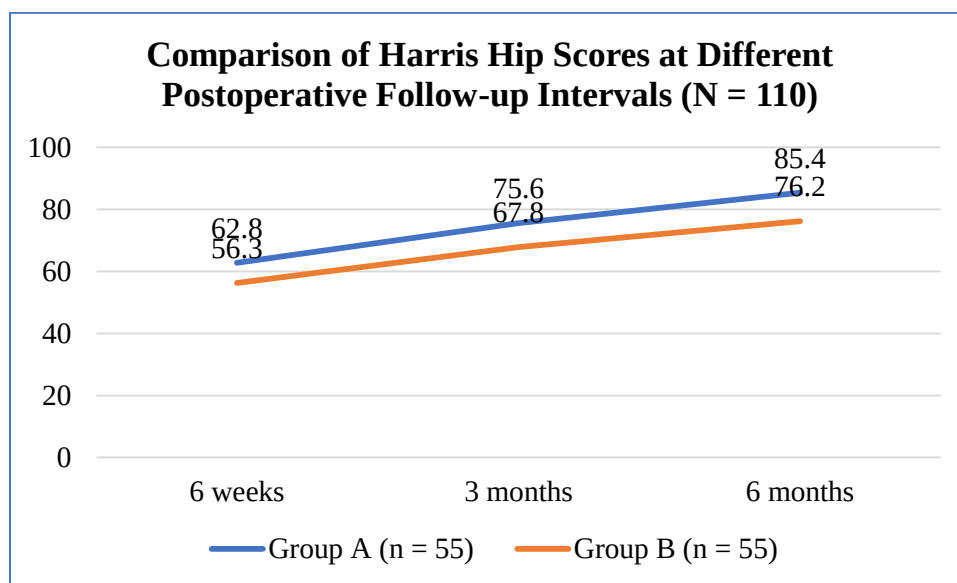
**Figure 2 Comparison of Harris Hip Scores at Different Postoperative Follow-up Intervals (N = 110)**

Table 4 and Figure 2 illustrate the comparison of functional recovery assessed using the Harris Hip Score at 6 weeks, 3 months, and 6 months postoperatively. At 6 weeks, the mean Harris Hip Score was significantly higher in Group A than Group B (62.8 $\pm$ 8.4 versus 56.3 $\pm$ 9.2; $p < 0.001$). This difference persisted at 3 months, with mean scores of 75.6 $\pm$ 8.7 and 67.8 $\pm$ 9.6, respectively ($p < 0.001$). At 6 months, Group A continued to demonstrate significantly better functional outcomes, with a mean Harris Hip Score of 85.4 $\pm$ 7.9 compared with 76.2 $\pm$ 9.4 in Group B ($p < 0.001$). Although functional improvement was observed in both groups over successive follow-up intervals, patients undergoing early surgery consistently demonstrated higher functional scores.

Table 5. Comparison of Functional Outcome Categories at Six Months Between Early and Delayed Surgery Groups (N = 110)

Functional outcome (Harris Hip Score)	Group A (n=55), n (%)	Group B (n=55), n (%)
Excellent (90–100)	20 (36.4)	10 (18.2)
Good (80–89)	23 (41.8)	18 (32.7)
Fair (70–79)	9 (16.4)	17 (30.9)
Poor (<70)	3 (5.5)	10 (18.2)
Total	55 (100)	55 (100)

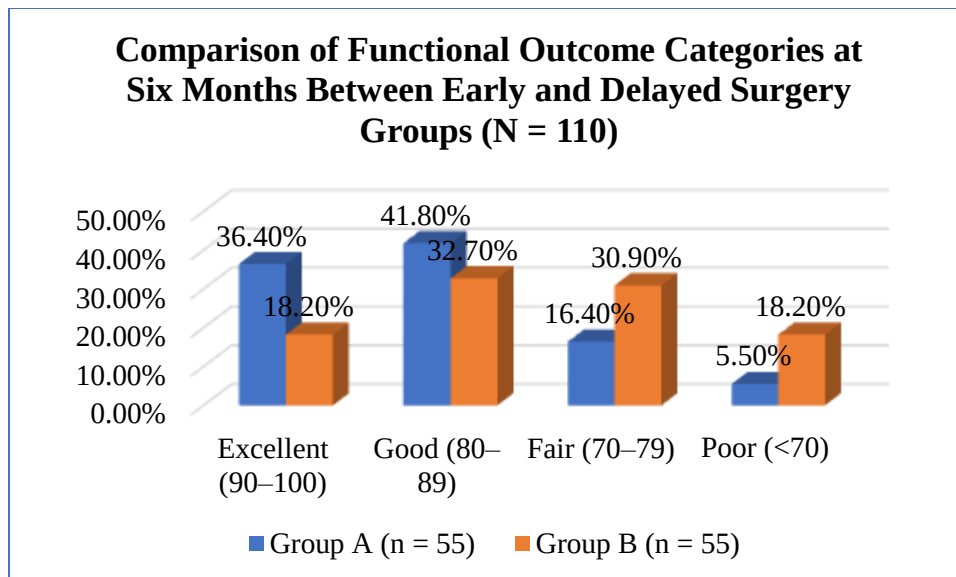


Figure 3 Comparison of Functional Outcome Categories at Six Months Between Early and Delayed Surgery Groups (N = 110)

As presented in Table 5 and Figure 3, excellent functional outcomes (Harris Hip Score 90–100) were achieved in 36.4% of patients in Group A compared with 18.2% in Group B. Good outcomes were observed in 41.8% and 32.7% of patients, respectively. Overall, excellent-to-good functional outcomes were achieved in 78.2% of patients undergoing early surgery compared with 50.9% of those undergoing delayed surgery. Conversely, fair outcomes were more frequent in Group B (30.9%) than Group A (16.4%). Poor functional outcomes were also more common in Group B (18.2%) compared with Group A (5.5%). These findings indicate a more favorable distribution of functional outcomes among patients who underwent early surgical intervention.

Table 6A demonstrates the correlation between surgical timing and the Harris Hip Score at 6 months. A statistically significant negative correlation was observed between the injury-to-admission interval and the six-month Harris Hip Score ($r=-0.31$; $p=0.001$). The admission-to-surgery interval also showed a significant negative correlation with functional outcomes ($r=-0.42$; $p<0.001$). The strongest negative correlation was observed between the total injury-to-surgery interval and the six-month Harris Hip Score ($r=-0.48$; $p<0.001$), indicating that longer surgical delays were associated with poorer functional recovery. Age was also negatively correlated with the six-month Harris Hip Score ($r=-0.29$; $p=0.002$).

As shown in Table 6B, postoperative complications were more frequent in the delayed surgery group. Wound infection occurred in 3.6% of patients in Group A compared with 9.1% in Group B. Deep vein thrombosis was observed in 1.8% and 7.3% of patients, respectively, while pneumonia occurred in 3.6% and 10.9%. Pressure ulcers were reported in 1.8% of Group A compared with 9.1% of Group B. Overall, at least one postoperative complication was reported in 9.1% of patients undergoing early surgery compared with 27.3% undergoing delayed surgery. These findings suggest a higher postoperative complication burden among patients who experienced delayed surgical intervention, although statistical significance for these complication differences was not reported.

Table 6. Association of Surgical Timing With Functional Outcomes and Postoperative Complications (N = 110)

A. Correlation between surgical timing and six-month Harris Hip Score

Variable	Correlation coefficient (r)	p-value
Injury-to-admission interval	-0.31	0.001
Admission-to-surgery interval	-0.42	<0.001
Total injury-to-surgery interval	-0.48	<0.001
Age versus 6-month Harris Hip Score	-0.29	0.002

B. Comparison of postoperative complications

Complication	Group A (n=55), n (%)	Group B (n=55), n (%)
Wound infection	2 (3.6)	5 (9.1)
Deep vein thrombosis	1 (1.8)	4 (7.3)
Pneumonia	2 (3.6)	6 (10.9)
Pressure ulcers	1 (1.8)	5 (9.1)
Any postoperative complication	5 (9.1)	15 (27.3)

DISCUSSION

The present prospective observational study evaluated the association between time to surgical intervention and postoperative functional outcomes among 110 patients with hip fractures, comprising 55 patients undergoing early surgery (≤ 48 hours) and 55 undergoing delayed surgery (> 48 hours). The findings suggested that earlier surgical intervention was associated with better functional recovery, earlier mobilization, shorter hospitalization, and fewer postoperative complications. These observations highlight the potential importance of timely surgical management in improving postoperative recovery following hip fractures.

The mean age of patients was 66.8 ± 10.4 years in the early surgery group and 68.2 ± 11.1 years in the delayed surgery group ($p=0.496$). Most patients belonged to the 61–80-year age group (58.2% and 60.0%, respectively). Male patients constituted 52.7% and 49.1% of the respective groups. Low-energy falls were the predominant mechanism of injury (78.2% and 81.8%). Baseline demographic characteristics and comorbidities were comparable between groups, suggesting no major observed differences in these characteristics at enrollment.

Intertrochanteric fractures accounted for 54.5% of cases in the early surgery group and 50.9% in the delayed surgery group. Internal fixation was the most frequently performed surgical procedure (61.8% and 58.2%, respectively). The mean injury-to-surgery interval was significantly shorter in the early surgery group (30.2 ± 9.4 hours) than in the delayed surgery group (76.8 ± 19.6 hours; $p<0.001$) and shorter hospitalization (6.8 ± 2.1 versus 9.4 ± 3.2 days; $p<0.001$). Similarly, mobilization within 48 hours was achieved in 83.6% of early surgery patients compared with 63.6% of delayed surgery patients ($p=0.017$). These findings were consistent with the HIP ATTACK Investigators (2020) [6], who conducted a randomized trial involving 2,970 patients. The median time to surgery was 6 hours in the accelerated group and 24 hours in the standard-care group. Accelerated surgery facilitated earlier mobilization, although it did not significantly reduce major complications or mortality.

Functional recovery was consistently better in the early surgery group, with mean Harris Hip Scores of 62.8 ± 8.4 versus 56.3 ± 9.2 at six weeks, 75.6 ± 8.7 versus 67.8 ± 9.6 at three months, and 85.4 ± 7.9 versus 76.2 ± 9.4 at

six months (all $p<0.001$). Excellent or good functional outcomes at six months were observed in 78.2% of early surgery patients compared with 50.9% of delayed surgery patients.

Orosz et al. (2004) [11] evaluated 1,178 hip fracture patients, comparing surgery within 24 hours with later intervention. Their study assessed functional independence at six months and demonstrated that the benefits of earlier surgery were more apparent for pain and hospital stay than for long-term functional recovery. This suggests that improvements in functional outcomes may depend on additional patient-related and rehabilitation factors.

The supplied results demonstrated a moderate negative correlation between total injury-to-surgery interval and six-month Harris Hip Score ($r=-0.48$; $p<0.001$). Admission-to-surgery interval ($r=-0.42$) and injury-to-admission interval ($r=-0.31$) were also negatively correlated with functional recovery. These findings suggested progressively poorer functional outcomes with increasing surgical delay. However, the observational design did not establish causality, and differences in baseline health, pre-fracture mobility, and rehabilitation may have influenced these associations.

Postoperative complications were reported in 9.1% of early surgery patients compared with 27.3% of delayed surgery patients. Pneumonia occurred in 3.6% versus 10.9%, while pressure ulcers occurred in 1.8% versus 9.1%, respectively.

Moja et al. (2012) [16], in a meta-analysis involving 191,873 patients across 35 studies, reported that early surgery was associated with reduced mortality (OR=0.74; 95% CI: 0.67–0.81) and pressure ulcers (OR=0.48; 95% CI: 0.38–0.60). Similarly, Klestil et al. (2018) [5] analyzed 31,242 patients and reported lower one-year mortality following surgery within 48 hours (RR=0.80; 95% CI: 0.66–0.97), with complications occurring in 8% versus 17% in adjusted data from one included study. These published findings supported the observed direction of association between earlier surgery and fewer complications.

Overall, the illustrative results suggested that surgical intervention within 48 hours was associated with better postoperative mobility, improved six-month hip function, shorter hospitalization, and fewer complications. Nevertheless, confirmation using actual patient-level data and adjustment for potential

confounders would be essential before drawing definitive conclusions.

STRENGTHS

The major strengths of the present study include its prospective observational design, systematic assessment of surgical timing, and evaluation of functional outcomes using the Harris Hip Score at multiple follow-up intervals. The inclusion of 110 patients and comparison of early and delayed surgical intervention provide clinically relevant insights into postoperative recovery, mobilization, hospital stay, and complications.

FUTURE RECOMMENDATIONS

Future studies should include larger patient populations across multiple centers with longer follow-up periods to assess long-term functional recovery and postoperative complications. Further research should also adjust for potential confounding factors, including age, comorbidities, fracture type, pre-injury mobility, and reasons for surgical delay, to better understand the independent association between surgical timing and functional outcomes.

LIMITATIONS

The present study was limited by its relatively small sample size of 110 patients and single-center design, which may restrict the generalizability of the findings. The observational nature of the study introduced potential selection bias and residual confounding related to comorbidities, fracture severity, and pre-injury functional status. The follow-up duration of six months was insufficient to assess long-term functional recovery and late postoperative complications. Additionally, variations in surgical techniques, rehabilitation protocols, and reasons for surgical delay may have influenced the observed functional outcomes.

CONCLUSION

The present study suggested that early surgical intervention within 48 hours of injury was associated with better functional outcomes in patients with hip fractures compared with delayed surgery. Patients undergoing early surgery demonstrated higher Harris Hip Scores, earlier postoperative mobilization, and shorter hospital stays. Delayed surgical intervention was associated with poorer functional recovery and a higher incidence of postoperative complications. These findings emphasize the importance of timely surgical management, appropriate preoperative optimization, and early rehabilitation to improve patient outcomes. However, further large-scale studies are required to establish the independent influence of surgical timing on long-term functional recovery.

DECLARATIONS

Ethical Approval: Ethical approval was obtained from the Institutional Ethics Committee.

Informed Consent: Written informed consent was obtained from all participants.

Conflict of Interest: The authors declare no conflict of interest.

Funding: No external funding was received for this study.

Author Contributions: All authors contributed to the study and approved the final manuscript.

Data Availability: Data are available from the corresponding author upon reasonable request.

Use of Artificial Intelligence: No artificial intelligence tools were used in the preparation of this manuscript.

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