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Postoperative Functional Status and Quality of Life Indicators in Patients Following Femoral Neck System Fixation

[*]Dr. Manash Chandra Sarker[1], Dr. Rajon Chandra Shaha[2], Prof. Dr. Md. Jahangir Alam[3], Dr. Devolina Bhowmik[4], Dr. Prianka Roy[5], Dr. Jhuton Chandra Banik[6], Dr. Md. Shohidullah[7], Dr. Takvir Ahmed

[1]*Senior Consultant, Department of Orthopaedics Surgery, Sarkari Karmachari Hospital, Dhaka, Bangladesh*
[2]*Junior Consultant, Department of Orthopaedics Surgery, Sarkari Karmachari Hospital, Dhaka, Bangladesh*
[3]*Professor, Department of Orthopaedics Surgery, Shaheed M. Monsur Ali Medical College, Sirajganj, Bangladesh*
[4]*Associate Professor, Department of Microbiology, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh*
[5]*Consultant, Department of Paediatrics, Popular Diagnostic Center, Narayanganj, Bangladesh*
[6]*Assistant Professor, Department of Orthopaedics & Traumatology, Government Employee Hospital, Dhaka, Bangladesh*
[7]*Assistant Professor, Department of Orthopaedics & Traumatology, Government Employee Hospital, Dhaka, Bangladesh*
[8]*Medical Officer, Department of Orthopaedics, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh*
Corresponding Author: *Dr. Rajon Chandra Shaha, Junior Consultant, Department of Orthopaedics Surgery, Sarkari Karmachari Hospital, Dhaka, Bangladesh*

Abstract
Background: *Femoral neck fractures (FNFs) are injuries of significant clinical concern, with their incidence rising globally and associated complications often leading to persistent functional limitations despite fracture healing. The purpose of the study was to evaluate postoperative functional status and quality of life in patients undergoing Femoral Neck System fixation.*
Methods: *This quasi-experimental study at the Department of Orthopedics, National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka, Bangladesh, from March 2022 to September 2024, included 45 patients aged 18–65 years with recent femoral neck fractures treated with FNS, assessing radiological union, Harris Hip Score, and postoperative complications. Preoperative evaluation, prophylactic antibiotics, early mobilization, and scheduled follow-ups were implemented, with data analyzed using SPSS v26 ($p < 0.05$).*
Results: *The study (n=45) had a mean age of 41.8 ± 9.3 years, mostly males (35, 77.8%), with injuries from road traffic accidents (27, 60.0%) and falls (18, 40.0%). Radiological union occurred in 43 (95.6%), with 39 (86.7%) healing without complications. Most patients reported no or slight pain (44, 97.8%), walked independently (38, 84.4%) with minimal limping (36, 80.0%), and demonstrated independence in daily activities. Functional recovery was excellent/good in 38 (84.4%) with mean HHS 86.1 ± 8.8 and range of motion 161–210° in 38 (84.4%).*
Conclusion: *Femoral Neck System fixation effectively restores mobility, function, and quality of life in patients with femoral neck fractures.*
Key words: *Femoral Neck Fractures, Functional Recovery, Quality of Life.*

I. Introduction

Femoral neck fractures (FNFs) are injuries of significant clinical concern, with their global incidence steadily increasing. Estimates suggest that hip fractures, including FNFs, may rise from 1.7 million cases in 1990 to over 6 million by 2050 [1]. Displaced femoral neck fractures, classified as Garden III and IV, are distinct from undisplaced fractures (Garden I and II) and from trochanteric fractures [2], due to their higher susceptibility to complications during healing. Although these fractures predominantly affect elderly individuals with decreased bone density, younger adults can also experience FNFs, typically from high-energy trauma. In patients under 70 years, such fractures carry the risk of lifelong disability and may adversely impact life expectancy [3-6]. Traditional assessments of recovery have focused on surgical complications and functional limitations, yet many patients continue to face restrictions in mobility and daily activities even after fracture union [7-10].

Management of femoral neck fractures continues to pose challenges because conventional internal fixation is associated with considerable rates of healing complications and secondary surgical interventions [8,11]. While internal fixation remains the primary treatment in several regions, arthroplasty procedures—hemiarthroplasty or total hip replacement—are increasingly preferred in others, particularly for older patients, influenced by both clinical outcomes and economic considerations. Despite technical advances, identifying the most effective fixation method to ensure stable fracture healing while maintaining hip function remains a subject of ongoing investigation. Comparisons between femoral neck and trochanteric fractures in predicting functional recovery have produced inconsistent findings, underscoring the need for improved fixation techniques that promote better postoperative outcomes [12]. The Femoral Neck System (FNS) has emerged as a modern alternative, offering stable, minimally invasive fixation and allowing early mobilization, which may enhance functional recovery compared to traditional approaches.

While achieving radiological union remains a key marker of fracture healing, functional outcomes and patients' quality of life are increasingly recognized as critical indicators of treatment success [13]. Historically, outcome reporting has emphasized surgical complications or hip-specific scores, but the broader impact on physical, psychological, and social functioning has often been underexplored [14]. Evaluating health-related quality of life (HRQoL) provides insight into the areas most affected by femoral neck fractures and can guide postoperative management and rehabilitation strategies. In younger adults, the ultimate aim extends beyond fracture union to restoring functional independence and HRQoL [14], highlighting the importance of studies that assess mobility, daily activity performance, and overall functional recovery following FNS fixation.

Despite the growing use of the Femoral Neck System (FNS), most existing studies have primarily focused on radiological outcomes, complication rates, or general hip scores, with limited attention to patient-centered measures such as functional status and quality of life. Additionally, the majority of research has concentrated on elderly populations, while evidence regarding younger adults sustaining high-energy femoral neck fractures remains sparse. Few studies have comprehensively evaluated postoperative mobility, independence in activities of daily living, pain, and overall health-related quality of life in patients treated with FNS. Addressing these gaps is essential for understanding the real-world impact of FNS fixation on patients' daily function and long-term recovery. The purpose of the study is to evaluate postoperative functional status and quality of life in patients undergoing Femoral Neck System fixation.

II. Objective

- To evaluate postoperative functional status and quality of life in patients undergoing Femoral Neck System fixation.

III. Methodology & Materials

This quasi-experimental study was conducted at the National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka, Bangladesh, from March 2022 to September 2024. A total of 45 patients with femoral neck fractures were recruited using purposive sampling to evaluate postoperative functional status and quality of life following Femoral Neck System (FNS) fixation.

Inclusion Criteria

- Adults aged 18–65 years with femoral neck fractures
- Fractures sustained within 14 days of injury

Exclusion Criteria

- Femoral neck fractures associated with hip dislocation
- Pathological fractures
- Unstable medical conditions increasing morbidity or mortality
- Associated pelvic or acetabular fractures

Variables

Independent variables included age, sex, mechanism of injury, affected side, fracture type, and time from injury to surgery. Dependent variables were radiological union, functional outcomes assessed using the Harris Hip Score (HHS), and postoperative complications.

Preoperative Assessment

All participants underwent detailed history-taking, clinical examination, and standard anterior-posterior and lateral hip radiographs. Routine investigations were conducted for anesthesia clearance. Surface traction was applied for immobilization as required, and written informed consent was obtained from all patients.

Surgical Procedure and Postoperative Care

Patients received a prophylactic dose of intravenous Cefuroxime one hour prior to surgery. Fracture fixation was performed using the Femoral Neck System according to standard operative protocols. Postoperatively, patients were monitored in the recovery room and initiated on isometric quadriceps exercises within 24 hours as tolerated. Discharge typically occurred on the 3rd or 4th postoperative day with instructions for continued exercises, active hip, knee, and ankle movements, non-weight-bearing ambulation with crutches, and scheduled follow-up visits at 2, 6, 12 weeks, and 6 months. Radiographs at each follow-up assessed fracture alignment, length, rotation, and union. Weight-bearing was gradually advanced from non-weight-bearing to partial and then full based on radiological evaluation. Functional outcomes were assessed using the Harris Hip Score.

Data Collection and Statistical Analysis

Data were recorded using a pretested structured questionnaire documenting demographics, clinical and radiological findings, intraoperative details, complications, and follow-up outcomes. Statistical analysis was performed using SPSS version 26. Categorical variables were expressed as frequencies and percentages, and continuous variables as mean ± SD and range. Student's t-test was used for continuous variables, and Chi-square test for categorical variables. A p-value <0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of NITOR. Written informed consent was obtained from all participants, and confidentiality and voluntary participation were ensured throughout the study.

Figure 1: Preoperative radiographs of the hip showing a displaced femoral neck fracture in an adult male patient, prior to Femoral Neck System fixation

Figure 2: Immediate postoperative radiographs demonstrating stabilization of the femoral neck fracture using a Femoral Neck System implant in an adult male patient.

Figure 3: Serial follow-up radiographs of the hip in an adult male patient following Femoral Neck System fixation: A. At 12 weeks, B. At 6 months, C. At 12 months

IV. Results

Table 1: Baseline Characteristics of Study Participants (n = 45)

Category	Variable	Frequency n (%)
Age (years)	18–27	0 (0.0)
	28–38	19 (42.0)
	39–49	13 (28.9)
	50–60	13 (28.9)
	61–65	0 (0.0)
	Mean ± SD (Range)	**41.8 ± 9.3 (28–60)**
Sex	Male	35 (77.8)
	Female	10 (22.2)
Mechanism of injury	Road traffic accident	27 (60.0)
	Fall from height	18 (40.0)

The study cohort had a mean age of 41.8 ± 9.3 years. The majority were males (35 patients, 77.8%). Road traffic accidents were the leading cause of injury (27 patients, 60.0%), followed by falls from height (18 patients, 40.0%).

Table 2: Postoperative Complications and Radiological Healing Status (n = 45)

Category	Variable	Frequency n (%)
Primary Healing Outcome	No complication with fracture union	39 (86.7)
	Any complication or adverse radiological outcome	6 (13.3)

Type of Postoperative Complication	Superficial surgical site infection (SSI)	3 (6.7)
	Avascular necrosis (AVN)	2 (4.4)
	Implant-related issue (broken guidewire)	1 (2.2)
Radiological Healing Status	Fracture united	43 (95.6)
	Fracture not united (non-union)	2 (4.4)

Most patients (39, 86.7%) experienced uneventful healing, and radiological union was observed in 43 patients (95.6%). Postoperative complications were rare, with superficial surgical site infection being the most frequent (3 patients, 6.7%).

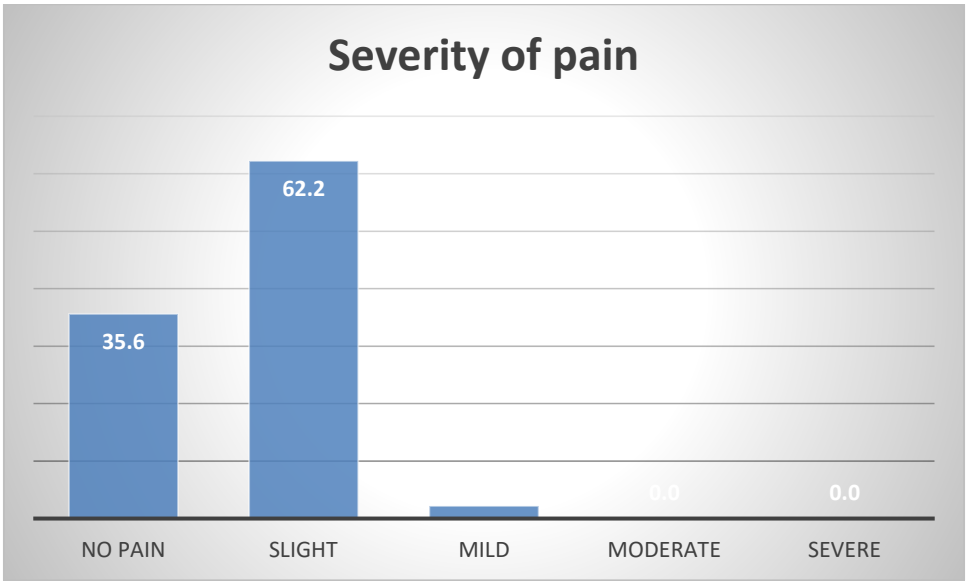

Figure 4: Distribution of Study Participants According to Postoperative Pain Severity (n = 45)

At final follow-up, the majority of patients reported slight pain (28 patients, 62.2%), while 16 patients (35.6%) experienced no pain. Only 1 patient (2.2%) reported mild pain. No patients reported moderate or severe postoperative pain following Femoral Neck System fixation.

Table 3: Postoperative Mobility Status of Participants (n = 45)

Category	Variable	Frequency n (%)
Walking Support	None	38 (84.4)
	Cane for long walk	5 (11.1)
	One crutch	2 (4.4)
Postoperative Limping	None	36 (80.0)
	Slight	3 (6.7)
	Moderate	6 (13.3)
	Severe	0 (0.0)
Walking Distance	2–3 blocks	11 (24.4)

	6 blocks	34 (75.6)

At final follow-up, most patients could walk without support (38 patients, 84.4%) and had no limping (36 patients, 80.0%). Walking distance of six blocks was achieved by 34 patients (75.6%). Pain was mostly slight (28 patients, 62.2%), with only 1 patient (2.2%) reporting mild pain.

Table 4: Independence in Activities of Daily Living (n = 45)

Category	Variable	Frequency n (%)
Use of Stairs	In any manner	2 (4.4)
	Normally with railing	10 (22.2)
	Normally without railing	33 (73.3)
Use of Shoes and Socks	With difficulty	27 (60.0)
	With ease	18 (40.0)
Capacity to Sit	On high chair for 30 min	7 (15.6)
	Comfortable on ordinary chair	38 (84.4)
Use of Public Transport	Unable	2 (4.4)
	Able to use	43 (95.6)

Most patients demonstrated independence in daily activities. The majority could use stairs without a railing (33 patients, 73.3%), sit comfortably on an ordinary chair (38 patients, 84.4%), and use public transport (43 patients, 95.6%). Wearing shoes and socks with ease was achieved by 18 patients (40.0%).

Table 5: Postoperative Functional Recovery (n = 45)

Category	Variable	Frequency n (%)
Range of Motion (degrees)	61–100	2 (4.4)
	101–160	5 (11.1)
	161–210	38 (84.4)
Harris Hip Score (HHS)	<70	2 (4.4)
	70–79	5 (11.1)
	80–89	20 (44.4)
	>90	18 (40.0)
	Mean ± SD	86.1 ± 8.8
Functional Outcome (FNS)	Excellent	18 (40.0)
	Good	20 (44.4)
	Fair	5 (11.1)
	Poor	2 (4.4)

Functional recovery was favorable. The majority achieved a hip range of motion between 161–210 degrees (38 patients, 84.4%). Mean HHS was 86.1 ± 8.8. Overall, 38 patients (84.4%) demonstrated excellent or good functional outcomes according to FNS criteria.

V. Discussion

Femoral neck fractures are clinically significant injuries that can result in long-term functional impairment and reduced quality of life if not appropriately managed. The Femoral Neck System (FNS) has been introduced as a modern fixation method aimed at providing stable fracture stabilization and facilitating early mobilization. The findings of this study demonstrate that FNS fixation is associated with high rates of fracture union, minimal complications, and favorable postoperative functional outcomes, including preserved mobility, independence in daily activities, and satisfactory hip function. These results highlight the importance of effective fixation and structured postoperative care in optimizing functional recovery and quality of life in patients with femoral neck fractures.

The baseline characteristics of the present cohort indicate that Femoral Neck System (FNS) fixation was predominantly utilized in a relatively young, working-age population, with a mean age of 41.8 ± 9.3 years and most patients concentrated between 28 and 60 years. This age distribution differs from several previously published FNS series that primarily involved older patients. For example, Yoon et al.[15] reported a higher mean age of 62.1 years in a retrospective cohort of 43 patients, while Chan et al.[16] described a mean age of 63.5 ± 16.9 years in their case series of 50 patients. The younger demographic in the current study likely reflects differences in injury mechanisms, as road traffic accidents accounted for 60.0% of cases, followed by falls from height in 40.0%, suggesting a predominance of high-energy trauma. In contrast, FNS cohorts with older populations commonly report low-energy falls as the leading cause of injury. A marked male predominance (77.8%) was also observed, which is consistent with greater exposure of males to high-velocity trauma in younger populations. Despite these demographic differences, the inclusion of age, sex, and mechanism of injury as baseline variables aligns with earlier FNS studies and highlights the applicability of FNS fixation across varying patient populations and injury patterns.

Radiological healing outcomes following FNS fixation in the present study were highly favorable, with fracture union achieved in 95.6% of patients and nonunion observed in only 4.4%. Uncomplicated fracture union without any adverse outcomes was documented in 86.7% of participants, a finding that likely contributed to the favorable postoperative functional recovery and quality of life observed. The overall complication rate was low (13.3%), with superficial surgical site infection being the most frequent complication (6.7%), followed by avascular necrosis (4.4%) and a single implant-related issue (2.2%). These findings are comparable to those reported by Yoon et al.[15], who observed bone union in approximately 90.7% of patients with only two cases of nonunion and one instance of osteonecrosis, as well as Lim et al.[17], who reported similarly low rates of nonunion (3.6%) and avascular necrosis (7.1%) in their FNS cohort. The consistently high union rates and low incidence of serious complications across studies support the role of FNS in providing stable fixation, promoting biological healing, and enabling early functional recovery—factors that directly influence postoperative comfort, mobility, and overall quality of life.

Postoperative pain levels in the present cohort were generally minimal at final follow-up, with 62.2% of patients reporting slight pain and 35.6% reporting no pain at all. Only one patient (2.2%) experienced mild pain, and none reported moderate or severe pain. This favorable pain profile suggests effective fracture stabilization and satisfactory postoperative recovery. These findings are consistent with those of Si et al.[18], who reported comparable postoperative pain levels between FNS fixation and total hip arthroplasty using validated pain assessment scales, alongside satisfactory functional outcomes. Similarly, Xu et al.[19] demonstrated that patients treated with FNS experienced lower postoperative pain and superior Harris Hip Scores compared with those treated with cannulated cancellous screws. The predominance of minimal pain in the current cohort likely facilitated early mobilization and functional independence, further supporting the contribution of FNS fixation to improved postoperative comfort and quality of life.

Functional mobility outcomes were similarly favorable, with most patients regaining independent ambulation and demonstrating minimal gait disturbance. Independent walking without support was achieved by 84.4% of patients, while only 11.1% required a cane for long distances and 4.4% required a single crutch. The absence of limping in 80.0% of participants further reflects effective restoration of gait mechanics, with no cases of severe limp observed. In terms of walking capacity, 75.6% of patients were able to walk up to six blocks, indicating good endurance and confidence during daily ambulation. These findings parallel those of Weng et al.[20], who reported significant improvements in functional mobility following FNS fixation using Harris Hip Score and Parker Mobility Score. Similarly, Kale et al.[21] observed marked functional gains with early mobilization and weight-bearing protocols, resulting in independent walking and minimal gait impairment. Together, these observations reinforce the role of FNS fixation in facilitating early and sustained postoperative mobility.

A high degree of independence in activities of daily living was also observed at final follow-up. Most patients were able to use stairs independently, with 73.3% climbing stairs normally without a railing and 22.2% using minimal support. Sitting comfort was well preserved, as 84.4% of patients could sit comfortably on an ordinary chair, and 95.6% were able to use public transport independently, reflecting confidence in community

ambulation. Additionally, 40.0% of patients were able to wear shoes and socks with ease, suggesting reasonable recovery of hip flexion and functional reach. These findings are consistent with the observations of Kale et al.[21], who reported significant improvements in functional independence following FNS fixation with structured rehabilitation, as reflected by improved Harris Hip Scores. Likewise, the meta-analysis by Wu et al.[22] demonstrated that higher postoperative Harris Hip Scores following FNS fixation correlate with better performance in walking, stair use, and general activities of daily living, indirectly supporting the high level of independence observed in the present cohort.

Overall functional recovery following FNS fixation in this study was excellent, with the majority of patients achieving substantial restoration of hip motion and function. At final follow-up, 84.4% of patients achieved a hip range of motion between 161° and 210°, while only a small proportion demonstrated more limited movement. Functional assessment using the Harris Hip Score showed that 84.4% of patients scored 80 or above, with a mean score of 86.1 ± 8.8, indicating good to excellent hip function. Correspondingly, excellent and good functional outcomes were observed in 40.0% and 44.4% of patients, respectively, while poor outcomes were uncommon. These results closely mirror those of Raj et al.[23], who reported a mean HHS of approximately 86.6 following FNS fixation in young adults, and Hu et al.[24], who demonstrated satisfactory postoperative functional improvement in patients treated with FNS compared with cannulated compression screws. Collectively, these findings suggest that FNS fixation consistently enables meaningful functional recovery, preserved joint mobility, and improved quality of life following femoral neck fractures.

VI. Limitations of the study

The study had several limitations:

- The study did not stratify outcomes based on different fracture types, which may influence results.
- The impact of postoperative rehabilitation protocols on functional recovery was not evaluated.
- Absence of a control group limits comparison with alternative fixation methods.
- Relatively short follow-up may not capture long-term outcomes or late complications.

VII. Conclusion

Femoral Neck System fixation provides reliable stabilization for femoral neck fractures, particularly in a relatively young, active population, facilitating early recovery and return to daily activities. In this study, patients demonstrated low postoperative pain, high levels of independent ambulation, and minimal gait disturbances, reflecting effective restoration of mobility. Most participants regained the ability to perform daily activities such as stair climbing, sitting comfortably, and using public transport, indicating substantial recovery in functional independence. Hip function was well preserved, with favorable range of motion and overall Harris Hip Scores, translating into predominantly good to excellent functional outcomes. These findings highlight the effectiveness of FNS in promoting fracture healing, functional recovery, and improved quality of life following femoral neck fractures.

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