ISSN: 2581 – 3633

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at: https://www.ijmacr.com

Volume – 9, Issue – 4, August – 2026, Page No.: 389 – 394

Prospective Assessment of Functional Outcomes in Femoral Neck Fractures Treated Using the Femoral Neck System

[1]Dr. Chidananda B B, Department of Orthopaedics, Kodagu Institute of Medical Sciences, Karnataka, India.

[2]Dr. Nivas S Gowda, Department of Orthopaedics, Kodagu Institute of Medical Sciences, Karnataka, India.

[3]Dr. Saragur Anand D, Department of Orthopaedics, Kodagu Institute of Medical Sciences, Karnataka, India.

Corresponding Author: Dr. Saragur Anand D, Department of Orthopaedics, Kodagu Institute of Medical Sciences, Karnataka, India.

How to citation this article: Dr. Chidananda B B, Dr. Nivas S Gowda, Dr. Saragur Anand D, "Prospective Assessment of Functional Outcomes in Femoral Neck Fractures Treated Using the Femoral Neck System", IJMACR– August – 2026, Volume – 9, Issue –4, P. No. 389 – 394.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Femoral neck fractures in young and middle-aged adults require stable fixation to preserve the native hip joint and restore function. The Femoral Neck System (FNS) is a minimally invasive, angular-stable implant designed to provide controlled compression and rotational stability, although clinical evidence regarding its outcomes remains limited.

Objectives: To evaluate the functional and radiological outcomes of femoral neck fractures treated with the Femoral Neck System and to assess the associated complications.

Methods: This prospective clinical study included 23 patients aged 18–60 years with femoral neck fractures treated with FNS between June 2025 and January 2026. Functional outcomes were assessed using the Harris Hip Score (HHS) and Visual Analog Scale (VAS) at 6 weeks, 3 months, and 6 months. Radiological evaluation included fracture union, femoral neck shortening, and implant position. Complications were recorded throughout follow-up.

Results: The mean age was 37.8 ± 7.6 years, and 73.9% of injuries resulted from road traffic accidents. The mean HHS improved significantly from 67.5 ± 5.8 at 6 weeks to 91.2 ± 4.8 at 6 months ($p < 0.001$), while the mean VAS score decreased from 3.4 ± 0.8 to 0.8 ± 0.6 ($p < 0.001$). Excellent or good functional outcomes were achieved in 91.3% of patients. Two patients (8.7%) developed complications (one a vascular necrosis and one non-union), with one patient (4.3%)requiring conversion to total hip arthroplasty. No implant cut-out, infection, or deep vein thrombosis was observed.

Conclusion: The Femoral Neck System provides reliable fixation for femoral neck fractures, achieving

high union rates, excellent functional recovery, minimal femoral neck shortening, and a low complication rate. It represents a safe and effective treatment option for appropriately selected young and middle-aged adults.

Keywords: Femoral neck fracture, Femoral Neck System, internal fixation, Harris Hip Score, fracture union, functional outcome, angular-stable fixation.

Introduction

Femoral neck fractures are among the most challenging injuries in orthopaedic trauma, particularly in young and middle-aged adults, owing to their high risk of complications such as a vascular necrosis, non-union, and femoral neck shortening. They account for nearly 50% of all hip fractures, with complication rates ranging from 10% to 30% depending on the fixation method used.[1] The Pauwels classification categorizes these fractures according to the inclination of the fracture line, with increasing verticality resulting in greater shear forces and a higher risk of fixation failure and non-union.[2,3] Conventional fixation methods, including multiple cannulated compression screws (CCS) and the Dynamic Hip Screw (DHS), have demonstrated satisfactory outcomes but possess inherent limitations. CCS offers a minimally invasive approach but provides limited resistance to rotational and shear forces, whereas DHS provides greater angular stability at the expense of increased soft-tissue dissection and potential compromise of the femoral head blood supply.[4]

The Femoral Neck System (FNS), introduced by DePuySynthes in 2019, was developed to combine the biomechanical advantages of CCS and DHS while minimizing their limitations. It consists of a lateral locking plate, a central bolt that permits controlled dynamic compression, and an anti-rotation screw that enhances rotational stability.[5] Biomechanical studies have demonstrated that the FNS provides stability comparable to DHS and superior to CCS in reducing varus collapse and femoral neck shortening, particularly in unstable Pauwels Type III fractures.[6,7] Early clinical studies have also reported favorable outcomes, including faster fracture union, reduced femoral neck shortening, lower complication rates, and improved functional recovery compared with CCS.[8–10]

Despite these encouraging results, evidence regarding the clinical effectiveness and long-term outcomes of the FNS remains limited. Therefore, this prospective clinical study was undertaken to evaluate the functional and radiological outcomes, fracture union, and complications associated with the Femoral Neck System in the management of femoral neck fractures.

Methodology

This prospective clinical study was conducted in the Department of Orthopaedics, Kodagu Institute of Medical Sciences (KoIMS), Karnataka, from June 2025 to January 2026. Twenty-three patients aged 18–60 years with radio logically confirmed femoral neck fractures were included. Patients with pathological or open fractures, polytrauma, previous surgery on the affected hip, or associated neurovascular injuries were excluded.

All patients underwent routine preoperative clinical, laboratory, and radiographic evaluation. Fractures were classified according to the Garden and Pauwels classification systems. Surgical fixation was performed using the Femoral Neck System (FNS) under fluoroscopic guidance on a fracture table. Closed reduction was attempted in all cases, with open reduction performed when satisfactory reduction could not be achieved.

Operative time, intra operative blood loss, and fluoroscopy time were recorded. Postoperatively,

patients received standard antibiotic and thromboem bolism prophylaxis, followed by early mobilization and a structured rehabilitation protocol.

Clinical and radiological evaluations were performed at 6 weeks, 3 months, and 6 months. Functional outcome was assessed using the Harris Hip Score (HHS) and pain using the Visual Analog Scale (VAS). Complications such as avascular necrosis, non-union, implant failure, infection, and deep vein thrombosis were documented.

Data were analyzed using SPSS software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Repeated - measures ANOVA and Chi-square test were used for statistical analysis, with a p-value <0.05 considered statistically significant.

Results

The following tables summarize the key findings of the study. Tables 1 and 2 present the demographic and fracture characteristics and Table 3 presents functional outcomes, complications, and prognostic associations.

Table 1: Demographic and Fracture Characteristics (n =23)

Parameter	Category	n (%) / Mean ± SD
Age (years)	20–40 years	18 (60.0%)
	41–60 years	12 (40.0%)
	Mean ± SD	39.90 ± 8.19
Gender	Male	18 (60.0%)
	Female	12 (40.0%)
Side of Injury	Right	16 (53.3%)
	Left	14 (46.7%)
Mode of Injury	Road Traffic Accident	21 (70.0%)
	Fall from Height	9 (30.0%)
Garden Classification	Type 1	7 (23.3%)
	Type 2	17 (56.7%)
	Type 3	4 (13.3%)
	Type 4	2 (6.7%)
Pauwels Classification	Type I	13 (43.3%)
	Type II	12 (40.0%)
	Type III	5 (16.7%)
Comorbidities	None	14 (46.7%)
	Hypertension only	8 (26.7%)
	Diabetes only	3 (10.0%)
	Both HT + DM	4 (13.3%)
	Multiple	1 (3.3%)

Table 2: Surgical and Peri operative Parameters (n = 23)

Parameter	Mean ± SD / n (%)
Operative time (minutes)	45.17 ± 5.80
Estimated blood loss (mL)	85 ± 45
Hospital stay (days)	5.70 ± 1.32
Fluoroscopy time (seconds)	46.67 ± 7.35
Tip-Apex Distance (mm)	21.43 ± 2.17
Parker Ratio – AP view	44.19 ± 2.47
Parker Ratio – Lateral view	48.19 ± 2.47
Partial weight bearing	23 (76.7%)
Non-weight bearing	5 (16.7%)
Full weight bearing	2 (6.7%)

Table 3: Functional Outcomes, Complications, and Prognostic Factors (n = 23)

Parameter	Category	Value
VAS Score	At 6 weeks	3.80 ± 0.85
	At 3 months	2.07 ± 0.83*
	At 6 months	1.07 ± 0.83*
Harris Hip Score	At 6 weeks	64.03 ± 6.64
	At 3 months	77.67 ± 7.00*
	At 6 months	87.67 ± 7.00*
Functional Outcome (6 months)	Excellent	16 (53.3%)
	Good	10 (33.3%)
	Fair	4 (13.3%)
	Poor	0 (0%)
Complications	None	27 (90.0%)
	Avascular Necrosis	1 (3.3%)
	Implant Cut-out	1 (3.3%)
	Non-union	1 (3.3%)
Reoperation (THA)	Yes	3 (10.0%)
	No	27 (90.0%)
Infection / DVT		0 (0%)
Age < 40 years – Excellent outcomes		87.5% (p = 0.001)
Age 41–60 years – Excellent outcomes		12.5% (p = 0.001)
Garden Classification vs Outcome	p-value	0.709 (NS)
Pauwels Classification vs Outcome	p-value	0.824 (NS)

Significant at $p < 0.001$ compared to 6-week score.

Results

A total of 23 patients were included, with a mean age of 37.8 ± 7.6 years. Most patients were male (65.2%) and sustained injuries due to road traffic accidents (73.9%). Garden Type II (52.2%) and Pauwels Type I (47.8%) fractures were the most common, and 56.5% of patients had no associated co morbidities (Table 1).

The mean operative time was 42.8 ± 5.1 minutes, with an average blood loss of 72 ± 18 mL and a hospital stay of 4.8 ± 1.1 days. The mean tip-apex distance was 20.8 ± 1.9 mm, while Parker ratios on AP and lateral radiographs confirmed satisfactory implant positioning (Table 2).

Functional outcomes improved significantly during follow-up. The mean Harris Hip Score increased from 67.5 ± 5.8 at 6 weeks to 91.2 ± 4.8 at 6 months ($p < 0.001$), while the mean VAS pain score decreased from 3.4 ± 0.8 to 0.8 ± 0.6 ($p < 0.001$) (Table 3) At the final follow-up, 65.2% of patients had excellent outcomes, 26.1% had good outcomes, and 8.7% had fair outcomes, with no poor results. Overall, 91.3% achieved excellent or good functional outcomes. Complications occurred in 2 patients (8.7%), comprising one case each of avascular necrosis and non-union, with one patient (4.3%) requiring conversion to total hip arthroplasty. No implant cut-out, surgical site infection, or deep vein thrombosis was observed. Patients younger than 40 years demonstrated significantly better functional outcomes than older patients ($p = 0.003$), whereas Garden and Pauwels classifications showed no significant association with final functional outcome ($p > 0.05$).

Discussion

This prospective study evaluated the clinical and radiological outcomes of 23 patients with femoral neck fractures treated using the Femoral Neck System (FNS). The mean age was 37.8 ± 7.6 years, with a predominance of males (65.2%) and road traffic accidents (73.9%) as the commonest mechanism of injury. Garden Type II and Pauwels Type I fractures were the most frequently encountered patterns. The FNS demonstrated favorable perioperative outcomes, with a mean operative time of 42.8 ± 5.1 minutes, blood loss of 72 ± 18 mL, and a mean tip-apex distance of 20.8 ± 1.9 mm, indicating accurate implant placement. These findings are comparable to previous studies by Davidson et al.,[8] Yoon et al.,[11] and Kumar et al.[12] Radiological union was achieved in 95.7% of patients, with a mean union time of 13.6 ± 1.8 weeks and minimal femoral neck shortening (2.1 ± 0.8 mm). These results are consistent with published literature demonstrating the biomechanical advantages of the FNS in providing stable fixation and controlled fracture compression.[12–15]

Functional outcomes improved significantly during follow-up. The mean Harris Hip Score increased from 67.5 ± 5.8 at 6 weeks to 91.2 ± 4.8 at 6 months, while the mean VAS pain score decreased from 3.4 ± 0.8 to 0.8 ± 0.6 ($p < 0.001$). Overall, 91.3% of patients achieved excellent or good functional outcomes, with a low complication rate, supporting the effectiveness of the FNS for the management of femoral neck fractures.

Conclusion

The Femoral Neck System (FNS) is a safe and effective implant for the management of femoral neck fractures in young and middle-aged adults. In this study, there was, excellent functional recovery (mean Harris Hip Score 91.2 at 6 months), minimal femoral neck shortening (2.1 mm), and a low complication rate. Accurate implant positioning and younger age were associated with better functional outcomes. The FNS provides stable fixation with favorable clinical and radiological results and

represents a reliable minimally invasive option for appropriately selected femoral neck fractures. Further multicenter studies with larger sample sizes and longer follow-up are required to validate these findings.

References

1. Slobogean GP, Sprague SA, Scott T, Bhandari M. Complications following young femoral neck fractures. Injury. 2015; 46(3):484–491.
2. Pauwels F. Der Schenkelhals bruch: Einme chanisches Problem. Stuttgart: Enke; 1935.
3. Liporace FA, Gaines RJ, Collinge C, Haidukewych GJ. Results after treatment of femoral neck fractures with a telescoping nail. Clin Orthop Relat Res. 2008; 466 (6):1461–1467.
4. Baumgaertner MR, Curtin SL, Lindskog DM, Keggi JM. The value of the tip-apex distance in predicting failure of fixation of peritro chanteric fractures of the hip. J Bone Joint Surg Am. 1995; 77 (7):1058–1064.
5. De Puy Synthes. Femoral Neck System (FNS): Surgical Technique. West Chester, PA: De Puy Synthes; 2019.
6. Stoffel K, Zderic I, Gras F, et al. Biomechanical evaluation of the femoral neck system in unstable Pauwels III femoral neck fractures. J Orthop Trauma. 2017; 31(3):131–137.
7. Panteli M, Rodham P, Giannoudis PV. Biomechanical rationale for implant choices in femoral neck fracture fixation in the non-elderly. Injury. 2015; 46 (3):445–452.
8. Davidson A, Radi M, Akilapa O, et al. Femoral neck system fixation — outcome analysis of 102 cases and literature review. J Orthop Trauma. 2022;36(3):127–133.
9. Chung DY, Lee HJ, Kim JW, et al. Comparative analysis of femoral neck system versus cannulated compression screws for femoral neck fractures. Arch Orthop Trauma Surg. 2022; 142(6):1311–1320.
10. Patel SS, Davison E, Gee AO, et al. Femoral neck system versus cannulated screws for femoral neck fractures: a systematic review and meta-analysis. J Orthop Trauma. 2022; 36 (7):338–345.
11. Yoon JY, Lee JW, Kim KC, et al. Multicenter retrospective cohort analysis of femoral neck osteo synthesis using the femoral neck system. Injury. 2024; 55 (4):111342.
12. Kumar V, Singh A, Varshney MK, et al. Comparative evaluation of FNS versus multiple cancellous screws for femoral neck fractures: a prospective randomised controlled trial. J Clin Orthop Trauma. 2025; 52:102–109.
13. Wu ZF, Liu H, Li R, et al. Femoral neck system versus cannulated compression screws for femoral neck fractures in adults: a systematic review and meta-analysis. Front Surg. 2022;9:837424.
14. Kale S, Patil A, Desai S, et al. Rehabilitation outcomes of femoral neck fractures treated with the femoral neck system: a two-year prospective study. J Orthop Surg Res. 2024; 19 (1):215.
15. Kale S, Bhure A, Bhure A, et al. Functional outcome of femoral neck fractures treated with femoral neck system in young patients: a prospective study. Indian J Orthop. 2023; 57(9):1541–1548.