Original Article

Outcome and Safety of Femoral Neck System (FNS) In the Treatment of Femoral Neck Fracture: A Prospective Study

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Abstract

Background: Femoral neck fractures are common injuries associated with significant morbidity and functional impairment. Multiple treatment modalities exist, including cannulated cancellous screws (CCS), dynamic hip screw (DHS), hemiarthroplasty, total hip replacement, and the recently introduced Femoral Neck System (FNS). The objective is to evaluate the clinical outcomes and safety of the Femoral Neck System (FNS) in the management of femoral neck fractures. **Material and Methods:** This prospective study was conducted in the Department of Orthopedics at Government Medical College, Srinagar. A total of thirty patients presenting with femoral neck fractures were included in the study. All patients underwent thorough clinical and radiological evaluation at presentation and during follow-up. Key outcome parameters assessed included operative time, fracture union rate, and procedure-related complications. Functional outcomes were evaluated using the Harris Hip Score. Patients were followed for 6 months to assess radiological healing and functional recovery. **Results:** The mean age was 44 years (range: 18–60 years). The average operative time ranged from 35 to 60 minutes. Mean radiological union was achieved at 12–15 weeks. Union was observed in 28 patients (93.33%). Nonunion occurred in 2 patients (6.66%). One case of avascular necrosis required total hip replacement. Functional outcomes improved significantly, with the mean Harris Hip Score rising from 78.8 to 92.3. **Conclusion:** FNS is a minimally invasive, biomechanically stable fixation method with high union rates and low complication rates, making it a promising option for femoral neck fractures.

Keywords: Internal fixation, hip fracture, femur neck fracture, femoral neck system.

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Introduction

Femoral neck fractures (FNF) constitute a major proportion of hip fractures and are associated with significant morbidity, mortality, and socioeconomic burden worldwide.[1] These fractures are particularly common in older people due to low-energy trauma such as falls in osteoporotic bone. In contrast, in younger individuals, they are typically the result of high-energy mechanisms like road traffic accidents or falls from height.[2] The management of femoral neck fractures remains challenging due to the unique anatomical and biomechanical characteristics of the femoral neck, including its intracapsular location, limited periosteal coverage, and precarious blood supply to the femoral head, which predispose to complications such as nonunion and avascular necrosis.

Several factors, including patient age, physiological status, fracture displacement, and bone quality, influence treatment selection.[3] In general, internal fixation is preferred in younger and active patients, especially for undisplaced or minimally displaced fractures. At the same time, arthroplasty is recommended in elderly patients with displaced fractures due to the higher risk of fixation failure.[4,5] Despite advances in surgical techniques and implant design, femoral neck fractures continue to be associated with poor outcomes, including prolonged disability and increased mortality.[6] Even with early surgical intervention, mortality rates may reach up to 10%, and complications tend to increase with delays in surgery.[7] Current guidelines recommend surgical intervention within 24–48 hours of admission to optimize clinical outcomes.[4]

Conventional internal fixation methods, such as multiple cannulated cancellous screws and dynamic hip screws (DHS), have been widely used; however, these techniques are associated with limitations, including insufficient rotational stability, risk of femoral neck shortening, implant failure, and varus collapse. These complications can adversely affect functional outcomes and may necessitate revision procedures. In recent years, the Femoral Neck System (FNS) has been introduced as an innovative fixation device designed to address these shortcomings. The FNS combines the principles of angular stability and minimally invasive fixation, incorporating a central bolt, anti-rotation screw, and a small side plate to provide enhanced resistance to axial, shear, and rotational forces.

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Several studies have demonstrated that the FNS offers superior stability compared to conventional fixation methods such as cannulated screws and DHS, particularly in unstable fracture patterns.[8,9] Furthermore, its minimally invasive approach reduces soft tissue disruption, operative time, and intraoperative blood loss, potentially contributing to faster recovery and improved functional outcomes.[10] The system also allows controlled fracture impaction, which is critical for promoting fracture healing. Despite these promising biomechanical and early clinical results, the evidence regarding the safety and efficacy of the FNS in diverse patient populations remains limited, particularly in prospective clinical settings. Therefore, the present study was undertaken to evaluate the clinical outcomes, radiological union, functional recovery, and complication profile associated with the use of the Femoral Neck System in the management of femoral neck fractures.

Materials and Methods

This prospective cohort study was conducted in the Department of Orthopedics at Government Medical College Srinagar from January 2024 to June 2025, after obtaining ethical approval. A total of 30 patients with femoral neck fractures who underwent fixation using FNS were included. Patients were followed for 6 months. The inclusion criteria were patients aged 18 to 60 years, of either gender, who were physically active or had sustained recent femoral neck fractures (Garden types I to IV). Patients were included in the study after obtaining informed consent. Patients younger than 18 years or older than 60 years, as well as those with pathological fractures or associated conditions such as Parkinson's disease, dementia, rheumatoid arthritis, or chronic renal failure, were excluded.

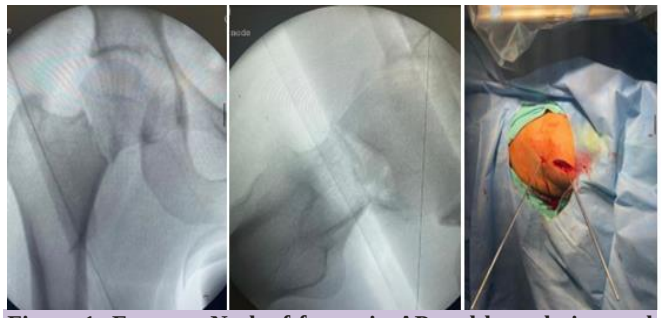

Figure 1: Fracture Neck of femur in AP and lateral view and lateral incision

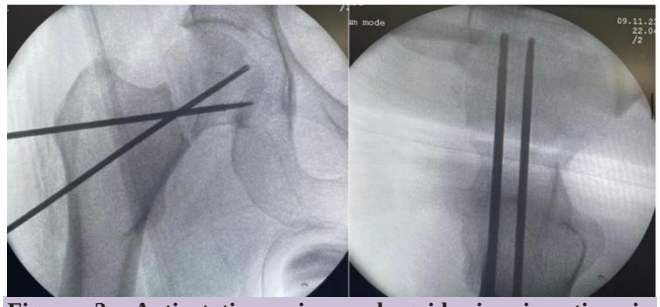

Figure 2: Antirotation wire and guidewire insertion in AP/Lateral views

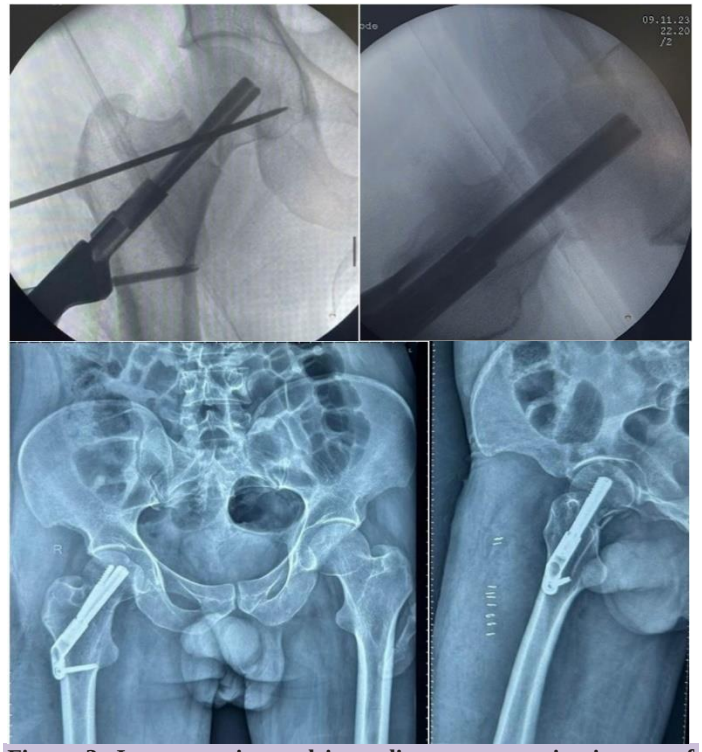

Figure 3: Intraoperative and immediate postoperative images of FNS

All patients were evaluated in the emergency department. Radiographs (AP and lateral views) were obtained. Clinical and radiological assessments included fracture type, bone quality, comorbidities, and other preoperative variables.

Surgical Procedure: The patient was positioned supine on the operating table. An image intensifier was appropriately placed to allow visualization of the proximal femur in both anteroposterior (AP) and lateral views. Fracture reduction was initially attempted using closed methods, including gentle traction, flexion, adduction, or abduction, and approximately 15° of internal rotation to align the femoral neck parallel to the operating table. In cases where satisfactory reduction could not be achieved by closed means, open reduction was performed. A lateral incision measuring approximately 3–5 cm was made distal to the greater trochanter. The proximal femur was exposed through careful superficial and deep dissection. Under fluoroscopic guidance, a central guidewire was inserted through the lateral cortex into the femoral neck and head, ensuring optimal positioning in both planes. Cannulated reaming was then performed over the guidewire. The reamed depth was measured, and an appropriately sized fixation bolt was selected. The bolt was inserted over the guidewire and advanced to the desired depth. Subsequently, the side plate was slid over the bolt and positioned flush against the lateral cortex, where it was secured using one or two locking screws. Using the insertion guide, a hole was drilled for the anti-rotation screw to the appropriate depth. An anti-rotation screw of the same length as the bolt was then inserted. Final insertion and tightening of the implant components were performed manually using a screwdriver shaft along with a 4 Nm torque limiter to ensure controlled fixation. Interfragmentary compression was applied in selected cases, where required, by turning the insertion screw

counterclockwise. After achieving satisfactory fixation, all insertion instruments were removed. Final confirmation of implant size and position was performed using the image intensifier before wound closure.

Case 2

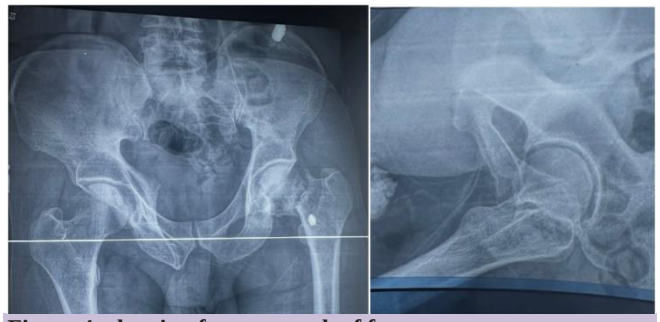

Figure 4: showing fracture neck of femur

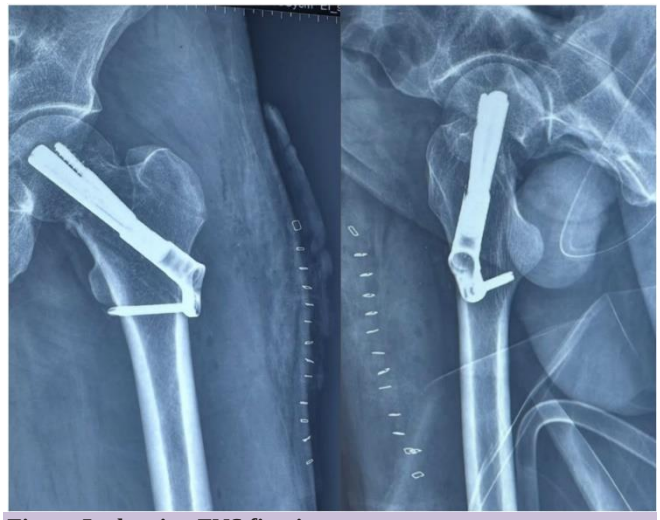

Figure 5: showing FNS fixation

Post-operative Care: Postoperatively, patients were mobilized starting from the second day with non-weight-bearing ambulation using assistive devices. Physiotherapy, including static quadriceps exercises and range-of-motion exercises for the hip, knee, and ankle, was initiated early. Postoperative radiographs were obtained on the first postoperative day. Wound inspection was carried out on the second postoperative day, and sutures were removed on the fourteenth day.

Patients were followed up at 2, 4, 6, 9, and 12 weeks, and thereafter monthly for up to 6 months. Toe-touch weight-bearing was allowed at approximately 6–8 weeks postoperatively, and progression to full weight-bearing was guided by radiological evidence of fracture healing. Functional outcomes were assessed using the Harris Hip Score (HHS) at the final follow-up. 11

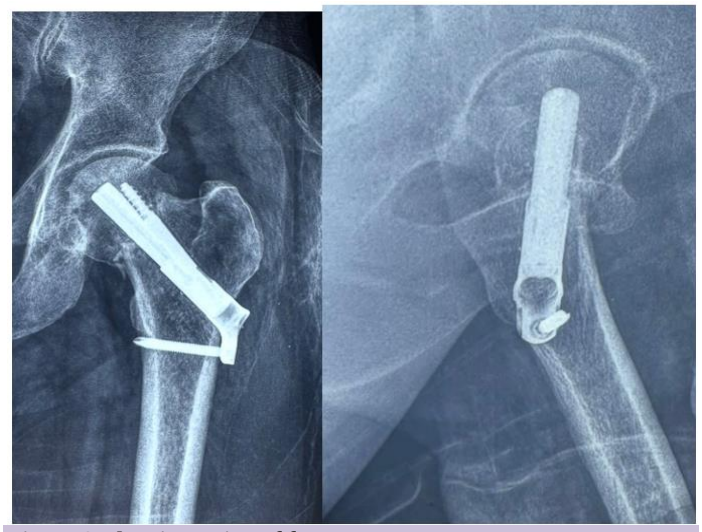

Figure 6: showing union of fracture

Results

The present study included 30 patients with femoral neck fractures treated using the Femoral Neck System. The mean age of the study population was 44.12 ± 2.0 years, with the majority of participants being young to middle-aged adults. There were 14 males (46.67%) and 16 females (53.33%). Comorbid conditions were present in 12 patients, of whom five had diabetes mellitus, four had hypertensions, and three had both diabetes and hypertension.

The distribution of fractures according to the Garden classification revealed that type II fractures were the most common (43.33%), followed by type III (30.0%), type IV (16.67%), and type I fractures (10%). The most common mechanism of injury was a simple fall, reported by 14 (46.67%) patients, followed by a fall from height (9, 30.0%) and road traffic accidents (7, 23.33%) [Table 1]. All patients underwent surgical intervention within 48 hours of sustaining the injury.

Table 1: Demographic characters of the enrolled population (N=30)

Demographic characters	No. of patients	Percentage
Gender		
Male	14	46.67
Female	16	53.33
Mechanism of injury		
Simple fall	14	46.67
Fall from height	9	30.00
Road traffic accidents	7	23.33
Garden classification		
I	3	10.00
II	13	43.33
III	9	30.00
IV	5	16.67

The mean surgical time was 47.10 ± 4.40 minutes, ranging from 35 to 60 minutes, and the mean intra-operative blood loss was 49.70 ± 8.32 mL, ranging from 50 to 120 mL.

Radiological union was achieved in 28 of 30 patients (93.33%), with a mean time of 12.80 ± 2.40 weeks, ranging from 12 to 15 weeks. Two patients (6.67%) developed nonunion. One of these cases was managed with implant removal followed by bipolar hemiarthroplasty. Avascular necrosis of the femoral head was observed in one patient, which required conversion to total hip replacement [Table 2]. No cases of superficial or deep infection, deep vein thrombosis, or pulmonary embolism were observed during the follow-up period.

Table 2: Surgical outcome in the study population (N=28)

Parameters	Strength
Operative time (Mean ± SD)	47.10 ± 4.40 (Minutes)
Blood loss (Mean ± SD)	49.70 ± 8.32 (ML)
Fracture healing time (Mean ± SD)	12.80 ± 2.40 (Weeks)
Non-union (No./Percentage)	2/ 6.67%
Femoral necrosis (No./Percentage)	1/ 3.33%

Functional outcomes improved significantly over time. The mean Harris Hip Score increased from 78.8 in the early postoperative period to 92.3 at six months of follow-up, indicating excellent functional recovery in the majority of patients. Serial radiographs obtained during follow-up demonstrated progressive fracture healing and maintenance of reduction, with minimal complications.

Discussion

Femoral neck fractures continue to pose a significant therapeutic challenge, particularly in young and active individuals, where preservation of the native hip joint is of paramount importance. The successful management of these fractures depends on multiple factors, including fracture pattern, quality of reduction, timing of surgery, implant choice, and patient-related variables such as age and comorbidities.[12] Traditional fixation methods, such as cannulated cancellous screws and DHS, have been associated with complications, including nonunion, avascular necrosis, and varus collapse, particularly in unstable fracture patterns. These limitations have prompted the development of newer implants such as the Femoral Neck System, which aims to provide improved biomechanical stability while maintaining a minimally invasive approach.

The prevalence of femoral neck fractures (FNFs) in young and middle-aged individuals has increased significantly due to high-energy trauma, such as falls from height and road traffic accidents.[2] Although certain factors influencing outcomes, such as initial fracture displacement and disruption of femoral head vascularity, are beyond the surgeon's control, several modifiable factors can be optimized to improve surgical results. In contrast, the majority of hip fracture patients are elderly and often present with multiple comorbidities, which further complicate management.

Successful healing of FNFs requires preservation of stability at the fracture site in both sagittal and coronal planes, along with adequate rotational stability. Outcomes are influenced by multiple factors, including patient age, physical status, fracture type, and the quality of stable internal fixation.[12] Therefore, an ideal fixation device should provide sufficient mechanical stability, maintain fracture fragment apposition, and withstand physiological loading to ensure proper fracture healing.[13]

The Femoral Neck System (FNS) has emerged as a promising fixation modality due to its shorter operative time, reduced radiation exposure, and robust, stable fixation. It is minimally invasive, typically requiring only a 4–5 cm lateral incision and limited disruption of the vastus lateralis, thereby minimizing soft-tissue damage.[10] However, optimal outcomes with FNS are highly dependent on appropriate patient selection, including consideration of bone quality, age, comorbidities, fracture pattern, and time elapsed since injury. Inadequate fracture reduction has been associated with complications such as osteonecrosis following femoral neck fractures.[14]Schopper et al.[15] demonstrated that the FNS provides superior shear resistance and enhanced mechanical stability, with improved sliding characteristics and angular stability, contributing to effective fracture compression.

Despite these advantages, the present study has certain limitations. The relatively small sample size and short follow-up duration may limit the generalizability of the clinical outcomes. Larger, multicenter randomized controlled trials with longer follow-up are warranted to validate the effectiveness of FNS implants further.[16]

The rationale for preferring FNS over conventional methods such as sliding hip screws and multiple cancellous screws (MCS) lies in its superior biomechanical performance. Studies have demonstrated improved rotational stability and reduced risk of varus collapse with FNS fixation. Stoffel et al.8 further reported that FNS provides at least 100% greater resistance to varus collapse compared to MCS, supporting its role as a reliable and advanced fixation system.

Conclusion

The Femoral Neck System (FNS) is a safe and effective modality for the management of femoral neck fractures, providing stable fixation with favorable union rates and good functional outcomes. Its minimally invasive design, controlled compression, and low complication profile make it a reliable option, particularly in young and active patients. Further large-scale, long-term studies are recommended to validate its advantages and establish standardized indications.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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