CASE REPORT

Use of the Femoral Neck System in Intracapsular Femoral Neck Fracture – A Case Report

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Abstract
Introduction: Intracapsular femoral neck fractures present a significant challenge due to the risk of avascular necrosis and nonunion. Preservation of the femoral head is preferred in younger individuals. The Femoral Neck System (FNS) is a relatively new implant designed to provide angular stability with minimally invasive fixation.
Case Presentation: A 41-year-old male presented with a traumatic intracapsular femoral neck fracture following a road traffic accident. He underwent closed reduction and internal fixation using the Femoral Neck System.
Results: The patient achieved stable fixation, early mobilization, and full weight-bearing by three months. At six months, he demonstrated near-normal hip function without complications such as avascular necrosis or nonunion.
Conclusion: The Femoral Neck System appears to be an effective option for intracapsular femoral neck fractures in young adults, offering biomechanical stability, controlled compression, and favorable functional outcomes.

Keywords: Femoral neck fracture, Femoral Neck System, Intracapsular fracture, Hip fixation, AVN
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INTRODUCTION

Femoral neck fractures are associated with high morbidity, especially in the elderly, and require prompt and appropriate management [1,2]. Preservation of the femoral head is preferred in younger patients [3]. Traditional fixation methods include multiple cancellous screws and dynamic hip screws (DHS) [4]. The Femoral Neck System (FNS) has emerged as a minimally invasive alternative offering angular stability and controlled compression [5,6].
This case report presents the clinical course, surgical management, and outcome of a patient treated with the Femoral Neck System.

Device Overview: Femoral Neck System (FNS)
The Femoral Neck System is a fixed-angle device composed of:
• A one-hole titanium plate
• A locking screw
• An anti-rotation screw
• A central bolt for controlled dynamic compression

Key Features:
• Angular stability similar to a dynamic hip screw (DHS)
• Minimally invasive surgical technique
• Reduced soft tissue dissection
• Controlled fracture impaction

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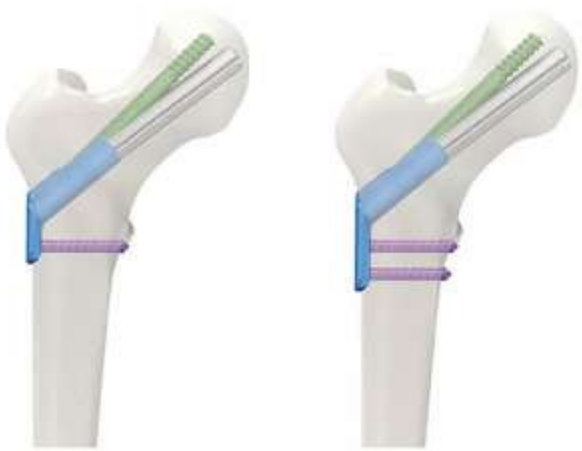
• Biomechanical stability superior to multiple cancellous screws in certainpattern



AIM OF THE STUDY

To evaluate the clinical and radiological outcomes of intracapsular femoral neck fractures treated using the Femoral Neck System.

Case Presentation

A 41-year-old male presented to the emergency department following a road traffic accident. He complained of severe right hip pain and inability to bear weight. There was no history of comorbid illness.Clinical Findings

• Shortened and externally rotated left lower limb
• Painful restriction of hip movements
• Neurovascular examination: intact

Radiographic evaluation confirmed an intracapsular femoral neck fracture. Based on the patient's age and fracture characteristics, head-preserving fixation was planned.

REVIEW OF LITERATURE

1. History of Femoral Neck Fracture Management

Management of femoral neck fractures has undergone significant evolution over the past century, driven by a better understanding of fracture biology, biomechanics, and implant technology.

Initially, treatment was non-operative, consisting of prolonged bed rest and traction [8]. While this avoided surgical risks, it was associated with high mortality, malunion, and complications such as pressure sores, deep vein thrombosis, and pneumonia.

The introduction of internal fixation marked a major advancement. Marius Smith-Petersen pioneered the use of the Smith-Petersen nail, a three-flanged device designed to provide rotational stability [9]. However, its fixation strength was limited, particularly in osteoporotic bone.

Subsequently, multiple cancellous cannulated screws became popular due to their minimally invasive insertion, preservation of blood supply, and ability to achieve compression across the fracture site [10]. These remain widely used for undisplaced fractures and younger patients.

The development of the Dynamic Hip Screw (DHS) introduced the concept of controlled collapse and sliding fixation, improving outcomes in basicervical and unstable fracture patterns. Over time, arthroplasty (hemiarthroplasty and total hip arthroplasty) became the preferred option in elderly patients with displaced fractures, due to high rates of avascular necrosis (AVN) and nonunion with fixation.

More recently, modern implants like the Femoral Neck System (FNS) have been introduced, combining angular stability, minimally invasive technique, and controlled compression, representing the latest evolution in head-preserving fixation strategies.

2. Anatomy

The femoral neck is a cylindrical intracapsular structure connecting the femoral head to the shaft, oriented at approximately 125°–135° (neck-shaft angle) and 10°–15° anteversion.

Blood Supply

The vascularity of the femoral head is critical yet vulnerable, explaining the high risk of AVN in intracapsular fractures.

• The primary supply arises from the medial femoral circumflex artery (MFCA) [11]
• Specifically, its retinacular branches run along the femoral neck within the capsule
• A minor contribution comes from:
• Lateral femoral circumflex artery
• Artery of ligamentum teres (insignificant in adults) [12]

Clinical Significance

• Intracapsular fractures can disrupt retinacular vessels, leading to:
• Avascular necrosis (AVN)
• Nonunion
• The posterior-superior retinacular vessels are most important and most commonly injured.

Capsular Considerations

• The femoral neck lies within the hip joint capsule, meaning:

• Fractures are exposed to synovial fluid, which inhibits healing
• No periosteum → limited external callus formation

3. Biomechanics
Femoral neck fractures are biomechanically complex due to the high forces transmitted across the hip joint.
Forces Acting on the Femoral Neck
• Compressive forces (inferomedial aspect)
• Tensile forces (superolateral aspect)
• Shear forces (especially in vertical fractures)
• Rotational forces during movement

Pauwels Classification (Biomechanical Basis)
• Type I (<30°) → compressive forces dominate → stable
• Type II (30–50°) → mixed forces
• Type III (>50°) → high shear forces → unstable [13]

Mechanical Challenges
• Tendency for:
• Varus collapse
• Femoral neck shortening
• Rotational displacement Fixation Requirements

An ideal implant should:
• Provide angular stability
• Resist shear and rotational forces
• Allow controlled compression without excessive collapse
• Maintain neck length and alignment
Traditional screws often fail in vertical fractures due to poor resistance to shear, whereas fixed-angle devices (DHS, FNS) perform better [14].

4. Components of Total Hip Arthroplasty (Contextual Reference)
Total Hip Arthroplasty is a replacement procedure used when fixation is unlikely to succeed, particularly in:
• Elderly patients
• Displaced fractures
• Failed osteosynthesis Main Components

1. Acetabular Component
• Cup (metal shell) fixed into acetabulum
• Liner (polyethylene/ceramic) provides articulation
• May be cemented or uncemented

2. Femoral Component
• Stem inserted into femoral canal
• Head (metal/ceramic) articulates with acetabular liner

Fixation Types
• Cemented → better for osteoporotic bone
• Uncemented → biological fixation via bone ingrowth

Indications in Femoral Neck Fractures
• Age >60–65 years
• Displaced fractures (Garden III/IV)
• Poor bone quality
• Pre-existing arthritis [15,16]

5. Pre-operative Radiographic Evaluation
Standard imaging includes AP pelvis and lateral hip views to classify fractures (Garden, Pauwels) and plan fixation [17,18].
Given the patient's age and bone quality, head-preserving fixation was planned using the Femoral Neck System.

6. Post-operative Radiographic Evaluation
Assessment includes reduction quality, implant position, tip–apex distance, and signs of complications [19].

Postoperative radiographs demonstrated:
• Anatomical reduction
• Proper implant positioning
• No joint penetration
• Stable fixation

7. Post-operative Functional Assessment
Postoperative Course
• Day 1: Static quadriceps exercises initiated
• Day 2: Partial weight bearing with walker support
• 6 weeks: Progressive weight bearing
• 3 months: Full weight bearing without support

There were no complications such as:
• Avascular necrosis
• Nonunion
• Implant failure
• Infection
At 6-month follow-up, the patient had regained near-normal hip range of motion and returned to daily activities. Functional outcomes are evaluated using scores like Harris Hip Score and return to activity levels [20].

8. Surgical Approaches
Minimally invasive lateral approach is commonly used for FNS insertion, reducing soft tissue damage [21].
Operative Technique
• Spinal anesthesia was administered.
• Closed reduction was performed under fluoroscopic guidance.
• A small lateral incision was made.
• Guidewire placement was confirmed in AP and lateral views.
• Reaming and insertion of the FNS bolt were performed.
• Anti-rotation screw and locking plate fixation were completed. Reduction quality was satisfactory with appropriate tip–apex distance.

DISCUSSION

Intracapsular femoral neck fractures pose a risk of:

- Avascular necrosis (AVN)
- Nonunion
- Implant cut-out

Traditional fixation options include:

- Multiple cannulated cancellous screws
- Dynamic hip screw (DHS)

FNS provides angular stability similar to DHS while maintaining minimally invasive advantages [22]. Studies show superior resistance to shear forces and reduced femoral neck shortening compared to cannulated screws [23,24]. Early mobilization and lower complication rates have been reported [25].

Parameter	Cannulated Screws	Dynamic Hip Screw (DHS)	Femoral Neck System (FNS)
Rotational Stability	Moderate	Good	Excellent
Invasiveness	Minimal (percutaneous)	Moderate(largerincision, more exposure)	Minimal (small lateral incision)
Compression Control	Limited (dependent on screw placement)	Good (sliding lag screw mechanism)	Controlled (central bolt with locking system)
Biomechanical Strength	Variable (depends on configuration)	Strong (fixed-angle construct)	Strong (angular stable + locking plate)
Resistance to Shear	Poor in vertical fractures	Good	Superior (ideal for Pauwels III fractures)
Femoral Neck Shortening	Common	Moderate	Reduced due to controlled collapse
Surgical Technique	Technically simple	Moderately demanding	Moderately demanding (guided system)
Soft Tissue Damage	Minimal	More due to exposure	Minimal
Indications	Undisplaced fractures, young patients	Stable/basicervical fractures	Unstable fractures, young active patients

CONCLUSION

The Femoral Neck System is a promising implant for the fixation of intracapsular femoral neck fractures, particularly in young and middle-aged patients. In this case, it provided stable fixation, early mobilization, and excellent functional recovery without complications. FNS is an effective implant for young patients with intracapsular femoral neck fractures, offering stable fixation and good functional outcomes [26–30].Further long-term studies are recommended to evaluate rates of avascular necrosis and implant longevity.

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