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Functional and radiological outcome of unstable intertrochanteric femur fractures treated with proximal femoral nail and PFNA2 – An analytical study

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Abstract
Background: Intertrochanteric femur fractures are common injuries in the elderly population and are frequently associated with osteoporosis. Unstable fracture patterns pose a challenge due to comminution, loss of medial support and high implant failure rates. Intramedullary devices such as Proximal Femoral Nail (PFN) and Proximal Femoral Nail Antirotation 2 (PFNA2) are widely used for stabilization.
Aim: To analyse and compare the functional and radiological outcomes of unstable intertrochanteric femur fractures treated with PFN and PFNA2.
Materials and Methods: This analytical study was conducted at District Hospital Palakkad on patients with unstable intertrochanteric fractures treated using PFN or PFNA2. Patients were followed up clinically and radiologically. Functional outcome was assessed using Harris Hip Score (HHS) and Parker–Palmer Mobility Score (PPMS). Radiological assessment included Tip Apex Distance (TAD) and Cleveland Index. Complications and implant failures were documented.
Results: Both PFN and PFNA2 provided satisfactory fracture union and functional recovery. PFNA2 showed advantages in terms of better rotational stability, reduced implant-related complications, and improved early mobilization. Radiological parameters such as TAD and Cleveland Index were within acceptable limits in both groups.
Conclusion: PFN and PFNA2 are reliable implants for unstable intertrochanteric fractures. PFNA2 offers biomechanical advantages with fewer complications and better early functional outcome, making it a preferable option in osteoporotic and unstable fracture patterns.

Keywords: Intertrochanteric fracture, PFN, PFNA2, Harris Hip Score, tip apex distance, unstable fractures, intramedullary fixation

Introduction

Intertrochanteric fractures are extracapsular fractures of the proximal femur occurring between the greater and lesser trochanters. They commonly affect elderly patients with osteoporosis following low-energy trauma such as a simple fall, though younger individuals may sustain these injuries following high-energy mechanisms. With the growing geriatric population, the incidence of intertrochanteric fractures is increasing worldwide, posing a major challenge to orthopaedic surgeons.

These fractures are associated with significant morbidity and mortality. Without early mobilization, patients are prone to complications including pressure sores, urinary tract infections, pneumonia, deep vein thrombosis, pulmonary embolism, muscle wasting, and prolonged dependency. Therefore, the primary goal of treatment is stable fixation that allows early rehabilitation and weight bearing while maintaining fracture alignment and promoting union.

Intertrochanteric fractures are broadly classified as stable and unstable. Stability depends largely on the integrity of the posteromedial cortex and the lateral wall. Unstable fractures include those with comminution of the posteromedial cortex, reverse obliquity patterns, subtrochanteric extension, and lateral wall fractures. These patterns are more difficult to manage and are associated with higher rates of fixation failure.

Traditionally, extramedullary devices such as the Dynamic Hip Screw (DHS) were used. Although effective for stable fractures, DHS may fail in unstable patterns due to excessive sliding, varus collapse, limb shortening, and screw cut-out. This led to the development and widespread adoption of intramedullary devices, which provide biomechanical advantages by placing the implant closer to the mechanical axis of the limb, reducing bending moments and improving load sharing.

The Proximal Femoral Nail (PFN) is an intramedullary implant that uses two cephalic screws: a larger lag screw for load bearing and a smaller anti-rotation screw to prevent rotational instability. While PFN has shown good results, complications such as Z-effect, screw back-out, varus collapse, and cut-out have been reported, especially in osteoporotic bone.

To address these issues, the Proximal Femoral Nail Antirotation (PFNA) system was introduced, and later modified as PFNA2 to better suit the anatomy of the Asian population. Instead of two screws, PFNA2 uses a single helical blade that is impacted into the femoral head. This blade compacts cancellous bone rather than removing it, increasing bone–implant interface and improving purchase in osteoporotic bone. The design provides greater resistance to rotation and varus collapse, potentially reducing implant failure.

Biomechanically, the helical blade offers superior anchorage compared to conventional screws. By compacting cancellous bone during insertion, it enhances stability and reduces the risk of cut-out. In addition, PFNA2 allows faster insertion, reduced operative time, and less blood loss, which is particularly important in elderly patients with multiple comorbidities.

Despite the advantages of both PFN and PFNA2, there is ongoing debate regarding which implant offers better functional and radiological outcomes in unstable

intertrochanteric fractures. Functional recovery is critical, as it determines a patient's ability to return to pre-injury mobility and independence. Radiological parameters such as fracture alignment, screw or blade position, Tip Apex Distance, and Cleveland Index are equally important to predict implant survival and fracture union.

This analytical study aims to compare PFN and PFNA2 in the treatment of unstable intertrochanteric fractures by evaluating both functional and radiological outcomes. Functional assessment is done using validated scoring systems such as the Harris Hip Score and Parker–Palmer Mobility Score, while radiological assessment includes measurement of Tip Apex Distance and Cleveland index. Through this comparison, the study seeks to determine the effectiveness, safety, and clinical value of these implants in managing unstable intertrochanteric fractures and improving patient quality of life.

Conclusion

Unstable intertrochanteric fractures represent a significant therapeutic challenge, particularly in the elderly population with poor bone quality. Early surgical stabilization and mobilization are essential to reduce morbidity, mortality, and prolonged dependency. The evolution from extramedullary to intramedullary fixation has significantly improved outcomes in these fractures by offering better biomechanical stability and facilitating early rehabilitation.

Both PFN and PFNA2 are effective intramedullary devices designed to manage unstable intertrochanteric fractures. PFN provides dual-screw fixation with good rotational control, while PFNA2 employs a helical blade that compacts cancellous bone and enhances fixation in osteoporotic femoral heads. The shorter lever arm and load-sharing properties of these implants reduce the risk of varus collapse and implant failure when compared with extramedullary devices.

Functional outcomes, assessed using tools such as the Harris Hip Score and Parker–Palmer Mobility Score, are crucial indicators of treatment success because they reflect the patient's ability to regain mobility and independence. Radiological parameters like Tip Apex Distance and Cleveland Index help predict implant stability and risk of cut-out. Proper fracture reduction, optimal implant positioning, and careful surgical technique remain the most important factors influencing outcome, regardless of implant choice.

The comparative evaluation of PFN and PFNA2 demonstrates that both implants can achieve satisfactory fracture union and functional recovery in unstable intertrochanteric fractures. However, PFNA2 offers certain advantages, including improved purchase in osteoporotic bone, reduced operative time, less blood loss, and lower incidence of screw-related complications such as Z-effect and rotational instability. These features make PFNA2 particularly attractive for elderly patients with compromised bone quality.

In conclusion, unstable intertrochanteric fractures can be effectively managed with intramedullary fixation using PFN or PFNA2. While both implants provide good functional and radiological outcomes, PFNA2 may offer additional biomechanical and perioperative benefits. Ultimately, successful treatment depends not only on implant selection but also on proper patient evaluation, accurate fracture reduction, correct implant placement, and early postoperative rehabilitation. Continued research and larger clinical studies will further refine treatment protocols and improve outcomes for patients suffering from these challenging injuries.

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