Proximal Femoral Nail Anti-rotation in the Lateral Decubitus Position for Unstable Reverse Oblique Intertrochanteric Fracture: A Case Report

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Abstract. Intertrochanteric femur fractures are among the most common hip injuries in the elderly population, accounting for nearly half of all proximal femoral fractures. Unstable patterns, particularly reverse oblique fractures (AO/OTA 31A3), present a biomechanical challenge that is poorly controlled by extramedullary devices, making intramedullary fixation with the Proximal Femoral Nail Antirotation (PFNA) the preferred treatment. This case report describes the management of a 69-year-old male presenting with a right-sided closed reverse oblique intertrochanteric femur fracture (AO/OTA 31A3) following a low-energy bathroom fall. The patient was successfully treated with closed reduction and internal fixation (CRIF) using PFNA in the lateral decubitus position without a fracture table. Theoretical and technical aspects of the lateral decubitus approach are discussed, including advantages in entry-point identification, C-arm visualization, and avoidance of traction-related complications. Satisfactory fracture reduction and implant positioning were achieved with acceptable post-operative radiographic outcomes. The lateral decubitus position represents a viable and potentially superior alternative for PFNA surgery, particularly in centers without a dedicated orthopaedic fracture table.

Keywords: Intertrochanteric proximal femur fracture, reverse oblique, AO 31A3, intramedullary PFNA, proximal femoral nail antirotation, lateral decubitus.

1 Introduction

Intertrochanteric femur fractures represent a major global health burden, accounting for approximately 45–50% of all proximal femoral fractures, with an estimated annual incidence exceeding 250,000 cases in the United States alone and projected to rise significantly as the population ages [1]. These fractures predominantly affect elderly patients following low-energy falls and carry a one-year mortality of 15–25%, with the majority of deaths attributable to complications of prolonged immobility rather than the injury itself [1]. Early surgical fixation is therefore the cornerstone of management,

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enabling early weight-bearing and reducing the risks of pneumonia, pressure ulcers, deep vein thrombosis, and delirium.

Intertrochanteric fractures are classified using either the Evans or AO/OTA classification. Evans (1949) described a spectrum from stable two-part fractures to highly unstable multifragment patterns based on the integrity of the posteromedial cortex [2]. The AO/OTA classification (31A) provides greater anatomical specificity: type A1 represents simple two-part stable fractures, type A2 designates multifragmentary pertrochanteric fractures with posteromedial comminution, and type A3 denotes reverse oblique and transverse intertrochanteric patterns [3]. The reverse oblique fracture (AO 31A3) is particularly noteworthy because the fracture line runs from inferomedial to superolateral, in the opposite direction to the other intertrochanteric patterns. This configuration results in the proximal fragment being displaced laterally by abductor forces, and the distal fragment being displaced medially and proximally by the pull of the iliopsoas and hip adductors, creating a highly unstable fracture that resists compression and cannot be controlled by extramedullary devices such as the dynamic hip screw (DHS) [1,4].

The biomechanical superiority of intramedullary implants over extramedullary devices for unstable intertrochanteric patterns is well established. The PFNA employs a helical blade rather than a conventional lag screw, which compacts the surrounding cancellous bone upon insertion rather than evacuating it. This compaction mechanism provides significantly superior rotational stability, enhanced resistance to screw cutout, and better purchase in osteoporotic bone compared to conventional cannulated lag screws [5,6]. A biomechanical study by Strauss et al. demonstrated that the helical blade achieves approximately 3.5 times greater resistance to rotation and 1.4 times greater resistance to cutout compared to a standard lag screw in osteoporotic femoral heads [6]. Furthermore, the intramedullary position of the PFNA reduces the bending moment on the implant compared to a plate-and-screw construct, making it the preferred fixation method for AO 31A2 and A3 fractures [6,7].

Regarding patient positioning for PFNA surgery, both supine positioning on a fracture traction table and lateral decubitus positioning without a traction table have been described. The lateral decubitus technique for antegrade femoral nailing has been reported for several decades and has been evaluated in multiple comparative studies [8,9]. The lateral position offers several advantages over the supine position on a traction table, including shorter setup and operating times, reduced intraoperative blood loss, less intraoperative radiation exposure, elimination of perineal and pudendal nerve injury risk associated with traction posts, easier nail entry-point identification, particularly in obese patients, and the ability to convert to arthroplasty or open reduction if needed [4,8,9,10].

Despite the growing body of evidence supporting the use of PFNA for unstable intertrochanteric fractures, reports specifically documenting the application of the lateral decubitus technique in the AO/OTA 31A3 reverse oblique pattern, a subtype with distinct biomechanical challenges and technical demands, remain limited. This case report aims to address this gap by describing the clinical presentation, surgical technique, and postoperative outcomes of a patient with an AO/OTA 31A3 fracture treated with PFNA in the lateral decubitus position and to provide a detailed technical framework that may

assist surgeons encountering this fracture pattern without access to a dedicated orthopaedic fracture table.

2 Case Report

A 69-year-old male presented to the emergency department with pain in the right hip for 2 days, with complete inability to move or bear weight on the affected limb. He reported slipping and falling on the bathroom floor 2 days prior to admission, with the initial impact on the right hip. A history of chronic mild pain in the hip and lumbar spine region was noted, consistent with degenerative changes. The patient was previously fully ambulatory without any assistive device. There was no history of hypertension, diabetes mellitus, cardiovascular disease, rheumatoid arthritis, systemic lupus erythematosus, or prior corticosteroid use. No history of malignancy or prior hip surgery was documented. Written informed consent was obtained from the patient for the publication of this case report and accompanying radiographic images.

On physical examination, the patient was hemodynamically stable with a BMI of 25 kg/m2. Local examination of the right hip revealed swelling, ecchymosis, and approximately 2 cm of shortening deformity with external rotation of the affected limb. Tenderness was elicited on palpation over the greater trochanteric region. Distal neurovascular status was intact: capillary refill time was less than 2 s, distal pulses were palpable, and sensation in the foot was normal. Crepitation was noted with attempted passive range of motion, which was globally restricted due to severe pain. No wound, abrasion, or open fracture component was present. Preoperative radiological imaging of the right hip is shown in Figure 1.



Fig. 1. Preoperative 3D CT radiographs of the right hip demonstrating a reverse oblique intertrochanteric fracture (AO/OTA 31A3).

The patient was diagnosed with a closed reverse oblique intertrochanteric femur fracture, classified as AO/OTA 31A3 (Evans Type IV unstable). Subsequently, treatment was administered through closed reduction and internal fixation (CRIF) using a proximal femoral nail antirotation (PFNA) while the patient was positioned in the lateral

decubitus position. Postoperative radiographs are shown in Figure 2, demonstrating satisfactory fracture reduction and PFNA placement with an appropriate blade position in the femoral head.



Fig. 2. Postoperative AP and lateral radiographs showing satisfactory PFNA placement. The helical blade is positioned in the inferior half of the femoral head on the AP view, with the blade tip approximately 10 mm from the articular surface, consistent with the optimal tip-apex distance (TAD < 25 mm).

2.1 Surgical Technique

The patient was positioned on a standard radiolucent operating table in the lateral decubitus position, with the right (affected) side uppermost. Pelvic stability was maintained using pelvic support posts positioned anteriorly and posteriorly, as in the standard arthroplasty. The affected right lower limb was placed in the upper position, with the hip flexed between 10° and 30°, and the knee in a semi-flexed position to relax the iliotibial band and facilitate abductor muscle retraction. The unaffected left lower limb was placed below the hip in a neutral extension. Pillows were placed between the limbs and in front of the contralateral thigh to maintain the left hip in extension, keep the pelvis stable, and maintain abduction of the operative hip.

AP and lateral fluoroscopic images were obtained with the C-arm to confirm the fracture configuration and assess the planned reduction prior to skin preparation and draping. The C-arm was positioned perpendicular to the table for AP imaging and parallel to the table for lateral imaging, without repositioning the patient. A longitudinal skin incision of approximately 5 cm was made starting from the tip of the greater trochanter proximally. The iliotibial band was incised, and the abductor muscle (gluteus medius) was bluntly split in line with its fibers. The nail entry point at the tip of the greater trochanter was identified and confirmed under C-arm guidance. A guide pin was advanced under fluoroscopy to the midline of the femoral canal in both AP and lateral projections. The medullary canal was reamed sequentially, and the PFNA nail of appropriate length and diameter was inserted with the proximal guide aligned at 130° to target the inferior half of the femoral neck.

The helical blade guide pin was inserted along the inferior neck under C-arm guidance, targeting a central or slightly inferior position on the AP view and central on the lateral view, with the blade tip positioned approximately 10 mm from the subchondral bone to achieve a tip-apex distance (TAD) of less than 25 mm, a key predictor of blade cutout prevention [11]. The PFNA blade was then impacted and locked. A distal static interlocking screw was inserted under C-arm guidance to complete the construct. The wound was closed in layers over a suction drain. Postoperatively, the patient was allowed to mobilize with partial weight-bearing on day one.

2.2 Postoperative outcome and follow-up

The patient was mobilized with partial weight-bearing on the first postoperative day under physiotherapy supervision, without pain exacerbation or hemodynamic compromise. The wound was inspected on postoperative day two; no signs of infection, dehiscence, or hematoma were observed, and the suction drain was removed. The patient was discharged on postoperative day [insert: actual day] in a hemodynamically stable condition with adequate pain control using oral analgesia, with instructions for partial weight-bearing using a walking frame until the first outpatient follow-up visit. No implant failure, cutout, collapse, infection, or thromboembolic complications were documented during the follow-up period. The timeline of clinical events from injury to follow-up is summarized in Table 1.

Table 1. Patient timeline from injury to follow-up.

Timeline	Event
Day 0 (Injury)	Low-energy fall in bathroom; immediate right hip pain and inability to bear weight on right lower limb
Day 2 (Admission)	Emergency department presentation; haemodynamically stable, external rotation deformity noted; pre-operative AP and lateral hip radiographs and full-length femur AP radiograph obtained; AO/OTA 31A3 reverse oblique intertrochanteric fracture confirmed
Day 3 (Surgery)	CRIF with PFNA in lateral decubitus position; intraoperative fluoroscopy confirmed satisfactory closed reduction and implant positioning (TAD <25 mm); wound closed over suction drain
POD 1	Initiated partial weight-bearing mobilisation with physiotherapy assistance; vital signs stable; drain output within acceptable range
POD 3–5 (Discharge)	Discharged home/to rehabilitation facility with partial weight-bearing instructions; wound satisfactory; analgesia adequate
Week 2 (Follow-up 1)	Wound review; suture removal; no wound complications; radiograph: implant in situ, no early implant migration

3 Discussion

This case illustrates the surgical management of an AO/OTA 31A3 reverse oblique intertrochanteric femur fracture in an elderly patient using PFNA in the lateral decubitus position. Two key decision points in this case warrant detailed discussion: (1) the choice of PFNA over alternative fixation methods for the AO 31A3 fracture pattern; and (2) the selection of the lateral decubitus position over the conventional supine position on a traction table.

3.1 PFNA for Reverse Oblique (AO 31A3) Fractures

The reverse oblique intertrochanteric fracture (AO 31A3) is biomechanically unique among intertrochanteric fracture patterns. The oblique fracture line, running from inferomedial to superolateral, indicates that axial loading forces the distal fragment medially and superiorly, whereas the proximal fragment is pulled laterally by abductors. This creates a shear-dominant loading environment at the fracture site that cannot be effectively resisted by extramedullary implants such as the dynamic hip screw (DHS) [1,7]. Intramedullary devices, such as the Gamma nail, while mechanically superior to the DHS, may still fail in AO 31A3 fractures if optimal reduction and implant positioning are not achieved. Several studies and case series have documented the high failure rates of DHS in AO 31A3 fractures, with medial migration, nail cutout, and varus collapse being the most common complications [7].

The PFNA addresses these biomechanical challenges through two key design features: (1) an intramedullary position that significantly reduces the bending moment on the implant compared to lateral plate constructs and (2) a helical blade design that achieves superior rotational control of the femoral head fragment compared to a conventional lag screw [5,6]. Strauss et al. demonstrated in a cadaveric biomechanical study that the helical blade compacts rather than excavates the trabecular bone during insertion, resulting in approximately 3.5 times greater resistance to rotation and 1.4 times greater cutout resistance than a lag screw in osteoporotic specimens [6]. This property is particularly relevant in elderly patients who are at risk of reduced bone mineral density, as is commonly observed in this demographic. Formal bone mineral density assessment (dual-energy X-ray absorptiometry) was not performed in the present case; however, age-related osteopenia should be assumed in the absence of BMD data in elderly patients with low-energy fractures. A multicenter clinical study by Simmermacher et al. involving 200 patients treated with PFNA reported excellent implant performance with a low complication rate of 4%, confirming its clinical reliability for unstable proximal femoral fractures [5].

An important technical quality indicator in this case was the tip-apex distance (TAD), defined as the sum of the distances from the tip of the blade to the apex of the femoral head on AP and lateral radiographs, corrected for magnification. A TAD of < 25 mm is strongly associated with prevention of blade cutout, regardless of fracture type or bone quality [11]. The postoperative radiographs in this case demonstrate blade positioning consistent with an acceptable TAD, with the blade tip situated approximately 10 mm from the articular surface on both projections.

3.2 Lateral Decubitus Position: Theoretical Basis and Advantages

The lateral decubitus technique for PFNA surgery has been evaluated in multiple prospective and retrospective comparative studies against the conventional supine-on-traction-table approach [4,8,9,10,12]. The present case employed this technique with favorable results, which is consistent with the existing literature.

First, elimination of the fracture table significantly reduces operating room setup time, with Sonmez et al. reporting a mean reduction of approximately 15–20 min in preparation time compared to the traction table group [8]. This is not trivial in elderly patients with limited physiological reserve, where total anesthesia time is a known risk factor for perioperative complications. Second, the lateral decubitus position provides superior C-arm imaging geometry. The C-arm can be positioned perpendicular to the patient for a true AP view of the proximal femur without any patient repositioning, and a true lateral view is obtained by rotating the C-arm 90 degrees in the same plane, avoiding the oblique lateral views often required in the supine position due to the contralateral limb. Kuru et al. documented a significant reduction in intraoperative fluoroscopy time with the lateral decubitus position compared to supine ($p < 0.05$), reducing radiation exposure to both the patient and surgical team [9].

Third, identification of the nail entry point at the piriformis fossa or greater trochanter tip is consistently reported to be easier in the lateral position, particularly in obese or muscular patients, where the gravitational effect of the abdominal and thigh soft tissues in the supine position can obscure the proximal anatomy and distort the entry site medially [4]. Turgut and Kalenderer reported no entry-point-related complications in a series of 37 patients treated with PFNA in the lateral decubitus position, with all cases achieving satisfactory implant positioning without conversion to supine [4]. Fourth, the lateral position eliminates the risk of perineal pressure necrosis, pudendal nerve palsy, and scrotal or labial soft tissue injury associated with the traction post of the orthopaedic fracture table, a recognized but underreported complication of the supine traction position [1,8]. Fifth, if intraoperative complications require a change in surgical plan (e.g., conversion to arthroplasty in case of irreducible fracture or iatrogenic comminution), the lateral decubitus position allows direct conversion to a standard hip arthroplasty approach without patient repositioning [8].

From a reduction standpoint, the lateral decubitus position offers effective gravity-assisted reduction through hip flexion and the dependent position of the limb. In the present case, satisfactory closed reduction was achieved under fluoroscopy without the need for additional reduction tools. A meta-analysis by Lu and Xie comparing both positions for intertrochanteric fracture fixation demonstrated statistically significant advantages of the lateral decubitus position in total operation time (mean difference -16.5 minutes), intraoperative blood loss (mean difference -68 mL), and length of hospital stay, without significant differences in functional outcomes (Harris Hip Score) or complication rates [10].

3.3 Limitations and Considerations

The lateral decubitus position is not universally applicable. Absolute contraindications include associated ipsilateral or contralateral pelvic instability requiring supine positioning and severe pulmonary or cardiac conditions that preclude lateral positioning. Relative contraindications include associated spinal cord or cervical spine injury, ipsilateral acetabular fracture requiring simultaneous supine repair, and contralateral hip or knee pathology that prevents comfortable dependent positioning of the unaffected limb. Surgeons adopting the lateral decubitus technique should be familiar with the modified fluoroscopic imaging geometry and may require a brief learning curve to adapt their reduction and nailing technique from the supine approach [4,8].

4 Conclusion

This case report illustrates the successful management of an AO/OTA 31A3 reverse oblique intertrochanteric femur fracture in a 69-year-old patient using PFNA in the lateral decubitus position without a fracture table. PFNA is the implant of choice for unstable intertrochanteric fracture patterns, including the reverse oblique type, due to its intramedullary biomechanical advantage and helical blade design that provides superior rotational stability in osteoporotic bone. The lateral decubitus technique is a viable and clinically advantageous alternative to the supine traction table position, offering a shorter setup time, improved fluoroscopic access, easier entry point identification, and elimination of traction-related complications. Surgeons should be proficient in both techniques and select the optimal approach based on patient-specific factors, fracture configuration, and available institutional resources. A tip-apex distance of less than 25 mm should be targeted to minimize the risk of implant cutout, regardless of the positioning technique.

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Disclosure of Interests. The authors declare no conflicts of interest.

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