

Case Report

A rare complication of pelvic perforation by an excessive medial slide of the helical blade after treatment of an intertrochanteric fracture with proximal femoral nail anti-rotation: A case report and literature review

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ABSTRACT

Intertrochanteric fractures have become a severe public health problem in elderly patients. Proximal femoral nail anti-rotation (PFNA) is a commonly used intramedullary fixation device for unstable intertrochanteric fractures. Pelvic perforation by cephalic screw is a rare complication. We reported an 84-year-old female who fell at home and sustained an intertrochanteric fracture. The patient underwent surgery with PFNA as the intramedullary fixation device. Routine postoperative examination revealed medial migration of the helical blade that eventually caused pelvic perforation. We performed a cemented total hip arthroplasty as the salvage procedure. At the latest follow-up of 12 months after total hip arthroplasty, the patient had no pain or loosening of the prosthesis in the left hip. Pelvic perforation should be considered when choosing PFNA as the intramedullary fixation device, especially in patients with severe osteoporosis wherein the helical blade can be easily inserted during the operation. The lack of devices to avoid oversliding of the helical blade in PFNA is an unreported cause of this complication and should be considered in such cases.

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Introduction

With the proceeding of aging society, the incidence of hip fractures is increasing, and the mortality rate in elderly patients raised by approximately 30% following hip fractures.^{1–4} Intertrochanteric fractures of the femur were usually treated with surgical fixation using extramedullary fixation devices (e.g., dynamic hip screw). However, after the launch of third-generation intramedullary nails, e.g., proximal femoral nail anti-rotation (PFNA), an increasing number of orthopedists prefer them for their superior biological and mechanical advantages.^{5–10} PFNA is a commonly used intramedullary fixation device for unstable intertrochanteric fractures, as it has a helical neck blade that provides rotational and angular stability.

A few studies have reported the local complications of PFNA, including sliding of the cephalic screw, varus collapse, cut-out, and cut-through.^{11–13} Herein, we report a very uncommon complication in which the excessive medial slide of the helical blade perforated the pelvis following the treatment of an unstable intertrochanteric fracture with PFNA.

Case report

An 84-year-old female presented with severe left hip pain at another hospital after a falling accident at home. Plain radiography demonstrated an unstable intertrochanteric fracture (AO/OTA classification 31-A2.2) of the left femur, and the Singh index was grade 3 (Fig. 1A). The patient underwent emergency surgery with closed reduction and intramedullary nail fixation under spinal anesthesia. PFNA with a (170 × 9)-mm nail and 100-mm helical blade was placed without difficulty. The helical blade was positioned centrally in the femoral head; the tip-apex distance was 21 mm, and the neck-shaft angle was 135° on postoperative anteroposterior and lateral radiographs (Fig. 1B). The surgical procedure and postoperative recovery were uneventful, and the patient was discharged to a rehabilitation institution on postoperative day 7,

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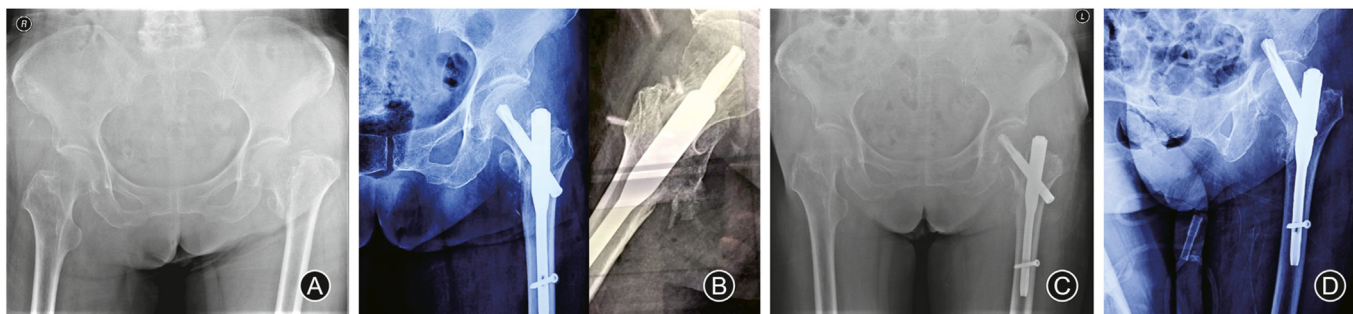


Fig. 1. (A) Initial X-ray showing an intertrochanteric fracture of the left hip (AO/OTA classification 31-A2.2); (B) Post-operative anteroposterior and lateral X-rays of the fracture treated with proximal femoral nail anti-rotation; (C) Anteroposterior X-ray at 4 weeks after surgery showing medial migration of the helical blade; (D) Anteroposterior X-ray at 8 weeks after surgery showing perforation of the helical blade into the acetabulum.

where she was mobilized under partial weight-bearing with a walker.

Routine plain radiography after 4 weeks showed a slight medial migration of the helical blade (Fig. 1C) without fracture displacement. We decided to wait, observe, and keep the patient bedridden because the patient was totally pain-free. However, 8 weeks after the surgery, the patient experienced sudden pain in the left hip on turning over in bed. A repeat radiograph (Fig. 1D) showed an obvious medial slide and perforation of the helical blade through the femoral head and acetabulum and the presence of slight varus collapse of the femoral head. CT showed that the tip of the helical blade was in the pelvis and the fracture was nonunion (Fig. 2A–D).

We removed the PFNA and performed a cemented total hip arthroplasty under spinal anesthesia (Fig. 2E). At the latest follow-up of 12 months after total hip arthroplasty, the patient had no pain or loosening of the prosthesis in her left hip.

Discussion

Intertrochanteric fracture is one of the most serious health hazards in elderly individuals, and the best treatment remains

controversial. At present, it is generally accepted that intramedullary nails should be used to treat unstable intertrochanteric fractures. However, the rate of complication has been reported to reach a maximum of 20.5% for the earlier intramedullary implants.¹⁴ PFNA is the improved third-generation intramedullary nail, in which the helical blade is designed to cause bone compaction around the implant during insertion and demonstrate a greater resistance to provide additional rotational stability.⁸ However, the resistance to axial migration has been found to be lower with helical blades than with conventional screws.¹⁵ The medial slide of the helical blade into the pelvis after surgical treatment of an intertrochanteric fracture with PFNA is a rare complication.

A review of literature revealed two articles, by Takigami et al.¹⁶ and Gomes et al.¹⁷ regarding this complication; however, none of them described any specific cause of the complication. We also retrieved five reports regarding a similar complication in which the femoral head was perforated but the acetabulum was intact. Nayak et al.¹⁸ considered the loosening of the locking mechanism with a medial migration of the blade as a cause of the femoral head perforation. Brunner et al.¹⁹ and Simmermacher et al.⁸ attributed

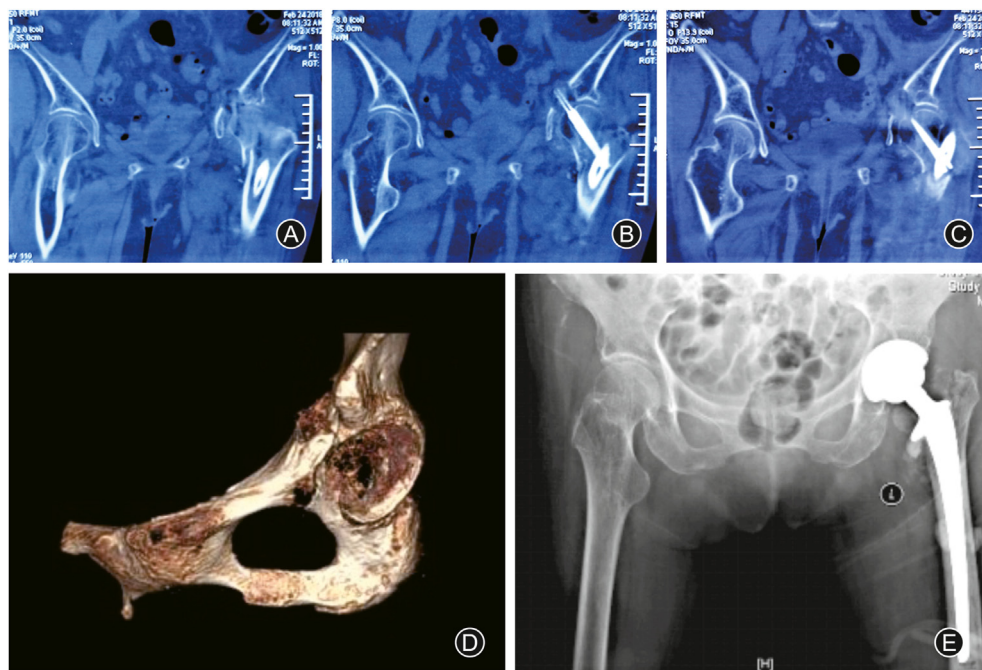


Fig. 2. (A–D) CT scan at 8 weeks after surgery showing the tip of helical blade in the pelvic and non-union fracture; (A–C) Three consecutive CT figures; (D) 3-D reconstruction of the acetabulum; (E) Anteroposterior X-rays of a cemented total hip arthroplasty after removal of the proximal femoral nail anti-rotation.

Table 1
Patient profiles in some reported cases of medial migration of the cephalic screw.

First author	Age/ Sex	Pelvic/ Femoral head perforation	OTA/AO classification	Cephalic screw/ length (mm)	Tip-apex distance (mm)	Neck-shaft angle (degrees)	Time to weight bearing (days)	Time to failure (weeks)	Vurus collapse	Cephalic screw sliding	Treatment
Gomes ¹⁷	88/F	Yes/Yes	31-A1	Helical blade/100	24	136	1	8	Slight	Obvious	Remove the nail
Takigami ¹⁶	79/F	Yes/Yes	31-A2	Helical blade/ unknow	15.8	Unknow	1	12	Obvious	Obvious	THA
Simmermacher ⁸	76/F	No/Yes	31-A2	Helical blade/ unknow	Unknow	Unknow	Unknow	6	Obvious	No	Unknow
Nayak ¹⁸	65/M	No/Yes	31-A2	Helical blade/95	20	128	1	12	No	Slight	Remove the nail
Brunner ¹⁹ Case 1	89/F	No/Yes	31-A2	Helical blade/105	14.63	129	7	6	Slight	No	Change a short blade
Brunner ¹⁹ Case 2	88/F	No/Yes	31-A2	Helical blade/105	19.32	131	9	6	Obvious	No	Change a short blade
Brunner ¹⁹ Case 3	67/F	No/Yes	31-A2	Helical blade/100	Unknow	140	1	6	Slight	Obvious	THA
Present case	84/F	Yes/Yes	31-A2	Helical blade/95	21	135	7	8	Slight	Obvious	THA

THA: total hip arthroplasty.

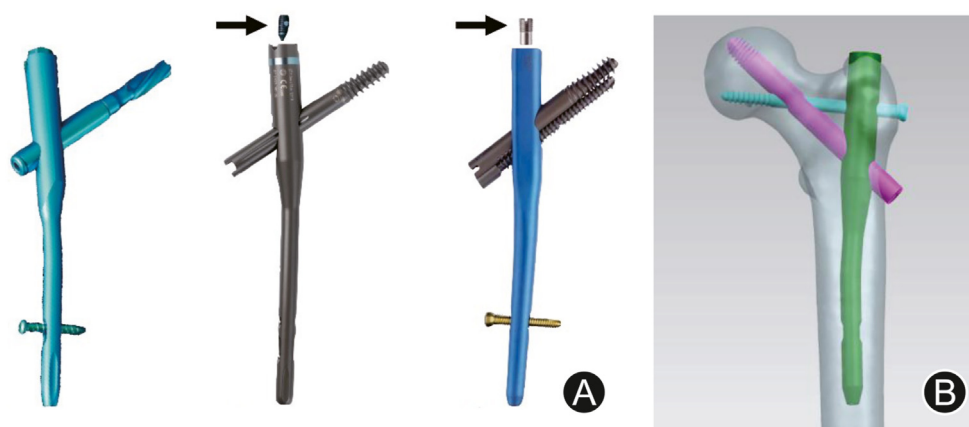


Fig. 3. Intraoperative images of femoral intramedullary nail products. (A) Three commonly used intramedullary fixation devices. Left: proximal femoral nail anti-rotation (PFNA, Synthes); Middle: Zimmer natural nail (ZNN, Zimmer); Right: intertrochanteric antegrade nail (INTERTAN, Smith & Nephew). The small screws pointed by the arrows are used to lock the nail and the cephalic screw together. (B) A new type of femoral intramedullary nail system designed by Zhang et al.²⁴

femoral head perforation to recent trauma. Brunner et al.¹³ conducted a retrospective analysis on 4109 patients who underwent nailing of trochanteric fractures using PFNA or trochanter fixation nail and observed that 0.6% of the patients had the complication of medial migration of the blade, which was termed as “cut-through.” They found that most of the patients with “cut-through” complication had helical blade exchanges during the operation. Chapman et al.²⁰ attributed this complication to the fact that the helical blade has a sharp leading edge compared with the screw.

Although perforation may occur after recent trauma in a few cases, this was not the reason for our case. In our case, we found that the helical blade had migrated medially and pelvic perforation was caused by varus collapse of the femoral head and the excessive medial slide of the helical blade. We found that in most of the reported cases with such complications, helical blades were used and they had varus collapse or helical blade slide (Table 1). Some theories on varus collapse include the lack of calcar support and poor bone quality.²¹ However, there are few studies and cases on helical blade slide. We speculate that the helical blade slide was due to PFNA that lacks device to avoid oversliding of the helical blade. We compared two commonly used intramedullary nail products—Zimmer natural nail (ZNN) and intertrochanteric antegrade nail

(INTERTAN) available in the market with PFNA and found that both ZNN and INTERTAN had a small screw inside to prevent the slide of the cephalic screw, while PFNA had none (Fig. 3A). Once the helical blade loosens, a slide may occur. However, PFNA design has its unique advantages with regard to allowing the fracture to gradually slide and compress after postoperative weight-bearing. Some studies have shown that there is no significant difference in the incidence of postoperative complications between INTERTAN and ZNN compared with PFNA, but the complications in this case have not been described.^{12,22,23} Zhang et al.²⁴ designed a new type of femoral intramedullary nail system (Fig. 3B), which retains the advantages of sliding compression while avoiding the complications of extreme neck screw sliding such as in PFNA. We also found that most of the cases, including ours, were mobilized with early weight-bearing. The selection of a helical blade that is too long may also be a cause of such complication.

In terms of treatment, in a few reported cases the intramedullary nails were removed or changed to a shorter helical blade. Brunner et al.¹³ recommended total hip arthroplasty as the valid treatment for such complication. In the present case, considering that the implant failure of reoperation was highly possible, the fracture may still be nonunion, and there was a risk of femoral head

punching into the perforated acetabulum after weight-bearing, we chose total hip arthroplasty as the salvage procedure.

In summary, we report a rare case of the complication of pelvic perforation by a helical blade after treatment of an intertrochanteric fracture with PFNA. This complication should be considered when choosing PFNA for intramedullary nailing, especially in patients with severe osteoporosis wherein the helical blade can be easily inserted during operation. The lack of devices to lock the nail and helical blade in PFNA is an unreported cause of the complication and should be considered in such cases.

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Ethical statement

This case has been reported in accordance with the principles of the Declaration of Helsinki. A written informed consent to publish this report was obtained from the patient.

Declaration of competing interest

The authors declare no competing interest.

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We thank the patient for her time, effort, and consent for this report.

Author contributions

Xiao-Kun Chen and Jian Xiong performed the literature search & review, and wrote the manuscript. Yi-Jun Liu and Quan Han contributed to the collection of data, edited the manuscript, and guaranteed the integrity of the entire study. Tian-Bing Wang and Dian-Ying Zhang are the guarantors of this study. The authors read and approved the final manuscript.

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