



Case Report

Pelvic migration of the helical blade after treatment of transtrochanteric fracture using a proximal femoral nail[☆]



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ABSTRACT

Proximal femoral nails with a helical blade are a new generation of implants used for treating transtrochanteric fractures. The blade design provides rotational and angular stability for the fracture. Despite greater biomechanical resistance, they sometimes present complications. In the literature, there are some reports of cases of perforation of the femoral head caused by helical blades. Here, a clinical case of medial migration of the helical blade through the femoral head and acetabulum into the pelvic cavity is presented.

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Migração pélvica de lâmina helicoidal após tratamento de fratura transtrocantérica com cavilha proximal do fêmur

RESUMO

As cavilhas proximais do fêmur com lâmina helicoidal representam uma nova geração de implantes usados no tratamento de fraturas transtrocantéricas. O desenho da lâmina fornece estabilidade rotacional e angular à fratura. Apesar da maior resistência biomecânica, por vezes apresentam complicações. Na literatura encontram-se descritos alguns casos de perfuração da cabeça femoral por lâminas helicoidais. Apresenta-se um caso clínico no qual ocorreu migração medial da lâmina helicoidal através da cabeça femoral e do acetábulo para a cavidade pélvica.

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Introduction

Transtrochanteric fractures are a prevalent condition in the elderly. The incidence of this disease has increased considerably in recent years, as a result of population aging.¹ Improving the treatment of these fractures is essential for patient quality of life, reducing the length of hospital stay and promoting a quick recovery to pre-fracture functional status. There are many implants available for the treatment of such fractures. In stable AO 31-A1 transtrochanteric fractures, extramedullary devices (plates) can be applied, with favorable results.² However, in unstable AO 31-A2/A3 fractures, intramedullary implants have a biomechanical advantage,^{2,3} with better transmission of the axial load. More recently, a new generation of proximal femoral nails with helical blades has been developed, featuring a larger contact area and compression between the blade and the cancellous bone, promoting better stability against varus collapse, especially in patients with osteoporotic bones.^{4,5} Nonetheless, complications are sometimes observed, especially those related to fixation.⁶⁻⁸ This study presents a case of perforation of the femoral head and the bottom of the acetabulum with pelvic migration of the helical blade.

Case report

An 88-year-old female, with a history of hypertension and heart failure, had a fall from her own height in 2014 with trauma in the left hip. A radiographic study revealed a left AO 31-A1 trochanteric fracture (Fig. 1). She was urgently treated with proximal femoral nail (10 mm × 170 mm, 130°) and antirotation blade (100 mm). Surgical procedure was uneventful. A helical blade was placed in the center-bottom position in the anteroposterior incidence (Fig. 2A) with a Parker's ratio (anteroposterior)⁹ of 38 and slightly posterior in the lateral incidence (Fig. 2B) with a Parker's ratio (lateral) of 36. The calculated "tip-apex" distance¹⁰ was 24 mm, and the cervicodiaphyseal angle was 136°. Postoperatively, the fracture was significantly reduced (Fig. 3). The patient was discharged to a rehabilitation institution, with the indication



Fig. 1 – Transtrochanteric AO 31-A1 fracture on the left.

of ambulation with a walker and partial load. She was re-evaluated at an outpatient consultation on the second month postoperative, complaining of pain in the left hip and difficulty in mobilization; the patient denied new traumatic episodes. Radiographically, a perforation of the femoral head and the bottom of the acetabulum by the helical blade was observed, with intrapelvic migration (Figs. 4 and 5). The material was extracted using the previous approach, uneventfully. The fracture evolved to varus malunion and allowed ambulation of the patient.

Discussion

The problem of rotational instability, followed by the varus collapse of the femoral head and by the cephalic

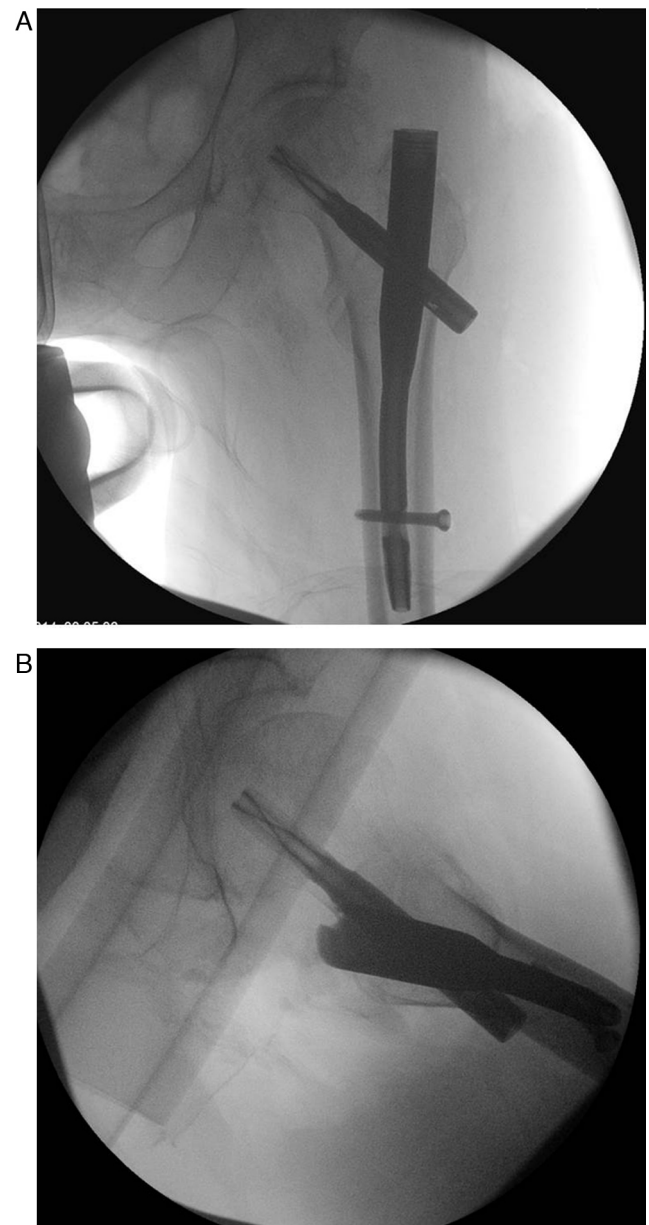


Fig. 2 – Intraoperative radiographic control: anteroposterior and profile.



Fig. 3 – Hip radiography in the immediate postoperative period.

perforation of the nail to the hip joint, is a well-described phenomenon,⁴ known as cut-out, and occurs with some plates and cephalomedullary nails used in the treatment of transtrochanteric fractures. Proximal femoral nails with helical blades were developed to address this problem. The spiral blade is inserted by impaction and promotes the compression of the cancellous bone around the implant. Several biomechanical studies have demonstrated the advantages of spiral blades when compared with conventional screws.^{4,5} The stability obtained after fracture fixation is influenced by several factors, such as the reduction achieved and the positioning of the nail in the femoral head. This insertion should be made



Fig. 4 – Pelvic migration of the helical blade on the second month postoperatively.

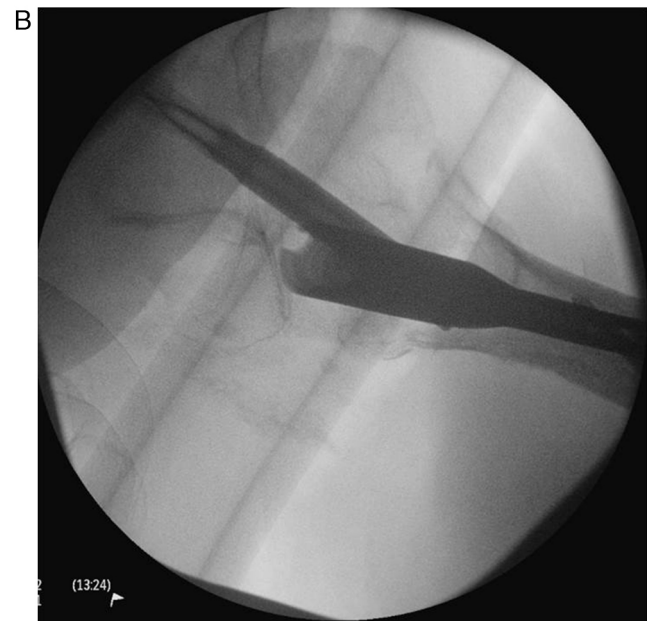
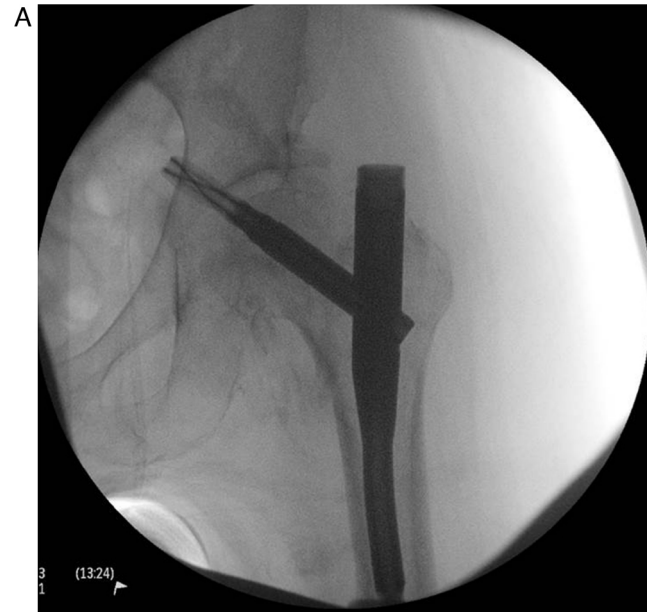


Fig. 5 – Amplified images (anteroposterior and profile) showing the perforation of the bottom of the acetabulum by the helical blade.

the center-bottom position in the anteroposterior and central focus on lateral incidence, thus placing the implant in the area with higher trabecular density. Baumgaertner¹⁰ defined the variable tip-apex distance and concluded that implants placed at a distance of more than 25 mm were at higher risk of cut-out. However, the complication presented in this report is not a conventional case of cut-out, but a new phenomenon of implant failure described as cut-through by Frei et al.⁶ and previously reported by Simmermacher et al.⁷ and Brunner et al.⁸ a perforation of the femoral head by the blade insertion axis, without significant loss of reduction. The case described, an acetabular perforation with pelvic penetration, could

have presented more serious complications with vascular injury and a different outcome. Recently, Nikoloski et al.¹¹ conducted a study to adapt the concept of tip-apex distance to PFNA implants; the previous variable showed a bimodal distribution in the cases of cut-out, which was not observed in previous implants. This suggests that the helical blades should not be placed too close to the subchondral bone. Zhou and Chang¹² defined a tip-apex distance between 20 mm and 25 mm for placement of the helical blade.

Osteoporosis influences the cut-out event. Bonnaire et al.¹³ have shown that bone mineral density of less than 0.6 g/cm³ increases the risk of implant failure. Most authors⁶⁻⁸ suggest that the main cause of central perforation of the femoral head are due to a failure of the helical blade to slide sideways as the fracture collapses. This failure to slide may occur due to defects of the blade/nail interface or to impaction of the base of the blade against the lateral cortex. Furthermore, it has been suggested the presence of the Z-effect, which, over several load cycles during ambulation, would promote medial migration of the helical blade.¹⁴ The occurrence of a new traumatic episode can also be the source of the problem. Regarding the treatment of these complications, which usually occur in the first two months after surgery, Brunner et al.,⁸ in their series of three cases, reviewed the fixation with a shorter helical blade, maintaining the same nail in two cases, and through cementless total hip arthroplasty in another case. In the present case, the entire material was extracted, since the 88-year-old patient did not present anesthetic conditions for total arthroplasty and because the use of the same implant in a new fixation attempt could result in migration, requiring reintervention. In order to reduce the incidence of this complication, the fracture should be adequately reduced and the blade should be correctly positioned in the femoral head. Prior drilling of the entire blade path is unnecessary and should be avoided, especially in the presence of osteoporotic bone.^{6,8} Recently, the possibility to improve fixation by cementing the femoral head using a perforated spiral blade was developed. The central perforation of the femoral head by the helical blade is a unique complication inherent to this type of implant. More biomechanical research is needed to clarify the perforation mechanism.

Conflicts of interest

The authors declare no conflicts of interest.

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