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Case Report

Disengagement and intrapelvic migration of a dynamic helical hip screw

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ABSTRACT

Some proximal femur fractures may be treated surgically with the use of fracture fixation hardware such as the sliding hip screw and its variants. These devices allow the femoral head and neck fragment to compress against the trochanteric or shaft fragment as the hip screw telescopes into the barrel of the side plate. We describe an unusual complication in which the hip screw disengaged in the opposite direction, migrated through the hip joint, and came to rest inside the pelvic cavity. The separated components of the device were surgically removed without further complication.

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Introduction

Basicervical femur fractures are a subset of proximal femur fractures that involve the distal femoral neck and potentially have trochanteric extension [1]. Several surgical options exist for the treatment of these fractures, including sliding hip screws, Dynamic Helical Hip System (DHHS), cephalomedullary nails, hemiarthroplasty and total arthroplasty, and multiple screw fixations. The choice of treatment is dependent on the specific fracture pattern, associated injuries, patient function, and associated comorbidities [2,3].

Case report

A 62-year-old man injured his right hip after a low energy ground-level fall. In the emergency room, radiographs showed

a displaced right basicervical femoral neck fracture (Fig. 1). Given the patient's social situation, medical history, and comorbidities, including hypertension, diabetes mellitus type II, and tobacco use, he was not considered a good candidate for hip arthroplasty. He gave consent for open reduction and internal fixation using the DHHS apparatus. At surgery, the fracture was found to extend vertically and distally through the medial cortex at the level of the lesser trochanter (Fig. 2). The procedure was performed without complication and the immediate postoperative course was unremarkable (Fig. 3). The patient was discharged to a supported living facility with wound care instructions and deep venous thrombosis prophylaxis. His activity instructions were weight-bearing as tolerated of the right lower extremity.

On his postoperative visit 6 weeks later, the patient was found to have extension of the helical blade medially through the articular surface of the femoral head and a fractured side-plate screw (Fig. 4). He was initially managed conservatively with weight-bearing restrictions. After approximately 4 weeks

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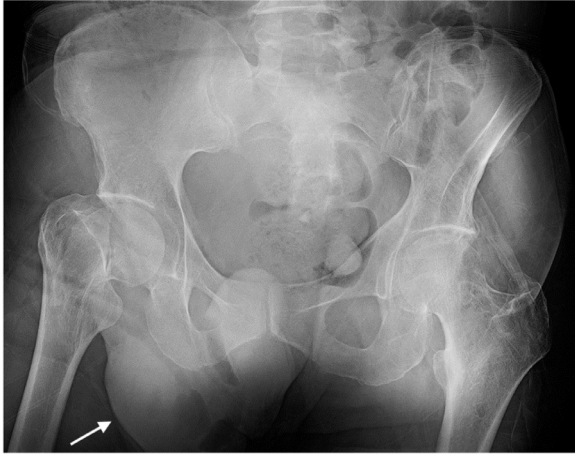


Fig. 1 – AP (anteroposterior) radiograph of the pelvis shows displaced transcervical fracture of the right femoral neck with valgus angulation, external rotation, and femoral foreshortening. There is an incidental large right inguinal hernia (arrow).

(10 weeks postoperative), he was noted to have worsening ambulatory capacity and follow-up radiography showed complete disengagement of the helical blade from its plate barrel with intrapelvic migration (Fig. 5). Out of concern for possible vascular or visceral injury, and for surgical planning, CT angiography of the abdomen and pelvis was performed, but no injury was found (Fig. 6). The patient was returned to the operating room and the side plate and screws were removed, including the fractured distal plate screw, through a lateral incision. The helical blade was visualized under fluoroscopy, retrieved with a solid coupling screw, and removed through the existing femoral head and acetabular defect (Fig. 7). The patient remained hemodynamically stable during hardware retrieval and did not demonstrate evidence of hollow viscus injury; therefore, laparotomy was avoided. An arthroplasty was not performed because the patient was considered to be a poor surgical candidate, given his marginal pre-existing ambulatory capacity, limited functional demands, and anticipated high risk of complications and failure. His postoperative course was unremarkable. He was discharged to a skilled nursing facility for rehabilitation with weight-bearing restrictions.

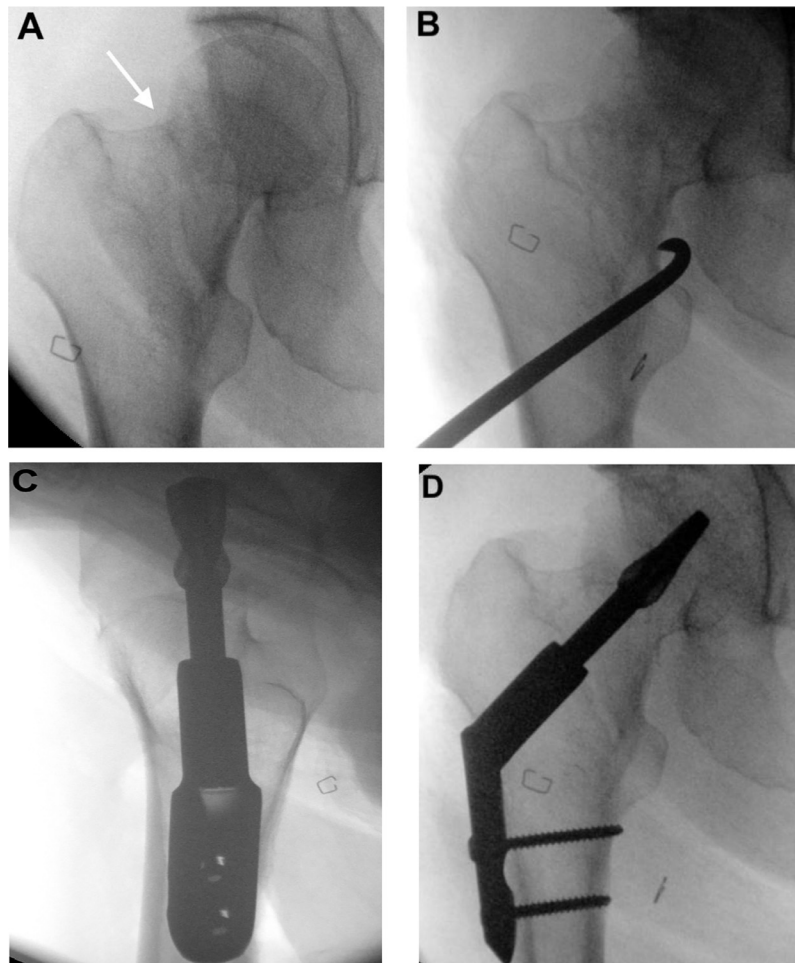


Fig. 2 – Intraoperative radiographs showing surgical treatment of the right basicervical femur fracture. Initial image shows mildly displaced vertically oriented fracture (arrow) (A). The fracture has been reduced with instruments (B). Lateral and AP images show appropriate position of the dynamic helical hip system device (C–D).



Fig. 3 – Immediate postoperative AP radiograph before weight-bearing shows anatomically reduced fracture with ideal position of hardware. Note that the hip screw has a helical blade rather than threads.

The patient was seen in clinic 4 weeks after hardware removal and reported only minor discomfort. Radiographs showed nonunion of the femoral neck fracture but no surgical complications (Fig. 8). It was decided that the patient could progress to weight-bearing activities as tolerated. Should the patient develop significant symptoms, particularly pain, a resection arthroplasty (Girdlestone procedure) would be the last resort.

Discussion

Fixation failure is an important radiologic finding that should be promptly identified, and then evaluated for its causation as well as the need for removal or revision. Identifying fixation failure from a radiologic standpoint includes both evaluating the integrity of the hardware and adjacent bone. For example, hardware misalignment, such as screw migration, or a fractured implant would indicate complications of the hardware. Periprosthetic fracture, a fracture that has developed adjacent to the hardware, or perihardware lucency, loosening of the hardware within the bone, would indicate complications secondary to hardware.

Depending on how well-healed the original fracture is, hardware failure can potentially lead to instability. Regarding basicervical fractures managed with the sliding hip screw constructs, there have been reported cases of construct failure. This includes cutout and migration of the lag screw, complete disengagement of the construct, varus angulation and eventual collapse, or plate loosening [2,4–7]. Screw cutout is one of the most common and most significant factors leading to hardware complications. Baumgaertne et al define cutout as



Fig. 4 – AP radiograph of the right hip 6 weeks after surgery shows subsidence of the femoral head fragment and protrusion of the tip of the hip screw through the articular surface. There is loosening of the hardware and breakage of the distal sideplate screw with migration of the head fragment into the soft tissues. There is a large right inguinal hernia.

“the collapse of the neck-shaft angle into varus, leading to extrusion of the screw from the femoral head” [8]. The population most commonly treated for peritrochanteric fractures is the elderly. This population also has a higher risk for fixation failure because osteoporosis can influence the ability to maintain stable osteosynthesis [2,9]. Technique can also be a contributing factor in fixation failure, particularly using an incorrect tip-apex distance (TAD). TAD is essentially a measurement that is used to describe the position of the screw tip within the femoral head [8]. An incorrect TAD can result in the lag screw terminating in a position that has suboptimal cancellous bone density.

The DHHS is a relatively new implant that utilizes the traditional sliding hip screw concept. The lag screw or helical blade is secured into the proximal head/neck fragment. The distal end of the lag screw or helical blade is then placed into the barrel of the side plate. By virtue of the design of both components, the screw or helical blade is allowed to travel axially within the barrel but not rotate. Intertrochanteric hip fractures with fracture surfaces that are compressible are ideal fracture patterns for sliding hip screw devices as the sliding of the proximal head/neck fragment into the distal shaft component creates fracture compression, and thereby enhances stability and facilitates union. In multifragmentary intertrochanteric hip fractures, the ability to create a compressible intertrochanteric fracture region is lost and the sliding of the head/neck fragment stops only when the broadest part of the lag screw or helical blade abuts the barrel of the side plate. This typically results in unacceptable shortening and deformity of the proximal femur. Cephalomedullary nails minimize

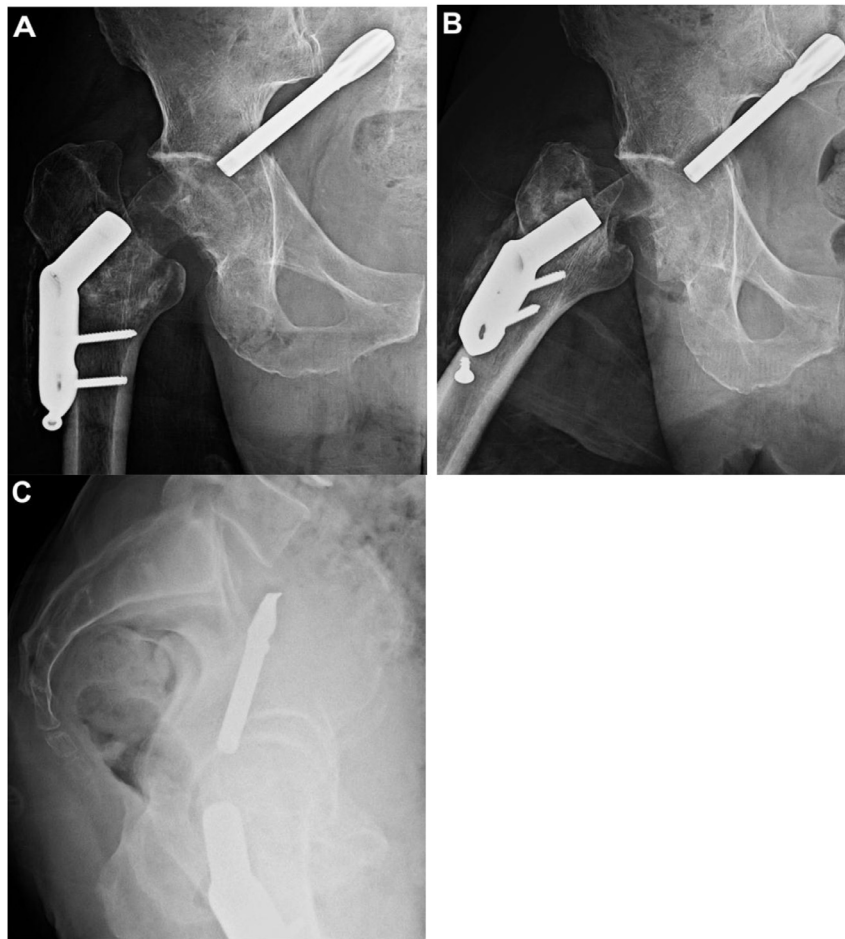


Fig. 5 – AP, frog-leg, and lateral radiographs of the right hip 10 weeks after surgery (A–C). There has been complete disengagement of the hip screw from the plate barrel and migration through the hip joint into the pelvic cavity. There is marked bone resorption at the fracture site, no evidence of healing, and proximal migration of the distal femur. Additionally there is redemonstration of the broken distal sideplate screw and right inguinal hernia.

this deformity, which is one of the prime reasons their use in unstable multifragmentary intertrochanteric hip fractures is preferred. The main difference between the lag screw and the helical blade is the theoretical improvement in fixation of the helical blade within osteoporotic bone.

Interestingly, very few case reports in literature describe hardware failure similar to the presented case when the hardware is on the left. One case was presented by *Pieres et al* of an 80-year-old woman with a left intertrochanteric fracture initially managed by osteosynthesis with proximal femoral nail using an antirotation screw and sliding screw. After 6 months, she was found to have lateral migration of the antirotation screw, however the sliding screw maintained its position. The antirotation screw was removed and fixation was maintained with the sliding screw. The screw migration was thought to be due to poor bone mineralization [10]. The predilection of right-sided hardware failure is not characterized in literature and is worth investigating.

Although the attempted fixation was unsuccessful, consideration must be given to the patient's medical history as a risk

factor for poor healing. There are no cases in literature with this degree of blade migration using the DHHS apparatus as presented above, however a similar phenomenon is seen and described in literature with reconstruction nail fixation. The so-called “Z-effect” and “reverse Z-effect” are characterized by lateral or medial migration of the interlocking screws relative to the femoral head respectively [10,11]. The underlying etiology for this migration is not well understood, however our case of blade migration may have a similar underlying mechanism.

In the case presented above, approximately 10 weeks postsurgery, there is complete disengagement of the construct with migration of the dynamic blade into the pelvis. As described, the patient was evaluated when there were symptoms concerning for worsening hardware complication and eventually taken to surgery. The remarkable finding in this case was the absence of intrapelvic injuries associated with the migration of the blade. Because of this finding, retrieval of the hardware was uncomplicated and the patient did not experience any other complications.

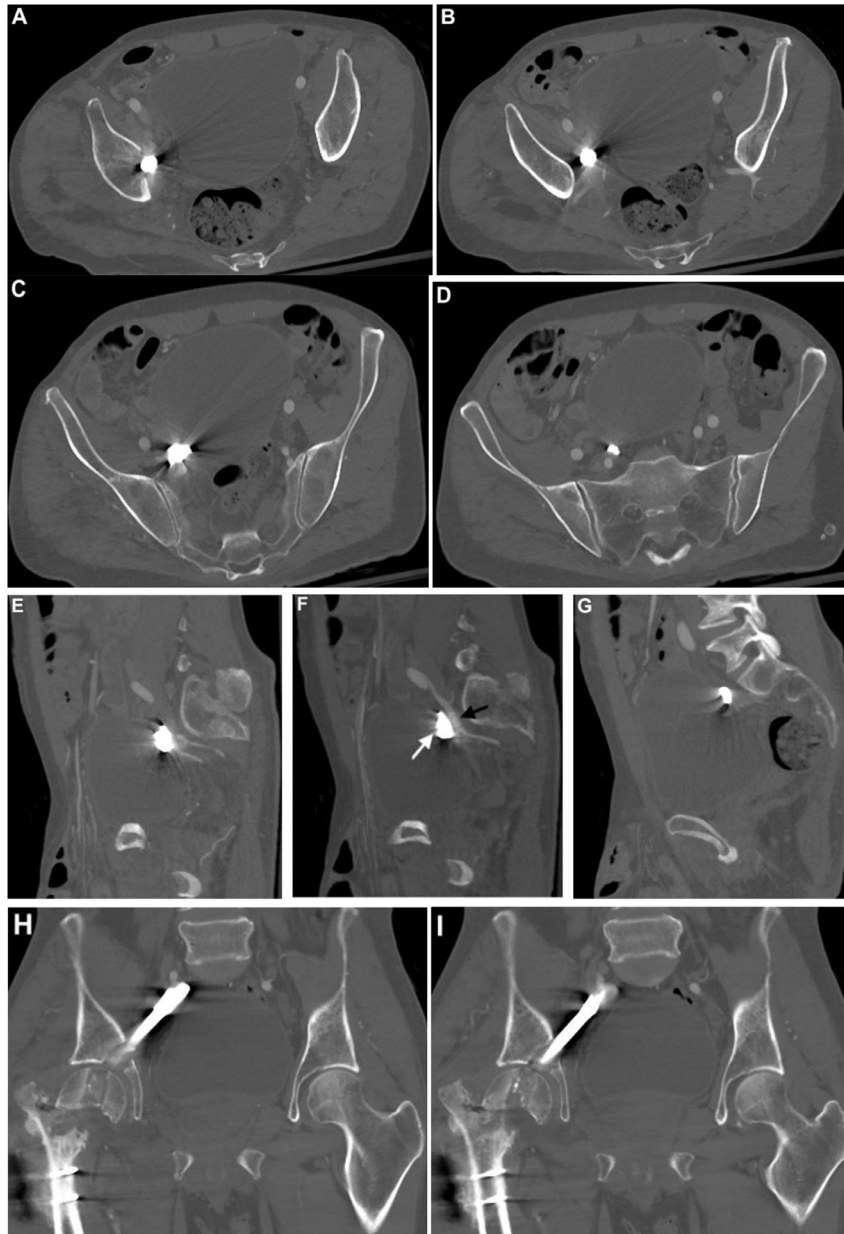


Fig. 6 – Standard axial (A–D) and sagittal maximal intensity projection (E–G) CT angiography images of the pelvis show the helical blade inside the pelvic cavity, but there is no evidence of vascular or pelvic visceral injury. The helical blade abuts the right internal iliac artery (white arrow pointing to the screw, black arrow pointing to the artery) (F). Coronal (H and I) CT angiography images show the migration path through the femoral head and acetabulum, as well as severe bone resorption at the fracture site.

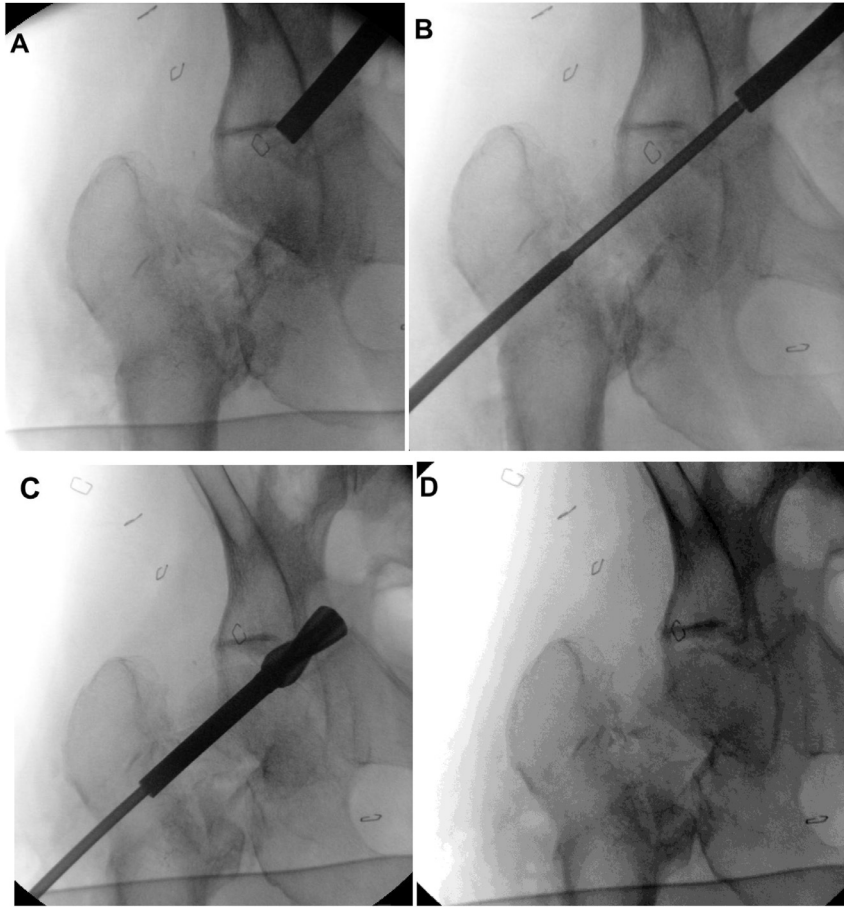


Fig. 7 – Intraoperative radiographs showing retrieval of the migrated helical blade. After removal of the side plate, the migrated helical blade could be visualized (A). The helical blade was captured by threading the solid coupling screw into the blade shaft (B). The helical blade was pulled out through the original hole (C). All of the hardware has been removed (D).



Fig. 8 – Postoperative follow-up at 4 weeks (14 weeks after original fracture fixation). AP radiograph of the right hip shows atrophic nonunion of the femoral neck fracture with proximal migration of the distal femur.

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