CASE REPORT

Pertrochanteric femur fracture at the proximal end of a retrograde intramedullary nail—a case report

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Introduction

Reamed antegrade medullary nailing remains the treatment of choice for most fractures of the femoral shaft. Retrograde medullary fixation of the femur, however, has also been demonstrated to be an effective stabilization method for femoral shaft fractures and may be preferred in certain clinical situations.1,5,12,14,17,18,20 Published literature evaluating the complications of this technique focus on nonunion rates, malunion rates, and morbidity related to the knee joint. Septic arthritis of the knee, damage to the distal femoral articular cartilage, and altered patellofemoral joint contact pressures may affect long-term knee function and have tempered enthusiasm for routine retrograde medullary nailing of isolated femoral shaft fractures. Fracture about the tip of medullary implants has been described as a complication of first generation intramedullary hip screw devices and retrograde supracondylar nails, but has not been described in association with full-length retrograde femoral nailing.3,7,9,10,16,21 We report a case of pertrochanteric femur fracture at the proximal end of a retrograde femoral nail that required surgical stabilization.

Case report

A 61-year-old female was a restrained driver in a high-speed motor vehicle collision. The patient was taken to a level I trauma centre and evaluated using the ATLS protocol. She was found to be awake, alert, and hemodynamically stable with the majority of her injuries localized to the right lower extremity. These consisted of a closed, right mid-diaphyseal femur fracture (Fig. 1), a displaced right medial femoral condyle fracture, a minimally displaced right patella fracture, and an open, comminuted ipsilateral intraarticular calcaneal fracture. After resuscitation, the patient was brought to the operating room where the distal femoral articular surface was stabilised with two 6.5 mm partially threaded cancellous screws. The femoral shaft fracture was then reduced using closed manipulative techniques and a reamed retrograde medullary nail (11 mm × 38 mm M/DN Zimmer, Warsaw, IN, USA) inserted. A nail length was chosen to ensure that the tip of the retrograde nail was above the level of the...
lesser trochanter. After distal interlocking, a single anteroposterior static proximal interlocking screw was placed using fluoroscopic imaging and a free-hand drilling technique (Fig. 2). The open calcaneus fracture was managed acutely with irrigation and debridement with delayed, definitive fixation performed several days post-injury. The patient was discharged to a nursing facility after an uncomplicated hospital course. She was kept non-weight-bearing on the right lower extremity, but was allowed unrestricted passive and active-assisted right knee range of motion. Her surgical incisions and traumatic wounds healed uneventfully.

Approximately, three months post-operatively, the patient sustained a fall from standing with immediate onset of right groin and buttock pain. Radiographic evaluation of the right hip and femur was performed at an outside emergency room and failed to demonstrate an acute fracture. The patient’s symptoms persisted and at one month after the fall (four months after the initial injury), she returned to our clinic. Plain radiographs at that time revealed a pertrochanteric femur fracture at the proximal tip of the retrograde nail (Fig. 3). There was incomplete bridging callus formation surrounding the femoral shaft fracture.

The patient was taken to the operating room, given a general anesthetic and placed supine on a fracture table. Traction was applied to the limb significantly improving the alignment at the fracture site. The patient’s retrograde nail was left in situ. Using a lateral approach to the proximal femur, the fracture was identified and noted to have a subacute appearance, corroborating the clinical history and radiographic appearance. Fixation was performed using a 95° angled blade plate with strategic placement of screws around the medullary implant. Routine peri-operative antibiotic and deep venous thrombosis prophylaxis was administered. She was discharged on post-operative day number three and mobilized with touch-down weightbearing restrictions. Six weeks later, she was gradually progressed to full weight-bearing. Her fractures healed uneventfully, and at 1.5 years following the initial injury, she has minimal pain about the right hip and ambulates without assistive devices (Fig. 4).

**Discussion**

Retrograde nailing of the femur has been shown to be an effective method of treating fractures of the femoral diaphysis. Reported complications of retrograde nailing focus on those that occur at the knee, such as septic arthritis, knee pain, heterotopic ossification, and altered patellofemoral mechanics.\textsuperscript{5,13,15} Complications associated with full-length retrograde femoral nails have concentrated on the potential neurovascular injury associated with proximal interlocking,\textsuperscript{19} and the creation of subtrochanteric stress zones secondary to the proximal locking screws.\textsuperscript{1,6} To avoid these proximal complications, it is recommended that the

Figure 1  This injury anteroposterior radiograph demonstrates a non-comminuted fracture of the mid-diaphysis of the right femur. There is no radiographic injury of the femoral neck or pertrochanteric region. Pre-existing osteopenia is noted.
nail be seated in the proximal femur to allow interlocking at or above the level of the lesser trochanter. Early retrograde nailing with an intra-articular starting point was initially reserved for distal femoral supracondylar fractures and utilized a relatively short nail, typically ending at the isthmus of the femur. Complications with these shorter nails included fractures of the implant as well as of the femoral diaphysis at the tip of the nail.\(^7,9,10\) These nails have largely been replaced with nails that span the femur into the subtrochanteric region to avoid these complications, and for improved fracture stability. Little has been published, however, regarding the mechanical properties of the proximal portion of modern retrograde femoral nails.

McLaurin et al. evaluated nail length and relationship of the proximal end with the lesser trochanter in synthetic and cadaveric femurs.\(^11\) They found that in the synthetic femurs, there was a lower mean load to failure with shorter nails than longer nails, and that failure occurred at the proximal end of the nail or the proximal interlocking screw interface in both the long and short nail groups. Interestingly, the cadaveric femurs all failed at the same mean load at the femoral neck, demonstrating the limitations of using synthetic femurs as a bone model. Given the lower load to failure associated with shorter nails, they suggested that the proximal tip of the retrograde nail should be at or above the level of the lesser trochanter.

Figure 2  (a and b) Anteroposterior and lateral radiographs six weeks post-injury demonstrate satisfactory position of the retrograde femoral nail within the proximal portion of the femur. The tip of the nail is above the lesser trochanter and a single static interlocking screw is seen.
In our patient, it is likely that a nondisplaced fracture was created at the time of the fall. Failure to initially diagnose and treat the injury enabled the fracture to displace over time, allowing the radiographic diagnosis one month later. A retrospective review of the injury and early follow-up radiographs prior to her fall failed to demonstrate any radiographic evidence of a missed fracture of the proximal femur that may have occurred from the initial injury. The history of a new fall combined with the new onset of persistent groin and buttock pain also corroborate the diagnosis of an acute pertrochanteric fracture. We hypothesize that the nail tip acted as a localizing area for the new fracture.

Given the patient’s pre-existing disuse osteopenia and age-related bone density changes, it is possible that the fracture would have occurred without the presence of the implant, however, the implant may have determined the ultimate fracture geometry and location.

Several options for surgical management were considered. Factors contributing to our choice of stabilization included the incomplete union of the femoral shaft, continued stability of the retrograde nail, and the location and geometry of the fracture. Other treatment options considered included removal of the retrograde nail followed by 95° condylar screw or blade fixation proximally and long

Figure 3  (a and b) Anteroposterior and lateral radiographs four months post-injury reveals a pertrochanteric fracture of the femur at the tip of the retrograde femoral nail. The fracture demonstrates significant apex anterior angulation. Subtle radiographic callus is noted about the pertrochanteric region, indicating a subacute nature to this fracture.
side plate application to neutralize the femoral shaft component; or, antegrade nailing using a reconstruction or trochanteric nail device.

This case illustrates that fracture about the tip of a retrograde nail may still occur despite adequate nail length. Contributing factors may be patient related, such as osteopenia, but may also be associated with the implant and localized stress concentration. Treatment of this injury combination, while challenging, can be successfully accomplished with retention of the medullary implant if required.

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References