It is uncommon for femoral neck fractures to occur after proximal femoral hardware removal because age, osteoporosis, and technical error are often noted as the causes for this type of fracture. However, excessive alcohol consumption and failure to comply with protected weight bearing for 6 weeks increases the risk of femoral neck fractures. This article describes a case of a 57-year-old man with a high-energy ipsilateral intertrochanteric hip fracture, comminuted distal third femoral shaft fracture, and displaced lateral tibial plateau fracture. Cephalomedullary fixation was used to fix the ipsilateral femur fractures after medical stabilization and evaluation of the patient. The patient healed clinically and radiographically at 6 months. Despite conservative treatment for painful proximal hardware, elective hip screw removal was performed 22.5 months after injury. Seven weeks later, he sustained a nontraumatic femoral neck fracture.

In this case, it is unlikely that the femoral neck fracture occurred as a result of hardware removal. We assumed that, in addition to the patient's alcohol abuse and tobacco use, stress fractures may have attributed to the femoral neck fracture. We recommend using a shorter hip screw to minimize hardware prominence or possibly off-label use of an injectable bone filler, such as calcium phosphate cement.
Reports of femoral neck fractures following proximal femoral hardware removal are uncommon in the orthopedic literature. The documentation that exists often reports age, osteoporosis, or technical error as the underlying causes of femoral neck fractures. To lessen the possibility of further trauma, limited weight bearing is usually advised for an average of 4 months after hardware removal. Clinically, most physicians recommend 6 weeks of limited weight bearing. Failure to comply may increase the likelihood of subsequent fractures. Also, several biomechanical investigations show that failure strength of the proximal femur is reduced after implant removal, in some instances by as much as 35%.

Another contributing factor to femoral neck fracture is excessive consumption of alcohol. Studies have shown that alcohol is associated with a decrease in bone mineral density, lower bone mass, and increased incidence of fractures. Schnitzler and Solomon reported that alcohol abuse can lead to femoral neck fractures. With a mean reduction in the volume and thickness of the trabecular bone, the bones of alcoholic patients resemble those of older, patients with severe osteoporosis.

We report a case of a middle-aged man who sustained polytrauma in a motorcycle crash, including an ipsilateral intertrochanteric hip fracture and a comminuted distal third femoral shaft fracture. The patient experienced continuous hip pain, which failed conservative treatment with iliotibial band stretches and steroid injections. The steroid injections provided him with complete but temporary relief. Eventually, the patient elected for hardware removal and, subsequently, sustained a femoral neck fracture during the postoperative period. This case was unique because the patient reported no trauma but had a history of alcohol abuse.

**CASE REPORT**

A 57-year-old man presented to the emergency room of an urban Level I trauma center following a motorcycle crash. The patient was operating the motorcycle without a helmet when he collided with a car and sustained multiple skeletal injuries. In the trauma bay, he was awake and alert with the primary complaint of right lower extremity pain. He was positive for alcohol, but no loss of consciousness had occurred. Aside from a small abrasion anteriorly over the thigh, skin integrity was intact. Also, on evaluation, he was able to flex and extend his toes with no discomfort, and perfusion in the right foot was present. His medical history was unremarkable, but his social history was significant for alcohol abuse and tobacco use; he consumed 24 beers per week and smoked 1 pack of cigarettes per day for 40 years. Trauma evaluation revealed multiple closed fractures in the right lower extremity. The patient sustained an ipsilateral intertrochanteric fracture, a comminuted distal third femoral shaft fracture, a displaced lateral tibial plateau fracture, and 2 undisplaced fractures of the great toe.

After preoperative surgical clearance, the patient underwent cephalomedullary nail fixation of his intertrochanteric and femur fractures and open reduction and internal fixation (ORIF) of his lateral tibial plateau. The risks, options, benefits, and expected outcomes were discussed with the patient.

Because the lateral tibial plateau was unstable, this fracture was addressed first. However, the femoral fracture was more challenging and technically difficult to treat because 2 fracture patterns existed. The distal third femur fracture was comminuted with extension into the metaphyseal region. Therefore, the fracture was treated using a combination of a cephalomedullary nail with multiple anteroposterior blocking or poller screws placed around the nail distally to achieve satisfactory anatomic alignment of the distal femur (Figures 1, 2).

His activity was nonweight bearing on the right lower extremity with a restricted range of motion (ROM) using a long-leg hinged ROM brace. Deep venous thrombosis (DVT) prophylaxis and nonweight bearing were continued for 12 weeks, and knee ROM exercises were started. At 12 weeks, the patient began progressive weight bearing and was fully weight bearing by 18 weeks after injury. His frac-
tures were clinically and radiographically healed by 6 months with no further surgical intervention.

At 15 months after injury, the patient reported a burning sensation and pain in the right hip. Physical evaluation revealed equal leg lengths, normal gait, symmetrical foot progression angles, and slightly restricted hip ROM. Pain occurred with palpation at the hip screw insertion site; the Ober test was positive. A steroid injection was administered at the site of maximal tenderness with complete resolution of hip pain. Physical therapy for iliotibial band stretching was prescribed.

The hip pain lessened but did not resolve with physical therapy. The relief from the steroid injection lasted 2 months. At 18 months after injury, a second steroid injection was given, with another 2 months of relief. The patient continued with the iliotibial band stretching program. At 21 months, the patient continued to have right hip pain consistent with symptomatic hardware, so he elected to have the hip screw removed.

At 22.5 months, uneventful removal of the hip screw was performed (Figure 3). The patient returned to partial weight-bearing status. Physical therapy was involved for gait training with a rolling walker. He was discharged home, and at 2-week follow-up he reported no pain in his right hip. At 6 weeks postoperatively, he returned without complaint and progressed to weight bearing as tolerated on his right leg.

Seven weeks following hip screw removal, he had the acute onset of sharp right hip pain, was unable to ambulate, and believed that something had snapped. He presented to another hospital and was found to have a displaced femoral neck fracture, but he reported no trauma or previous groin discomfort after the screw was removed from his hip. Transfer was arranged, and radiographs showing the displaced femoral neck fracture were reviewed on arrival (Figure 4). A bone scan was obtained to check the viability of the femoral head, but no evidence of blood flow existed.

Options regarding management were discussed with the patient. His level of alcohol consumption and tobacco use had not changed. A hemiarthroplasty with a modular revision component was performed uneventfully 2 years and 1 week after his initial injury (Figure 5). Five months after the hemiarthroplasty, the patient was asymptomatic. Two and a half years after the hemiarthroplasty, the patient reported no complications or issues.

**DISCUSSION**

Fracture after hardware removal is not uncommon. Recommendations regarding timing of removal vary, but 12 to 18 months for intramedullary nail fixation of femoral shaft fractures is generally accepted. In the pediatric literature, it has been demonstrated that the stiffer the hardware, the higher the likelihood of refracture after removal. After hip hardware removal, refracture is possible, and the suggestion of protected weight bearing for 4 to 6 weeks has been made. Our case is unusual for 2 reasons. Despite partial weight bearing for 6 weeks with a walker, a fracture occurred. Also, the subsequent fracture was at the midcervical neck and not at the previous intertrochanteric site.
This unexpected complication raises several questions. We suspect that a combination of factors led to the femoral neck fracture. After the healing of the intertrochanteric fracture, the neck-shaft angle was in slight varus (right = 127°; left = 135°). Beaulé et al. studied 119 patients who underwent hip resurfacing arthroplasty and found that individuals who had a stem-shaft angle < 133° were at a higher risk for complications, including femoral neck fractures.

Although a bone mineral density test was not performed, osteopenia or osteomalacia may have contributed to the fracture. Osteopenia may have resulted from his nonweight-bearing status, initial injury, and long history of tobacco use, whereas his alcohol abuse may have caused the osteomalacia. Although osteopenia is a temporary condition, it has been speculated that this form of bone loss can be attributed to the disruption of the blood supply in the bone or even stress shielding. Low bone density among men older than 50 years is more prevalent, and chronic alcohol abuse has been shown to be a risk factor for fractures resulting from osteoporosis. The patient reported prodromal symptoms may lead to earlier weight-bearing. Our future area of research is to evaluate hip fracture models with and without the injectable calcium phosphate cement into the void left by removed hardware.

**REFERENCES**


