



Prophylactic Fixation of an Incomplete Subtrochanteric Femur Fracture Due to a Low-velocity Gunshot Injury: A Unique Case

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We report on a 17-year-old man who underwent prophylactic fixation of the incomplete subtrochanteric femur fracture produced by a low-velocity gunshot. The subtrochanteric region is a high-stress site. Therefore, to avoid progression to complete fracture and displacement requiring secondary surgical stabilization, we used a proximal femoral nail for prophylactic fixation of the incomplete subtrochanteric femur fracture. The patient was able to walk and bear weight on the injured side immediately after surgery. At the 1-year follow-up, the patient was pain-free with a full range of motion of his right hip and had a bony union.

Key words: Gunshot, subtrochanteric femur fracture, proximal femoral nail

INTRODUCTION

During the past decade, the rates of morbidity and mortality related to gunshot wounds in civilians have increased at an alarming rate in many parts of the world. In the USA, gunshot wounds are the second leading cause of death and injury in youth.¹

A complete fracture produced by a gunshot injury requires stable bone fixation, antibiotic coverage, removal of foreign bodies, and appreciation of the soft-tissue healing process.² If the fracture is incomplete, these treatment principles are usually applicable, although the need for a stable bone fixation is questionable. On the other hand, progression to a complete fracture may cause both medical and legal problems. Studies evaluating fracture due to gunshot injuries usually exclude incomplete fractures, and the risk of progression to complete fractures has been overlooked.³

Here, we report a case of incomplete subtrochanteric femur fracture produced by a low-velocity gunshot and discuss the indication for prophylactic stabilization.

CASE REPORT

A 17-year-old male was brought by ambulance to the emergency department, 30 min after being shot in the lateral

aspect of the proximal third of the right thigh from a distance of approximately 5-6 m. Examination revealed an irregular entry wound approximately 1.5 cm in diameter [Figure 1a]. There were 2 similar sized exit wounds around the anus [Figure 1b]. The evaluation of blood support to both legs, which was performed by a vascular surgeon, revealed valid foot pulses and excluded damage to the main arteries; all pulses and sensation were preserved. There were no other remarkable findings, and he remained hemodynamically stable. Intravenous opiate analgesia and antibiotics (1 g cefazolin) were given. Tetanus immunity was confirmed, and urgent blood examinations were performed. There was bone loss in the posterior medial cortex of the medial calcar and a broken lateral cortex in the right subtrochanteric region, and the bullet was visualized in the soft-tissue of the left thigh on the X-ray film and computed tomography scan [Figure 2a-c]. The patient was diagnosed with an incomplete subtrochanteric femur open fracture due to the gunshot injury. A pediatric surgeon performed an operation to the patient in the prone position under spinal anesthesia to examine the wound around the anus [Figure 1b]. The bullet was removed from the subcutaneous tissue of the left thigh [Figure 1c]. Necrotic tissue around the hole was excised, and the wound was irrigated with saline solution. Wound cultures were taken, and the wounds were packed and dressed with fluffed gauze. Antibiotics were continued postoperatively for 3 days, and the wounds were dressed daily. Seven days later, the results of the wound cultures taken during the operation were found to be negative. The incomplete fracture was stabilized with a proximal femoral nail (synthes) [Figure 2d, left and middle], the fracture site was impacted with an artificial bone graft (ALLOMATRIX® 1cc), and the wound was closed.

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The patient began a regimen of hip and knee motion exercises, and weight-bearing as tolerated was allowed immediately after surgery. Full range of motion of the right hip was achieved in the first postoperative week. Routine follow-up radiographs were obtained every 6-8 weeks until the fracture line vanished. At the 1-year follow-up, the patient had no hip pain, with a full range of motion and a bony union [Figure 2d, right].

DISCUSSION

A gunshot-related fracture is a unique type of open fracture. The standard care in the management of acute gunshot fractures includes stabilization of the peripheral vascular and cardiovascular systems, tetanus prophylaxis, removal of the bullet, wound debridement, irrigation with saline solution, soft-tissue coverage, and stable fracture fixation.⁴

A surgeon confronting an incomplete femur fracture produced by a gunshot injury may ignore the need for stable fixation and treat the patient using a nonweight-bearing approach, relying on the theoretical fast healing capacity of gunshot injuries.³ However, the gluteus medius, gluteus minimus, adductors, and iliopsoas muscles may act as a deforming force during contraction, thus increasing the stress on the femur without weight-bearing. The solution to the problem of how incomplete fractures should be stabilized is not yet clear.^{5,6}

Subtrochanteric femur fractures are those occurring at or 5 cm distal to the lesser trochanter. Because the proximal femur is eccentrically loaded, this subtrochanteric area is subjected to high levels of stress. Medial cortical comminution is not uncommon, making these fractures unstable.⁷ The major compressive stress in the femur is highest in the medial cortex 1-3 inches below the lesser trochanter. Compressive medial forces are considerably greater than lateral tensile forces.⁸ There are many reports of a broken lateral cortex in the subtrochanteric region induced in a subtrochanteric femur fracture⁹ [Figure 3].

The combination of very high stress in the proximal femur and a large, unsupported lateral cortex or medial buttress defect that is broken greatly increases the likelihood of fracture with weight bearing, as in the case presented here.

Prophylactic nailing of long bones is a method used to prevent complete pathologic fracture or diminish pain in bone metastases. In addition, prophylactic nailing is performed in the management of stress fractures.¹⁰ In view of the fracture risk, incomplete subtrochanteric femur fractures can be considered to be similar to bone metastasis or stress fractures with a partially fragmented cortex. A defect in the tubular bone not only decreases the amount

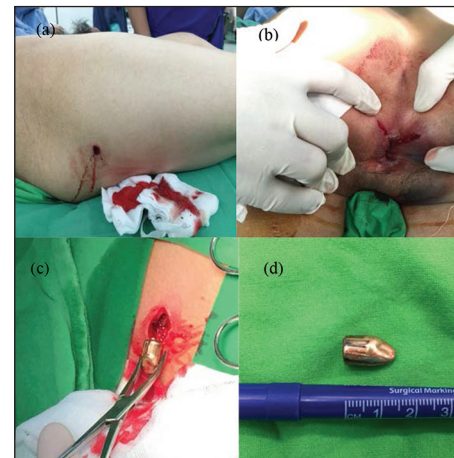


Figure 1: (a) The entry wound was approximately 1.5 cm in diameter in the right lateral proximal thigh. (b) The bullet tract from the right buttock to the left buttock around the anus. (c and d) The bullet was removed from the subcutaneous tissue of the left thigh

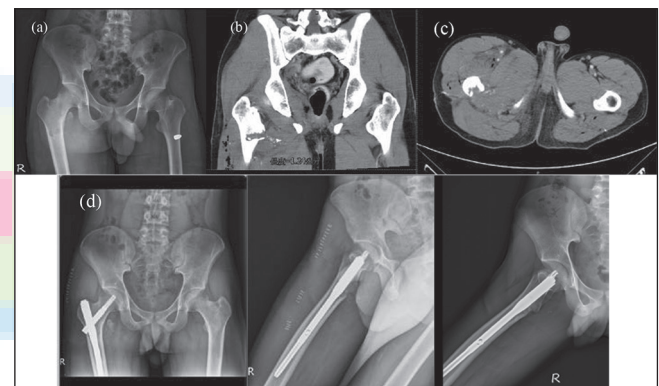


Figure 2: (a) The bullet was embedded in the left thigh (arrow). (b) The computed tomography showed a bullet tract from the lateral cortex to the posterior medial cortex in the subtrochanteric area of the right femur. (c) A defect of the posterior medial cortex that was more than 50% of the femoral diameter (arrow). (d, left and middle) The patient underwent internal fixation using a proximal femoral nail, and the defect was obvious (arrow); (right) radiographs taken at the 1-year follow-up showing bony union (arrow)

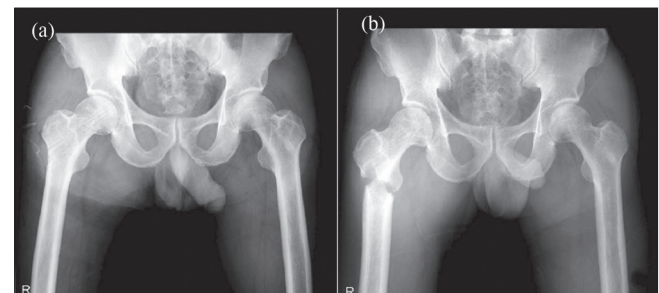


Figure 3: (a) Anteroposterior radiograph showing multiple radiolucent lines from the lateral cortex of the proximal femur to the femoral head after core decompression of the femoral head. (b) Anteroposterior radiograph of the right hip showing a transverse fracture line in the subtrochanteric area

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of bone available to withstand applied loads, but also increases the amount of local stress. The width of the defect is the major factor influencing bone weakness. If the width of the defect involves more than 50% of the bone, a serious weakness is present.¹¹

The decision to surgically treat an incomplete subtrochanteric femur fracture is controversial. Although activity modification with partial weight-bearing on the affected extremity is an option, it does not appear to be reliable because of the risk of progression to complete fracture. Prophylactic fixation may prevent the fracture from progressing, as well as any related morbidity. In the presented case, we used a proximal femoral nail for prophylactic fixation, because these intramedullary devices are currently widely used owing to their mechanical and biological advantages in the management of subtrochanteric femur fractures. Insertion of a nail is easier before than after fracture completion, with no periosteum disruption and much shorter healing time. In addition, the postoperative hospital stay is shorter. Therefore, the significance of preventive nailing is noteworthy.

Prophylactic fixation with a proximal femoral nail is not without potential risks. Intraoperative and postoperative complications including deep infection, fracture of the greater trochanter during insertion of the nail, lateral sliding of the blade (>10 mm), cut out, and the secondary fractures below the tip of the implant have been reported. According to the literature, these complications, which necessitate reoperation, occur in 3-7% of cases.¹² After analyzing the cause of these complications, it appeared that the osteoporotic bone was the major source of these problems; therefore, in the case presented here, the risk of complications was lower.

CONCLUSION

Incomplete subtrochanteric femur fracture produced by a low-velocity gunshot is rare. The decision to surgically treat this type of fracture is controversial. The subtrochanteric area is subjected to a high level of stress. Medial cortical comminution is not uncommon, making these fractures unstable. Prophylactic stabilization in incomplete subtrochanteric femur fractures may prevent further

complications, and this procedure appears to achieve a more efficient postoperative course.

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