



## Case report

## Gunshot Wound Resulting in Femoral Neck Fracture Treated With Staged Total Hip Arthroplasty

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## ARTICLE INFO

## Article history:

Received 29 November 2021

Received in revised form

29 December 2021

Accepted 31 December 2021

Available online xxx

## Keywords:

Gunshot wound

Femoral neck fracture

Total hip arthroplasty

THA

GSW

## ABSTRACT

A 39-year-old male presented with multiple gunshot wounds and resultant left comminuted femoral head and neck fractures with retained intraarticular bullet fragments. Successful staged reconstruction was performed with initial placement of an antibiotic spacer and subsequent conversion to total hip arthroplasty. Staged reconstruction with an antibiotic spacer and conversion to total hip arthroplasty is a viable treatment approach for a gunshot wound resulting in intraarticular bullet fragments and comminuted femoral head and neck fractures not amenable to open reduction and internal fixation to reduce the risk of periprosthetic joint infection.

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## Introduction

Although intraarticular gunshot wounds are uncommon, they raise concern for secondary joint infection due to the introduction of a foreign body to the joint. The initial assessment and management of a trauma patient uses a systematic approach to detect and treat any actual or life-threatening injuries [1]. From an orthopedic standpoint, the treatment of intraarticular gunshot wounds includes stabilization of fractures, wound care, and infection prevention [1]. It is recommended that violation of a joint, with retained intraarticular bullet fragments, should be treated with irrigation and debridement along with removal of retained bullet fragments [1–5]. Removal of bullet fragments is recommended to prevent the risk of complications such as septic arthritis, systemic sepsis, lead toxicity, mechanical abrasion, and delayed damage to the articular surface from loose bodies [6–14]. After irrigation and debridement, fracture treatment options involving a joint may include open reduction and internal fixation or arthroplasty.

There is a paucity of literature describing outcomes after bullet injury to a joint and the risk of periprosthetic joint infection after a subsequent total joint arthroplasty. Tornetta and Hui reported that 71% of patients with low-velocity intraarticular gunshot wounds to the knee without evidence of radiographic injury had intraarticular debris (skin, clothing, bullet fragments) at the time of surgical management [15]. Naziri et al. evaluated 4 patients with gunshot wounds to the hip who were treated with total hip arthroplasty (THA) for posttraumatic arthritis [16]. No patients developed periprosthetic infection at the final visit of the 26-month follow-up [16]. The International Consensus Meeting on Musculoskeletal Infection provided a recommendation with strong consensus that the presence of prior bullet fragments in a joint does not increase the risk of subsequent periprosthetic joint infection in patients undergoing elective arthroplasty in the same joint. However, this report acknowledged a lack of evidence regarding postoperative outcomes and the risk of infection for patients treated with a total joint arthroplasty with a history of intraarticular bullet fragments [17].

We report a case of a patient who sustained comminuted femoral head and neck fractures and significant soft-tissue injury secondary to a gunshot wound who was successfully treated with staged THA. Informed consent for this case report was obtained through independent discussion with the patient.

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## Case history

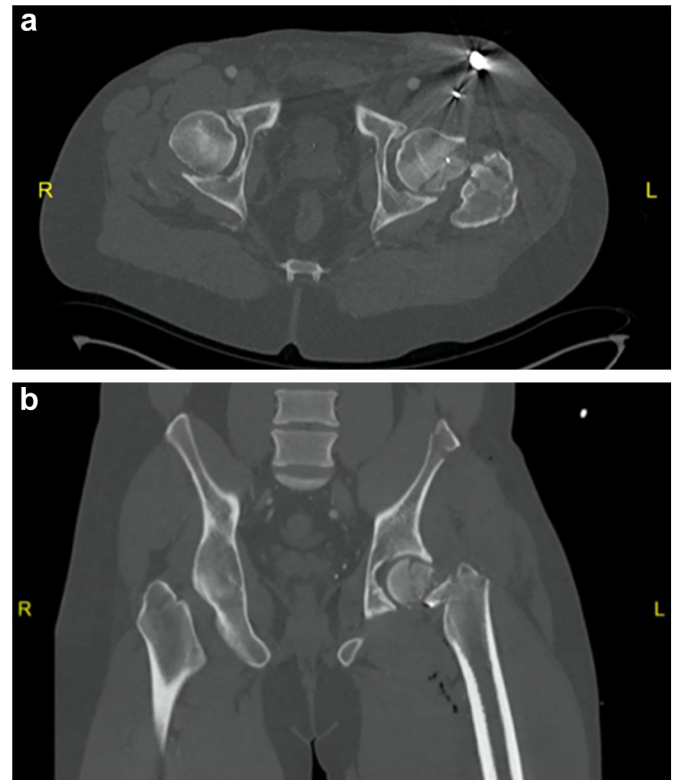
A 39-year-old healthy male, with no significant medical or surgical history, presented with a trauma with multiple gunshot wounds. He reported abdominal, left thigh, and flank pain. On physical examination, he had 7 gunshot wounds involving his abdomen, left flank, buttock, lateral distal thigh, posterior medial thigh, and right medial and lateral thigh. He was neurovascularly intact in bilateral lower extremities. Radiographs of his left hip demonstrated comminuted femoral head and neck fractures with multiple bullet fragments (Fig. 1).

The patient was hemodynamically unstable with an abdominal gunshot wound, so he was taken from the emergency department directly to the operating room for an emergent abdominal exploratory laparotomy and started on intravenous ertapenem. At that time, 2 gunshot wounds were identified within the small bowel, which resulted in a small bowel resection and primary anastomosis. An additional gunshot wound and serosal tear were found in the sigmoid colon, and the tear was repaired without complications.

A computed tomography scan was subsequently obtained, which demonstrated left comminuted femoral head and neck fractures with comminution of the greater trochanter and intra-articular bullet fragments (Fig. 2). Owing to the fracture pattern and retained intraarticular bullet fragments, 2 days after the initial injury, the patient was taken for irrigation and debridement of the hip through a posterior approach to the joint with staged reconstruction including an antibiotic cement spacer, treatment with intravenous antibiotics, and a delayed THA. At the time of surgery, the degree of soft-tissue injury was significant with no identifiable tissue planes and edema. Staging allowed for resolution of the acute local trauma to more optimized conditions for arthroplasty and prophylaxis against infection. Initial surgical management included irrigation and debridement with 12 liters of irrigation and placement of an antibiotic cement spacer (Fig. 3). Simplex P with tobramycin bone cement plus an additional 2 grams of vancomycin and 1 gram of tobramycin per bag of cement was used. The fracture of the greater trochanter was repaired with heavy nonabsorbable sutures as the fracture was not displaced, and this avoided the use



**Figure 1.** Anteroposterior radiograph of the left hip demonstrating a comminuted femoral head and neck fracture with multiple bullet fragments.



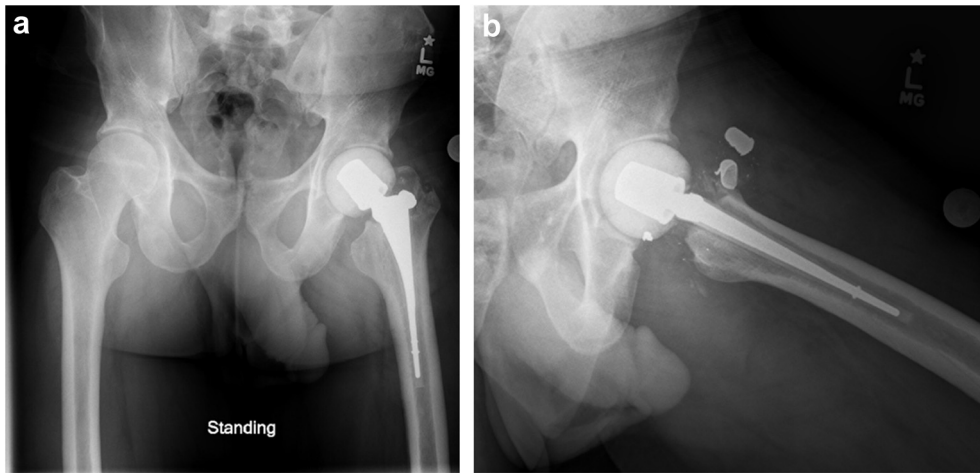
**Figure 2.** Axial (a) and coronal (b) computed tomography scan demonstrating a left comminuted femoral head and neck fracture with associated comminution of the greater trochanter and multiple bullet fragments.

of implants within a contaminated field. Postoperatively, he was toe-touch weight bearing on the left lower extremity and received 48 hours of intravenous piperacillin-tazobactam. He was discharged home on 6 weeks of oral amoxicillin-clavulanate, 500 milligrams, 3 times a day. His intraoperative tissue and fluid cultures resulted in no growth.

The patient was lost to follow-up after 12 weeks postoperatively because of difficult social circumstances. He presented to the clinic at 12 weeks after antibiotic spacer placement and was ambulating with a cane. He was then admitted for medical evaluation before second-stage reconstruction, and erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) were obtained, which were normal for our laboratory references at 14 and 8 mg/L, respectively. An aspiration of the hip before the second-stage surgery was recommended; however, the patient declined. At 13 weeks postoperatively, the articulating spacer was removed, and THA was performed. Intraoperative cultures remained negative. Postoperatively, the patient was weight bearing as tolerated. Overall, the procedure and postoperative recovery were uneventful. The patient was discharged home without further antibiotics. The patient presented for follow-up at 6 weeks postoperatively. At that time, the incision was completely healed without signs of complication. The patient was able to bear full weight without the need for an assistive device. Radiographs appeared stable (Fig. 4). At 2 years postoperatively, the patient was walking with a normal gait pattern with no limp or pain. He returned to normal activities with no local hip discomfort and remained free of signs of infection.

## Discussion

A gunshot wound resulting in retained intraarticular bullet fragments and comminuted femoral head and neck fractures in a



**Figure 3.** Anteroposterior (a) and lateral (b) radiographs of the left hip status after placing an antibiotic spacer.

young patient is a rare and potentially devastating injury. Contaminants can be introduced by the bullet itself as well as from objects through which the bullet passes (clothes, skin,) before entering the body [18]. Therefore, prompt thorough debridement as well as removal of intra-articular bullet fragments is indicated to prevent potential septic arthritis, possible lead toxicity, and damage to the articular surface [6].

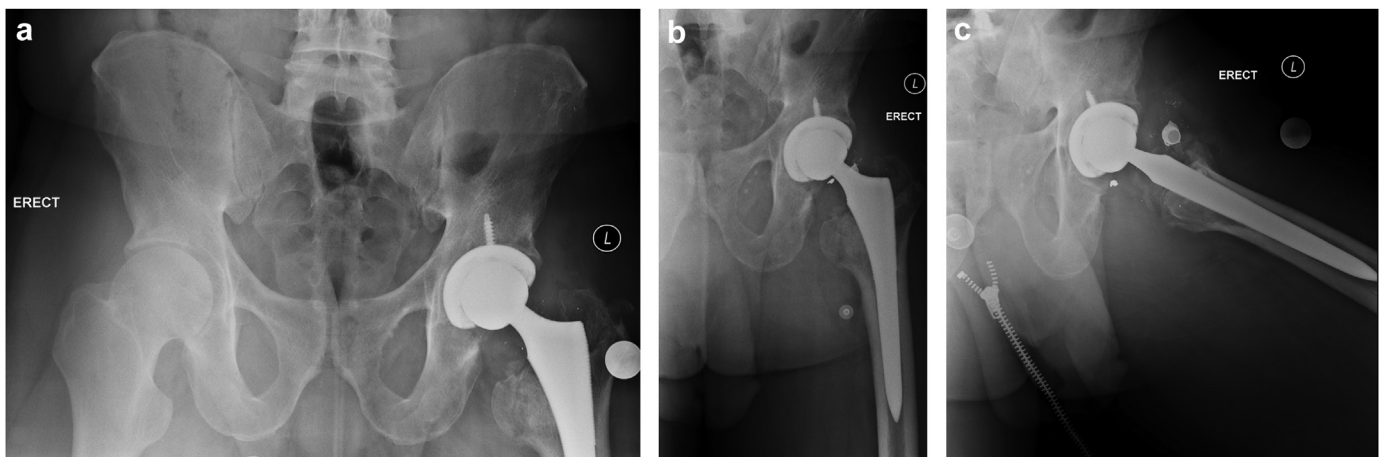
Displaced femoral neck fractures in young patients even without associated gunshot wound injuries have extremely high rates of both nonunion and avascular necrosis [19]. In addition, these patients when treated with open reduction and internal fixation are at high risk for reoperation [20]. Prior literature has demonstrated poor outcomes after joint salvage and internal fixation for gunshot wounds to the hip associated with femoral neck fractures. Zhang et al. reported on 14 patients with gunshot wounds that involved the femoral head and neck treated with internal fixation with a high incidence of nonunion, hardware failure, post-traumatic arthritis, as well as heterotopic ossification [21]. Long et al. noted that 5 patients with gunshot injuries to the hip associated with femoral neck fractures had poor outcomes with internal fixation [4]. The authors recommended delayed hip arthroplasty as the possible definitive management for these injuries [4].

Pazarci et al. published a case series of 10 patients with hip joint gunshot injuries and discovered that rapid traumatic osteoarthritis

was likely to develop in patients with intra-articular bullet fragments [22]. All 10 patients were treated with delayed definitive THA ranging from 3–10 months from the time of gunshot wound injury, and 2 patients developed a postoperative infection after THA. Of note, these 2 patients with infection had gunshot wound injuries to the hip as well as accompanying intestinal injury and presumed contamination of the hip joint by intestinal flora. The authors recommended that patients with possible contamination of the hip joint with bowel contents should receive debridement with the application of an antibiotic spacer and THA applied at the second stage [22].

Pazarci et al. found that all 10 patients had an increase in their clinical score and quality of life score after THA, and relative patient satisfaction was observed [22]. This is in line with the results of the study by Naziri et al. who also found significant increases in clinical outcome scores after delayed THA for gunshot injuries to the hip [16]. Both studies demonstrate that hip arthroplasty is an effective method for post-traumatic arthritis developing from gunshot hip injuries.

The objective of this case report is to add evidence to the limited number of prior case reports or small series describing the risk for subsequent periprosthetic joint infection after a bullet injury to a lower extremity joint indicated for a total joint arthroplasty. This topic was raised by the International Consensus Meeting on



**Figure 4.** Anteroposterior pelvis (a) and AP (b) and lateral (c) radiographs of the left hip status after removal of the antibiotic spacer and total hip arthroplasty.

Musculoskeletal Infection with a “consensus” level of evidence that the presence of prior bullet fragments in a joint, unless the joint was previously infected, does not increase the risk of subsequent infection in patients undergoing elective arthroplasty in the same joint. Our case report discusses the uncommon clinical presentation where THA was indicated in the acute setting after a bullet injury involving the hip joint. Owing to the severity of soft-tissue insult and the concern for periprosthetic joint infection secondary to the bullet fragment involving the hip joint, reconstruction was staged with an initial emphasis on irrigation and debridement, removal of intraarticular bullet fragments, and prophylactic antibiotics to avoid infection.

### Summary

We report a successful outcome of staged THA after a gunshot wound involving the hip joint. There were no complications, particularly infection, and the patient achieved an excellent functional outcome.

### Conflicts of interest

The authors declare that there are no conflicts of interest.

### Informed patient consent

Informed consent for this case report was obtained through independent discussion with the patient.

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