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Case Report

Fracture of an Exeter Femoral Stem With Extensive Ipsilateral Periacetabular Osteolysis

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ABSTRACT

The Stryker Exeter stem (Stryker, Kalamazoo, MI) has been in service for over 50 years and remains the most widely used cemented stem. Stem fracture is a rare complication, with recently reported rates of 1 in 10,000. We present a case of Exeter stem fracture 25 years following initial implantation as well as a large periacetabular defect secondary to osteolysis. A revision total hip arthroplasty was performed, including periacetabular bone grafting for extensive osteolysis along with retention of a stable acetabular component. This case highlights the rare complication of Exeter stem fracture as well as the technique of bone grafting a large periacetabular defect with a retained acetabular component. This is of particular interest given the rarity of this event and the resurgence in North America of cemented femoral components in total hip arthroplasty.

Introduction

The Stryker Exeter stem (Stryker, Kalamazoo, MI), the preeminent dual-taper polished stem, has been in service for over 50 years and remains the most widely used cemented stem worldwide [1]. The original stem, introduced in 1969-1970, demonstrated a fracture rate of up to 2% [2]. Changes to the alloy and design in subsequent generations, leading to the release of the universal stem in 1988, have made implant fractures exceedingly rare. An analysis by Bolland et al. in 2016 found only 80 reported cases of Exeter stem fractures worldwide between 1991 and 2008, corresponding to a fracture rate of 1 in 10,000 [3]. When fracture does occur, it is typically described in 2 primary locations: within the neck or in the femoral portion of the stem. Neck fractures are further delineated as occurring just below the trunnion or at the neck-stem junction through the introducer hole.

Case history

A 67-year-old male presented as a referral from an outside community with the onset of severe left hip pain approximately 25 years following primary left total hip arthroplasty secondary to avascular necrosis. Of note, the left hip was surgically treated with core decompression prior to the total hip arthroplasty. On presentation, he required an assistive device, which was new for him. The patient's medical history is significant for a renal transplant on immunosuppressive medications, bilateral femoral artery stents, and multiple surgeries involving bilateral hips secondary to avascular necrosis. The patient's right hip currently has a diaphyseal-fitting modular femoral component and a constrained liner with significant osteolysis about the femoral component, but was asymptomatic at the time of his initial presentation. Radiographic evaluation of the symptomatic left hip by the referring physician demonstrated a subtle lucency about the medial aspect of the femoral portion of a Stryker Exeter cemented stem (Stryker, Kalamazoo, MI) and severe osteolysis surrounding a DePuy Duraloc acetabular component (DePuy, Warsaw, IN) (Fig. 1). Further radiographic evaluation in the authors' facility demonstrated a more apparent, displaced fracture of the femoral stem (Fig. 2).

Prior to presentation, workup by the outside surgeon included left hip aspiration, serum inflammatory markers, and serum metal ions. Serum cobalt and chromium levels were noted to be 1.2 ug/L and 2.7 ug/L, respectively. Left hip aspiration demonstrated 26,900 white blood cells (WBCs), 11,000 red blood cells, and 30% polymorphonuclear cells (PMNs) on an automated cell count. Final

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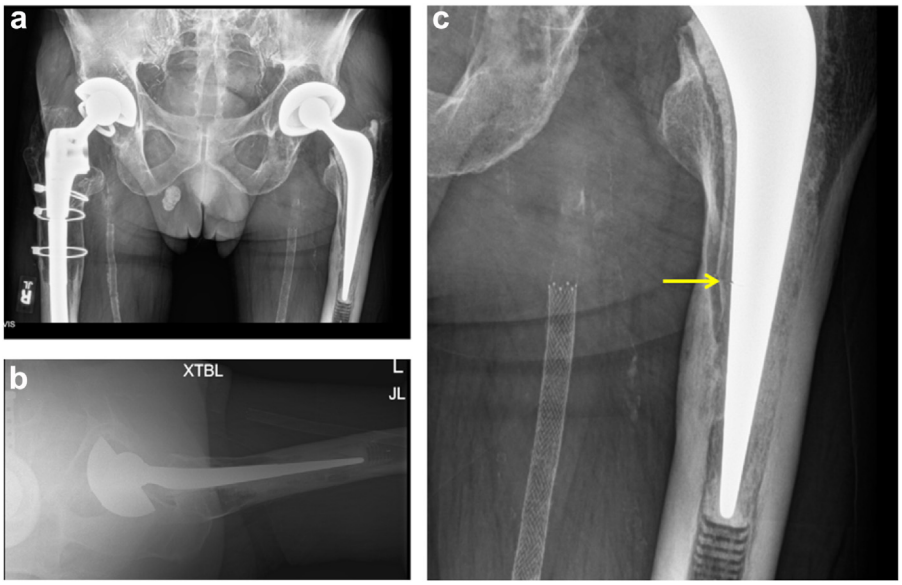

Figure 1. (a) Initial preoperative anterior-posterior (AP) pelvis and (b) cross-table lateral radiographs of the left hip from an outside hospital. An enhanced view of the left hip on the AP view demonstrates a subtle lucency (arrow) that represents a cracked femoral stem.

cultures remained negative for growth at greater than 2 weeks post-aspiration. Serum inflammatory markers demonstrated an erythrocyte sedimentation rate of 1 mm/hr and C-reactive protein <0.5g/dL. Though the synovial WBC count was elevated, the elevated serum metal ions and synovial differential deemed the concern for periprosthetic joint infection less likely, with osteolysis more attributed to polyethylene wear as opposed to infection. Treatment options were discussed with the patient, who ultimately agreed to proceed with revision left total hip arthroplasty.

Following preoperative optimization and clearance by appropriate medical subspecialists, revision total hip arthroplasty was performed. Intraoperatively, there was a significant amount of cloudy fluid deep in the iliotibial band with chunky debris as well as cement debris observed within the posterior capsule consistent with polyethylene wear and a grossly loose proximal femoral component. Multiple tissue samples were collected and sent for culture. Following dislocation, the proximal aspect of the femoral stem was found to be grossly loose and was easily removed after debridement. No cement was noted to be adhered to the polished surface, as expected, and there was debonded cement about the bone proximally. The proximal cement was removed to allow access to the distal stem, which remained well-fixed. A pencil-tip burr was utilized to circumscribe the component, followed by a trephine reamer, with the size based upon the proximal component diameter. The trephine reamer was advanced over the bound distal stem, and the stem was then extracted as 1 piece along with some cement. An ultrasonic cement extraction device along with reverse curettes were utilized to remove the cement plug and remaining cement. The canal was then prepared for a Biomet Arcos modular stem measuring 21 mm $\times$ 150 mm (Zimmer Biomet, Warsaw, IN).

Attention was turned to the acetabulum, which was found to have catastrophic polyethylene wear. The polyethylene was severely oxidized and was quite brittle. It had to be removed in a piecemeal fashion. The cup was found to be stable on testing and traction

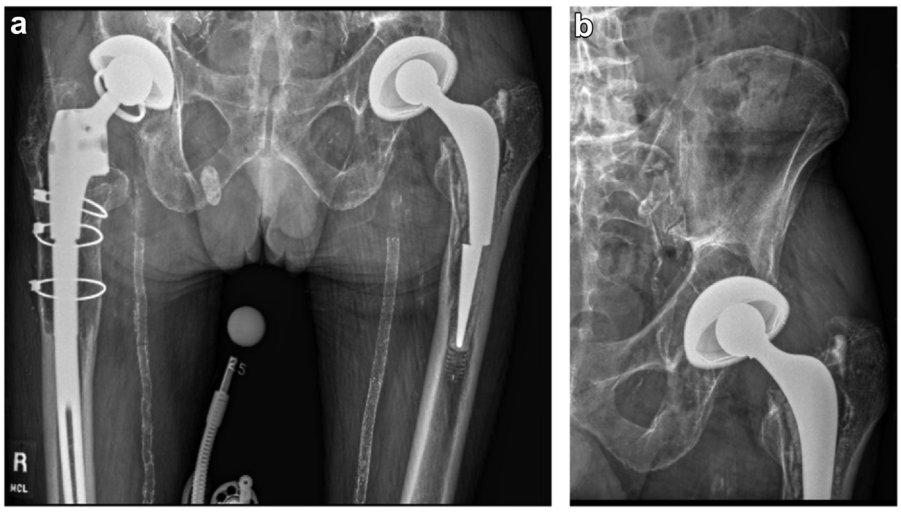

Figure 2. (a) Preoperative anterior-posterior (AP) pelvis and (b) AP left hip radiographs demonstrating a fractured Exeter hip stem and significant osteolysis about the acetabular component.

following grasping it with a Kocher, despite the known surrounding osteolysis. The decision was made to retain the cup as it was in an acceptable position and to avoid the morbidity of having to address a possible pelvic discontinuity by removing the cup with the known defect behind it. The dome cover was removed, and an obvious cavity behind the acetabulum was identified, consistent with preoperative imaging. This was irrigated thoroughly, followed by a diluted betadine soak. Through the dome hole cover, a total of 90 cc of cancellous chips mixed with vancomycin powder was packed behind the acetabular component. A new DePuy Apex hole eliminator was placed. After trialing, a DePuy Duraloc Marathon polyethylene acetabular liner, +4 mm 10 degree for 36 mm inner diameter and 64 mm outer diameter (DePuy, Warsaw, IN), was then impacted into place with the lip placed in a posterior superior position after the locking ring was positioned appropriately in the acetabulum. A size C 70 Biomet Arcos cone proximal body was impacted along with a 36 mm + 0 head (Zimmer Biomet, Warsaw, IN).

Immediate postoperative radiographs confirmed prosthesis alignment as well as containment of the bone graft behind the acetabulum (Fig. 3). The patient was able to discharge home on postoperative day 2. He was prescribed empiric Minocycline 100 mg twice daily for 4 weeks. All intraoperative fluid and tissue cultures were negative for infection. The patient was doing well at his 4-week follow-up appointment. At 1, 2, and 3-year follow-up appointments, the patient was extremely satisfied with his left hip. He remained without pain and did not require any assistive devices. Radiographs at 2 years postsurgery demonstrated maintained prosthesis alignment and satisfactory incorporation of the periacetabular bone graft (Fig. 4). On 3-year follow-up radiographs, the components remained stable, and no additional changes were noted about the left hip. The patient provided informed, written consent for the publication of this case.

Discussion

We present a case of Exeter stem fracture 25 years following initial implantation. To our knowledge, this is the longest implanted Exeter stem to require revision secondary to an implant fracture. A review of available literature demonstrates a wide range of time reported from implantation to fracture, ranging from 2-155 months (~12 years) [3-6]. The patient in this case had his stem for nearly twice as long as the upper end of this timeframe. Additionally, while bone grafting is a proven and widely utilized technique to address pelvic osteolysis, to our knowledge, this is the first report of bone grafting of such extensive osteolysis with retention of a clinically well-fixed acetabular component with over 1 year of clinical and radiographic follow-up.

Exeter stem fractures can occur within the neck or the femoral portion of the stem. In previously reported cases of stem fracture, as in this case, the proximal portion of the stem was found to be loose while the distal portion remained well-fixed. Poor cementing technique, stem undersizing, varus component positioning, and champagne glass femoral morphology have all been previously described as risk factors for stem fracture [3,7-9]. Additionally, elevated body mass index and high patient activity have previously been noted as general risk factors for fracture of the Exeter stem [3]. Due to the longevity of the primary implant in the current case, it is difficult to comment on the contributions of all the implant-associated risk factors mentioned previously. However, based on the alignment of the distal stem, varus positioning is not likely a contributing factor in this case. Based on the location of the fracture, radiographic findings at the time of presentation, and clinical findings intraoperatively, it is clear that loss of proximal support led to increased stress across the stem and eventually to a fatigue fracture.

Also noted in this case was the preoperative hip aspiration, which demonstrated 26,900 WBCs, 11,000 red blood cells, and 30% PMNs. A WBC count above 3000 and PMN percentage greater than 80 have typically been the cutoffs for the diagnosis of prosthetic hip joint infection. Wyles et al. in 2013 investigated the utility of synovial fluid analysis in metal-on-metal (MoM) total hip arthroplasty. They found that synovial WBC, serum erythrocyte sedimentation rate, and C-reactive protein had poor predictive value, whereas PMN >80% was 100% sensitive and 97.1% specific for prosthetic hip joint infection [10]. While the implant described in this case is not MoM, the patient was found to have elevated serum metal ions, mimicking the clinical scenario seen in MoM patients. This further supports the decision to proceed with the revision arthroplasty as performed. While not a unique isolated case of a complication of the Exeter stem, implant fracture is an important complication to be aware of, as are the techniques to remove

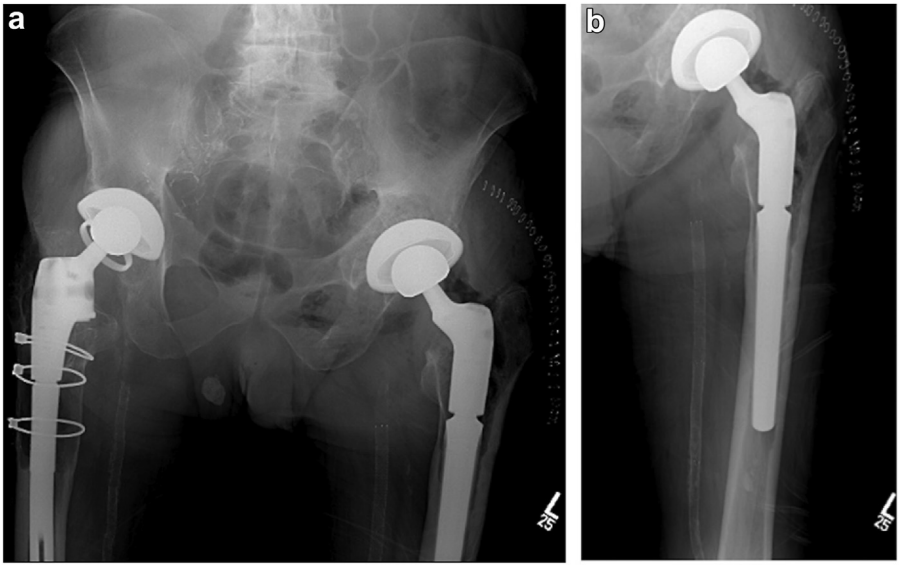

Figure 3. (a) Immediate postoperative anterior-posterior (AP) pelvis and (b) AP left hip radiographs demonstrating the patient's left revision total hip arthroplasty with noted periacetabular bone grafting.

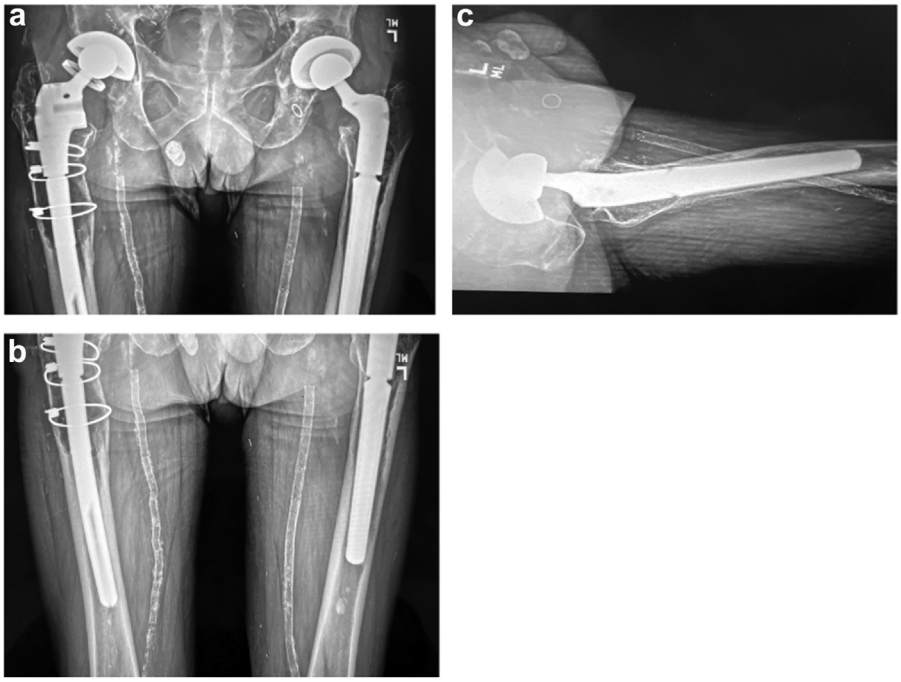

Figure 4. (a and b) Anterior-posterior pelvis and (c) cross-table lateral left hip radiographs demonstrating a well-fixed, well-aligned prosthesis and incorporation of periacetabular bone grafting at 2 years postsurgery.

retained distal cement and metal. This is especially relevant, given the resurgence of the cemented femoral component in total hip arthroplasty in North America, and stresses the importance of appropriate implant choice and technique during implantation to avoid an increase in such complications. While long-term follow-up is always warranted to monitor for common and uncommon complications of total hip arthroplasty, stem fracture is an important complication to be aware of in patients with new-onset hip pain. The implant should be scrutinized for any evidence of failure in order to make a timely diagnosis and implement an appropriate treatment plan. Early recognition could prevent further implant fracturing and more morbid complications, such as a fall and subsequent periprosthetic fracture.

Summary

This case illustrates the importance of diagnosis and judicious management of this uncommon complication of the Stryker Exeter stem, leading to an excellent outcome at 3 years postoperatively. Additionally, we utilized bone grafting through a well-fixed acetabular component to fill a large defect resulting from debris-induced osteolysis with evidence of graft incorporation and partial restoration of bone density at 3-year follow-up.

Conflicts of interest

D. R. Mesko is a paid consultant for Stryker Orthopaedic Instruments. All other authors declare no potential conflicts of interest.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2024.101436.

Informed patient consent

The author(s) confirm that written informed consent has been obtained from the involved patient(s) or if appropriate from the parent, guardian, power of attorney of the involved patient(s); and, they have given approval for this information to be published in this case report (series).

CRediT authorship contribution statement

Ethan D. Ruhland: Writing – review & editing, Writing – original draft, Methodology. **Daniel G. Antonoff:** Writing – review & editing, Writing – original draft. **Daniel R. Mesko:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation.

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