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Case report

Prosthetic femoral head erosion through an acetabular component treated with revision and implant preservation

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A B S T R A C T

We present a case report of the rare complication of a femoral head prosthesis eroding through the acetabular liner and shell resulting in a clinical presentation of pseudo-dislocation. The patient presented with a 1-month history of progressive anterior and peritrochanteric hip pain without antecedent trauma. Radiographs demonstrated presumed hip dislocation with superior-posterior superimposition of the femoral head over the acetabular component. The patient underwent revision total hip arthroplasty with intraoperative evidence of extensive metallosis, osteolysis, and femoral head erosion through the acetabular polyethylene liner, acetabular shell, and implantation into the ilium. The femoral stem and acetabular shell were well-fixed, allowing for filling of the defect with bone void filler and cementation of a new polyethylene liner into the acetabular shell.

Introduction

Total hip arthroplasty remains one of the most commonly performed and successful procedures available for the treatment of degenerative arthritis of the hip. Although multiple evolutions in design have been introduced, implant survivorship for early designs demonstrates survivorship in multiple studies approaching 90% at 20 years [1-4]. Continued surveillance of radiographs often allows for identification of polyethylene wear, which in many cases allows for revision of modular components without full implant revision. Complete polyethylene wear often results in articulation of the femoral head on the acetabular component, which may result in metallosis, pain, and component damage. We present a rare case of complete erosion of a metal femoral head both through the polyethylene liner and acetabular component resulting in entrapment within the ilium, mistakenly presenting as acute dislocation.

Case history

A 92-year-old woman with a history of total hip arthroplasty performed 31 years previously at an outside institution, presented to our emergency department after a 1-month history of progressively worsening anterior and peritrochanteric hip pain. She denied any fall or obvious trauma and denied any antecedent hip pain with no functional limitations. Initial radiographs performed demonstrated evidence of a presumed total hip dislocation, with superior/posterior superimposition of the femoral head over the acetabular component (Fig. 1). An attempt at a closed reduction was made by the emergency room physician, which was unsuccessful. Orthopaedic consultation was requested, and consent for open reduction and possible total hip revision was recommended. We discussed the multiple treatment options available to the patient, including nonoperative management as well as operative intervention with revision total hip arthroplasty. After a thorough discussion of the risk, benefits, and alternatives of revision total hip arthroplasty, the patient elected to proceed with the proposed surgical procedure and informed consent was obtained.

Surgical technique

A direct lateral approach that used the previous posterolateral incision was performed as this approach was preferred by the senior author for most revisions based primarily on his training.

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Preoperatively, the implant was identified as an uncemented Zimmer Harris-Galante I acetabulum and cemented Mueller monoblock femoral component. A split in the anterior one-third of the abductors was made with a partial anterior capsulectomy to allow for adequate visualization. As exposure of the acetabulum continued, it became evident that the femoral component was not dislocated as anticipated, but the femoral head had in fact eroded through both the polyethylene as well as the posterior-superior quadrant of the acetabular shell implant, becoming entrapped within the ilium. Multiple attempts to disengage the femoral head from the acetabulum with traction were made without success. Eventually, a curved Mueller curette was placed at the interface between the trunnion and the acetabulum, and with progressive leverage, we were able to distract and disengage the femoral head from the acetabulum. The femoral head was scratched, as expected, but had no obvious deformation. Unfortunately, a clinical photograph of the femoral head was not obtained at the time of surgery.

The femoral component was evaluated and found to be well fixed with approximately 5 degrees of anteversion. The acetabulum was circumferentially exposed with removal of the eroded polyethylene liner using a curved osteotome. Extensive osteolysis and metallosis were noted around the acetabulum, most noticeable in the retroacetabular space as evaluated through the site of component penetration (Fig. 2a). An originally placed screw appeared to be cold welded to the acetabulum and stripped immediately upon attempted removal. The acetabular cup was noted to be in approximately 45 degrees of abduction and 10 degrees of anteversion. Although gross deformation and damage to the acetabulum were obvious, a cup tester confirmed rigid fixation of the implant to bone.

The cup tester is a “T”-shaped instrument manufactured by Depuy that slides within the inner diameter of the cup, locking into either a screw hole or inner edge of the cup (Fig. 3). This allows for aggressive evaluation of a cup in all 4 quadrants in both traction and rotation.

Approximately 20 percent of the cup was eroded. Given this finding, the morbidity likely involved in removing the cup, and the potential difficulty with acetabular revision given the degree of osteolysis encountered, it was felt that retention of the cup with cementation of a constrained liner would be a reasonable option. The cup was 50 mm in outer diameter with an inner diameter of 40.7 mm. The cemented constrained liner for a 50 mm shell has an outer diameter of 38 mm, which also has a 2 mm offset and 1 mm groove. This allowed for a minimal cement mantle of 3-4 mm.

A minimal 2 mm circumferential cement mantle is recommended when an acetabular component is retained, as described by Callaghan et al [5]. At 3.9-year follow-up of 29 implanted liners using this technique, survivorship was noted to be 94%. Survivorship at 15 years for the end of point of revision due to mechanical failure was 90% [6]. If one is not able to achieve at least a 2 mm circumferential mantle with use of a cemented liner, then revision of the acetabular component is recommended.

A constrained liner was used given this patient's advanced age, low functional demands, and our inability to use a trial liner as a result of the preexisting damage to the cup. The femoral head was able to lock within the constrained polyethylene and remained stable throughout trialing, which suggested integrity. Fifteen mL of crushed cancellous allograft was placed within the screw holes of the cup. Ten mL of Cerament bone void filler (BoneSupport AB) was injected within the acetabular component defect and allowed to harden. This was performed with the goal of providing a barrier to prevent intrapelvic cement extrusion with liner placement, as well as to provide an osteoconductive substrate within the defect (Fig. 2b). A pencil-tip burr was used to scratch the concave surface of the acetabular component in a “spider-web” pattern, with cementation of a Zimmer Longevity 28 mm cemented constrained polyethylene liner to match the diameter of the femoral head of the monoblock component. The locking ring was affixed, and stability of the hip confirmed. We were able to achieve approximately 100 degrees of flexion, 45 degrees of external rotation, and 30 degrees of internal rotation. Ranawat's sign was not assessed as the implants were retained in this case and the cemented liner was placed in the same version of the acetabulum. Postoperative radiographs demonstrated no evidence of complication or cement extrusion (Fig. 4). The patient was permitted to be weight-bearing as tolerated immediately postoperatively.

There were no perioperative complications, and the patient was discharged to a skilled nursing facility on postoperative day 3. At 1-year follow-up, the patient reported complete resolution of her pain with a return to her baseline function of ambulating with a walker. One-year follow-up radiographs demonstrated continued fixation of the cemented liner with the acetabular component

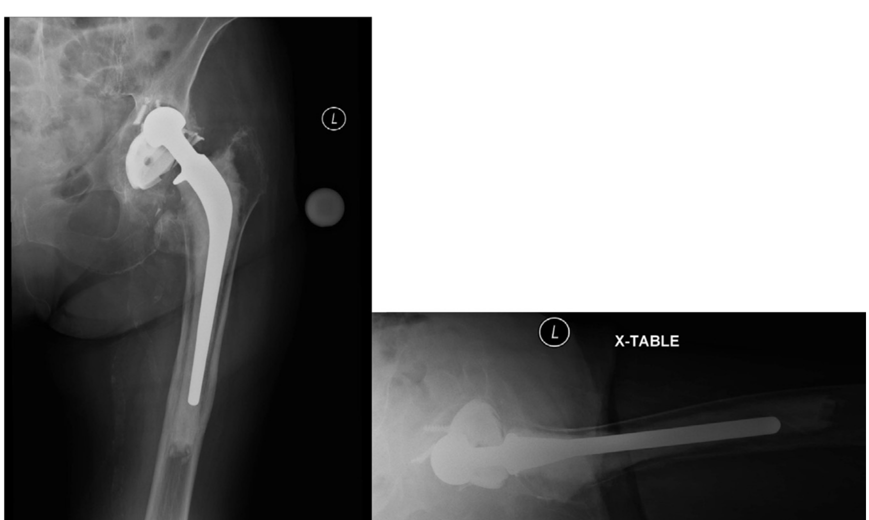

Figure 1. Anteroposterior (AP) pelvis and lateral radiograph with superimposition of the femoral head beyond the acetabulum.

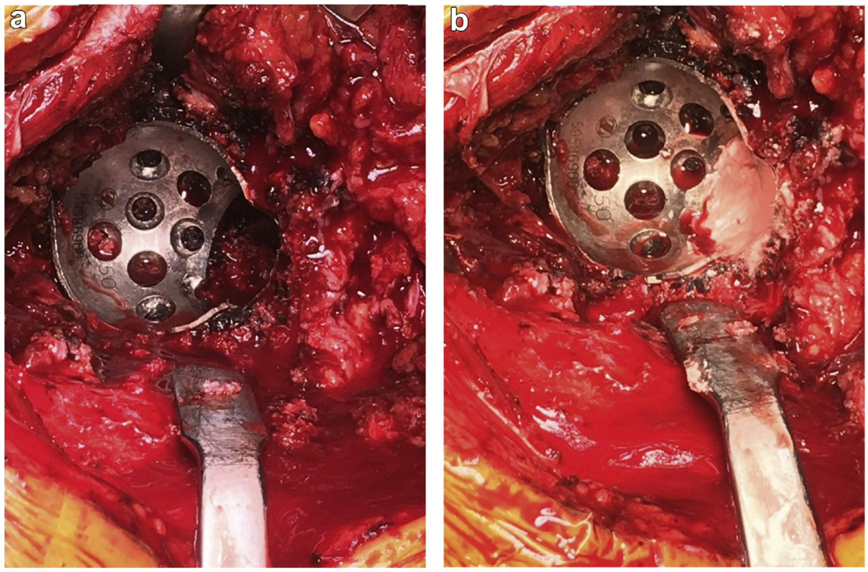

Figure 2. (a) Large erosion of the superior/posterior aspect of Harris-Galante I acetabular component. (b) Cerement bone void filler used to fill erosive defect.

without obvious mechanical complication. The bone void filler appeared to have resorbed almost entirely. In addition, there was suspicion of a possible osteolytic fracture of the medial wall (Fig. 5). There was no modification of the patient's activity precautions as she reported no pain, she denied any functional limitations, and we had no impression as to the timing of the presumed fracture. Informed consent with a discussion of our intentions to publish the case report was performed with the patient in clinic. We provided the patient with opportunities to provide her own perspective about the case and she did not have any specific insight to add.

Discussion

The Harris-Galante Total Hip Arthroplasty system (Zimmer, Warsaw, Indiana) was part of the first generation of porous-coated, cementless systems that was designed to promote osteointegration and biologic fixation. In an attempt to minimize excessive component wear and early failure, Harris proposed a new modular implant that incorporated a high density polyethylene acetabular liner with a chrome-cobalt acetabular shell [1]. This system eventually evolved into the Harris-Galante prosthesis, which was advocated for use in primary and revision total hip arthroplasty [2]. The modularity of the system allowed for a reduction in implant inventory necessary to accommodate variations in patient anatomy and allowed for theoretical exchanging of the "replaceable" components [1].

Several investigators have reported on the long-term survivorship free of any revision of the Harris-Galante system, including 87% at 24.6 years [3], 86.8% at 22.5 years [4], 94% (acetabular component only) at 16 years [7], and 95.7% (acetabular component only) at 15 years [8]. Despite the reported excellent long-term results of the Harris-Galante systems, several investigators reported on dissociation of the polyethylene liner from the acetabular shell leading to early failure [9]. Failure of the locking metallic tines or distortion of the metallic flanges of the locking mechanism were the most common causes of locking mechanism failures in a review of 30 case reports [9]. A case series of 18 patients with dislodgement of polyethylene liners from Harris-Galante I and II acetabular shells reported a radiographic eccentric position of the femoral head with a well-fixed acetabular shell in all the patients at an average follow-up time of 7 years [10]. Six patients had intraoperative evidence of broken metallic locking tines, with evidence of fatigue failure on scanning electron microscopy [10]. Other investigators have reported liner and cup dissociation as a result of fatigue fracture of the polyethylene liner without evidence of locking metal tine fracture [11]. These same authors proposed cementing a new polyethylene liner into the well-fixed acetabular shell [11], as was performed in our case report.

Although femoral head penetration through a cobalt-chrome or titanium acetabular shell is a rare complication, it has been reported in several case reports over the last 25 years. We were able to identify 19 English-language case reports of prosthetic femoral heads penetrating through acetabular liners and at least partially through acetabular shells from 1994 to 2017 in multiple countries including the United States, Greece, the United Kingdom, Taiwan, Italy, and Singapore [12-30]. Multiple different implant systems as well as bearing surfaces (including metal-on-metal, ceramic-on-polyethylene, and metal-on-polyethylene) have at least one case report on prosthetic femoral head erosion through the acetabular

Figure 3. The "cup tester" is a "T"-shaped instrument manufactured by Depuy that slides within the inner diameter of the cup, locking into either a screw hole or inner edge of the cup. This allows for aggressive evaluation of a cup in all 4 quadrants in both traction and rotation.

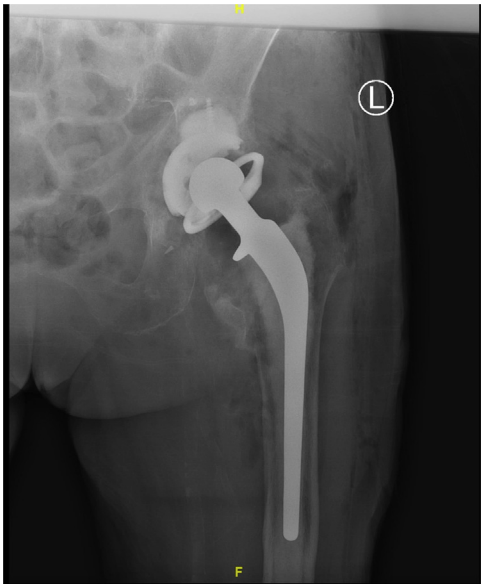

Figure 4. Postoperative AP hip demonstrating cemented constrained polyethylene liner with bone void filler.

liner and shell. Several of the case reports describe dissociation of the acetabular liner from the acetabular shell, either from a failure in the locking mechanism between the two components, or without evidence of liner dissociation, resulting in femoral head direct articulation with the acetabular shell. As the higher density femoral head articulates with the acetabular shell, it eventually erodes through the shell and may present clinically and radiographically as a pseudo-dislocation.

Although extensive polyethylene wear has been reported in long-term follow-up of the Harris-Galante prosthesis, even in cases of catastrophic liner failure, extensive osteolysis, or femoral head protrusion through the cup, the acetabular component may remain well fixed (as in our case report). Our report suggests that at short-term follow-up, retention of even a heavily damaged acetabular implant with use of cemented polyethylene liner may result in successful clinical outcomes without the need for full acetabular revision. Although the wide adoption of highly crosslinked polyethylene has decreased the radiological appearance of wear and osteolysis, the continued long-term survivorship of early-generation uncemented implants serves as a testament to the extraordinary contribution of pioneering design surgeons such as William Harris and Jorge Galante.

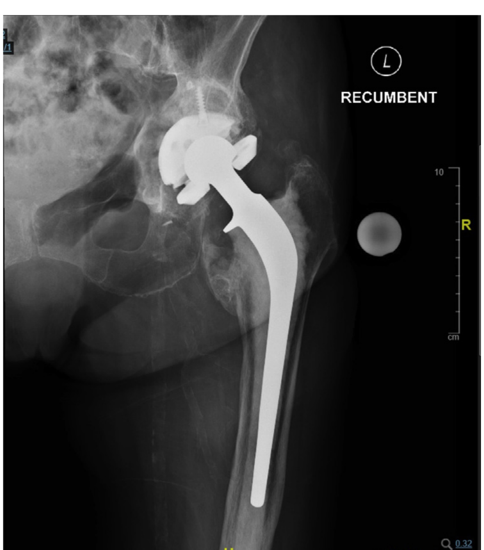

Figure 5. One-year postoperative radiograph. Resorption of bone filler noted with possible fracture of medial wall. No obvious loosening or mechanical complication.

Summary

This case highlights a rare phenomenon of a prosthetic femoral head eroding through an acetabular liner, acetabular shell, and implanting into the ilium. Other investigators have reported femoral head erosion through acetabular components in the presence of acetabular liner dissociation with or without locking mechanism failure. Multiple implant systems used in multiple countries have experienced a version of this complication over the last 25 years. This case demonstrates how a heavily damaged, but well-fixed, acetabular shell can be retained with cementation of a new polyethylene liner with successful postoperative outcomes at short-term follow-up. In addition, clinicians should be cautious when encountering radiographs with superimposition of the femoral head over the acetabular components on both orthogonal planes which may represent femoral head erosion through the acetabular components as was noted in our case report.

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