Bilateral Catastrophic Acetabular Component Failure after Ceramic-on-Polyethylene Total Hip Arthroplasty -A Case Report-

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Ceramic-on-polyethylene components have better wear characteristics than metal-on-polyethylene components in total hip arthroplasty (THA), and thus, extensive wear resulting in penetration of the femoral head through the acetabular cup is rare after ceramic-on-polyethylene THA. However, several reports have been issued regarding catastrophic polyethylene failure in ceramic-on-polyethylene systems. Here, the authors report the first case of bilateral complete polyethylene wear failure with acetabular cup perforation after ceramic-on-polyethylene THA. The patient was informed that case data would be submitted for publication, and provided consent.

Case Report

A 53-year-old man had undergone THA of the right hip during July 1991, and of the left during November 1991. An Opti-fix femoral stem, a 32 mm ceramic femoral head, and an Opti-fix acetabular shell with 9 mm thick UHMWPE liners (Smith & Nephew Richards Orthopaedics, Memphis, Tennessee) were used during both procedures. Manufacturing method for polymer consolidation used on UHMWPE liner was ram extrusion, and sterilization was done with ethylene oxide. The THAs were conducted for avascular necrosis of the femoral head due to dysbarism associated with deep sea.
dving.

He was re-admitted to our hospital in March 2007, for worsening right hip pain with no previous trauma or fall history or history of dislocation. He had not been followed routinely at our outpatient clinic. Plain radiography showed superior subluxation of the right femoral head component with an acetabular component inclination angle of 47°, and superior migration of the left femoral head component, indicating PE wear, with an acetabular component inclination of 43°. There was no osteolysis around the periphery of the right acetabular component or screws, and the femoral stem appeared well fixed, although some osteolysis was observed at the greater trochanter (Fig. 1A).

He underwent right acetabular revision using a posterolateral approach. At the time of surgery, we observed significant metallosis immediately upon entering the distended hip joint capsule. The removed ceramic femoral head was intact but showed dark metallic staining, but complete polyethylene wear and perforation of the cranial portion of the metal shell were noted (Fig. 1B-D). Intra-operatively, although perforated, the cup was stable. After augmentation of the superior part of acetabular cup with a cancellous screw, we fixed a metal inlay polyethylene (Metasul®, Centerpulse Orthopedics, Austin, TX) liner with cement and inserted a 32 mm metal head. The femoral stem was stable, and we decided not to revise (Fig. 2A). At his 1 year follow-up after revision surgery, a postoperative infection had developed in the right hip, which was treated by two-stage re-revision using PROSTALAC (Fig. 2B, C). At second stage re-revision surgery, no obvious PE liner wear progression was observed in the left THA (Fig. 2C).

At his 6-month follow-up after right hip re-revision, he complained of increasing pain in his left hip of 1-week duration. Plain radiography showed aggravated superior migration of femoral head in the left THA.
indicating massive PE liner wear, and a dense, lumpy mass at the lateral aspect of the left hip (Fig. 2D). We recommended urgent revision surgery on the left THA, but for personal reasons, the patient delayed surgery for about 4 weeks.

A left hip radiograph and a CT scan taken before left hip revision surgery revealed a huge mass at the lateral aspect of the hip (Fig. 3A, B). During revision surgery, a $10 \times 4 \times 13$ cm sized mass containing dark fluid, presumably the result of metallosis, was observed (Fig. 3C). The femoral head showed increased surface roughness and characteristic "pencil marks". The PE liner had completely worn and the metal shell had perforated (Fig. 3D-F). Despite some osteolysis, the acetabular cup was stable, and therefore, we changed the liner and head to metal-on-metal articulation using same method described for the right hip.

At his one-year follow-up, the patient reported that he had returned to his previous level of activity. He walked without support and had a complete and painless range of motion in both hips. In addition, there were no signs of implant loosening or migration in either hip (Fig. 4).

**Discussion**

Catastrophic failure of a THA component is a rare occurrence with a rate of less than 0.5\%\(^{5}\). Although ceramic-on-PE components have better wear characteristics than metal-on-PE components\(^{6}\), reports on alumina-on-PE components have demonstrated variable wear rates of from 0.001 to 0.34 mm/y\(^{7}\), and several authors have indicated that a wear rate of greater than 0.2 mm/y is predictive of early component failure\(^{8}\). To date only 6 case reports have been issued on complete or catastrophic PE failure in a ceramic-on-PE system\(^{3-5}\). However, no report has previously been issued on complete or catastrophic bilateral PE failure in ceramic-on-PE THA.

Orishimo et al. found that right hip wear was nearly twice left hip wear in 21 patients of bilateral THA (0.12 vs 0.06 mm/y), but added that wear rates in first and second hips implanted were nearly identical in different

![Fig. 2. (A) Immediate postoperative radiograph of the right revision THA. (B) Immediate postoperative radiograph after implant removal and PROSTALAC insertion. (C) Immediate postoperative radiograph after second stage revision THA. (D) Six-month follow up radiographs showing severe metallosis and the bubble sign on the left THA.](image-url)
patients (0.059 vs 0.062 mm/y). Furthermore, a cup abduction angle of >45° is known to indicate increased acetabular polyethylene wear, and in our patient right and left acetabular component inclinations were 47° and 43°, respectively. After first revision surgery on the right hip, he ambulated by weight bearing more on the left hip for several months, which presumably aggravated PE wear in the left side. As demonstrated by our case, if one hip is revised after bilateral THA, the other must be followed carefully for more rapid PE wear even when the patient is asymptomatic.

PE debris produced by interfacial wear between the femoral head and the PE liner, or between the PE liner and acetabular shell, causes osteolysis and loosening. Furthermore, clinical and laboratory studies have identified several correlates of increased acetabular PE wear. These correlates include a thin PE shell, a high patient activity level, an age of <50 years, nonarticular wear at the metal-PE interface within the acetabular component, and a male gender. Moreover, after the
acetabular liner has been penetrated, the ceramic femoral head erodes the acetabular shell, causing metallosis and severe osteolysis around the acetabular component, and at revision surgery in such cases, the acetabular shell invariably has to be changed because of massive bone loss. Thus, the early detection of significant PE wear and osteolysis is important because only femoral head and acetabular liner replacement may be necessary if the acetabular shell remains well fixed and correctly positioned. In present case, both acetabular shells, although eroded, were well fixed, and thus, we retained both to save bone stock.

A minimum liner thickness of 4 mm may be acceptable for virtually conforming surfaces, such as those used in THA, and no failure has been reported in a patient with a liner thickness greater than 5 mm. In our patient the liner thickness of left THA was about 4.8 mm at the time of second revision THA (Fig. 2C). However, a plain radiograph taken after 7 months later showed aggravated PE liner wear, screw breakage, and the development of a huge mass at the lateral aspect of the left hip (Fig. 3A), which suggests that prompt revision surgery should be considered when if PE liner is less than 4 mm thick and closer follow-up is required in patients with asymptomatic PE liner wear. The presented case is the first reported case of bilateral catastrophic ceramic-on-PE THA failure (after 16 and 18 years, respectively) due to complete PE liner wear. Although ceramic-on-PE articulation is viewed as a favorable articular bearing surface with superior wear characteristics, surgeons must consider more accelerated PE liner wear, especially in bilateral THA patients who have undergone one side revision.

REFERENCES