

# Ceramic Head Fracture in Ceramic-on-Polyethylene Total Hip Arthroplasty

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Revision rates of total hip arthroplasty have decreased after introducing total hip arthroplasty (THA) using ceramic component, since ceramic components could reduce components wear and osteolysis. The fracture of a ceramic component is a rare but potentially serious event. Thus, ceramic on polyethylene articulation is gradually spotlighted to reduce ceramic component fracture. There are a few recent reports of ceramic head fracture with polyethylene liner. Herein, we describe a case of a ceramic head component fracture with polyethylene liner. The fractured ceramic head was 28 mm short neck with conventional polyethylene liner. We treated the patient by total revision arthroplasty using 4th generation ceramic on ceramic components.

**Key Words:** Ceramic head fracture, ceramic-on-polyethylene, total hip arthroplasty, revision arthroplasty

## INTRODUCTION

Revision rates of total hip arthroplasty (THA) have decreased after introducing THA using ceramic component, since ceramic components could reduce components wear and osteolysis owing to wear particles from metal or polyethylene.<sup>1,2</sup> Ceramic-on-ceramic articulation has the lowest wear rate among various articulation, and has been introduced as one of more durable articulations in THA.<sup>1-3</sup> However, ceramic head fracture has increased according to the increase of THA using ceramic-on-ceramic articulation, and this bearing-related complication results in a serious problem such as difficult revision surgery.<sup>1,4,5</sup> The fracture of a ceramic component is a rare but potentially serious event. Thus, ceramic-on-polyethylene articulation is gradually spotlighted to reduce impact force between hard ceramic materials, as well as lower wear rates of polyethylene liner than metal-on-polyethylene articulation.<sup>1,6</sup> Recently, there are a few reports of ceramic head fracture with polyethylene liner.<sup>7,8</sup> Herein, we report a case of ceramic head fracture 12 years after THA with polyethylene liner.

## CASE REPORT

A 72-year-old woman underwent THA for idiopathic osteonecrosis of left femoral

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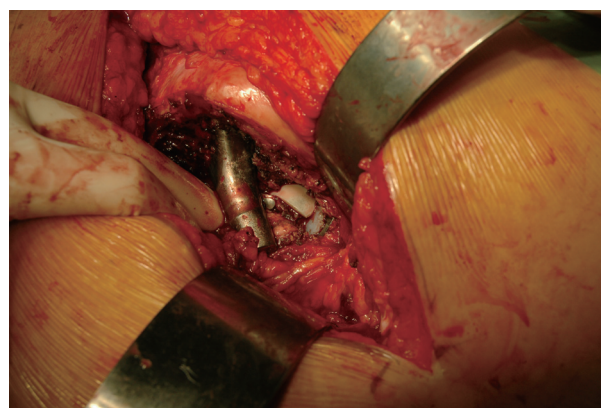


**Fig. 1.** Preoperative plain radiographs shows a ceramic head fracture with polyethylene liner. In computed tomographs, numerous ceramic particles were found around the joint, and mild osteolytic lesions were observed around proximal femur and lateral aspect of acetabular cup.

head in February, 2000. In 2012, she visited our emergency room for left hip pain with clunk sounds after squatting position 3 days ago. She had no problems in gait before the accident of squatting position. She has obese appearance; her height was 164 cm, weight was 90 kg, and bone mass index was 33.5 kg/m<sup>2</sup>. There was no evidence of infection including redness or heating sensation around left hip.

Plain radiographs showed ceramic head fractures with multiple fragments around the joint. The former arthroplasties included the cementless cup (Trilogy<sup>®</sup> acetabular system, Zimmer, Warsaw, IN, USA), cementless stem (Versys<sup>®</sup> hip system, Zimmer, Warsaw, IN, USA), polyethylene liner (Trilogy<sup>®</sup> acetabular system, UHMWPE, Zimmer, Warsaw, IN, USA), and ceramic head (Versys<sup>®</sup> hip system, 28 mm diameter, short neck length, zirconium oxide ceramic). The inclination of acetabular cup was 43 degree, and anteversion was 10 degree, which were within acceptable range (Fig. 1).<sup>9</sup>

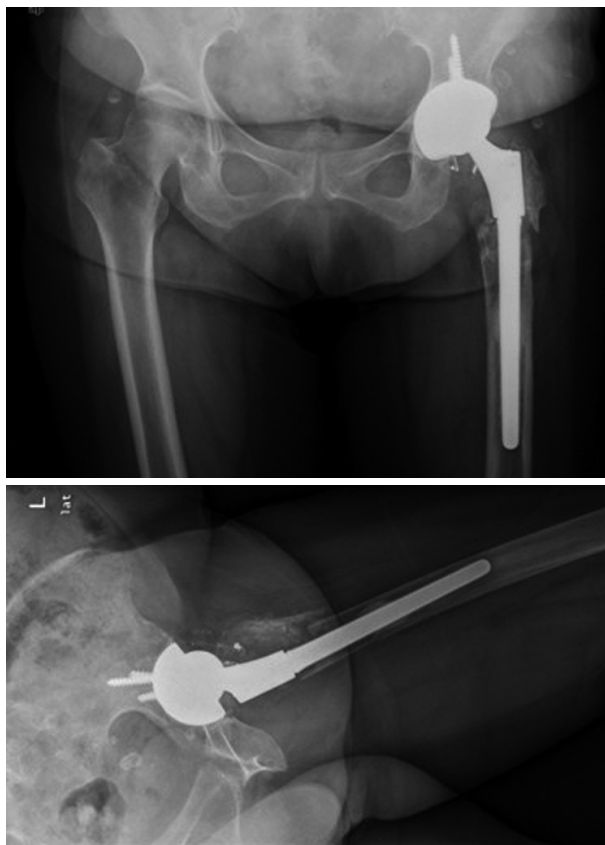
Revision operation was done. Posterolateral approach was used, similar to previous operation. After capsulectomy thorough posterolateral approach, various sizes of ceramic particles were observed. Intraoperatively, ceramic fragments were meticulously removed, and extensive capsulectomy was performed. Inner surface of polyethylene liner and metal neck taper junction of the femoral components were severely scratched to retain (Fig. 2). There were concerns about refracture of ceramic head and galvanic corrosion of metal head because of the scratched femoral neck. Thus, femoral stem was removed. In addition, the acetabular



**Fig. 2.** Photograph shows fractured ceramic head on polyethylene liner and scratched taper of the stem. Some particles are attached to anterior and posterior joint capsules. Black discoloration, which is suspected of metallosis, is observed at proximal femur.

lar cup that was loosened because of osteolysis was also removed. After the removal of all components, massive irrigation and extensive synovectomy were done to remove microscopic ceramic fragments.

For revision, new cementless acetabular cup (Delta-PF Cup, Lima, Udine, Italy), full-coated modular cementless stem (Revision hip uncemented stem-Lima, Udine, Italy) were used. And, the 4th generation ceramic liner (Neutral liner, 36 mm I.D., BioloX Delta, CeramTec, Plochingen, Germany) was implanted for revision surgery. Full-coated modular cementless stem (Revision hip uncemented stem-diameter 16 mm, length 140 mm, Neck with screw-height 60 mm, Lima, Udine, Italy) was inserted with allogenic bone graft around proximal femur. Finally, the 4th genera-



**Fig. 3.** Radiographs after total revision of a ceramic head fracture.

tion ceramic head (Femoral head, 36 mm short taper 12/14, BioloX Delta, CeramTec, Plochingen, Germany) was applied. Intraoperative testing of the stability of the revised implants was advisable. The cup position was checked with 42 degree of abduction, and 31 degree of anteversion in postoperative plain radiographs (Fig. 3).

At her 6 months follow-up, she could return to her previous level of activity, and had Harris hip score of 82. In radiographs, the implant showed stable fixation without sign of osteolysis or loosening.

## DISCUSSION

Ceramic materials have been used for THA with better clinical results, compared with conventional metal-on-polyethylene articulation.<sup>1,2,6</sup> Ceramic on ceramic articulation has the lowest wear rate among various articulations.<sup>1</sup> However, there is a concern about ceramic head fracture, therefore, ceramic head with polyethylene liner has been introduced. Several laboratory and clinical studies<sup>6,10</sup> found that ceramic-on-polyethylene articulations have lower wear rate than those of metal-on-polyethylene articulation. The fracture

rate of ceramic head in ceramic-on-ceramic articulation has been shown to range from 0.004% to 0.05%.<sup>5</sup> It is very rare but catastrophic event which requires revision operation.<sup>4,5,11</sup> To our best knowledge, there are only a few reports on ceramic head fracture in ceramic-on-polyethylene THA.<sup>7,8</sup>

Revision arthroplasty should be performed, because a fractured ceramic component carries a high risk of failure.<sup>2,8,11,12</sup> The ceramic fragments are harder than metal. Microscopically small ceramic particles are easy to remain and can lead to third-body wear of replaced new components in spite of meticulous removal of ceramic fragment after revision THA.<sup>4,5</sup> Thus, new ceramic-on-ceramic articulation should be considered as one of the possible bearing options in revision THA.<sup>4,5</sup> In the present case, the former acetabular cup was not stable due to acetabular osteolysis. Furthermore, metal taper of the femoral component was badly scratched. Thus, all components were revised using 4th generation ceramic composition.

The fractured ceramic head was 28 mm short-neck taper in this patient. Callaway, et al.<sup>8</sup> reported four cases of ceramic head fracture with polyethylene liner in 1995. The diameter of femoral component was 28 mm and the neck length was short in all instances. Koo, et al.<sup>11</sup> also reported that the rate of ceramic head fracture associated with a 28 mm short-neck modular alumina femoral head was 1.4% (5 of 359). The stress at the taper-bore interface is decreased with a 28 mm short-neck femoral head. Thus, 28 mm short-neck ceramic heads also might be at a risk of fracture.<sup>11</sup> The fatigue fracture in ceramic head with vulnerable design as well as obesity and squatting position during daily activity could be responsible in this patient.<sup>13,14</sup>

In the present case, we were able to solve the ceramic head fracture with polyethylene liner by performing total revision arthroplasty. Our finding suggests that ceramic head fracture could occur not only in ceramic-on-ceramic articulation, but also in ceramic-on-polyethylene articulation, especially in not-contemporary ceramic materials with vulnerable design of 28 mm short-neck ceramic head. We recommend that surgeons should not implant 28 mm short-neck ceramic femoral head regardless of the composition of acetabular liner.

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