



Ceramic Liner Fracture after Ceramic-to-Ceramic Total Hip Replacement: A Case Report

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Abstract

Background: Ceramic-on-ceramic materials in total hip replacement are a better choice for younger and more active patients. The fracture rate of ceramic-on-ceramic bearing surface is currently very low. We report a rare case of ceramic liner fracture after total hip arthroplasty and analyzed the reason.

Case Presentation: A 50-year-old man received a left total hip replacement with ceramic-to-ceramic bearing surfaces 1 year ago. He presented with left hip pain that had begun when a noise had occurred when he carried a heavy box 1 week ago. Radiography revealed a ceramic liner fracture, and a part of the broken liner was out of the cup. Revision surgery was performed; a new ceramic liner was inserted, and the head was changed. The outcome was good at 1 year after revision surgery.

Conclusion: Most orthopedic surgeons consider total hip arthroplasty to be a routine and non-challenging surgery; however, the present case highlights the need for care when inserting the ceramic liner into the cup.

Level of evidence: V.

Keywords: Total hip arthroplasty (THA); Ceramic liner; Fracture; Ceramic head

Introduction

Total Hip Arthroplasty (THA) is a great invention of the 21st century. The increasingly aging population is leading to an increasing number of older adults with severe hip arthritis, which is treated with total hip replacement [1,2]. The bearing surfaces used in THA include metal-on-polyethylene, ceramic-on-polyethylene, and ceramic-on-ceramic [3]. Ceramic-on-ceramic bearing surfaces are increasing in popularity, as they have less wear-induced osteolysis than the metal-on-polyethylene and ceramic-on-ceramic bearing surfaces [4]. The wear rate of ceramic-on-ceramic bearing surfaces is reportedly 1,000 times less than that of metal-on-polyethylene bearing surfaces and 40 times less than that of metal-on-metal bearing surfaces [5]. Furthermore, the polyethylene linear wear rate is about 0.1 mm/year, while the ceramic liner wear rate is about 0.025 $\mu\text{m}/\text{year}$ [6]. The development of ceramic-on-ceramic bearing surfaces means that this is a better choice for younger and more active patients, and is thus being used in an increasing number of patients.

Fracture of ceramic-on-ceramic bearing surfaces has rarely been reported in recent years. Over the past 20 years, a new generation of ceramic bearing surfaces has been created that have improved wear characteristics with lower fracture rates compared with previous ceramic bearing surfaces [7]. Therefore, the fracture rate of ceramic-on-ceramic bearing surface is currently very low. The fracture rate of ceramic heads is reportedly 0.009%, while the fracture rate of ceramic liners is reportedly 0.126% [3].

The THA procedure is well established and relatively simple, and most surgeons perform THA after training. However, it is important for orthopedic surgeons to be aware that ceramic liners can fracture. Herein, we present a case in which the ceramic liner of the ceramic-on-ceramic bearing surface fractured.

Case Presentation

A 50-year-old man presented to our department with a painful left hip. The patient had experienced bilateral femoral head necrosis 5 years ago, and had received a total hip replacement of the left hip with ceramic-to-ceramic bearing surfaces (Zimmer, Mercedita, America) and core decompression of the right hip 1 year ago at another institution. The outcome had been good at

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Figure 1: Preoperative radiograph. There was a ceramic liner fracture with a part of the broken liner protruding out of the cup.



Figure 2: The plain radiograph of pelvis after initial THA. The ceramic liner was slightly out of the acetabular cup.

1 year postoperatively. However, the patient had experienced pain on the left side since hearing a noise that occurred when he carried a heavy box 1 week previously. The patient had a significant hip pain and varying degrees of lameness, limited hip joint (the range of flexion extension was 0° to 90°). Radiographs revealed a ceramic liner fracture with a part of the broken liner protruding out of the cup (Figure 1).

The pelvic radiographs were carefully analyzed by our surgery team. Enlargement of the pelvic radiographs taken immediately after the initial THA surgery showed that the ceramic liner was slightly out of the acetabular cup. Therefore, the major problem was the inaccurate placement of the ceramic liner in the initial surgery. Incorrect placement of the liner likely led to uneven forces on the liner and femoral head, resulting in fracture of the liner and wear of the ceramic head. This hypothesis was verified after the removal of the ceramic liner and head (Figure 2).

The revision surgery plan was discussed by our team before surgery. The surgery team prepared to loosen the acetabular component. The patient was operated on using the previous incision site.

There was no loosening of the femoral component seen after the surgery site was reopened. The femoral prosthesis and acetabular cup were stable. The ceramic femoral head was unbroken and the bearing had worn edges (Figure 3). The ceramic liner was fragmented into three major parts, the fragmented edge of the liner had detached from the acetabular component, and there was widespread very small debris in the joint from the fragmented edge (Figure 4).



Figure 3: The ceramic femoral head removed from the patient. The bearing surface had worn severely.



Figure 4: The ceramic liner removed from patient. The fragmented edge of the liner had detached from the acetabular component and the small debris from the fragmented edge were removed around the joint.



Figure 5: Radiograph after revision. The seating of the ceramic liner was good after revision.

All fractured ceramic fragments were removed. A new ceramic head and ceramic liner of the same size as the original components were inserted. The seating of the liner was checked twice before femoral head restoration.

The patient received professional rehabilitation training by the rehabilitation nurses, and the training included going to walk early, passive hip and knee bending, regular follow up. The patient did not have any further symptoms during 1 year of postoperative follow-up (Figure 5).

Discussion and Conclusion

THA is a good treatment for severe hip arthritis and osteonecrosis of the femoral head. An increasing number of THA surgeries are being performed worldwide. There were 440,000 THA procedures performed in China in 2018, and this number will increase quickly with the aging population. Various materials are used to prolong the



Figure 6: Soft tissue removed from patient. There were some tiny debris in the black soft tissue.

survival of the THA components. The bearing surfaces used for THA include ceramic-on-ceramic, metal-on-polyethylene, and ceramic-on-polyethylene. Ceramic-on-ceramic materials with the lowest wear are a better choice for younger and more active patients [1,2]. However, the main problem with ceramic material is its fragility [6,8].

The fracture rate was relatively high when ceramic material was first introduced for use in THA. However, the development of new improved ceramic materials has markedly decreased the fracture rate of the ceramic liner and head; the fracture rate is 0.004% for femoral heads manufactured after 1994 [8]. Furthermore, the ceramic liners fracture less frequently than the ceramic heads. Compared with the original ceramic materials, the new ceramic materials are smoother, harder, and more slippery. In addition, the current ceramic materials induce less inflammation than other surface materials [4,7].

Fracture of ceramic THA materials leads to numerous complications [6]. The presence of many ceramic pieces around the joint capsule leads to foreign body reactions, as shown by the black soft tissue seen in the present case (Figure 6). It was necessary for our team to remove more of the joint capsule and more soft tissue, which will probably lead to dislocation in the future [9]. Furthermore, a new ceramic liner and head were needed to replace the original ones. Thus, the costs of revision surgery are high, which is not good for the patient and the healthcare system [10].

The patient got a quick and good diagnosis and revision after ceramic liner fracture. He did not have any further symptoms during 1 year of postoperative follow-up. The main reason for ceramic liner fracture is incorrect seating within the cup before impaction.

In the present case, the main reason for ceramic liner fracture was the wrong seating of the liner in the initial THA surgery. This highlights the fact that it is very important to follow the THA procedure strictly, especially for less experienced surgeons.

In conclusion, ceramic materials are strong and resistant, and prolong THA prosthesis survival when the ceramic head and ceramic liner are appropriately aligned. However, the possibility of liner fracture should be considered when treating patients who have undergone THA with a ceramic liner.

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