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Case Report Open Access

Ceramic Femoral Head Fracture and Severe Wear of the Cone: A Case Report and Review of the Literature

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Abstract

A case of a fractured ceramic femoral head without subsequent trauma, 8 years after a primary total hip arthroplasty, in a 36-year-old man with Osteonecrosis of femoral head (ONFH) is reported. Intraoperative findings were multifragment femoral head without damage of the ceramic insert along with diffuse metallosis and excessive wear of the cone of the stem. Both the stem and the acetabular component were stable. After the removal of ceramic fragments, metallotic tissue excision and careful lavage of the joint and a ceramic femoral head was placed to the existing notched taper of the firmly incorporated stem, the ceramic inlay was kept. At 3-month follow-up examination, the patient had no pain, used no walking aids and had normal activity.

Keywords: Fractured ceramic head; Metallosis; Cone wear; Hip arthroplasty

Introduction

Revision rates of total hip arthroplasty (THA) have decreased after introducing THA using ceramic component, since wear rates for ceramic-on-ceramic bearing surfaces have been calculated to be 1,000 times less than metal-on-polyethylene and 40 times less than metal-on-metal bearing surfaces [1,2].

The development of this alternative bearing surface is particularly relevant to younger, more active patients to prevent the need for future revision or to decrease the amount of polyethylene wear-induced osteolysis [3]

However, ceramic head fracture has increased according to the increase use of THA ceramic-on-ceramic articulation, due to their lower elasticity and plasticity in comparison to metals carrying the potential risk of sudden material failure [4]. Contamination of the joint by particulate ceramic fragments is a well-recognized consequence of fracture [5].

In the case described below, a massive metallosis and severe cone wear were found during the revision operation for a fractured ceramic femoral head.

The purpose of this case is to report a rare complication of THA managed by a 'conservative' treatment.

Case Report

In December 2007, a 28-year-old man, with bilateral osteonecrosis of femoral head (ONFH) underwent an uncemented left THA for secondary degenerative osteoarthritis.

The inclination of acetabular cup was 43 degree, and anteversion was 10 degree, which were within acceptable range. All the components had been manufactured by Biomet Medical Ltd, and consisted of a size 14 standard uncemented stem with 12/14 taper, a 28 mm short neck ceramic head, a 54 mm expansion shell and a 54/28 ceramic insert.

The operation was straightforward and carried out according to the manufacturer's instructions. The head was placed with a twisting motion and gently impacted twice, with a femoral head inserter.

During the 8 years evaluation the patient had no symptoms of pain and the hip motion was excellent (Figure 1).

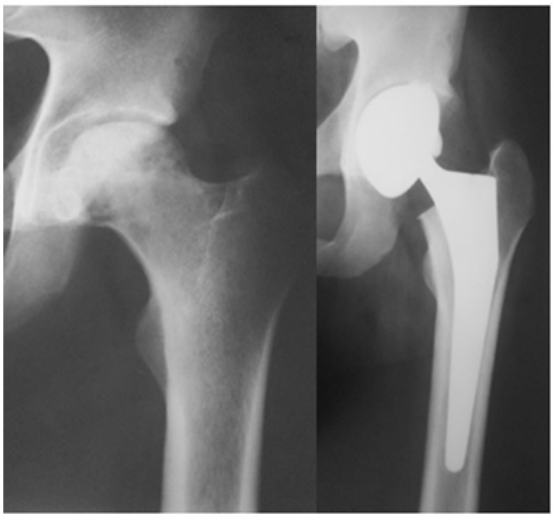

Figure 1: Preoperative plain radiograph showing an Osteonecrosis of femoral head (ONFH) with secondary degenerative osteoarthritis. At 7 years follow-up evaluation, there are no signs of loosening or other implant-related pathology.

In April 2015, he was referred back to the orthopaedic outpatient office complaining of left groin pain and audible squeaking or clicking, with no history of trauma.

Radiographs showed a multiple fragmented ceramic head and significant notching of the cone (Figure 2, arrows).

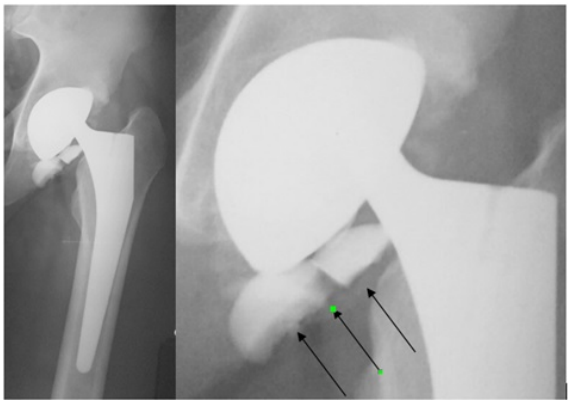

Figure 2: Eight years postoperatively, a multifragmented ceramic head failure (arrows) is detected on plain radiographs.

The patient underwent revision surgery. Intraoperative findings included diffuse metallosis (Figure 3), a pseudocapsule containing black metalloid fluid, excessive wear of the cone that had impacted the ceramic insert without damaging it and a multifragmented ceramic head. The uncemented stem and the acetabular component were not loose.

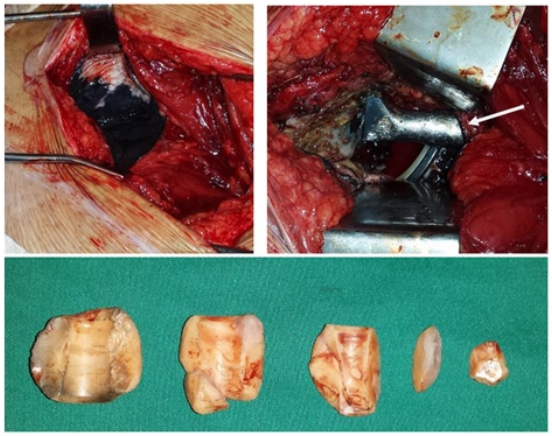

Figure 3: Intraoperative findings at revision operation showing diffuse metallosis, multifragmented ceramic head, notching of the cone (arrow).

Metallotic tissue was excised, ceramic debris was carefully removed, the area was well irrigated and the undamaged ceramic insert was not replaced. Although there were apparent imperfections at the taper of the stem, we decided not to replace it, as it was absolutely stable. A 28 mm small ceramic femoral head was finally placed at the existing taper.

Postoperatively, the patient had an uneventful recovery. He was discharged from the hospital 6 days postoperatively.

At the 3-month follow-up examination, the patient had no pain, used no walking aids and had normal activity without any signs of loosening or other implant pathology on plain radiographs (Figure 4).

Figure 4: Normal plain radiograph of the involved hip 3 months after the revision operation.

Discussion

Ceramic-on-ceramic bearing surfaces are an attractive option for younger, active patients due to low wear rates [6,7].

Early ceramics had significant fracture rates due to large grain size and impurities [1,7,8]. Ceramic fracture can have severe consequences.

The resulting revision requires an extensive capsulectomy to prevent accelerated wear of the new bearing surface from potentially retained ceramic within the soft tissue [9].

Newer ceramic bearing surfaces have improved wear characteristics [7] with much lower fracture rates, on the order of 0.004% for femoral heads manufactured after 1994 [7,10]. Ceramic liner fractures are thought to be less frequent than femoral head fractures.

While some authors state that the ceramic head failures usually appear during the first months after the operation [11-13], others have observed that they are more frequent after the first year [14,15]. In our case the fracture occurred 8 years postoperatively.

Several reasons have been proposed as risk factors for failure of a ceramic femoral head but few are significant according to the literature.

Traina et al. [16] in a systematic review in 2013 found that based on the available literature, Current knowledge consider the use of short neck 28 mm heads as the only factor that significantly affects the risk of ceramic head fracture, and malposition of the cup on the axial plane and misalignment of the liner during insertion as the only two relevant factors affecting the risk of liner fractures.

In the present case, the fractured ceramic head was 28 mm short-neck taper in this patient. Callaway, et al. [17] 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.

Revision arthroplasty should be performed, because a fractured ceramic component carries a high risk of failure [17-20]. 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 [4,5]. Thus, new ceramic-on-ceramic articulation should be considered as one of the possible bearing options in revision THA [21,22].

The operative technique for the treatment of a ceramic head fracture remains controversial and varies among different cases.

The most important parameters are the insert revision, total synovectomy, the type of the exchanged head and the condition of the cone. Most authors agree to revise the insert at the time of revision [5,11,14,15,23,24] even when it appears normal macroscopically, because non-visible ceramic particles may be embedded on it, creating a third abrasive component at the interface between the cup and the femoral head, especially when a stainless-steel femoral head is used instead of the fractured ceramic head.

In our case, since the acetabular component was intact and quite stable and no wear of the ceramic insert was found although the cone of the stem had been articulated with it so we did not replace it.

Diffuse metallosis is mainly reported during the first revision in cases where the stem had made an articulation with the undamaged ceramic insert [24,25] as in our case.
When a synovectomy is performed, the principles of tumour surgery would have to be applied, including thorough lavage of the joint and wide borders of resection up to the healthy tissues [26].

More controversies exist about the type of head, which had to be used for replacement of the fractured ceramic head. This particular choice is strongly associated with the condition of the cone of the femoral component. The combination of a metal/polyethylene articular pairing, proposed by various authors in the past [5,11,12,27], is no longer recommended as it is considered a cause of diffuse metallosis and loosening [5,12,14].

Allain et al. [5] reported a 47% incidence of repeat revision(s) when a stainless-steel femoral head had been used, whereas the rate was only 17 and 11%, respectively, when a ceramic and a cobalt-chromium head had been used.

The use of a ceramic head for replacement, in order to avoid third body damage of metal, has been proposed by some authors [28], even in cases with mild cone wear.

In our case, we decided to replace the fragmented head with a ceramic one because the cone was notched and it was impossible to revise the stem unless an extensive and complex approach was preferred.

The best approach with regard to the stem cannot be strictly determined based on the existing literature. In cases of loosening, the stem must be replaced without second thoughts.

According to Allain et al. [5], 25 of 105 revised hips had a normal cone, 59 were slightly scratched and 14 had a notched cone. All femoral stems with a notched cone were revised but 17 with a slightly scratched cone were left in place. The authors recommend revision of the stem in all cases with visible damage of the taper and advocate the use of ceramic head for replacement.

For the same reasons McLean et al. [24] do not recommend the use of a ceramic head on the existing cone because minor, unrecognizable flaws on it may lead to the formation of cracks in the ceramic head with subsequent fracture [13]. In such cases the use of a cobalt-chrome femoral head is indicated.

Our decision to leave the firmly incorporated stem in place, despite the fact that it was notched, was based on the potential risk of further complications by the extensive approach and the subsequent necessary wide opening of the femoral bone. A ceramic head was placed on the existing taper thus minimizing the need for reoperation.

Conclusion

Ceramic Ceramic femoral head fracture is a rare, severe complication of THA thatcould occur in ceramic-on-ceramic 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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