Ceramic Liner Fatigue Fracture: 3-D CT Findings in a Late Recurrent THA Dislocation

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abstract

Dislocation is one of the most common complications of total hip arthroplasty (THA). To the authors’ knowledge, late recurrent dislocation of a THA with a ceramic-on-ceramic coupling secondary to fatigue fracture of the ceramic liner has never been described.

A 76-year-old woman with right hip osteoarthritis underwent cementless modular THA with a ceramic-on-ceramic coupling. Approximately 10 years postoperatively, she experienced right hip pain with no trauma, which resolved in 14 days. Family members reported that the patient had shown a progressive cognitive and muscular decline in the previous months. Six months later, the patient was admitted for THA dislocation, which was immediately reduced. Computed tomography revealed that the right acetabular component had a retroversion of 4° and an inclination angle of 45°. An orthopedic brace was applied, but dislocation recurred 2 days after discharge. A 3-dimensional CT reconstruction showed a fracture of the ceramic liner in the posterolateral region. The patient underwent revision surgery, and the ceramic liner breakage was confirmed. After removal of the acetabular components, a cemented polyethylene cup was implanted. The stability of the stem was verified. The existing modular neck was replaced with a chromium–cobalt neck, and a new ceramic head was applied. At 7-month follow-up, the patient had good functional recovery with no hip instability.

Fatigue failure of a ceramic liner should be considered as responsible for late dislocation after ceramic-on-ceramic THA. As part of the diagnostic strategy, 3-dimensional CT reconstruction should be used to evaluate ceramic liner breakage.

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Dislocation is one of the most common complications following total hip arthroplasty (THA) and may occur early or late postoperatively. It is defined as late dislocation when 5 or more years have passed after prosthetic implantation. Previous studies have pointed to trauma, prosthetic component malposition, polyethylene wear, muscle structure deterioration, and neurological diseases as factors contributing to late dislocation.

The current study reports an unusual case of recurrent late dislocation after ceramic-on-ceramic THA, demonstrating that fatigue fracture of the ceramic liner was the cause of the dislocation. To the authors’ knowledge, this event has never been described. The patient provided informed consent for data concerning her case to be submitted for publication.

**Case Report**

In June 2002, a 76-year-old woman with right hip osteoarthritis and a body mass index of 23.8 kg/m² underwent cementless modular THA with a ceramic-on-ceramic coupling (ANCA FIT; Wright Medical Technology, Inc, Arlington, Tennessee). The prosthesis includes a titanium-made hemispheric cup coated with hydroxyapatite and an internal truncated tapered cone fitted with a ceramic liner (Biolox Forte; CeramTec, Stuttgart, Germany). The anatomical stem is titanium and proximally coated with hydroxyapatite. A modular titanium neck is inserted into the stem by a double-tapered coupling. The modular ceramic head (Biolox Forte) is fitted to the neck by a tapered coupling. Surgery was performed with the patient under general anesthesia using an anterolateral Watson-Jones approach.

In January 2009, the patient underwent left THA for primary hip osteoarthritis. In June 2011, the patient experienced right hip pain with no trauma that resolved in 14 days. Family members reported that the patient had shown a progressive cognitive and muscular decline in the previous 6 months, but clinical and radiological findings were normal (Figure 1).

In January 2012, the patient presented to the emergency department for acute lower right limb functional impotence with no trauma and reported a 1-week history of progressive right hip pain. Radiographs of the right hip showed radiopaque small fragments in the calcar area and THA dislocation (Figure 2), which was immediately reduced (Figure 3). No signs of prosthesis infection were apparent. Computed tomography (CT) of the pelvis revealed that the right acetabular component had a retroversion of 4° (Figure 4) and an inclination angle of 45° and a femoral offset of 32 mm. A hip brace was applied, and the patient was discharged. Two days later, she returned to the emergency department for a new dislocation of the same hip, which was reduced again. A 3-dimensional CT reconstruction demonstrated a fracture of the ceramic liner in the posterolateral zone (Figure 5), which was responsible for prosthetic instability.

Under general anesthesia, the patient underwent revision surgery using a Watson-Jones anterolateral approach, and the breakage of the ceramic liner was confirmed (Figure 6), along with the presence of several small ceramic fragments. After removal of the acetabular components, a cemented polyethylene cup (Procotyl C; Wright Medical Technology, Inc) was implanted (Figure 7). The stability of the stem was verified. The existing modular neck was replaced with a long chromium–cobalt neck, and a long Biolox Delta 36-mm ceramic head was applied. At final follow-up 7 months postoperatively, the patient had a good functional recovery with no hip instability.

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**Figure 1:** Bilateral anteroposterior radiograph of ceramic-on-ceramic right total hip arthroplasty 7 years postoperatively showing normal signs of prosthesis osteointegration.

**Figure 2:** Anteroposterior radiograph of the right hip showing total hip arthroplasty dislocation and small fragments near the calcar.

**Figure 3:** Anteroposterior radiograph of the right hip after reduction.

**Figure 4:** Pelvic computed tomography showing right acetabular retroversion.

**Figure 5:** Volume-rendered 3-dimensional computed tomography reconstruction showing the defect of the ceramic liner in the posterolateral zone.
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In the current case, the authors observed that the primary causes of late recurrent THA dislocation are associated with intense activity, trauma, and obesity. An excess load during flexion movements (e.g., rising from a chair or climbing a steep staircase) is considered to be a possible mechanism of dislocation. Other mechanisms are related to surgical planning and procedures, such as malposition of the cup, stem, or both.

In the current case, the authors believe that muscle loss associated with acetabular cup retroversion encouraged an impingement between the femoroacetabular modular neck and ceramic liner. This mechanical stress caused fatigue failure of the insert and the defect on the posterolateral region of the insert.

Clinical signs of ceramic component alteration are represented primarily by sound sensations. A creaking or squeaking sound is a sign of articular malposition and initial failure; a duller clicking sound is indicative of rupture. Other symptoms are limited range of motion and hip pain.

Diagnostic procedure in cases of late dislocation should include conventional radiography and CT to highlight the incorrect positioning of the components and to evaluate the possible ceramic liner wear. In cases of polyethylene wear, conventional radiology is able to highlight asymmetry in the relationship between the head and the insert. The evaluation of small cracks in the ceramic liner can be difficult with conventional radiology.

Toni et al. proposed the assessment of joint fluid to investigate the presence of ceramic particles issued as a result of rupture. In the current case, the use of 3-D CT reconstruction clearly highlighted the ceramic liner failure in its peripheral area.

**Conclusion**

Ceramic liner fatigue failure should be considered to be responsible for late dislocation after ceramic-on-ceramic THA. As part of the diagnostic strategy, 3-D CT reconstruction should be used to evaluate ceramic liner breakage, allowing early diagnosis and proper revision.

**References**


