

## Implant Fracture of the Emperion Modular Femoral Stem at the Stem-Sleeve Interface

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### ABSTRACT

**INTRODUCTION:** Modular femoral implants have gained increased popularity and widespread use in both primary and revision procedures. While the modular design allows surgeons greater flexibility, the addition of another mechanical interface poses the possibility of mechanical wear and failure. Implant fracture has been described in other modular implants, however fracture of the Emperion modular femoral stem is poorly represented in the literature.

**CASE DESCRIPTION:** Here we describe the case of a 66-year-old male who underwent a primary total hip arthroplasty with the Emperion modular femoral stem. Approximately twenty-five months after his initial procedure, the patient presented with an atraumatic fracture of the femoral component at the stem-sleeve interface. He subsequently underwent a revision total hip arthroplasty including an

extended trochanteric osteotomy.

**CONCLUSIONS:** Modular total hip systems are a good option in cases where achieving stable implant fixation, version, offset and leg length is challenging. However, there are multiple reports of early catastrophic failure due to cyclical stress at the modular interface coupled with mechanical corrosion. Given the possibility of early failure, patients with modular components should undergo close observation beyond the typical perioperative period.

**Key words:** Implant failure; Femoral stem; Fracture; Modular; Total hip arthroplasty

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### INTRODUCTION

Modular femoral implants have gained increasing popularity for primary and revision total hip arthroplasty (THA). Their use allows surgeons to address difficult anatomic variations in order to restore leg length, version, offset, and hip joint biomechanics. Early designs such as the S-ROM (Depuy, Warsaw, Ind) have been shown that have good long-term clinical and functional outcomes<sup>[1]</sup>. Though the modular design allows for greater surgical flexibility, micro-motion at the modular junction poses an increased risk of mechanical wear. Fretting and corrosion at the modular interface can ultimately lead to catastrophic failure<sup>[2]</sup>. Although uncommon, several cases have reported failure at the modular taper junction resulting in fatigue fracture of the femoral component<sup>[2-5]</sup>.

The EMPERION™ Modular Hip System (Smith & Nephew, Memphis Tenn) introduced in 2006 has a similar design to other modular stems consisting of a fit and fill proximal sleeve. Since each component's insertion and implantation is independent, anatomic deformity can be addressed while optimizing anteversion of the entire construct. To our knowledge, only five cases of catastrophic failure of this stem with spontaneous fracture at the modular junction have been described in the literature<sup>[6,7]</sup>. This case report adds to the

limited sample and describes our experience and retrieval analysis of the Emperion femoral stem used for a primary THA with resultant fracture at the modular junction.

## CASE DESCRIPTION

A 66-year-old male underwent primary left total hip arthroplasty via posterolateral approach in June 2014 after failed non-operative management of end-stage primary osteoarthritis. He received a 11 × 140 mm high offset femoral stem with size 11 sleeve (Smith & Nephew, Memphis, Tenn). The femoral head was a 36 -3mm (Smith & Nephew, Memphis, Tenn) and the acetabular component was an R3 size 56 mm cup (Smith & Nephew, Memphis, Tenn). The patient's post-operative course was uncomplicated with significant improvements in pain and ambulation. Approximately twenty-five months after the primary procedure the patient presented to the emergency room after hearing a loud pop with immediate pain in the left hip after rising from seated to standing position. Approximately three months preceding this event, the patient endorsed new onset start-up pain in the left hip associated with intermittent thigh pain but did not receive formal evaluation. At the time of presentation, he was 180 cm in height, and weighed 73 kg with a BMI of 22.5 (m/kg<sup>2</sup>). On radiographs, he was noted to have a fracture of the left femoral component at the stem-sleeve interface (Figure 1).

Within twenty-four hours of presentation the patient was taken to the operating room and underwent a revision left total hip arthroplasty. A posterolateral approach through the previous incision was used and the proximal femoral component was identified and removed. Metal debris in the surrounding tissue and significant wear was noted at the stem-sleeve interface, with an oblique fracture above the modular junction (Figure 2). Attempts at removing the sleeve and distal aspect of the stem using high-speed burs, flexible osteotomes, and a combination of various clamps and slap hammer failed. An extended trochanteric osteotomy (ETO) was then performed to aid in removal of the femoral component. The sleeve was found well osseointegrated circumferentially and was extracted as one piece with the distal aspect of the stem.

After extraction of the stem, the decision was made to use a distal fixation Monoblock titanium femoral component given poor remaining proximal bone stock and use of ETO. An Alteon Monobloc size 17 × 195 mm stem (Monoblock tapered stem) was implanted (Exactech, Gainesville, FL). Repair of the osteotomy was achieved using a Stryker 10 cm trochanteric plate (Stryker Orthopaedics, Mahwah, New Jersey) and Dall-Miles cables with sleeves (Howmedica, Rutherford, NJ). Post-operative the patient was made toe-touch weight bearing for 6 weeks on the left lower extremity and discharged to subacute rehab. At 6-months post-operatively patient was doing well and ambulating without pain. Radiographs demonstrated well positioned components and a healed ETO (Figure 3).

## DISCUSSION AND CONCLUSIONS

While modular hip systems improve surgical flexibility, the addition of multiple interfaces creates increased susceptibility to implant wear, and ultimately failure. In their retrieval analysis of 78 S-ROM stems, Huot *et al.* noted seven stems with catastrophic failure requiring revision for fractures at a location almost identical to that presented here. Compared to non-fractured stems, those with fatigue fractures were under high stress, had larger offset, longer implantation times, and exhibited significant wear at the stem-sleeve interface<sup>[8]</sup>. These

risk factors have also been identified in other cases of femoral stem fractures (4-6). Koch *et al* analyzed four Emperion stem fractures noted over a four-month period. All four patients received high offset implants, had BMI > 30, and evidence of corrosion and pitting at the origin of the fracture on the lateral stem<sup>[6]</sup>. These factors may increase the bending moment across the neck, thereby predisposing the modular junction to early wear and fatigue fracture<sup>[7,8]</sup>. In our case, the patient's BMI was 22.5 m/kg<sup>2</sup>, however significant wear at the interface and evidence of corrosion affecting the surrounding tissues was identified, indicating a high degree of mechanical wear.

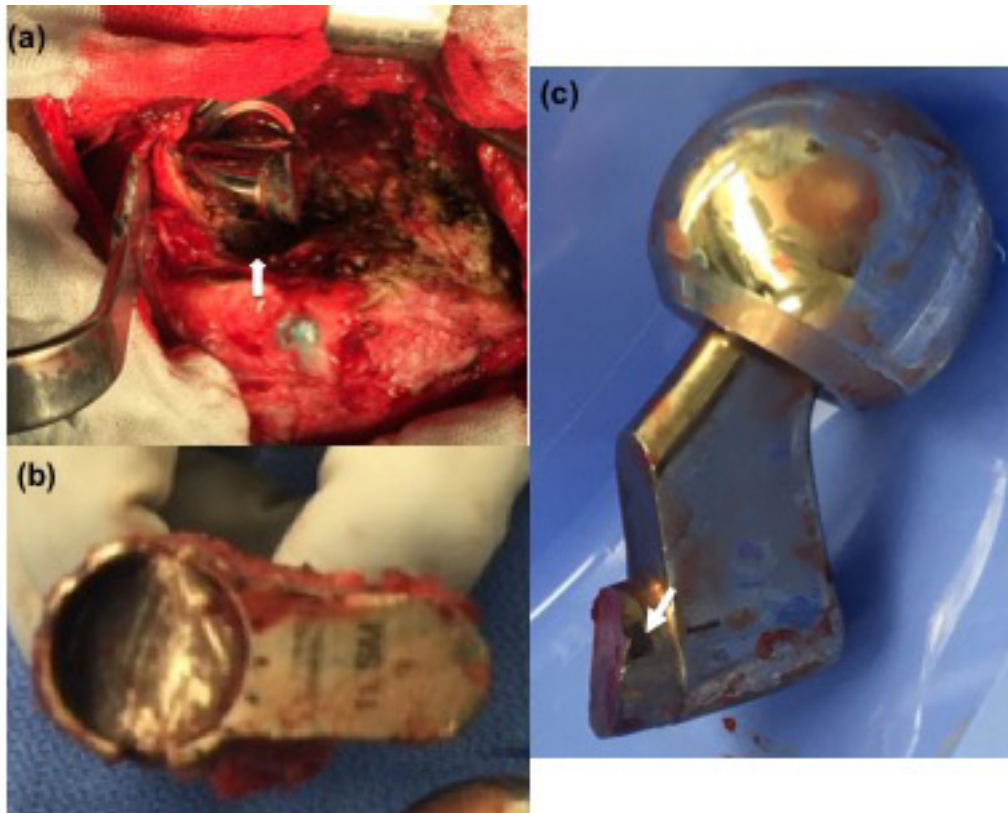
The time to failure for our case was twenty-five months following the index procedure, which is consistent with previous reports. Stronach *et al.* noted a fracture approximately 6 years after implantation, while Koch *et al* noted failure at 1.2-8.3 years, with two fractures occurring before the two-year mark<sup>[6,7]</sup>. Our patient also reported three months of prodromal symptoms, indicating that failure was not the result of an acute event, but instead secondary to ongoing mechanical wear. De Martino *et al* analyzed 60 retrieved modular-neck stem implants and found evidence of corrosion as early as 4 months<sup>[9]</sup>. Thus, it is likely that cyclic loading coupled with ongoing corrosion resulted in fatigue and mechanical failure.

Once identified, fracture at the modular junction poses technical difficulties where a well-fixed stem must be explanted while preserving adequate bone stock for a revision procedure. In this case, an ETO was required to remove the failed components. This technique is a powerful tool that provides wide exposure and direct access to the femoral diaphysis. In this setting, ETO has been demonstrated to have high healing and success rates with few complications<sup>[10]</sup>. Four of the five cases of Emperion failure previously described have required an ETO for successful implant retrieval<sup>[6,7]</sup>. In all instances, proximal fixation with extensive bony ingrowth was noted. Additional options for stem retrieval include creation of a cortical window distal to the stem, followed by reverse tamping of the stem from below<sup>[7]</sup>.

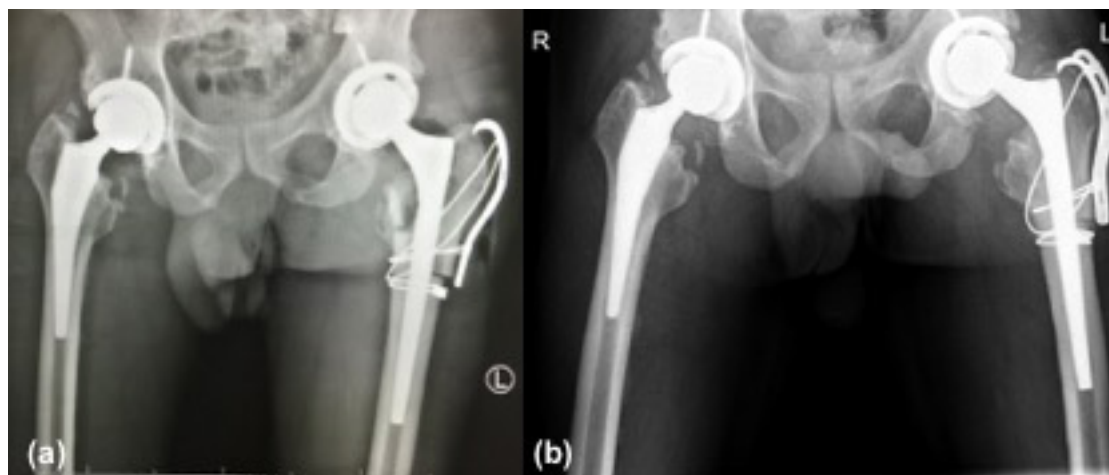
Modular total hip systems are a good option in cases where achieving stable implant fixation, version, offset and leg length is challenging. Their use should be applied to select patients, as repeat, cyclical stress at the modular interface coupled with



**Figure 1** Anteroposterior (AP) radiographs demonstrating fracture of a Emperion femoral stem.



**Figure 2** Intraoperative imaging following (a) exposure and implant identification and photographs of retrieved components including the (b) taper sleeve and (c) femoral neck.



**Figure 3** Postoperative AP radiographs after left hip revision arthroplasty with an ETO and Monobloc stem at (a) immediately post-operative (b) 6 months post-operative.

mechanical corrosion increases the risk of early catastrophic failure. When a fatigue fracture is identified, the surgeon should be prepared to encounter a well fixed stem necessitating the use of an ETO. Compared to similar implants, the Emperion demonstrates earlier failure and therefore close observation beyond the typical perioperative period is warranted.

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