



Case Report

Fracture of the Neck of a Modern Cementless, Titanium Femoral Stem

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ABSTRACT

Intraprosthetic fracture of a femoral component is a rare but devastating complication after total hip arthroplasty (THA). We present the case of a 68-year-old man who presented with acute hip pain approximately 8 years after a left THA with a modern cementless, titanium femoral component. Radiographs revealed a fracture of the midportion of the neck of the stem, below the level of the trunnion. The patient underwent an isolated 1-component revision THA with a modular exchange. To our knowledge, this is the only reported case of a catastrophic failure fracture of this particular prosthesis. © 2020 The Authors. Published by Elsevier Inc. on behalf of The American Association of Hip and Knee Surgeons. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

With a survival rate of 88.6% at 18 years [1], total hip arthroplasty (THA) is a highly successful procedure to restore the function of a hip affected by many conditions. As shown by Lehil and Bozic [2], the vast majority (93%) of procedures performed in the United States use cementless femoral component designs. This has also recently been validated in the last report of the American Joint Replacement Registry [3].

The Corail stem (DePuy, Warsaw, IN) is one of the most commonly implanted cementless femoral components worldwide [1,4]. It is made of a titanium alloy with a full hydroxyapatite coating on a grit-blasted surface. Its geometry includes a proximal trapezoid and a distal quadrangular cross-section. The Corail stem was first implanted in 1986, and an early retrieval study showed excellent osseointegration at 9 months [5]. The stem was redesigned in 2002 (second generation) to replace the circular neck with a trapezoid cylindrical design, but the device references were kept laser etched on the anterior and posterior sides of the neck. Merini et al. [6] in a retrospective study (n = 286 patients) showed a rate of 5.4% implant neck fracture with the second generation Corail

stem. Several failures involving fractures of the neck urged the manufacturer to recall all laser-etched batches.

A third-generation design was introduced in December 2003 where the laser etching was moved to the taper. This third-generation stem is the one currently in use and is also known as Corail AMT (Articul/EZE Mini Taper). Louboutin et al. [7] in a retrospective study (n = 133 patients) of the third generation showed no recurrence of the neck fracture at a mean of 10-year follow-up.

The Corail stem track record shows excellent survivorship with 97% at 15 years according to the Norwegian Arthroplasty Register [8]. Similar results have been reported in other studies. [1,9–12]

Here, we present a case of a catastrophic failure of a THA presenting with a fracture of the neck of a third-generation Corail stem, which is, to the best of our knowledge, the first report of this mode of failure in this modern design.

Case history

A 68-year-old gentleman presented to our institution for evaluation of acute left hip pain, having previously undergone an uncomplicated left THA in 2012 via a direct anterior approach (Fig. 1).

In late December 2019, he felt a sudden pop in his left hip while playing golf. The patient did not report any antecedent symptoms (eg, pain or subluxation episodes) before that event. He presented to an outside hospital where his plain radiographs showed a fracture of his prosthesis. He was reportedly scheduled for a revision

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Figure 1. Anteroposterior view of the pelvis before failure. The left THA was performed in 2012.

but developed both a pulmonary embolism and a stroke, within a week, which left him with a complete left hemiparesis (reported to be of full strength before the stroke). He was eventually transferred to our institution for definitive care approximately 5 weeks removed from his initial injury.

In addition to his acute comorbidities, his past medical history was also notable for obesity (the body mass index on presentation was 36), paroxysmal atrial fibrillation, congestive heart failure (most recent ejection fraction of 35%), and recurrent urinary tract infections. His physical examination revealed a well-healed conventional direct anterior incision, with no appreciable edema, erythema, or ecchymosis. There was mild pain with palpation about the hip and with any attempted passive motion. His thigh compartments were soft and easily compressible. Motor assessment showed complete deficit in the entire left upper and lower extremities. Vascular examination revealed normal capillary refill in all toes and palpable distal pulses.

His plain radiographs showed a fracture of the midportion of the prosthetic femoral neck in an otherwise well-fixed Corail stem (Fig. 2).

Of note, his serum C-reactive protein was 315 mg/L (normal <5 mg/L) and the erythrocyte sedimentation rate was 79 mm/hr

(normal <10 mm/hr). A hip aspiration was performed, which showed synovial fluid of bloody appearance, with a red blood cell count of 6×10^6 and a white blood cell count of 13,800 (<500 when corrected for serum values using a method previously reported [13]) with 97% polymorphonuclear neutrophils. The fluid was also sent for culture, and no organism grew.

Per his outside operative records, implants used in the initial surgery were a cementless Pinnacle Gription sector (DePuy), 58-mm acetabular component with an AltrX (DePuy) polyethylene liner, a size 36/+8.5 Biolox delta ceramic head (DePuy), and a cementless size 14 standard offset Corail AMT stem.

The patient and his wife were provided information about treatment options, including 1- vs 2-stage revision and resection. Given his high preoperative function and unknown level of long-term recovery from his stroke, a mutual decision was made to proceed with a revision THA.

We used a posterolateral approach to the hip. An approximately 18-cm incision was made. A tissue sample from the capsule and synovium was sent for intraoperative frozen section, which confirmed the absence of acute inflammation. The hip was then carefully delivered posteriorly. A single cerclage cable (Dall-Miles; Stryker, Mahwah, NJ) was inserted just distal to the level of the lesser trochanter. Using a combination of high-speed burr and flexible osteotomes, the interfaces of the femoral component were carefully developed. A DePuy threaded inserter was then applied and the femoral component was removed with a series of impacting and extracting blows using a back-slapping mallet (Figs. 3 and 4). The stem was found to have evidence of ongrowth throughout. There was no evidence of impingement and no metal debris present in the periarticular soft tissues. We were not able to disengage the head from the short segment of the remaining neck and trunion, but the visible surfaces had evidence of corrosion. There was no evidence of polyethylene wear in the patient's modern highly crosslinked polyethylene liner. The femoral canal was then carefully debrided and samples were sent for culture.

The femoral reconstruction was performed using a non-modular titanium tapered-fluted femoral component (Wagner SL femoral stem; Zimmer Biomet, Warsaw, IN) and a 36/+7mm Biolox delta ceramic head (Zimmer Biomet). A 36-mm constrained liner (ESc; DePuy) was also used in the setting of his complete hemiparesis.

At the 6-week clinical follow-up, the patient was noted to be doing well with no changes in his radiographic examination (Fig. 5). His incision healed uneventfully, and his intraoperative cultures showed no growth.

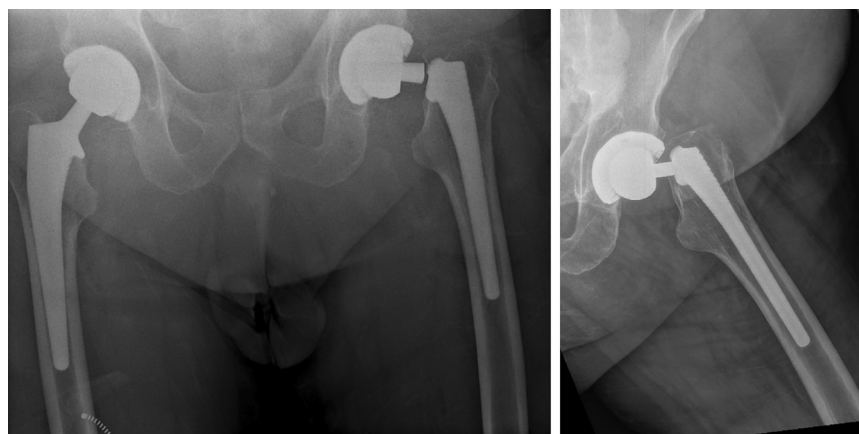


Figure 2. Anteroposterior view of the pelvis (left) and lateral view of the left hip (right) at the time of the failure. Note the fracture of the midportion of the prosthetic femoral neck.



Figure 3. Intraoperative pictures of the broken stem. The midportion of the neck is broken with a transverse pattern.

Discussion

Prosthetic femoral neck fractures are extremely rare, as opposed to trunnion failures, which are not uncommon [14]. Heck et al. [15] reported a 0.27% rate of femoral component fracture in a retrospective survey conducted by the American Association of Hip and Knee Surgeons. However, this study did not provide details regarding the location of the fracture within the component. The 2019 Australian registry reported a rate of 0% implant breakage of femoral components (nonmodular neck stems) for primaries and 1% for revisions [1].

Fracture of the proximal part of the femoral component can occur in different locations: the neck-shoulder junction, the neck itself, or the trunnion. Lee et al. [16] reported on 2 neck-shoulder fractures. For both cases, the femoral component was a cemented

Exactech (Exactech, Gainesville, FL) Opteon femoral component (forged cobalt-chromium alloy). Surprisingly, the fracture occurred at 43 months postoperatively for both patients. After extensive analysis, it was concluded that the fracture was due to pronounced laser etching at the lateral neck-shoulder junction. The manufacturer immediately recalled all implants with laser etching at the neck-shoulder junction. Similarly, Jang et al. [17] also reported on a fatigue fracture at the neck-shoulder junction of a second-generation Corail stem.

Botti et al. [18] described a case of a trunnion fracture. In that case, the broken implant was a cementless cobalt-chromium AML stem (DePuy) with a remaining intact trunnion of approximately 5 mm. After analysis, the DePuy laboratory found a fracture with characteristics of intergranular and crevice corrosion. Fractures of the “true neck” have also been reported. Gilbert et al. [19] discussed neck fractures of 2 cementless wrought cobalt alloy PCA stems (Howmedica, Mahwah, NJ). In that case, microscopic analysis revealed intergranular corrosive attack. The authors also concluded that conditions for manufacturing may have contributed to the failure as well. Banerjee et al. [20] reported a case of a broken cemented RMHS (Smith & Nephew Richards, Memphis, TN) stem just at the base of the skirted femoral head sleeve.

To conclude, as this is the first report of such a complication, our assumption is that this may be an isolated microscopic defect in the manufacturing, intrinsic integrity of the stem itself, or intergranular corrosion as was previously reported in other stems. Although the prosthesis was not evaluated microscopically, it was reported to the manufacturer.

Summary

The third-generation Corail stem was designed after several reports of fracture of the neck of the second-generation stem. This is the only report of a broken femoral neck of the third-generation Corail stem since its clinical introduction in late 2003. This might be due to an isolated manufacturing defect. In addition, this case highlights technical challenges of femoral component extraction with incomplete prostheses and consideration of patient factors in the 1-component revision.



Figure 4. Zoomed-in view of the area of neck fracture.

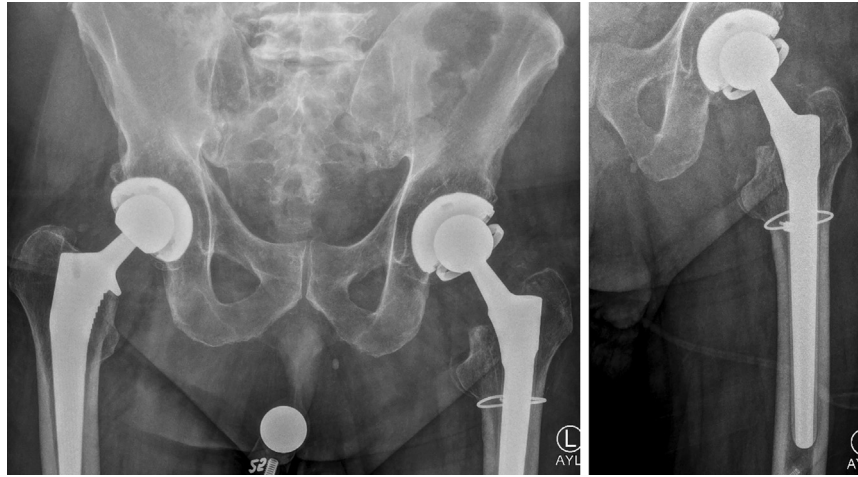


Figure 5. Anteroposterior views of the pelvis and the left hip at 6 weeks after the revision surgery.

Conflict of interest

The authors declare there are no conflicts of interest.

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