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Case Report

Trunnion fracture of a cobalt–chrome fully porous-coated femoral stem: A case report

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ABSTRACT

Modular femoral stem-head systems are used increasingly due to their ease of application and offset adjustment. However, this modularity has brought complications of trunnion wear and breakage. Although very rarely encountered, trunnion fracture is a catastrophic complication that requires challenging revision surgery. This report presents a trunnion fracture of a cobalt-chrome alloy, fully porous-coated femoral stem. Following single-stage revision surgery, full weight-bearing was achieved in six weeks, and the patient was painlessly mobile with a single cane and had a Hip Score of 81 in the last follow-up. Despite all the advantages of the femoral stem and head modularity, one should remember that a catastrophic complication such as trunnion wear and fracture that require revision surgery is possible.

Introduction

Thanks to modern manufacturing techniques and developing metallurgy, today femoral stem fracture after hip arthroplasty is a rarely encountered complication, which yet remains a challenging issue in revision surgery. The National Joint Registry for England, Wales, Northern Ireland, the Isle of Man, and the States of Guernsey, which has recorded data for close to 1 million hip arthroplasties since 2003, reported the number of failures as 0.16 per 1000 prosthesis-years for implant fracture.[1]

The literature holds many case reports of femoral stem fractures. Most of these cases are about cementless, fully porous-coated, cobalt–chrome stem fractures involving the distal femoral neck.[2-6] Cases about taper fractures of the femoral stem have also been reported, but most of these cases involve dual modular stems.[7,8] Taper fracture of titanium alloy non-modular femoral stems[9] or femoral stem neck fracture of cemented stems has also been reported.[10] In the literature, we have not come across a trunnion fracture of the stem as the one examined in our case.

In this article, we present an atraumatic trunnion fracture of a fully porous-coated, non-modular, cobalt–chrome alloy cylindrical stem (Echelon®, Smith and Nephew, Inc., Andover, Mass, USA) and a cobalt–chrome alloy head.

Case Presentation

A 54-year-old female patient with a weight of 105 kg, height of 163 cm, and body mass index (BMI) of 39.6 was admitted to the emergency department with acute pain in her right hip without trauma and inability to walk. Upon inquiring about her medical history, we learned that she had undergone 2 surgeries on the same hip before—a total hip arthroplasty for the treatment of primary coxarthrosis 10 years ago and revision surgery for aseptic loosening 6 years ago. In the revision surgery, a 190-mm, size 14, straight, non-modular, fully porous-coated cylindrical femoral stem (Echelon®), a 32-mm cobalt–chrome +12 femoral head, a PE liner, and a 52-mm cementless acetabular cup (REFLECTION™ INTERFIT™ Shell) were used. When the patient's comorbidities were inquired, we observed that she had systemic lupus erythematosus, diabetes mellitus, and hypothyroidism. The physical examination revealed shortness and external rotation in the right lower extremity. Her neurological and vascular examination findings were normal. We also noticed that the posterolateral incision in the right hip had healed without any redness or increase in temperature. Radiographic examination revealed that the femoral head and stem were separated from each other (Figure 1). According to Engh's criteria, we found the fully porous-coated femoral stem to be "bony stable." We evaluated the acetabular component–bone interface radiolucency as stable when comparing it with the old radiographs. In addition, we found the infection parameters to be negative in the biochemical evaluation of the patient.

In the revision surgery, we used a posterior approach over the old incision and observed that the neck of the femoral stem was fractured in the trunnion region and the fractured part remained inside the femoral head (Figures 2 and 3). There was no macroscopic finding in favor of infection. We took tissue samples from different regions for microbiological examination but

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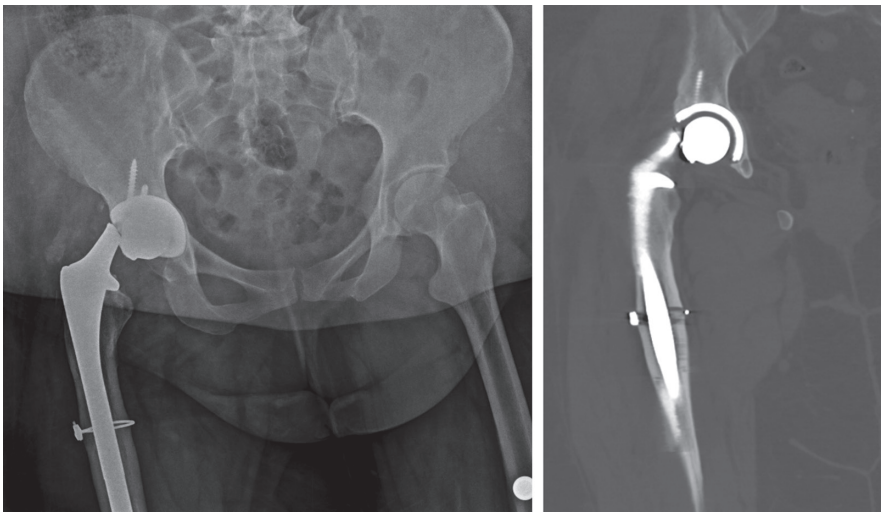

Figure 1. Preoperative radiological image: dissociation of the femoral stem and head.

Figure 2. Trunnion fracture of the femoral stem.

Figure 3. The femoral stem and the trunnion fracture surface.

observed no bacterial growth in the samples. We revised the eccentric wear seen on the PE liner with highly cross-linked polyethylene. We performed an extended trochanteric osteotomy to remove the well-fixed femoral stem. After cleaning the intramedullary canal, appropriate reamerization, and rasping, the trial stem was placed. Following fluoroscopic control, we concluded that the femoral stem size was appropriate. Then, we evaluated the hip stability and found it to be stable, with normal range of motion. Following the femoral reconstruction where we used a size 14, 260-mm, cementless, bowed, fully porous-coated, cylindrical femoral stem (Echelon®) and

HIGHLIGHTS

- Trunnion wear and fracture caused by femoral head and trunk modularity is an important complication that requires revision surgery.
- This case presentation reports trunnion fracture of a cobalt-chromium alloy, fully porous encased femoral body.
- The use of a ceramic head instead of a metal head and not increasing the length of the femoral neck seem to be the most reasonable precautions in avoiding this complication.

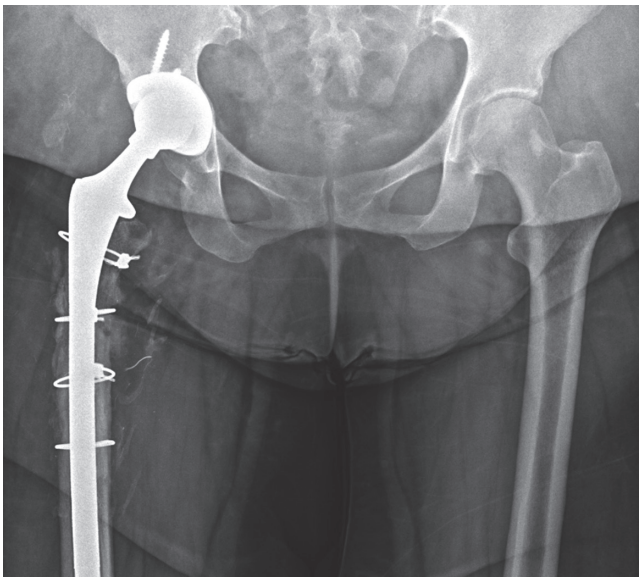

Figure 4. Postoperative x-ray image: revision of the femoral stem and fixation of the trochanteric osteotomy.

a 36-mm +16 femoral head, we fixed the trochanteric osteotomies using 4 cerclage wires (Figure 4). The surgery was performed by the mentor author.

No postoperative complications were observed. The patient was mobilized on the second postoperative day with the help of a walker and touchdown weight-bearing. With a gradual increase, full weight-bearing was achieved in 6 weeks. The patient was painlessly mobile without cane and had a good Harris hip score (81 points). Written informed consent was obtained from the patient.

Discussion

Modular femoral stem–head systems are being used increasingly during surgery due to their ease of application and offset adjustment. Although trunnion fracture is a very rare complication, it requires difficult revision surgery. We believe that presenting a previously unreported case of stem trunnion fracture and discussing the ways to avoid this difficult-to-treat complication is of importance and will contribute to the literature. Our case demonstrates a trauma-free fracture of the femoral neck in the trunnion section, the bottom of the femoral head, in the articulation of a chrome–cobalt fully porous-coated stem and a chrome–cobalt head.

In a systematic review examining the femoral head–neck taper interface corrosions that manifest itself with clinical symptoms, aseptic loosening in 27.3%, unexplained pain in 22.7%, soft tissue reaction due to metal debris in 19.9%, infection in 7.8%, dislocation in 3.5%, fractures in 3.1%, and other causes in 13.7% of the cases were reported.[11] Trunnion fractures were observed in 2 case reports reviewed within this systematic review. In Botti et al's[12] case report, the authors stated that the patient had a history of isolated acetabular revision and femoral head replacement surgery. Again, as mentioned by the authors, there was a possibility that the taper and neck region may have been damaged during this surgery. In our case, the trunnion fracture has developed without any additional revision after surgery. In addition, the stem (AML® Hip System; DePuy Orthopeadics Inc., Warsaw, Ind, USA) they used had similar characteristics with the stem used in our case but was not the same one. Unnanuntana et al[13] used a fully porous-coated stem (AML A Plus; DePuy International, Leeds, England) and a 28 mm +6 metal femoral head. In the 2 cases presented above, atraumatic trunnion fractures were seen at the sixth and seventh years postoperatively. While the stems the authors used were 9/10 taper, as stated by them, the taper was 12/14 in our case. In addition, the manufacturers were also different.

In the literature, we came across another case report that was not included in the systematic review of Carli et al.[11] Gilbert et al[14] reported femoral neck fractures in 2 uncemented, proximally porous-coated femoral stems (PCA™; Howmedica Inc., Rutherford, NJ, USA) in their case report. This stem, unlike our case, has a proximal coating and a different manufacturer. In another recent study in which Wylde et al[15] examined catastrophic failures in patients using Accolade I (Stryker, Kalamazoo, Mich, USA) femoral stem, the researchers reported 4 trunnion fractures. The authors also stated that these catastrophic failures were seen in the articulations of Accolade I stems and 36-mm or bigger LFIT or MITCH heads. In addition, Accolade I stem differs from our case in that it is a titanium alloy (TMZF: Ti-12Mo-6Zr-2Fe). In another study evaluating 35 femoral stem fractures, trunnion fractures were observed in a cemented stem.[16] This reported case is completely different from ours since the femoral stem used in our case was uncemented and fully porous coated. We searched the literature for Echelon® stem (Smith and Nephew) used in our case, and we came across fractures of the stem shaft,[5] but no trunnion fractures.

Trunnion fractures can occur due to many reasons, but the primary factor is the modular structure of the femoral head and taper. Mechanical forces including friction, micro-movement, and the eccentricity of applied stress cause abrasive loss of the passivation layer. Crevice corrosion occurs at the femoral head–taper interface, which is wetted by joint fluid.[17] As shown by Goldberg et al.[18] flexural stiffness in the femoral component is directly related to the diameter of the neck component raised to the fourth power, indicating that small changes in neck diameter can have significant effects on neck stiffness. Therefore, as in the cases reported in the literature, there were smaller taper sizes and larger head sizes in our case. Although increasing the head–neck ratio is clinically used to improve movement and stability, it also increases head–neck module mismatch. Another parameter related to mechanical micromovement is the length of the femoral neck. Brown et al[19] reported that the length of the neck was related to the severity of the corrosion at the head–neck junction in 79 implants in which they examined the taper corrosion. Consistent with this, in our case, the femoral neck length was +12 mm. Although long neck preferences increase the risk of trunnion fracture, we had to use a long neck to provide stability in revision surgery. Patient-related factors affecting corrosion have been reported to be excessive body weight and high activity level.[20] Similarly, our case was an obese patient with a high activity level.

Conclusion

Despite all the advantages of the femoral stem and head modularity, we should not forget that a catastrophic complication such as trunnion wear or fracture that requires revision surgery is possible. It should be kept in mind that this risk increases especially in patients with a high activity level and a high BMI. The use of a ceramic head instead of a metal head and not increasing the length of the femoral neck seem to be the most reasonable precautions in avoiding this complication.

Informed Consent: Written informed consent was obtained from the patient.

Author Contributions: Concept - A.T.; Design - M.K.; Supervision - A.T.; Materials - M.K.; Data Collection and/or Processing - M.K.; Literature Review - M.K.; Writing - M.K.; Critical Review - A.T.

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