Rupture of Extensively Porous Coated Stems. - A Case Series of 2 Patients

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What to Learn from this Article?

Occurence, Risk factors, Management of this Rare Complication.

Abstract

Introduction: Mechanical failure of femoral stems of revision hip arthroplasty has been rarely reported. In the current study, the cause of two stem fractures, which occurred in vivo, was analysed with use of clinical and radiological data, and the functional result after revision is presented.

Case Report: Two patients, A 70-year-old male and a 73-year-old female, both of Mediterranean ethnic, and both patients underwent a revision total hip replacement to an uncemmented extensively porous coated stem. Both stems suffered an implant fatigue in vivo at three years and at two years follow-up respectively.

Conclusion: Revision total hip arthroplasty is a procedure that will be performed more often the following years due to aging of population. Any orthopaedic surgeon performing hip surgery should be aware of the risk factors that can lead to total hip arthroplasty failure. In the analysed cases we can learn that the main factors related to this failure included the use of a small size stem (inferior to 14mm), an inadequate proximal osseous support because of trochanteric osteotomy, and a reduced preoperative bone stock. Although the use of cables has not been stated as a predisposing factor, we consider that they could also play a role in the development of this rare complication.

Keywords: Ruptured hip prosthesis; Complications; Device removal; Stem; Trephine.

Introduction

Implant rupture has been reported as an uncommon reason for failure of a revision total hip arthroplasty (THA). This rare type of stem failure poses a surgical challenge since the distal portion of the stem is usually well fixed due to significant bony ingrowth and removal can create femoral perforations, femoral fractures or could require the creation of a cortical window [1,2]. The use of hollow trephine reamers in order to over-drill the well-fixed distal femoral component has been reported as a satisfactory technique in recent reports [3]. We hereby present two cases in which this complication occurred and present how they were managed, the clinical result obtained, and discuss the possible causes leading to this rare complication.

Case Report

Case One - A 70-year-old male had undergone uncemented THA for the treatment of primary osteoarthritis in 1996. Comorbilites included cardiovascular disease without angor

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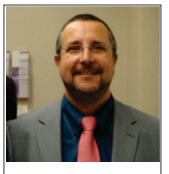
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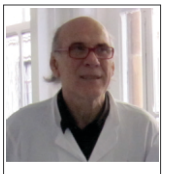
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since 2003, Diabetes Mellitus type 2 and Hypertension.

An aseptic loosening of the femoral and acetabular components was diagnosed in 2009. The primary implant was revised to a 190-mm-long, 11-mm-diameter extensively porous coated straight stem (Echelon, Smith & Nephew ®) and to a 56-mm-diameter acetabular component (Reflection, Smith & Nephew ®). Through surgery an anterior metaphyseal window was performed in order to facilitate removal of the primary implant and it was closed by using three 1.6 mm Dall-Miles cable system (Stryker ®). An intra-operative greater trochanter fracture was noted right after extraction. The proximal femur fracture was managed with the use of another 1.6mm Dall Miles cable system.

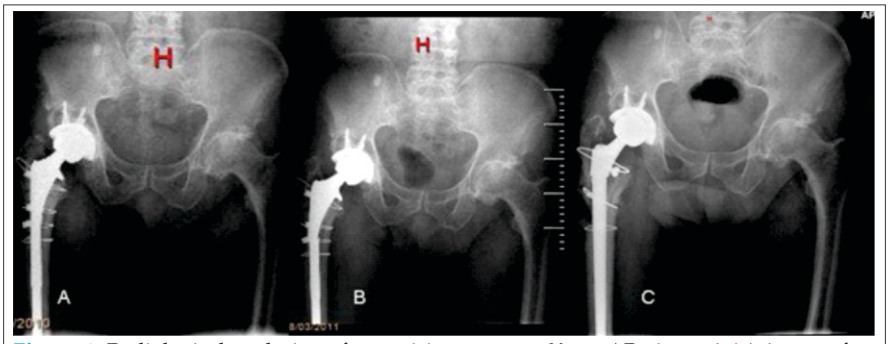

Figure 1: Radiological evolution after revision surgery; X-ray AP views: 1.A.) 1 year after primary hip arthroplasty revision; 1.B.) 25 months after hip revision; the femoral stem fracture can be observed at the junction of the proximal and the middle third; 1.C.) 1 year after revision of the fatigued femoral stem

The postoperative period was uneventful, and the patient was discharged. During follow-up the patient remained asymptomatic, and the radiological studies depicted a progressive healing of the trochanteric fracture.

However 22 months after revision the patient consulted referring thigh pain. At that moment, plain radiographies showed no evidence of implant failure. 25 Months after hip revision the patient consulted again, explaining an increase in pain intensity, focusing mainly on the thigh while walking. This time the radiographic study revealed a transverse femoral stem fracture at the junction of the proximal and the middle third, at the level of the third cable (Fig. 1). The blood tests did not suggest a septic loosening.

At revision surgery, proximal release of the femoral stem was easy because it was loose. The distal portion of the femoral component was removed by using a series of hollow trephines (Depuy, Warsaw, Ind®) since the distal portion of the implant was well fixed. The new femoral component implanted was a non-cemented, 200-mm-long 16mm-diameter modular stem with a 60mm modular metaphysis (Lima Corporate®) (Fig2).

Intra-operative cultures were negative; and the patient was discharged after a satisfactory postoperative evolution, with a total hospital stay of 13 days. At one-year follow-up, the patient walks with the aid of one stick and refers no pain, with a Harris Hip Score 79.19.

Case Two- The present patient is a 73-year-old female with a pathological history of hypertension, dyslipidaemia and hiatal hernia. She underwent cementless THA for the treatment of primary osteoarthritis 12 years before, and in 2006 the patient was diagnosed of aseptic loosening. During the revision surgery, a trochanteric extended osteotomy was performed to remove the femoral stem; it was revised to a 190-mm-long, 12-mm-diameter extensively porous coated straight stem (Echelon, Smith & Nephew ®) and to a 52-mm-diameter acetabular component (Reflection, Smith & Nephew ®). The trochanteric osteotomy was closed using one 1.6mm Dall-Miles system cable.

In October 2009 the patient consulted referring medial thigh pain. Radiographies were considered normal. In February 2010 the patient suffered a sudden increase in the thigh pain and disability. The radiographic study revealed a femoral stem fatigue fracture just proximal to the diaphyseal isthmus [Fig.2]. She underwent revision surgery: as in the previous case, the proximal part of the broken femoral stem was released easily due to its loosening; on the other hand, the distal part of the femoral stem was firmly attached to the bone and again a series of hollow trephines (Depuy, Warsaw, Ind®) were used. In order to expose the distal femur and to guide the trephines, a transverse osteotomy was performed one centimetre distal to the rupture site. Due to the increase of the diameter of the medullar canal after using the trephines, the failed femoral stem was revised to a non-cemented, bowed 16mm-diameter, 200-mm-long, modular stem with a 70 mm modular metaphysis (Lima Corporate®). The patient was discharged after an uneventful postoperative period of 15 days. At 18 month follow up the patient is walking with the aid of one crutch. Harris Hip score is 72.7 and the follow-up radiographies show a correct integration of the implant [Fig.2].

Discussion

Extensively porous coated stems are commonly used in revision hip arthroplasty, and rupture of the implant is rare. Several factors can be related to this breakage: those related to the implant itself, and those that depend on the patient.

Implant related risk factors involve: the stem diameter, the material composing the implant and the use of cables. Stems with smaller radii are considered substantially more susceptible to fatigue fracture, and the use of metals with a high Young modulus (such as cobalt-chrome) is preferable [4]. Each of the two patients in the present series presented a mechanical failure of an extensively porous coated stem (Echelon, Smith & Nephew®), which is a cobalt-chrome, non- modular, fully porous-coated, distally slotted, and fluted implant. This stem is available in two lengths: 190 mm (straight stem) and 260 mm (bowed stem); and diameters from 11 to 22 mm are available. It is important to outline that some manufacturers do not produce implants with a diameter lesser than 14 mm in order to avoid implant fracture [5]. In a previous series by Landa et al. [1] only one patient had an implant diameter lesser that 13mm; in our cases both patient's implants had a small diameter, 11 mm and 12 mm respectively.

Also, for both patients, cables were previously used. Although the use of cables has not been proven to be a risk factor for fracturing a prosthetic revision stem, it is possible that they serve as a fulcrum for the cantilever bending forces and may predispose to fractures in particular when they erode into the cortical bone [6].

Patient related risk factors involve: age, body mass index (BMI), and poor proximal bone stock. Younger aged patients probably have an increased activity, which may lead to more cycles of cantilever loading. Some works describe cohorts, who usually are under 65 years old [1, 8]; nevertheless this is not the case in our study where the mean age was actually 72 years old. It is

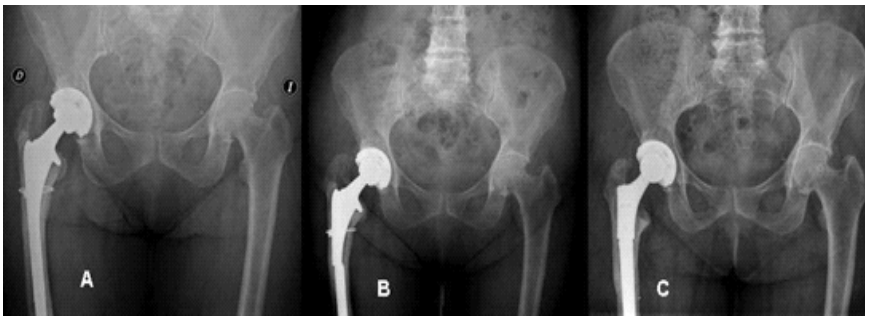

Figure 2: Radiological evolution after revision surgery; X-ray AP views: 2.A) 1 year after primary hip revision; 2.B) 37 Months after revision surgery; the femoral stem fractured at the junction between de proximal loose part and distally well-fixed zone and 2.C) 1 year after revision of the fatigued femoral stem

unknown to what degree age might be a factor in fatigue failure of revision femoral stems.

Overweight or obesity could add stress on the implant. Charnley reported an inordinately high rate of stem fractures in patients who weighed more than 88 kg [7], However, the BMI of presented cases were not elevated (their BMI was 27,67Kg/m2 and 24,75 Kg/m2 respectively).

Perhaps the most important patient risk factor is inadequate proximal femoral bone stock. Both of these patients were noted to have significant proximal osteolysis. One of them had a trochanteric fracture in the primary implant extraction process and the other one had to undergo a trochanteric osteotomy in order to retrieve the primary implant. These two processes healed with no complication in the postoperative period but while doing so, and coupled with distal bony ingrowth, it would have created a cantilever force that was the most likely cause of metal fatigue and ultimate failure of the femoral component with cyclic bending stress [9].

The use of trephines for extraction of the distal portion of a cylindrical broken femoral stem has previously been described [3,10,11]. A transverse osteotomy one centimetre distal to the distal ruptured part of the implant was conducted. This allowed the trephines to be self-guided in the reaming process making the final extraction easier and preserving the bone stock as much as possible.

Trephine reaming is not without complications. The teeth on the trephines are quickly worn out during reaming of the well-fixed prosthesis; multiple trephines must be available, particularly if the prosthesis is long. These drill-powered reamers build up considerable heat, and continuous irrigation is necessary [12-13].

It is also noticeable that in both cases thigh pain was a common reason of symptomatic complaining previously to the occurrence of the stem fracture. This raises the question on how to detect the impending fracture of a long stem. However, thigh pain is a relatively common finding after total hip arthroplasty revision using long stems, and nowadays there are not imaging techniques to detect an impending fracture of the stem.

Conclusion

Few ruptures of extensively porous coated stems have been previously reported in the literature [1,5,8,12]. Many of the characteristics that were previously described, were present in our two patients; mainly, poor proximal bone support and extended trochanteric osteotomy. In addition, the use of a small diameter stem (defined as less than 14mm) was used in both cases. Other factors such as young age or elevated BMI were not present in our patients. Although there is not a consensus about the possible role of the previous use of cables in the development of the stem rupture, we consider that they could also play a role. More cases need to be evaluated to support this statement. Finally, in order to ease the revision procedure, the use of hollow trephines is recommended and, as presented in one of the cases, a transverse osteotomy of the femur can be considered in order to aid in the removal of the broken hardware.

Clinical Message

Rupture of the stem in revision total hip arthroplasty is a rare condition, however risk factors can be identified in order to prevent them. Stem rupture is a challenging situation that should be assessed by specialized hip units with a very detailed preoperative planificaction.

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