Mid-Term follow up of Bilateral THA performed after Failed Core Decompression and Porous Tantalum Rod insertion for Femoral Head Osteonecrosis: a Case Report

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Abstract

We present the case of a patient with bilateral osteonecrosis of the femoral head treated with core decompression and porous tantalum rod insertion who required early conversion to bilateral total hip arthroplasty (THA). Not withstanding the early failure of the rods, the patient had a good clinical outcome 8.1 years after the bilateral conversion to THA. Particulate debris produced during the removal of the porous tantalum rod was observed on postoperative radiographs but these findings seemed to have minimal effect on implant fixation or liner wear. Histological analysis of the retrieved porous tantalum implants demonstrated good bone apposition and ingrowth. However, the clinical significance of these findings remains to be seen as both rods failed early. In conclusion, a good clinical outcome can be expected in the mid-term after conversion of a porous tantalum rod to THA as long as a meticulous surgical technique is followed.

Keywords: Total hip arthroplasty; Conversion; Core decompression; Osteonecrosis; Porous tantalum rod.

Introduction

Osteonecrosis of the femoral head remains difficult to treat, particularly in younger patients. The most commonly accepted pathogenic mechanism is ischemia leading to osteocyte necrosis [1]. This disease typically affects young patients in their third to fifth decades of life and its natural history usually includes progressive articular incongruity and subsequent secondary osteoarthritis [2].

Joint preserving procedures may be performed prior to the collapse of the femoral head in an attempt to delay the progression of the disease and the need for a total hip arthroplasty at an early age [3]. Hip core decompression has been shown to be a safe and effective joint preserving procedure for early stage osteonecrosis [4]. It intends to reduce intraosseous hypertension in the femoral head thus providing pain relief, improving venous drainage, and promoting revascularization [5, 6].

The use of a porous tantalum rod to provide adequate structural support to the weakened femoral head after core decompression is a treatment option [3, 7]. Porous tantalum has a high-volume porosity (>80%) with fully interconnected pores that allow bone ingrowth [8]. The material also has excellent biocompatibility [9]. As a bone graft substitute, a porous tantalum rod can afford sufficient support of physiologic loads while bone ingrowth occurs [10]. In addition, porous tantalum has a modulus of elasticity similar to the one of cancellous bone which can minimize stress-shielding [8, 11].

Case History

In the current report, we present the case of a patient with bilateral osteonecrosis of the femoral head treated with bilateral core decompression and porous tantalum rod insertion that failed early requiring subsequent conversion to bilateral total hip arthroplasty. The patient was followed for 8.1 years after both arthroplasty procedures. Histopathological analysis of the retrieved porous tantalum rods was also performed. The patient provided informed consent.

A thirty seven year old Hispanic African American female patient presented in 2003 complaining of left hip pain. She had received 5 mg per day of oral prednisone for approximately one year as treatment of systemic lupus erythematosus. Clinical evaluation and imaging studies demonstrated Ficat stage II pre-collapsed osteonecrosis of the left femoral head [5] for which she underwent core decompression and insertion of a 10mm x 75mm Zimmer Implex Intecell Porous Tantalum Rod Implant [Figure 1]. At her one week postoperative visit, the patient reported significant pain improvement and a painless full range of motion of the left hip.

The patient presented the next year (2004) with severe pain of the right hip. The MRI and x-rays at that time revealed Ficat stage II osteonecrosis of the right femoral head. Core decompression and porous tantalum rod insertion was performed on the right hip. This procedure provided significant relief of the symptoms. The postoperative protocol for both surgeries included toe touch weight bearing for six weeks. Nevertheless, after surgery, the patient progressed to full weight bearing as tolerated.

In 2005, ten months after the right hip operation, she presented to our office complaining of severe bilateral hip pain and a severe limp. Plain radiographs revealed symmetrical diminution of the joint space and subchondral sclerosis of the dome of the acetabulum in both
hips as well as an apparent collapse (with a visible drop or step) in the weight bearing surface of the right femoral head [Figure 2]. After a detailed discussion with the patient concerning the treatment options and full explanation of all surgical risks associated with the procedures, a bilateral conversion total hip arthroplasty was recommended.

On the second day after conversion of the left hip to THA (the latter) an AP radiograph demonstrated bilateral well-fixed, press-fit total hip arthroplasties with excellent position of all components [Figure 3a]. In spite of the meticulous precautions taken during the surgical intervention, metallic particulate debris were observed within the periprosthetic soft tissue, more so around the left hip than the right hip.

At about eight years after the bilateral conversion to THA, the patient had no pain in either hip and enjoyed a full and painless range of motion in both joints. The patient only complained of low back pain. The anteroposterior pelvis radiograph at this time [figure 3b] demonstrated bilateral eccentric wear measuring 0.16 mm/year and 0.19 mm/year on the right and left side, respectively. Proximal migration of metallic debris particles was noted when the radiograph at this time [figure 3b] was compared with the one obtained a few days after the conversion of both hips to THA [Figure 3a]. Both acetabular components appeared to be well fixed. On the right acetabular component, there was a 1mm radiolucent line in De Lee-Charn-ley Zone 3. Both femoral components appeared to be well fixed, had proximal stress shielding, evidence of cortical thinning laterally, and evidence of a radiolucent line in Gruen Zones 4 and 5 with evidence of neocortex formation.
Histologic features of the retrieved porous tantalum rods suggested good bone apposition and ingrowth without evidence of a surrounding fibrous membrane [Figures 4-6]. In the femoral head, there appeared to have been some cancellous bone hypertrophy associated with the implant surface especially near the subchondral bone and endosteum by the tip of the rod [Figure 4]. Macrographs [Figure 4] and micrographs [Figure 5] taken of the edge of the implant showed bone apposition and focal bone ingrowth. Spicules of histologically viable cancellous bone [Figure 6a] and blood vessels [Figure 6b] were evident deep into the implant. No significant inflammation related to the implant was observed.

Discussion

In the current case, we can only speculate that the progression to full weight bearing as tolerated after surgery could have contributed to the early failure of the core decompression with porous tantalum rod insertion. The literature seems to support this conjecture. Stronach et al. [12] and Zhang et al. [13] reported cases of early failure of this procedure that were attributed to early weight bearing. Recommendations for the weight bearing protocol after this procedure vary [14] but should allow time for adequate bony ingrowth into the implant. Zhang et al. [15] concluded via meta-analysis that the porous tantalum rod was a safe and effective treatment for early stage femoral head osteonecrosis, and in the short term, it resulted in a significantly lower incidence of femoral head collapse and a better Harris hip scores than did bone grafting [15]. The use of a porous tantalum rod also seems to avoid the morbidity associated with vascularized fibular grafting or non vascularized bone grafting techniques [16-18].

Only a few reports have addressed the outcomes of THA after failed core decompression and tantalum rod insertion [19, 20, 21]. Lee et al. [19] followed for 36–57 months a cohort of eight hips (six patients) that underwent conversion from tantalum rod to THA and compared it to an age- and sex-matched osteonecrosis control group that received THA without prior hip surgery (sixteen hips in twelve patients; follow-up, 38–57 months after surgery). No significant differences

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were found between both groups in the Harris Hip Score or the inclination/anteversion of the acetabular cup. No evidence of radiographic osteolysis or femoral stem subsidence was found in either group. Of note, the conversion THA group had six cases of particulate debris noted radiographically. Olsen et al. [20] followed twenty-one tantalum rod cases (twenty-one patients) for a mean of 4.2 years (range, 2–6 years) after conversion to THA and age and sex-matched each case to a patient that received THA without prior hip surgery. The authors found no statistically significant differences between both groups in the Harris Hip Score, femoral stem alignment, acetabular component inclination, or the linear wear rate. No evidence of catastrophic radiographic wear was found in either group. Noteworthy, particulate debris was observed in the radiographs of all conversion THA patients. Shuler et al. [21] reported no complications, no revisions, and no clinical observation of third-body wear in three patients up to three years after conversion from the rod to THA. We followed the current case for 8.1 years, which to the best of our knowledge makes it the first mid-term follow-up case report of bilateral THA performed after core decompression and porous tantalum rod insertion for femoral head osteonecrosis.

We observed metallic particulate debris in the radiographs obtained after conversion to THA, prominently on the left hip. The metallic particulate debris generated during removal of the implant and conversion to THA has the potential to enter the bearing surface and cause third-body wear as well as soft tissue reaction. In the current study, particulate debris produced during removal of the porous tantalum implant appeared on the postoperative radiographs and seem to have migrated proximally over time. However, 8.1 years after the conversion to THA, the fixation of the implant was good and the liner wear was minimal, suggesting a negligible adverse effect of the metallic particulate debris observed. Other investigators have reported the presence of particulate debris in postoperative radiographs after the removal of the porous tantalum rod and conversion to THA [14, 15, 19, 21-28]. Olsen et al. [20] reported that this porous tantalum rod did not appear to accelerate polyethylene wear in the short term (2–6 years). Further, they found no significant correlation between the amount of debris detected and either the linear wear rate or the functional outcome scores. Lee et al. [19] postulated that the presence of this debris caused squeaking of a ceramic-on-ceramic conversion THA. They speculate that the debris entered the bearing surface and caused microseparation, edge loading, and thus squeaking. Liu et al. [28] hypothesized that retained porous tantalum particles were the cause of an uncommon case of initial hip pain after conversion to THA, possibly by inducing inflammation. Shuler et al. [21] acknowledged the possibility of these particles causing third-body wear but did not observe this clinically in three patients up to three years after conversion to THA. The long-term risk of these particles on wear rate and soft tissue reaction is unknown [19, 24, 28-30].

In the current case, histologic features of the retrieved porous tantalum implants suggested good bone apposition and ingrowth, and no evidence of a surrounding fibrous membrane. Previous histological analyses of porous tantalum rods retrieved at conversion to THA have detected various degrees of bone growing onto and into the implant [17, 30-33]. In a study of fifteen porous tantalum rods retrieved at an average of 13.4 months (range 3–36 months), Tanzer et al. [30] found that thirteen (87%) of them had bone ingrowth, although the amount was minimal (average 1.9% and mostly < 2 mm inward). In three porous tantalum rods removed at 13, 14, and 20 months postoperatively, Fernandez-Farien et al. [31] measured bone ongrowth of around 80% (including regions of bone-implant contact) and bone ingrowth of around 75%. Bone ongrowth and ingrowth were present to a lesser extent in porous tantalum rods removed at six weeks (n=1) and at six months (n=1). Zhang et al. [17] analyzed four porous tantalum rods retrieved early (average 10 months, range 6.4–15.7 months). All four displayed interfacial gapping averaging 0.27 mm between the rod and the surrounding bone, and only sparse, isolated ingrowth 1–4 mm inward. Ronga et al. [32] reported three cases of porous tantalum rods with complete bone penetration in the short term (times to retrieval were not specified). In a case study of a porous tantalum rod retrieved at 7 months, Oh et al. [33] found bony trabeculae contacting the implant surface and bone growing into the rod. In the current case, the presence of good bone apposition and ingrowth, blood vessels, and no significant inflammation related to the implants demonstrates good biocompatibility of the porous tantalum and suggests some remodeling of the bone on the implant surface. However, the clinical significance of these findings remains to be seen as ultimately both rods failed in the short term. Fortunately, the conversion to THA was a success even up to the midterm (8.1 years after surgery).

Summary

The patient had a good clinical outcome 8.1 years after bilateral conversion to THA subsequent to early failure of bilateral core decompression and porous tantalum rod insertion. Particulate debris produced during removal of the porous tantalum rod was observed on postoperative radiographs after conversion to THA. However, at least in the mid-term, these radiological findings had minimal effect on implant fixation or liner wear. Histological analysis of the retrieved porous tantalum implants demonstrated good bone apposition and ingrowth. Nonetheless, the clinical significance of these findings remains to be seen as both rods failed early. In conclusion, a good clinical outcome can be expected in the mid-term after conversion of a porous tantalum rod to THA as long as a meticulous surgical technique is followed.

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