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Case report

A novel use of a tibial cone in a proximal femoral replacement

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ABSTRACT

Revision total hip arthroplasty in the setting of severe femoral bone loss can be challenging, with salvage options often limited to modular tapered stems, allograft prosthetic composites, and megaprostheses. This case highlights a 79-year-old woman with 2 years of thigh pain who is 8 years status post a revision proximal femoral allograft prosthetic composite reconstruction. Radiographs demonstrated significant stem subsidence into the femoral condyle. In an attempt to avoid a total femoral replacement and spare her functioning native knee, a tibial cone was used in conjunction with a proximal femoral replacement to structurally fill the flaring femoral canal and serve as a stable pedestal for the megaprosthesis body and provide the potential for biologic ingrowth. At 12-month follow-up, she ambulates with a cane, and radiographs reveal stable implant position.

Introduction

Total hip arthroplasty (THA) reliably provides significant improvement in functional outcome and quality of life in patients with hip arthritis [1,2]. By the year 2030, the incidence of primary and revision THA is expected to increase by 174% and 137%, respectively, compared with 2005 [3]. Undoubtedly, revision THA continues to burden our health-care system [4], with the most common reasons for revision to be dislocation and mechanical loosening, followed by infection, osteolysis, and periprosthetic fracture [5].

In patients requiring revision THA with extensive proximal femoral bone loss (Paprosky class IIIB and IV) [6], surgical treatments become more limited consisting of uncemented modular tapered stems, impaction bone grafting, allograft prosthetic composites (APCs), and proximal femoral replacement [7]. An APC is theoretically advantageous for its restoration of bone stock and amenability to soft-tissue reattachment; however, it has a high complication rate [7-10]. After an APC fails, a proximal femoral replacement is often the best salvage option, with good reported 5-year survivorship [11,12]. Even amidst promising outcomes of megaprostheses, in cases of severe metaphyseal and diaphyseal femoral bone loss, reconstruction is often challenging and may require creativity on the part of the surgeon to build a stable and durable construct.

We present the following case to demonstrate a novel approach to femoral reconstruction in revision THA where a highly porous tantalum tibial cone was used in conjunction with a proximal femoral replacement in a patient with substantial bone loss after a prior APC failure.

Case history

Informed consent was obtained to having deidentified details of this patient's case submitted for publication.

A 79-year-old woman with a history of congenital hip dysplasia underwent a primary THA at the age of 38, in 1975. In 1995, she had a revision THA to a modular system (DePuy Synthes, Warsaw, IN), with an associated wire at the level of the metaphyseal sleeve. In 2006, the patient presented to our institution with severe start-up pain and antalgic gait. Radiographs demonstrated severe osteolysis, secondary to metal debris from the wire eroding through the sleeve, resulting in bone loss and component loosening. The patient was revised to a long S-ROM APC component supplemented by lateral femoral strut grafts. One week postoperatively, she heard a pop, and she sustained a periprosthetic distal femoral shaft fracture

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at the tip of the stem. A subsequent revision, involving a similar APC 6 cm longer, was completed. At the 1-year postoperative visit, she had no pain, ambulated without an assistive device, and radiographs demonstrated a well-positioned revision APC (Fig. 1 – earliest available radiographs through the electronic medical record).

At the 4-year postoperative visit in 2012, she had radiographic evidence the stem was loose, and beginning to subside (Fig. 2a and b). At this time, she had no desire to undergo revision surgery, given her lack of symptoms. In 2016, she represented (now for the first time to our orthopaedic surgery team) with worsening left thigh pain for the past 2 years, and the sense of her left leg was getting shorter. Radiographs demonstrated massive subsidence of the stem distally through the lateral femoral condyle (Fig. 2c and d). C-reactive protein was normal at <0.1 mg/dL (normal range 0.0-1.0 mg/dL), and erythrocyte sedimentation rate was slightly elevated at 18 mm/h (normal range, 0-15 mm/h). Left hip synovial fluid revealed 968 total nucleated cells and no growth on cultures after 5 days, indicating no underlying periprosthetic infection preoperatively.

After a discussion regarding surgery, she consented for a left proximal femoral replacement vs total femoral replacement. In effort to avoid a total femoral replacement and save her otherwise well-functioning native knee, it was felt preoperatively that her distal femur with surrounding allograft would benefit from additional structural support in the form of a tibial cone. This would serve to provide a stable base for the megaprosthesis to sit within her widening femoral canal distal to the isthmus, while at the same time maximizing the native distal femoral length to accommodate a cemented stem. In addition, the porous tibial cone would provide for osseointegration to maximize the potential for long-term survivorship because the length of the cemented stem was limited by the length of the remaining femoral bone.

The patient ultimately underwent revision THA with a proximal two-thirds femoral replacement. An extended version of her prior posterior approach was employed at the hip and continued down the lateral aspect of the femur with removal of extensive heterotopic ossification around the acetabulum. Frozen sections were negative for acute inflammation. Cables were removed, and an osteotomy was made at a templated region of the proximal aspect of the native femur, allowing for the removal of the majority of the APC. The acetabular component was stressed and found to be stable. A new 28-mm +0 femoral head and 10 degree lipped 50-mm DePuy Duraloc liner were placed. The distal femur was reamed centrally to accept a new stem. Given the widened femoral canal and the paucity of good bone stock, there was concern that the stem would be at an increased risk of failure, secondary to loosening, if the construct relied solely on cement fixation. Therefore, an 8-mm Stryker tritanium tibial cone was then reamed for in the proximal most aspect of the remaining femur, cables were placed distally, and the cone was impacted into place. The megaprosthesis was then constructed and was cemented in place at the appropriate height and anteversion. An intraoperative photograph (Fig. 3) draws attention to the interface between the femoral body proximally and the tibial cone distally. Immediate postoperative radiographs are shown in Figure 4a and b. She was made weight-bearing as tolerated on her left lower extremity and educated on posterior hip precautions. She was maintained on aspirin 81 mg twice daily for 4 weeks for deep venous thrombosis prophylaxis and discharged on prophylactic oral doxycycline 100 mg twice daily until intraoperative cultures returned negative.

Postoperatively, she experienced 2 hip dislocations at 6 months and 1-year and underwent successful closed reduction in the emergency room on both occasions. Radiographs at 1-year follow-up show a stable reconstruction (Fig. 4c-e)—though it should be noted that the radiographs obtained at the time were non–weight-bearing, which is a limitation in assessing the stability of this construct. At 15-month follow-up, a discussion regarding placement of a constrained liner was held, though the patient was not interested in pursuing this. At this time, no new radiographs were taken, and she ambulates with a cane without pain.

Discussion

Revision hip reconstruction in cases of severe femoral bone loss can be challenging, with surgical options often limited to modular tapered stems, APCs, and megaprostheses [7]. Contemporary protocols employing APCs have shown superior tissue-surface attachment in addition to sparing bone height [7,8,10]. Notwithstanding these mechanical merits, our patient's course parallels existing literature demonstrating a notable failure rate in APCs,

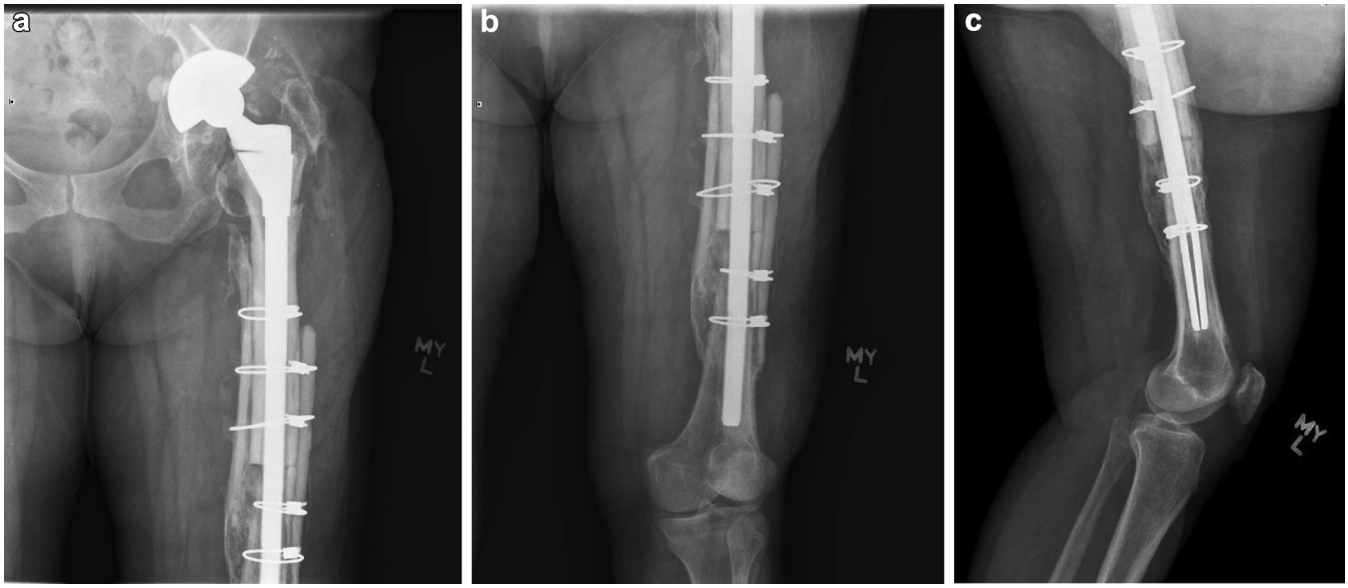

Figure 1. Anteroposterior (AP) proximal (a), AP distal (b) and lateral (c) radiographs of the left femur show a stable femoral allograft prosthetic composite in 2008, using an S-ROM stem reinforced with strut grafts laterally.