CASE REPORT

Case Report

Failure of Rotating-hinge Total Knee Prosthesis by Disengagement of the Hinge-post Extension

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Abstract

Background Although modern-generation rotating-hinge knee implants have been modified to mitigate earlier complications related to aseptic loosening with these devices in revision TKAs, there are few, if any, reports of failure related to the hinge mechanism in these prostheses. **Case Description** We present a case of disengagement of the hinge-post extension in a contemporary rotating-hinge knee prosthesis originally implanted during revision surgery for instability and extensor mechanism insufficiency. We hypothesize the screw home kinematics of the knee

resulted in a counterclockwise torque, contributing to the hinge post locking screw disengagement in this case.

Literature Review Although some authors have reported complications and failures related to aseptic loosening with rotating-hinge knee prostheses, there have been no reports regarding complications related to the hinge mechanism, which simultaneously links and permits rotation between the femoral and tibial components.

Clinical Relevance Arthroplasty surgeons who use rotating-hinge knee prostheses need to be aware of this potential mode of failure. Design modifications, including more secure locking mechanisms and side-specific implants, may avoid this complication.

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Introduction

Rotating-hinge knee prostheses are used in revision TKAs when instability cannot be treated reliably with articulations using less constraint [3]. Despite reports of reduced pain and improved ROM, Knee Society scores, and patient satisfaction after the use of modern-generation rotating-hinge prostheses in complex revision situations [1, 6], medium- and long-term followup is limited [2, 6, 9, 13, 14, 16] and some authors continue to report complications and failures related to aseptic loosening, infection, and periprosthetic fracture with these devices [14, 19]. None of these described failures of the hinge mechanism.

We describe the case of a patient who experienced spontaneous disengagement of the hinge-post extension of a contemporary rotating-hinge knee implanted for instability and extensor mechanism insufficiency. The patient was told information regarding this case would be submitted for publication.

Case Report

A 70-year-old man underwent a primary TKA, at an outside institution, that was complicated by a chronic quadriceps tendon tear. The patient presented to the senior author (CJDV) with a worsening extensor lag and persistent instability and underwent a revision TKA using a rotating-hinge knee (NexGen® Rotating Hinge Knee; Zimmer, Inc, Warsaw, IN, USA) with a concomitant extensor mechanism reconstruction with Marlex mesh [4] (Fig. 1). A hinge-post extension was placed through the femoral hinge, across a slot in the polyethylene liner, and into the tibial base plate. A torque wrench was used to tighten the hinge-post extension to 130 inch-pounds, which locks the threads of the hinge-post extension into the femoral hinge post as per the manufacturer recommendations.

Despite a persistent 45° extensor lag, the patient was satisfied with his pain relief at 6 months postoperatively. At 10 months postoperatively, the patient presented with an acute onset of pain, clunking, and instability. Radiographs showed dissociation of the femoral and tibial components at the hinge with disengagement of the hinge-post extension into the patellofemoral compartment (Fig. 2).

Fig. 1A–B Postoperative (A) AP and (B) lateral radiographs show the knee after implantation of a rotating-hinge prosthesis.

The patient was operated on to reevaluate the components and perform a revision reconstruction of the extensor mechanism with an extensor mechanism allograft [5]. The components were well fixed and appropriately positioned and the threads of the hinge-post extension were observed to be intact with no evidence of fracture, corrosion, or stripping (Fig. 3). The polyethylene liner was exchanged from a 17-mm to a 20-mm insert and a new hinge-post extension was placed and tightened.

Fig. 2 A lateral radiograph shows disengagement of the hinge-post extension, which is displaced into the patellofemoral joint.

Fig. 3 A photograph shows the polyethylene component and hinge-post extension explanted after failure of the rotating-hinge knee prosthesis. The threads are intact with no evidence of irregularity in the hinge-post extension or the polyethylene component.

Discussion

Rotating-hinge knee prostheses are considered for patients with instability that cannot be managed with unconstrained prostheses [11, 14]; we also have used them at our institution when reconstructing the extensor mechanism as instability is one of major complaints of these patients. In our patient, a rotating-hinge knee was originally implanted for intraoperative instability and chronic extensor mechanism dysfunction but failed at 10 months secondary to disengagement of the hinge post locking screw.

Clinical studies of modern-generation rotating-hinge prostheses have been reported by numerous authors [2, 6, 9, 13–16]. Numerous authors have reported improvements in pain and function [2, 9, 10, 13] and ROM [10, 15] after the use of rotating-hinge prostheses. Despite these findings, major complication rates ranging from 0% to 44% at 3.8 to 15 years have been reported secondary to infection, aseptic loosening, patellar instability, and prosthetic dislocation [6, 16]. Less common modes of failure also have been identified, including failure of the polyethylene bushing [20], fracture of the tibial metal post [18], fracture of the tibial yoke [8], failure of an antidislocation mechanism [12], and tibiofemoral distraction disengagement [21].

We describe a mode of failure for a rotating-hinge knee prosthesis via atraumatic disengagement of the hinge-post extension and resultant tibiofemoral instability. At the time of the original revision, the hinge-post extension was appropriately tightened with 130 inch-pounds of torque and the implant exhibited appropriate stability. The screw threads were intact at the time of revision, indicating gradual loosening of the locking mechanism.

Dennis et al. [7], in a kinematic study of more than 1000 TKAs, reported a majority of TKAs conform to the screw home mechanism observed in normal knees: axial external rotation of the femur on the tibia during knee flexion and internal rotation of the femur on the tibia during knee extension with a relatively static medial femoral condyle. Rapuri et al. [17] postulated this kinematic mechanism may have contributed to the disengagement of a locking screw in five knees implanted with a NexGen[®] Legacy[®] Constrained Condylar Knee (Zimmer). They specifically implicated knee extension, in which internal rotation of the femoral component is converted into a counterclockwise torque in the right knee and clockwise torque in the left knee that is exacerbated in constrained prostheses. Under repetitive cycles of motion, this would lead to a hypothetical increased risk of post loosening in right knees and prevention of loosening in left knees. Four of the five failures in their series occurred in right knees, and they proposed the failure in the left knee may have occurred secondary to reversed knee kinematics [17], which can be observed in approximately 1/2 of all TKAs.

Although the implants are different, we believe the mechanism of disengagement of the hinge-post extension in the rotating-hinge knee prosthesis in our patient, which also occurred in a right knee, is similar to the mode of failure reported by Rapuri et al. [17]. We think this mechanism of failure also might be exacerbated in cases with substantial instability despite the use of a constrained prosthesis. In our patient, a major intraoperative flexion and extension gap mismatch was observed at the time of the initial revision; postoperatively, an extensor lag persisted despite the attempted Marlex mesh reconstruction. It is conceivable persistent instability, particularly with an incompetent extensor mechanism, may act synergistically with the torque generated by a rotating-hinge prosthesis to contribute to loosening of the hinge-post extension.

Potential design modifications, such as the development of a screw that could withstand higher forces, locking caps to prevent thread backout, and opposing configurations for hinge threads specific to right and left knees, could be considered to avoid this complication and the need for additional revision surgery. Additionally, diligent attempts at appropriate flexion and extension gap balancing should be done to minimize any residual instability at the time of implantation of a rotating-hinged knee prosthesis. Alternatively, a design in which the interlocking devices were not used in the rotating hinge could avoid this complication, although documented cases of distraction dislocation have occurred with such implant designs [21].

To our knowledge, this is the first report describing disengagement of the post mechanism in a modern-generation rotating-hinge knee prosthesis. We suggest the hinge-post extension loosened with time via repetitive counterclockwise torque created by external rotation of the femur on the tibia during extension in a constrained prosthesis. Based on this experience, we recommend surgeons who use rotating-hinge prostheses recognize this potential mode of failure particularly if enhanced stability is not achieved with the reconstruction.

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