Case report

Recurring intraprosthetic dislocation of rotating-hinge total knee prosthesis. Effect of implant design on intrinsic stability


Institut de l'appareil locomoteur, clinique Pierre Paul Riquet, place Baylac, 31000 Toulouse, France

ARTICLE INFO

Article history:
Accepted 12 July 2014

Keywords:
Rotating-hinge total knee prosthesis
Intraprosthetic dislocation
Revision arthroplasty

ABSTRACT

During total knee replacement, hinged total knee implants are used in cases where ligament balancing cannot be achieved with less-constrained implants. The case of a patient who experienced two episodes of intraprosthetic dislocation of his rotating-hinge total knee prosthesis is described. There are very few reports of this type of dislocation with these implants. The implant’s design, particularly of the hinge, plays an important role in stability. The balance between the flexion and extension spaces is very important even when using a hinged total knee implant. The role of the extensor mechanism in anteroposterior stability is reviewed, along with simple ways to augment it.

© 2014 Elsevier Masson SAS. All rights reserved.

1. Introduction

Rotating-hinge total knee replacement (RH-TKR) is indicated when the knee’s intrinsic stability is disrupted due to ligament deficiency [1–3]. Despite limited follow-up [3–8], satisfactory outcomes have been reported [5–9]. But this procedure is not without complications and failures [3,10]. Among these complications, ones related to the hinge itself are rare and have been described in clinical case reports [11–13]. Analyzing these particular complications can help us understand limitations in the implant’s design and can provide avenues to preventing these complications.

Here, the case of one patient who experienced two episodes of intraprosthetic dislocation of a rotating-hinge knee implant by two separate hinge-related mechanisms is described.

2. Case report

An 82-year-old male patient had received a posterostabilized total knee replacement for knee osteoarthritis. Five years later, he experienced a patellar fracture that was treated by partial patellectomy. The postoperative recovery was marred by anterior instability and pain. Clinical examination revealed lateral subluxation of the extensor mechanism, along with laxity in the frontal and sagittal planes.

The existing implant was revised with a rotating-hinge knee implant (NexGen® RH Knee, Zimmer®, Warsaw, IN, USA). The hinge post-extension was inserted through the femoral hinge post and into the hole on the tibial base plate with the knee at 90°, then screwed with a hex screwdriver and tightened to 130 N with a torque wrench while holding the femoral component, as recommended by the manufacturer. Lateral retinacular release was performed, along with patellar tendon medialization with suture anchors (Healix™, DePuy Synthes Mitek Sports Medicine, Raynham, MA, USA). One month after this surgical procedure, the patient reported that his knee had locked. X-rays showed posterior tibial dislocation and the hinge post-extension had unscrewed (Fig. 1).

A second revision surgery was scheduled. There were no abnormal intraoperative findings or signs of wear at the threads of the hinge post-extension, the hinge post, or in the polyethylene insert. However, the flexion gap was discovered to be much larger than the extension gap. A thicker polyethylene insert was inserted, the hinge post-extension was changed and then screwed according to manufacturer’s recommendations. The extensor mechanism was not reinforced because it was continuous and solid. The knee was immobilized for 1 month in a hinged split with range of motion limited to 0–90°.

Two weeks after use of the splint was discontinued, the patient again experienced posterior dislocation of the implant (Fig. 2) but without disassembly of the hinge post-extension. It was decided to completely revise the implant and replace it with a different revision-specific modular rotating-hinge design (GMRS-MRH®, Stryker, Kalamazo, MI, USA) (Fig. 3). This revision was accompanied by augmentation of the extensor mechanism using a double hamstring graft secured with a Blount staple. Postoperatively, a hinged split with range of motion limited to 0–90° was used for 1 month. At the latest follow-up 12 months later, the patient was able to walk.


* Corresponding author.
E-mail address: cavaignac.etienne@gmail.com (E. Cavaignac).

http://dx.doi.org/10.1016/j.otsr.2014.07.009
1877-0568/© 2014 Elsevier Masson SAS. All rights reserved.
without assistance, was fully able to bear weight and had a range of motion of 0–120°. No new instability episodes occurred.

3. Discussion

Rotating-hinge total knee implants are a good solution for patients with severe deficiency in their periarticular tissues. The outcomes in terms of implant stability are generally very good [5,9]. However, these implants have limitations that cannot be ignored, as evidenced by the case reported here and other published case reports [3,11–14].

In this report, the dislocation mechanism was different for each episode. In the first episode, the hinge post-extension had unscrewed and disengaged from the tibial baseplate, which led to the dislocation. In the second episode, an excessive flexion gap seems to have allowed sufficient joint distraction for the post-extension to come out of its tibial baseplate. The flexion and extension gap asymmetry did not allow us to use a thick enough polyethylene insert to ensure good flexion stability without limiting extension.

Unscrewing of the hinge post-extension and its disengagement from the tibial baseplate have previously been reported [12]. The kinematics of a knee after arthroplasty are similar to the one of a healthy knee [15]. During flexion, the tibia internally rotates and during extension, it externally rotates. The medial compartment remains relatively static during these movements. Loads induced by tibial rotation may be transmitted to the post-extension – hinge post-junction in the form of rotational torque [14]. This torque is counterclockwise for a right knee and clockwise for a left knee. It is hypothesized that repeated flexion – extension cycles increases the risk of separation in right knees and reduces this risk in left knees. In fact, the case reported here and 5 of the 6 similar published cases involve the right knee [12,14]. This risk could be reduced by developing side-specific implants, or adding a lock nut or reverse threads in implants destined for the right knee.

Disengagement of the hinge post-extension from the tibial baseplate is rare [11]. A rotating-hinge knee implant has two axes of motion. The first one is a transverse axis corresponding to the femoral hinge post, around which flexion – extension occurs. The second one is a vertical axis corresponding to the hinge post’s extension in the tibial baseplate, around which the tibia rotates under the femur. A “post-in-channel” design – where a non-fixed post can slide within the tibial component – allows for joint distraction in flexion that is somewhat limited as a function of the integrity of the periarticular soft tissues [16]. This distraction has two consequences. On one hand, it allows for greater flexion; but on the other, it allows the hinge post-extension to disengage from the tibial baseplate. Once the joint is distracted and the post-extension had disengaged, it could tilt and dislocate from the tibial baseplate. This risk depends on factors that are intrinsic and extrinsic to the implant. Intrinsic factors are related to the extension post’s geometry, namely its length and taper [11]. Extrinsic factors are related to the quality of the periarticular soft tissues. An excessive flexion gap, as in the case reported here, contributes to the distraction of the hinge post-extension and to its disengagement in full flexion. Moreover, if the extensor mechanism is weakened or its lever arm is
shorted because of patellectomy [17], soft tissue tension is reduced further.

In the case described here, we acted on the intrinsic factors by selecting a revision implant with a longer, less flared post-extension to reduce the risk of disengagement (Fig. 4). We also addressed the extrinsic factors by reinforcing the extensor mechanism, thereby improving joint coaptation. This is a simple procedure that barely increased the morbidity of the surgical procedure, while optimizing the knee’s anteroposterior stability.

It is essential to understand the limitations of rotating-hinge total knee implants. Because of the preexisting soft tissue deficiencies, the post-extension screwed into the hinge post is the only structure ensuring the implant’s primary stability. The manufacturer’s implantation instructions must be followed, especially for the hinge post-extension. But one should also keep in mind that the design of the implant used can have a major role in the implant’s intrinsic stability. And it is crucial to analyze the functional condition of the extensor mechanism to control potential extrinsic instability factors for this type of implant.

![Fig. 4. A. Locking screw for the NexGen® RH Knee (Zimmer®, Warsaw, IN, USA). B. Connection peg for the GMRS-MRH® implant (Stryker, Kalamazo, MI, USA). The GMRS-MRH is less flared, which reduces the risk of dislocation.](image-url)