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Case Report

Failure of the Rotating-Hinge Knee Megaprosthesis

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ABSTRACT

Recently, rotating hinge knee prostheses were applied more frequently due to improving modern implant designs. They are predominantly used in specific conditions with major bone defect or insufficiency of the collateral ligaments around the knee, often as salvage procedures. A case of rotating hinge knee megaprosthesis failure due to isolated tibial polyethylene stopper broken, which was never reported before, was investigated and treated in our institution. We suggested that rotating hinge knee prosthesis with incompetent medial collateral ligament is apt to failure due to the high valgus moment during gait. Sacrificing lateral collateral ligament or cutting the femur in slightly less than the normal 5° to 7° valgus may eliminate the risk of complication.

Rotating hinge knee prostheses can be useful in certain specific indications such as gonarthrosis associated with major ligament instability, a distal femoral or proximal tibial bone defect, or in revisions for aseptic or septic loosening with major bone defect or insufficiency of the collateral ligaments. The complication rate is higher in rotating hinge prostheses than in less constraining implants [1]. Breakage of prosthetic component is a relatively rare complication. In the previous reports, polyethylene (PE) bushing failure and tibial yoke breakage are the major reasons in failed rotating hinge total knee prosthesis involving breakage of prosthetic component [2–5]. To our knowledge, isolated PE stopper fracture has not reported before. In this study, we investigated a failed case of rotating hinge knee megaprosthesis which involved the tibial PE stopper.

Case Report

This 61-year-old female patient, 160 cm in height and 68 kg in weight, suffered from pain and swelling at proximal tibia of left knee. She also had obviously valgus deformity at the first presentation. Open bone biopsy was done first and the pathology revealed chondrosarcoma, grade II. Wide excision of the tumor and knee reconstruction were performed in July 1998. Twenty centimeter of proximal tibia was resected together with posterior, anterior cruciate ligament and medial collateral ligament. Fibular head and lateral collateral ligament, on the other hand, were reserved. Cemented United oncology modular knee system (United Orthopedic Co., Hsinchu, Taiwan) was used. Extracortical bone bridge was applied for the tibial side (Fig. 1). The prosthesis design included several major components: a metal femur component with a 7° valgus stem, a tibial PE stopper, a metal tibial stem with a metal hinge axle–yoke mechanism, and a full-PE tibial main body. Postoperatively, the patient received regular follow-up at our clinics without complications.

Unfortunately, 5 years after her operation, she heard a crackle sound while walking and felt pain and a sudden locking in her left knee. She visited our outpatient clinics again and physical examination revealed some joint effusion with limited range of motion of left knee. There were no local erythema, heat, swelling, or fever noted. Femoral stem loosening with varus, posterior drift and femur posterior cortex remodeling and thickening were seen in radiography (Fig. 2A). The joint space was symmetrical and there was no femoral component migration. During revision surgery in November 2003, we noted wearing, scratching, and slight delamination over all articulating surfaces of tibial PE stopper. The fracture occurred at inner cut-out region of the PE stopper, which featured as interior sharp margin and long transverse pattern (Fig. 3A, C). Furthermore, the PE bushing was worn and the femoral component was loosened with many granulation tissues within the joint.

Removal of the broken tibial PE stopper, the tibial bearing component, and the loosened femoral component was done. Granulation tissues were debrided. A new femoral component with 2.5-cm segmental part was inserted and cemented. Extracortical bone bridge was also applied. The tibial PE stopper with tibial bearing component was changed (Fig. 2B). The soft tissues from the

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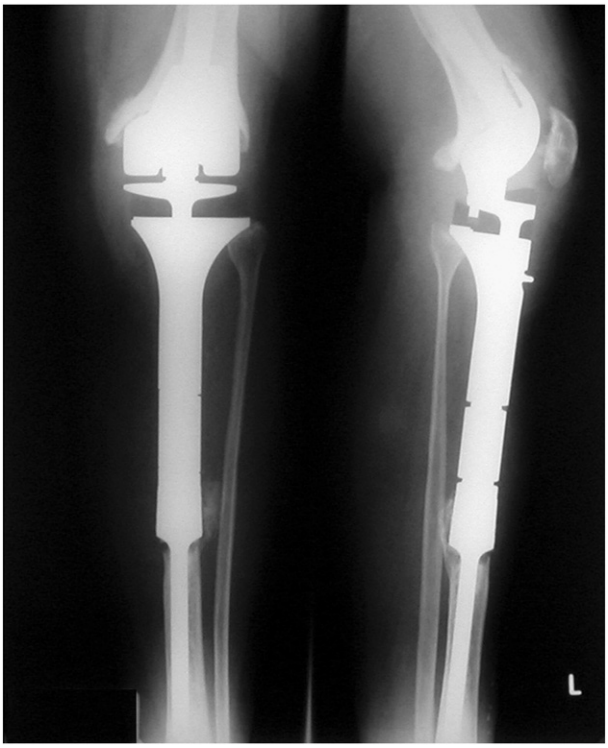

Fig. 1. Radiographs of the left knee in anteroposterior and lateral views show status post-wide excision of tumor and total knee arthroplasty with rotating hinge megaprosthesis.

granulations showed fragments of polyethylene engulfed or surrounded by foreign body giant cell. The bony fragments reveal foci of reactive fibrosis. Scanning electron microscopy of the fracture site of tibial PE stopper and the wearing of bushing showed no fracture source or particular material defect. At the last follow-up in October 2005, the patient's condition became satisfactory with relief of pain and no complications noted.

Discussion

Limb-sparing surgery can offer patients with malignant tumors potentially excellent function without compromising tumor control [6–8]. Among the various reconstructive methods available, prosthetic replacement offers several advantages, including early stability, mobilization, and weight bearing. However, this procedure inevitably sacrifices the knee ligaments and thus a constrained prosthesis is often required.

Earlier designs of hinged knee prosthesis with a true fixed hinge only allowed motion in flexion and extension. However, excess stresses applied to the bone–cement interface and articulation appeared to result in early osteolysis and loosening of the components [9,10]. In order to solve this problem, adding axis rotatory motion and ability of distraction was applied in the initial design of rotating hinged knee prosthesis [11]. Because of incongruent mobile-bearing articulation, poor alignment and fixation of stem, and shallow patellofemoral groove, it led to high failure rates as well and impeded the clinical application [12]. More recent designs incorporated features that offered improved torsional stability for fixation as well as further improvements of the articulation between the rotating hinge and the tibial component [13]. According to the previous report, this design had promising medium-term results [12,14].

The reason why there was high complication rate in rotating hinge knee prostheses than in less constraining implants had been mentioned [1]. As Springer et al. [3] reported, deep periprosthetic infection was the most common complication (14.5%), followed by patellar complications (13%), and prosthetic component breakage (10%). However, there have been few reports of the breakage of prosthetic component in the modern rotating hinged knee arthroplasty. Wang and Wang [15] described two cases of axis dislocation due to broken PE bearing bush. Schwarzkopf et al. [2] reported two cases of tibial metal stem fracture. Kawai et al. [5] presented two cases of breakage of tibial yoke and one case of breakage of tibial bushing. Wilkinson and Douglas [16] presented one case of tibial sleeve PE bushing fracture and one case of tibial peg fracture. Among these literatures, PE bushing failure and tibial yoke breakage are the major

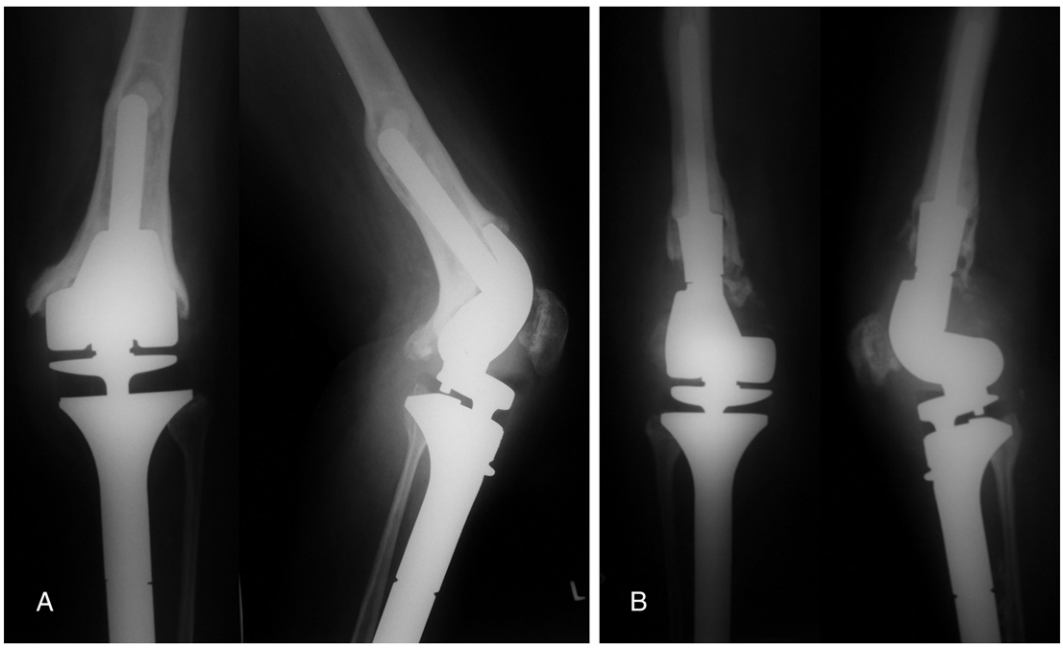

Fig. 2. (A) Radiographs of the left knee in anteroposterior and lateral views show knee prosthesis femoral stem loosening with varus and posterior drift and femur posterior cortex remodeling and thickening. (B) Radiographs of the left knee in anteroposterior and lateral views show satisfactory rotating hinge total knee megaprosthesis and allografts.