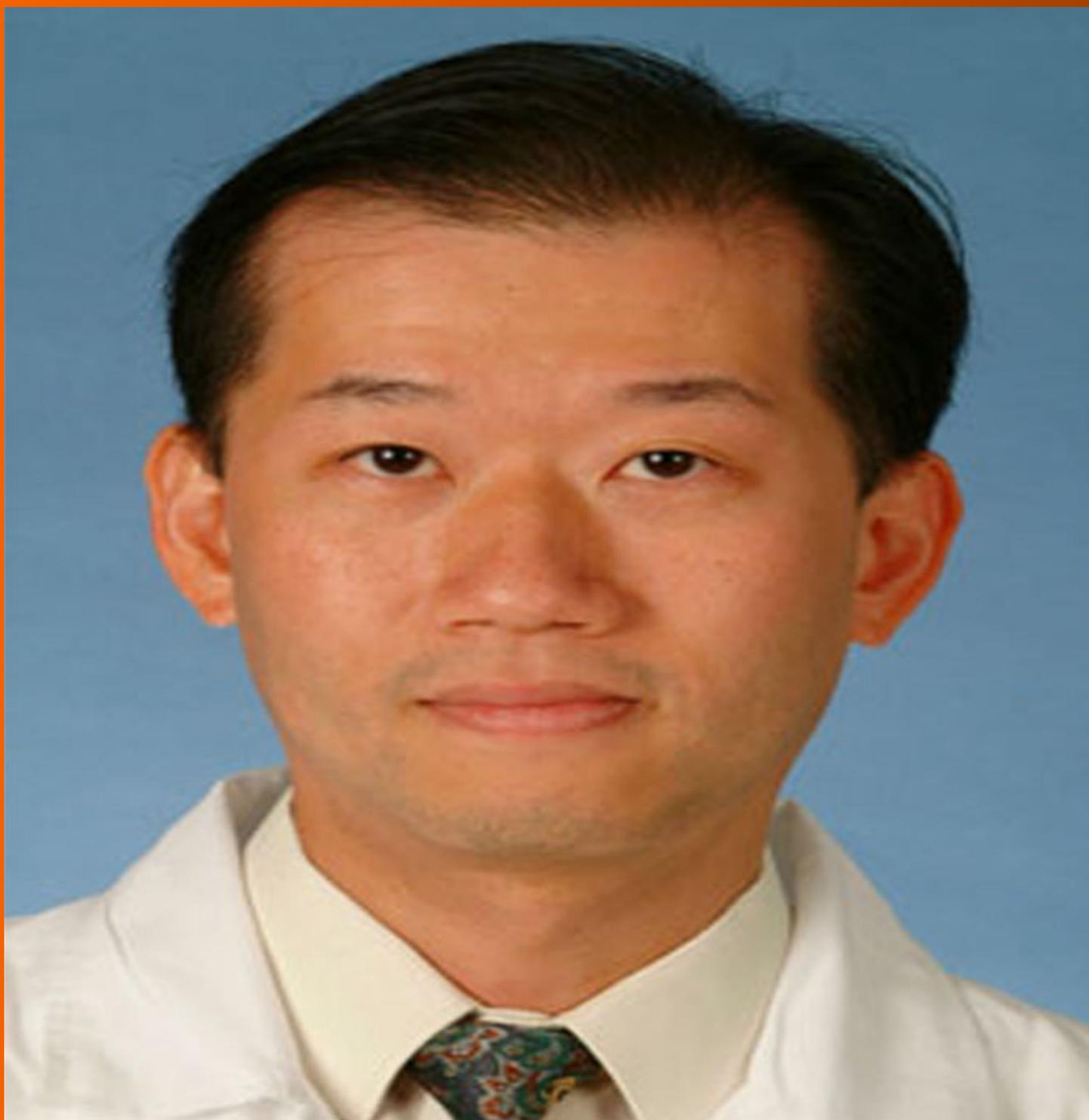


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Re-revision surgery for re-recurrent valgus deformity after revision total knee arthroplasty in a patient with a severe valgus deformity: A case report

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Abstract

BACKGROUND

A recurrent valgus deformity was a common complication after total knee arthroplasty (TKA) in patients with valgus deformity. However, re-revision surgery for re-recurrent valgus deformity after revision TKA in patients with valgus deformity before primary TKA was uncommon.

CASE SUMMARY

We reported a 72-year-old female patient with two recurrent valgus deformities after TKA for a valgus knee deformity who underwent two revision surgeries to rectify the deformity. In the re-revision surgery, bone defects were successfully reconstructed by the augments and cement in combination with screws and a sleeve. An appropriate neutral alignment of the lower limb was restored by the perfect femoral entry point and the long diaphyseal cementless stem. Adequate fixation of the metaphysis and diaphysis of the femur was obtained by the sleeve and long diaphyseal cementless stem. The patient was pain-free and deformity-free for 2.5 years.

CONCLUSION

The management of bone defects, the choice of the stem and the femoral entry point were of vital importance in the revision or re-revision TKA for a recurrent valgus deformity.

Key words: Revision total knee arthroplasty; Valgus deformity; Bone defects; Recurrent; Case report

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Core tip: Recurrent valgus deformity was a complication of total knee arthroplasty (TKA) in patients with a severe valgus deformity. It is very difficult to perform the revision TKA. The management of bone defects, the choice of the stem and the femoral entry point were of vital importance in the revision TKA.

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INTRODUCTION

For more than a decade, the number of total knee arthroplasties (TKAs) had been steadily increasing with the increased demand for rectifying deformities and alleviating pain^[1,2]. However, TKA with valgus deformity was considered a surgical challenge, and the incidence of recurrent valgus deformities was very high^[3]. The revision surgery for failed TKAs became unusually complex because of the presence of tremendous bone defects of the lateral femoral condyle. While the development of highly porous cones and sleeves has enabled the reconstruction of areas with massive metaphyseal bone defects and the improvement of solid fixations^[4-6], the fixation of the diaphyseal stem was also crucial for revision TKA success. The extension of the stem was important in transferring the bending and torsional stresses generated by articulation of the joint away from the joint surface toward the strong diaphyseal bone^[7]. The length of the diaphyseal stem and the entry point of the femoral intramedullary (IM) rod were the cornerstones of achieving perfect lower limb alignment. Therefore, the management of bone defects, the choice of the stem and the femoral entry point were of vital importance in revision TKA for recurrent valgus deformity. Here, we report a patient with a rare, severe valgus deformity who underwent two revision surgeries for recurrent valgus deformity after TKA.

CASE PRESENTATION

Chief complaints

A 72-year-old female patient visited our hospital 6 years after revision surgery for left TKA with a chief complaint of pain, and the pain worsened for 1 mo.

History of present illness

The patient underwent left primary TKA (NexGen LPS-FLEX, Zimmer, Warsaw, Indiana, United States) and sliding osteotomy of the lateral femur condyle in 2008 for a severe valgus deformity at another institution. Six months later, she again presented with valgus deformity and pain in the left knee. In-house X-rays revealed notable femoral component loosening and recurrent valgus deformity (Figure 1).

Then, the revision of the knee components was performed in 2010 at another institution. The system that the surgeon used was the press fit condylar, Sigma, total condylar III (TC3) system (DePuy, Warsaw, Indiana, United States). All the stems on the femoral and tibial sides were cementless, and the cement that was reinforced with screws was used to reconstruct the defects of the lateral femoral condyle (Figure 2). The patient did not report any serious symptoms for six years. In 2016, she started complaining of knee pain again, and she showed limited movement and valgus deformity.

History of past illness

She suffered from hypertension for 2 years. Her blood pressure was controlled by using antihypertensive drugs.

Personal and family history

The patient did not have any specific personal or family history of disease.

Physical examination upon admission

We evaluated her before re-revision TKA. In the clinical examination, the knee was



Figure 1 The radiographs of left knee at 6 months after primary total knee arthroplasty showed the signs of femoral component loosening and recurrent valgus deformity. A: Anteroposterior radiograph; B: Lateral radiograph.

equally painful with weight-bearing and passive motions. The range of motion was from 5° to 80° of flexion. There was anterior-posterior laxity of 5-10 mm. With valgus stress, there was a marked medial instability of more than 15°.

Laboratory examinations

The patient was evaluated to rule out infection. The knee was aspirated preoperatively. The synovial red blood cell count was 13-18/HPF, and the synovial white blood cell count, polymorphonuclear (%) and leukocyte esterase were normal. There was no bacterial growth in the aspirate. Likewise, the serum C-reactive protein, erythrocyte sedimentation rate and interleukin 6 were normal. An emission computed tomography scan of the bone in the whole body was also found to be negative for infection.

Imaging examinations

In 2016, X-rays showed loosening of the femoral component and the stem (Figure 3).

FINAL DIAGNOSIS

The final diagnosis included loosening of the components and stem of the femoral side and recurrent valgus deformity in the left knee.

TREATMENT

During surgery, the medial joint space opened widely with valgus stress during flexion and extension. The quadriceps snip technique was used to assist in the surgical exposure of the knee. The components and stem of the femoral side were loosened, and those of the tibial side were well stabilized. After removal of the loose femoral component and stem, we evaluated the intraoperative bone defects (type FIIB) according to the Anderson Orthopaedic Research Institute (AORI) classification (AORI classification of bone defects in revision TKA)^[8]. The cement reinforced with screws was used to reconstruct the defects of the lateral femoral condyle. A lateral distal femoral block augment (4 mm thick) and posterior femoral augments (the medial and lateral sides were 4 mm and 8 mm thick, respectively) were used to restore the defects of the joint surface and epiphysis. A porous titanium metaphyseal sleeve (size: 40 mm) was used in the treatment of metaphyseal bone defects. A TC3 femoral component (size: 4) in combination with a cementless stem (size: 16 mm × 115 mm), which was engaged in the cortical bone of diaphysis, was implanted with a hybrid fixation. Then, a new constrained polyethylene liner (17.5 mm) was placed in the tibial component plate (Figure 4).

OUTCOME AND FOLLOW-UP

Postoperative X-rays confirmed excellent placement of the components after left TKA (Figure 5). Continuous passive motions and partial weight-bearing actions with a

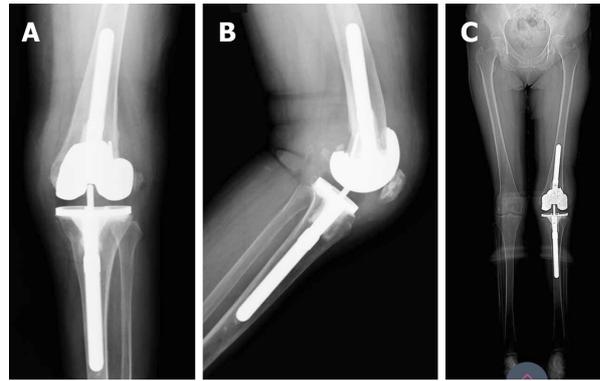


Figure 2 The radiographs after revision total knee arthroplasty showed residual valgus deformity. A: Anteroposterior radiograph; B: Lateral radiograph; C: The standing hip-to-ankle anteroposterior radiograph.

walking aid were initiated on the second postoperative day, and the range of motion was gradually increased to 0°-90° of flexion. The patient had no postoperative complications and was discharged from the hospital on postoperative day 4. Physical therapy stressed a gentle range of motion and strengthening exercise with no forced flexion. Four weeks after surgery, she gradually resumed full weight-bearing activities.

Following this surgery, the patient made an eventful recovery, and 2.5 years have now passed after the re-revision TKA. She was satisfied with her knee, with a hospital for special surgery score of 84 (preoperative score: 31), was pain-free, and had a range of motion of 0°-100° of flexion. The X-rays showed that the left knee arthroplasty was in the expected position with no radiographic signs of loosening (Figure 6).

DISCUSSION

We presented an experience with a 72-year-old female patient with two recurrent valgus deformities after TKA for a valgus knee deformity. The patient underwent two revision surgeries because of the recurrent valgus deformity.

A primary TKA for a valgus knee deformity represented a challenge for orthopaedic surgeons, especially beginners^[9,10]. Nikolopoulos *et al*^[9] presented in his review article several complications that have been reported more frequently in patients with a valgus knee deformity who underwent TKA, and the incidence of recurrent valgus deformity ranged from 4% to 38%. A recurrent valgus deformity could result in massive bone defects of the lateral femoral condyle. For large or uncontained defects, including AORI type II, treatment alternatives include modular augments, the cement reinforced with screws and porous titanium metaphyseal sleeve. Distal and posterior femoral defects managed with modular augments allow for the placement of well-positioned and correctly sized femoral components in contact with host bone^[11], and posterior femoral augments are particularly useful in restoring the proper anteroposterior dimension of the component, achieving the correct rotation of the femoral component and addressing the extension-flexion mismatch by altering the flexion gap^[12]. Porous titanium metaphyseal sleeves with a stepped shape and titanium bead coating were easy to use for fixation by bone ingrowth and were available to fill the metaphyseal defects. The femoral component was attached to the sleeve through the Morse junction on the instrument^[13]. Although many authors recommended the use of cement in combination with screws in cases of contained or uncontained defects between 5 mm and 10 mm, we still used the cement to reconstruct the massive defects of the lateral femoral condyle. According to zonal fixation concepts, solid fixation should be achieved in at least two of three zones^[14]. The cementless stem and metaphyseal sleeve at least helped in promoting an additional fixation in the metaphysis (zone 2) and diaphysis (zone 3) of femur, so the cement in combination with screws was safe to use to reconstruct the lateral femoral condyle.

We analysed the causes of failure of the revision TKA and considered the invalid entry point of the femoral IM rod and the short cementless stem as the main causes.

According to the postoperative X-rays after revision TKA, the entry point of the femoral IM rod was located at the centre of the coronal plane and posterior to the centre of the femoral marrow cavity in the sagittal plane, which resulted in residual valgus deformity, gross flexion-extension mismatch and loading stresses on the lateral

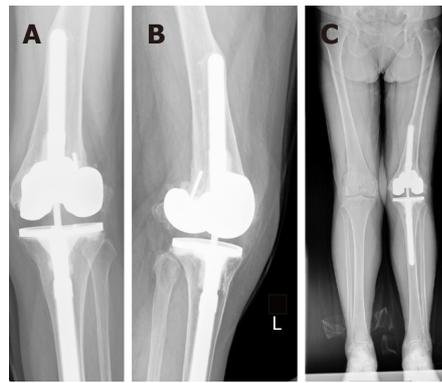


Figure 3 The radiographs at 6 years after revision total knee arthroplasty showed signs of the loosening of femoral components and recurrent valgus deformity, and the femoral cementless stem broke through the cortical bone of femur. A: Anteroposterior radiograph; B: Lateral radiograph; C: The standing hip-to-ankle anteroposterior radiograph.

femoral condyle and ultimately led to the failure of the reconstruction of the lateral femoral condyle. Tan *et al*^[15] suggested that the femoral entry point should be located medial to the centre of the knee joint in the coronal plane for a valgus knee arthroplasty. In the re-revision surgery, we adjusted the entry point of the femoral IM rod to be medial of the centre of the joint in the coronal plane (the intersection of the anatomical axis and the distal femoral joint line) and in the centre of the femoral marrow cavity in the sagittal plane, restoring the neutral alignment of the lower limb.

While augments and sleeves greatly enhanced the modern surgeon's ability to gain solid fixation in metaphyseal bone, stems continue to be useful in revision TKA to bypass defects and enhance the structural stability of revision components^[16]. In revision surgery, the surgeon chose a cementless stem to bypass the metaphyseal defect. However, the stem was too short and thin to achieve solid fixation in the diaphysis (zone 3) of the femur. In the re-revision surgery, we used a long diaphyseal cementless stem, which engaged in the cortical bone of diaphysis, to transfer loads to the diaphysis and reduce micromotions. The long diaphyseal cementless stem not only assisted in offloading interface stresses but also guided the IM rod to prevent malalignment^[17,18].

When the joint surface and epiphysis (zone 1) were inadequate, fixation of the metaphysis (zone 2) and diaphysis (zone 3) of the femur became particularly important. In this case, the insufficient fixation of the metaphysis and diaphysis were reasons the revision TKA failed. The invalid entry point of the femoral IM rod and the short cementless stem, which led to lower limb malalignment, were major causes of failure and re-revision surgery.

CONCLUSION

Recurrent valgus deformity was the most commonly reported complication after TKA for a valgus knee deformity, leading to massive bone defects of the lateral femoral condyle. The restoration of bone defects, component stability and perfect lower limb alignment were the main challenges in the revision or re-revision TKA. Bone defects were successfully reconstructed by the augments, the cement in combination with screws and the sleeve. An appropriate neutral alignment of the lower limb was restored by the perfect entry point of the femoral IM rod and the long diaphyseal cementless stem. Adequate fixation of the metaphysis and diaphysis of the femur was obtained by the sleeve and the long diaphyseal cementless stem. All these factors were the cornerstones of the success of this case.

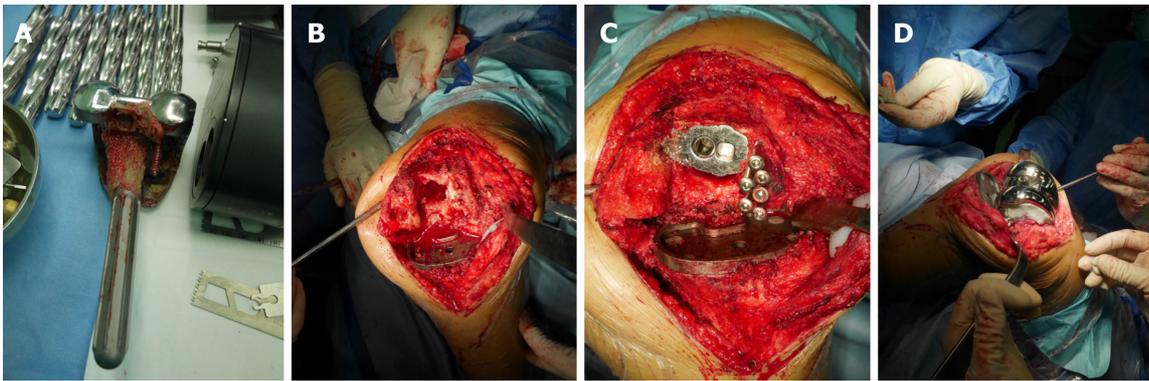


Figure 4 Intraoperative images. A: Removal of femoral components from the previous revision and the cementless stem; B: Tremendous bone defects (type FB) in the lateral femoral condyle; C: The screws were used to reconstruct the defects of the lateral femoral condyle; D: A total condylar femoral component with a sleeve that was implanted with a hybrid fixation and the cement reinforced with screws was used to reconstruct the defects of the lateral femoral condyle.

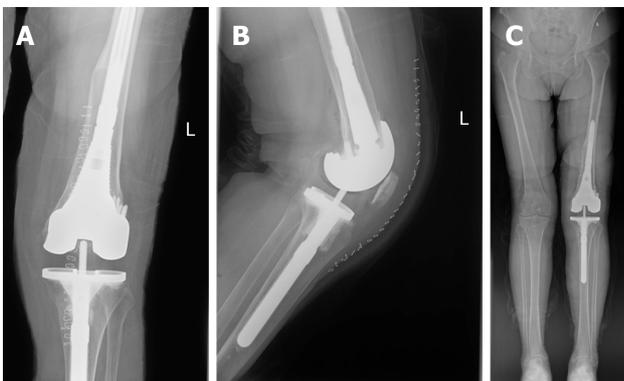


Figure 5 The radiographs after re-revision total knee arthroplasty. The positions of the components were satisfactory based on the radiographs, and an appropriate neutral alignment of the lower limb was restored. A: Anteroposterior radiograph; B: Lateral radiograph; C: The standing hip-to-ankle anteroposterior radiograph.

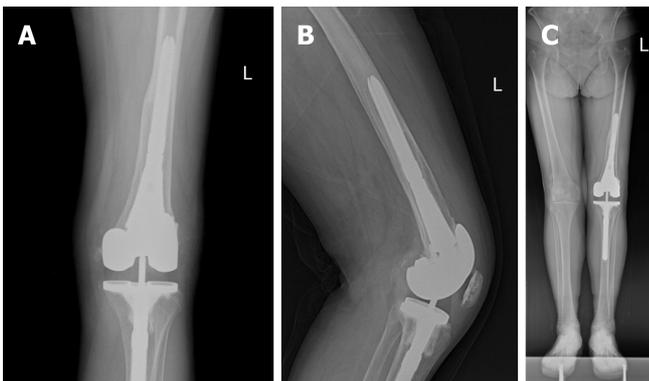


Figure 6 The radiographs at 2.5 years after re-revision total knee arthroplasty. The left knee arthroplasty was in the expected position with no radiographic signs of loosening. A: Anteroposterior radiograph; B: Lateral radiograph; C: The standing hip-to-ankle anteroposterior radiograph.

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