CASE REPORT

Intraoperative Femoral Condylar Fracture during Primary Total Knee Arthroplasty: Report of Two Cases

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Introduction

Total knee arthroplasty (TKA) is routinely used to treat end-stage knee diseases. It is well tolerated in correctly selected patients and the results are satisfactory in a high portion of them¹. The frequency of this procedure has been increasing, as have the number of associated complications. The most commonly observed complications are aseptic loosening, polyethylene wear, periprosthetic fracture, limited range of motion (ROM) and infection². The complication of periprosthetic fracture can occur either during surgery or after surgery (secondary to trauma) and potentially affects the outcomes of the arthroplasty. The occurrence of postoperative periprosthetic fractures is well known. However, little is known about intraoperative fractures that occur during primary TKA. To the best of our knowledge, few reports have focused on femoral condylar fractures during primary TKA.

We have performed more than 5000 primary TKAs in patients with end-stage knee diseases since 1998; femoral condylar fractures occurred in two of these cases, which we here report.

These cases are reported with the approval of the Medical Ethic Committee of the West China Hospital.

Case Reports

Case One

A 49-year-old woman was hospitalized with a 20-year history of bilateral knee pain and a 10-year history of valgus and flexion deformity of both knees. Based on the history and physical and radiographic examinations (Fig. 1A,B,C), the

diagnoses of rheumatoid arthritis, bilateral tibial bone defects (Anderson Orthopaedic Research Institute [AORI] T2b)³ and severe osteoporosis were made. Staged bilateral primary TKAs were performed. Before the surgery on the left knee, the Knee Society knee and function scores were 4 and 15 points, respectively, and the range of left knee motion was 90°.

The TKA was performed in the standard way, using a midline skin incision, a standard medial parapatellar approach and a measured resection technique. A cemented total knee system NRG (Stryker, Allendale, NJ, USA) was used. During trialing of the femoral component, a medial femoral condylar fracture occurred. This was reduced and internally fixed with two 6.5 mm × 30 mm cancellous screws (Synthes GmbH, Solothurn, Switzerland) (Fig. 1D,E,F), after which cemented components were put in place. After the surgery, active and passive ROM exercises were implemented. Oral anti-osteoporosis treatment (Caltrate D 600 mg daily; [Pfizer, New York, NY, USA], vitamin D₃ 0.25 µg daily and alendronate 70 mg, weekly) was prescribed from the first postoperative day for at least 12 months. A brace was used and partial weight bearing with a walker encouraged for the first 2 postoperative months. By her 3-month follow-up, union had been achieved (Fig. 2A,B). Knee Society knee and function scores were 70 and 65, respectively, at the 2-year follow-up (Fig. 2C,D). There was no evidence of component loosening or ligament instability.

Case Two

A 42-year-old man was hospitalized with a 7-year history of bilateral knee pain and a 2-year history of flexion and varus deformity of both knees. Diagnoses of rheumatoid arthritis,

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Fig. 1 Preoperative and postoperative X-ray films of Case 1. (A) Preoperative anteroposterior (AP) view showing bilateral tibial bone defects. (B) Preoperative lateral view showing space narrowing of three compartments. (C) Preoperative weight loading full-length view of lower limbs showing valgus deformity of the left knee. (D) Postoperative AP view. (E) Postoperative lateral view. (F) Postoperative weight loading full-length view of lower limbs.

medial tibial bone defect (AORI T2a), bilateral femoral bone defects (AORI F2b) and severe osteoporosis were made based on the patient's history and physical and radiographic examination (Fig. 3A, B, C). The patient requested left primary TKA. The preoperative Knee Society knee and function scores were 14 and 15 points, respectively, and the ROM of the left knee was 40°.

The same surgical technique as has been described for Case one was used in this patient. A cemented total knee system, PFC (Depuy, IN, Warsaw, USA) was used. In this case,

a lateral femoral condylar fracture occurred at the time of tailing of the femoral component. Again, a reduction and internal fixation was achieved with two 4.5 mm × 30 mm cancellous screws, after which the component was carefully put in place (Fig. 3D,E,F). Anti-osteoporosis treatment and postoperative care were the same as for Case one. Union had been achieved by the 3 month follow-up (Fig. 4A, B). Knee Society knee and function scores were 68 and 70, respectively, at the 2 year follow-up (Fig. 4C,D). There was no evidence of component loosening or ligament instability.

Fig. 2 X-ray films and functional views at the 2-year follow-up of Case one. (A) AP view. (B) Lateral view showing bone union has been achieved. (C) Functional view of knee extension (0°). (D) Functional view of knee flexion (120°).

Discussion

TKA is a routine treatment for end-stage knee diseases such as osteoarthritis and rheumatoid arthritis. Many published reports have shown that it has a better survivorship than total hip arthroplasty^{4,5}. Though TKA has few complications, there is controversy about the cause(s) of those complications and their treatment. Periprosthetic fracture is a rare but well-recognized complication of primary TKA. Compared with postoperative periprosthetic fracture, intraoperative periprosthetic fracture is relatively rare and less studied. Alden *et al.* reported an incidence of less than 0.3% of 17,389 cases⁶. According to their analysis, fractures usually occur in the distal femur (0.2%), followed by the tibia (0.1%). However, to the best of our knowledge, no case of intraoperative femoral condylar fracture has been reported so far.

Risk factors for intraoperative periprosthetic fracture are osteoporosis, anterior cortical notching, chronic steroid use, advanced age, female sex, use of uncemented prosthetic components and technical errors^{6,7}. We have several theories concerning the reasons for the fractures in our cases. Firstly, both patients had rheumatoid arthritis. A correlation between rheumatoid arthritis and osteoporosis is well recognized and is attributable to the associated inflammation, glucocorticoid treatment and low body mass index⁸. Secondly, we believe the design of the components is an important factor. According to intraoperative measurements, the size for both patients was 2.5, which is relatively small. And according to the data in the handbooks of both systems, the box of the femoral component (16.3 mm × 16.3 mm) does not change according to the size of the prosthesis. After intercondylar resection has been performed, the left bone mass of both femoral condyles is smaller, which makes the left femoral

condylar more vulnerable to intraoperative and postoperative forces. Thus, we believe that future components design should focus on preserving more bone in patients undergoing TKA. Thirdly, both of these patients had severe valgus/varus deformity. Valgus/varus deformity determines the distribution of daily load forces between the medial and lateral femoral condyles. That is to say, the more force is loaded, the greater local bone density the femoral condyle will have. This may well explain why a medial femoral condylar fracture occurred in the patient with valgus deformity and why the opposite occurred in the patient with varus deformity. Fourthly, the primary TKAs of these two patients were relatively complex. Full exposure of the surgical field was essential to the success of these surgeries. Additionally, the techniques used to achieve intramedullary positioning when orientating the femoral component may have created increased stress. Thus, some micro fractures may already have occurred during exposure and preparation of the bones. The mechanical vibration caused by tailing of the components may then have made these micro fractures visible. In both cases, the fractures occurred during tailing of the femoral component. According to Alden *et al.*'s study, fractures that occur during tailing of the components account for 33% of all intraoperative periprosthetic fractures, followed by those that occur during exposure⁶.

Many techniques can be used to treat femoral condylar fractures. In our cases, we chose cancellous screws rather than plates. Our reasons for this choice are as follows: (i) unlike postoperative fractures, perfect reduction of intraoperative fractures is easy to achieve; (ii) placing a plate could have affected the position of the femoral component, which is essential to the survivorship; and (iii) because cemented components were used in both cases, the cement provided an

Fig. 3 Preoperative and postoperative X-ray films of Case 2. (A) Preoperative AP view showing medial tibial bone defect (AORI T2a) and bilateral femoral bone defects (AORI F2b). (B) Preoperative lateral view showing space narrowing of three compartments. (C) Preoperative weight loading full-length view of lower limbs showing varus deformity of both knees. (D) Postoperative AP view. (E) Postoperative lateral view. (F) Postoperative weight loading full-length view of lower limbs.

additional stable force for the fracture fragments. Though some studies have reported a high rate of nonunion and loss of motion associated with femoral condylar fractures treated surgically^{9,10}, in both of our cases, unions had been achieved by the 3 month follow-up and a satisfactory ROM was achieved by the final follow-up. We believe that perfect reduction, anti-osteoporosis treatment and postoperative care

may all have contributed to the satisfactory outcomes. The component fixation and limb alignment were good.

Intraoperative femoral condyle fracture is a rare complication of TKA. Surgeons should be aware of the possibility of this complication during primary TKA, especially when the patient has osteoporosis, has been receiving long-term steroids or is elderly and female.

Fig. 4 X-ray films and functional view at the 2-year follow-up of Case 2. (A) AP view. (B) Lateral view showing bone union has been achieved. (C) Functional view of knee extension (0°). (D) Functional view of knee flexion (95°).

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