

Intraoperative Femoral Condyle Fracture during Bone Preparation in a Cruciate-retaining Primary Total Knee Arthroplasty

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Learning Point of the Article:

The surgeon should be aware of the possibility of intraoperative fracture during primary TKA and needs proper treatment for good functional results.

Abstract

Introduction: Intraoperative fracture in revision knee arthroplasty is commonly described. Intraoperative fracture during primary total knee arthroplasty (TKA) is a significant yet infrequently reported complication. The literature about intraoperative fractures during primary TKA is limited. It is usually seen in posterior-stabilized prosthesis during primary TKA, however, its occurrence in cruciate-retaining (CR) primary TKA is rarely reported.

Case Report: The authors describe a unique case of intraoperative medial femoral condyle fracture in primary CR TKA during bone preparation. The fracture was managed successfully by fixation with a 3.5 mm screw followed by cemented primary CRTKA. Bony union was achieved with a good clinical outcome as shown by the Knee Society Knee Score of 86 and a Function Score of 90 without any signs of prosthesis failure/loosening at 2 years' follow-up.

Discussion: Careful pre-operative evaluation and planning are necessary for patients with risk factors to avoid poor outcome. A stable internal fixation abiding the standard principles of fracture fixation and arthroplasty is needed to achieve a satisfactory functional and radiographic outcome, thus avoids early prosthetic failure

Keywords: Intraoperative fracture, complication, distal femur, medial condyle, primary total knee arthroplasty, cruciate retaining.

Introduction

With an increase in demand and the number total knee arthroplasty (TKA) performed worldwide, even the rare complications are frequently encountered in daily practice. Common complications associated with primary TKA include aseptic loosening, infection, polyethylene wear, stiffness, and periprosthetic fracture [1]. Post-operative periprosthetic fracture after TKA is a well-documented and potentially devastating complication adversely affecting the outcome [2].

However, intraoperative fractures in primary TKA are rare and there are limited clinical data available in the literature on this topic [3, 4]. Intraoperative femoral condyle fracture is commonly described during posterior-stabilized (PS) TKA attributing to excessive box cut or osteoporotic bone [2, 3, 4].

These can occur at any step during TKA including surgical exposure, bony preparation, component trial, cementation, insertion of the final components, and seating of the polyethylene insert [3, 4, 5]. Various treatment options are available and include observation, internal fixation using screws, plating, the use of stems and augments, increasing constraint of the prosthesis, and modifying the post-operative rehabilitation [2, 3, 4].

To the best of our knowledge, only a few reports are available describing intraoperative femoral condyle fracture during primary cruciate-retaining TKA (CR TKA). This report discusses a case of a 68-year-old female who sustained an intraoperative fracture of medial femoral condyle during primary TKA.

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Author's Photo Gallery



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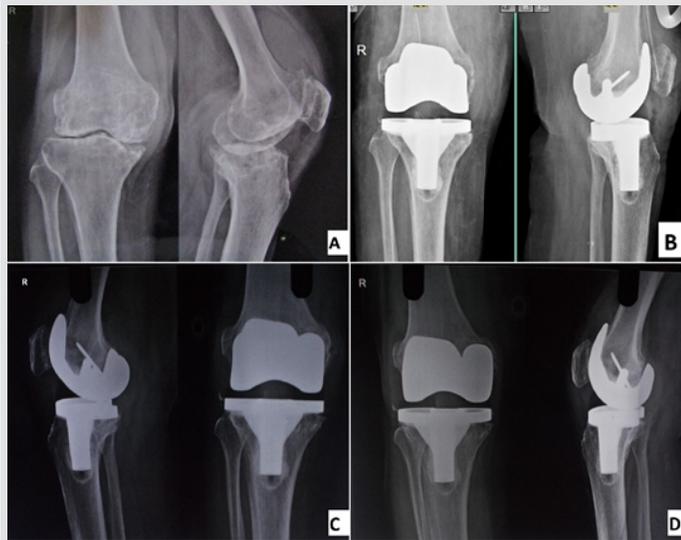


Figure 1: A pre-operative radiograph (a) of a 68-year-old female showing advanced osteoarthritis of the right knee with tibial bone defect (AORI T2A). An immediate postoperative radiograph (b) showing a satisfactory alignment of the prosthetic components and a well-fixed fracture of medial femoral condyle fracture using a screw. The medial femoral condylar fracture was united at 3-month follow-up radiograph (c). Final follow-up radiograph at 2 years showing a healed fracture with a well-fixed implant without any loosening.

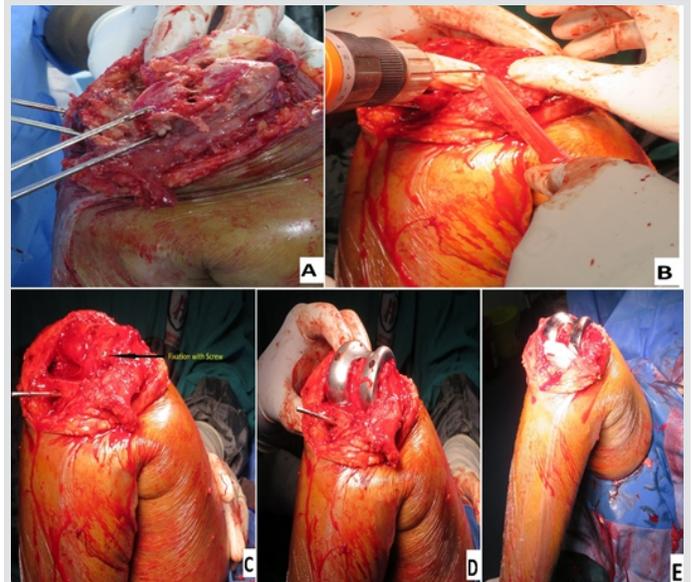


Figure 2: Intraoperative photograph (a) showing fracture of the medial femoral condyle in the coronal plane. The fracture was reduced anatomically and temporarily stabilized with K-wire (b) followed by fixation with screw (c). Photograph showing well-fixed stable fracture during trialing of the femoral component (d) and after final implant positioning (e).

Case Report

A 68-year-old female was admitted with a 10-year history of bilateral knee pain. She was diagnosed with advanced osteoarthritis (OA) of both knees and did not have any history of neurologic disorders, chronic steroid use, inflammatory arthropathy, or previous knee surgery. She requested for the right primary TKA to be done first. Her pre-operative Knee Society Knee and Function Scores were 21 and 35 points, respectively, with a range of the right knee motion of 90° (10–100°). Dual-energy X-ray absorptiometry was done to assess her bone mineral density and revealed a T-score of -1.8 (L1-4) and -1.2 (femur total). Her body mass index was 26.5 kg/m². Pre-operative radiographs (Fig. 1a) revealed varus deformity, severe osteoporosis, and tibial bone defect

(Anderson Orthopaedic Research Institute [AORI] T2A) [6].

Her knee was exposed with a subvastus approach. The distal femur and proximal tibia cuts were taken with a saw using a measured resection technique. After distal femur cutting, while securing the femoral anteroposterior (A/P) and rotational block with the medial and lateral pins, a fracture of the medial femoral condyle occurred in the coronal plane through the medial pin site (Fig. 2a). The fracture was reduced anatomically and temporarily fixed with k-wires (Fig. 2b) in a way such that the k-wires do not obstruct the placement of the cutting block and use of a saw. Femoral and tibial bony preparation is done in the usual manner followed by trialing of components (Fig. 2d). The fracture fragment was then internally fixed using a 3.5 mm*60 mm locking screw (Fig. 2c) followed by the placement of original cemented components (size, femur – 1.5, and tibia – 1.5) (Fig. 2e) and insertion of polyethylene insert (thickness – 8



Figure 3: Clinical photographs of the patient showing satisfactory clinical outcome (a and b) at the final follow-up of 2 years.

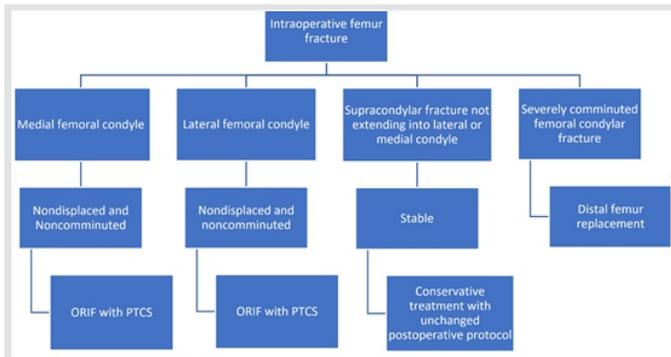


Figure 4: An algorithm for the management of intraoperative distal femur fracture in primary TKA.

mm). Right-sided cemented CR TKA was performed using PFC (De Puy, Johnson & Johnson, Warsaw, USA) total knee system. Knee was stable throughout the range of movements without any mobility at the fracture site.

Post-operative radiographs showed satisfactory alignment (Fig. 1b). Immediate active and passive knee range of motion (ROM) exercises were started immediately after surgery. Walker assisted full weight-bearing with knee brace was started the next day. The fracture was united (Fig. 1c) at a 3-month follow-up and her right knee ROM was 0–110° (Fig. 3). At 2-year follow-up, her Knee Society Knee and Function Scores (Fig. 3) were 86 and 90, respectively, without any evidence of component loosening or ligament instability (Fig. 1d).

Discussion

Intraoperative fractures are commonly seen in revision TKA with a reported incidence of 1.9–3% [7]. Although, the reported incidence of intraoperative fracture in primary TKA ranges from 0.2% to 4.4%, the true incidence is underestimated with limited literature available on this topic as many of them go unnoticed or not reported [2, 3, 4].

The cause of intraoperative femoral condyle fracture is multifactorial [2, 3] and several patients, implant, and

technique-related factors known to increase the risk of intraoperative fracture in primary TKA are presented in [Table 1]. In our case, osteoporosis, difficulty in surgical exposure, microfractures during intramedullary positioning and bone preparation, and deeper penetration of the medial pin while securing the femoral cutting block were the possible reasons responsible for the medial condyle fracture.

Alden et al. [3] reported that 73.1% of the intraoperative fractures occurred in the distal femur (0.2%), while a study by Pun et al. [5] reported tibial fractures (89%) as the commonest site in their study. Fracture of the lateral femoral condyle is more common in patients with OA knee with varus deformity as the varus deformity will result in the transfer of more force to the medial side, leading to greater bone density in the medial condyle with weak lateral condyle and vice versa. However, in our case, the medial femoral condyle was fractured despite varus deformity [3].

The intraoperative fracture can occur at any step during primary TKA, especially during surgical exposure, bone preparation, and final component impaction [2, 3]. About 33% of all intraoperative fractures in a study by Alden et al. occur during trialing of the femoral component [3], whereas, in our case, the medial femoral condyle fracture occurred during bone preparation. The surgeon should be cautious during pin insertion through a femoral A/P and rotational block into the either of the femoral condyles to prevent cortical perforation or fracture and vigilant while reviewing the postoperative radiograph for any missed intraoperative fracture. If a fracture line is diagnosed surprisingly on a post-operative radiograph, it is imperative to differentiate between the medial femoral condyle cortical perforation and fracture, as cortical perforation does not require additional surgery. However, fracture of the femoral condyle demands an additional procedure to fix the medial femoral condyle. In such cases, a computed tomography scan can be helpful to reach a definitive diagnosis and planning [8].

Most of the previously published studies describing intraoperative fractures during TKA are retrospective, and only a few case reports have been published for intraoperative femoral condyle fracture [1, 3, 4, 5, 8, 9]. PS knee design is an independent risk factor for intraoperative femoral condyle fractures in primary TKA as most of them are reported during the use of PS prosthesis and are associated with excessive

Table 1: Various factors associated with increased risk for intraoperative femoral condyle fracture during primary TKA

Patient-related factors	Implant or instrument-related factors	Technical/surgeon-related factors
1. Advanced age	1. PS knee design	1. Malalignment during insertion and extraction of the trial and final components
2. Female gender	2. Large/wide box cut	2. Difficulty in exposure
3. Small knee	3. Pin-track positioning in Computer navigation or robotic TKA	3. Inadequate/excessive/
4. Osteoporosis	4. Uncemented prosthesis	4. Eccentrically placed box cut
5. Rheumatoid arthritis		5. Anterior notching
6. Chronic steroid use		6. Excessive hammering
7. Metabolic bone disease		7. Force during final implant positioning
8. Bony defects		
9. Prior knee surgery		
10. Advanced arthritis with severe pre-operative deformity		

Table 2: A list of things to avoid during primary TKA in patients with risk factors

1. PS knee design in female patients with smaller knees and poor bone quality
2. A mismatch between the box cut size of the trial and final femoral component
3. Varus or valgus malalignment during insertion and extraction of the trial and final components
4. Overstuffing of femoral or tibial component with cement
5. Overzealous hammering during final component insertion
6. Use of punch during the preparation of the sclerotic bone for cement penetration
7. Inadequate/excessive/eccentrically placed box cut
8. Elevation of the tibial tuberosity
9. Placement of posterior tibial retractor in patients with poor bone quality



intercondylar notch/box cut which can act as a stress riser [1, 2, 3, 4, 9]. Therefore, the surgeon should be cautious when using PS knee design in a patient with increased risk factors such as female gender, osteoporosis, rheumatoid arthritis, and smaller knees. A cruciate-retaining design of a femoral component or ultracongruent polyethylene insert can be useful in females with smaller knees to avoid extra bone removal during box cut associated with PS design of the femoral component.

Numerous fixation strategies have been described for fracture treatment. However, we chose locking screw as

1. Plating would not be feasible for such a small fragment and may pose difficulty in placement of the femoral component.
2. We were able to achieve an anatomical, stable reduction of the fracture easily using a screw, with additional compression and stability provided by the cemented femoral component as the fracture was in the coronal plane.

The joint exposure should be generous in patients with complex deformity and poor bone quality before flexing the knee. A mismatch between trial and final component should be avoided when using PS knee design, rather the box should be slightly wider than the final box size and lateralized to avoid stress risers and femoral condyle fractures. [Table 2] shows a list of things to avoid during primary TKA in patients with risk factors for the prevention of intraoperative fracture of the femoral condyle.

We believe that anatomical reduction with stable fixation, anti-osteoporosis treatment, and post-operative care may all have contributed to bony union and satisfactory clinical outcome in

our patient as compared to high rates of non-union, restricted movements, and need for revision surgeries in the previous studies [3, 10]. An algorithm for the management of intraoperative distal femur fracture in primary TKA is shown in [Fig. 4]. The authors recommend that the possibility of intraoperative fracture should be kept in mind during primary TKA in patients having two or more risk factors. Careful pre-operative evaluation of bone stock and bone mineral density should be done and stemmed femoral or tibial components, augments, plates, and screws should be available in inventory as a backup when performing primary TKA in such patients.

Conclusion

Intraoperative fracture in primary TKA is a rare but serious complication. Careful evaluation and pre-operative planning are crucial in patients having two or more risk factors for the prevention of intraoperative fracture in primary TKA. Standard principles of fracture fixation and arthroplasty principles should be followed to achieve a satisfactory radiographic and functional outcome and to avoid early prosthetic failure.

Clinical Message

Although rare, intraoperative fracture in primary TKA is a significant complication. The satisfactory radiographic and functional outcome can be expected with proper treatment. If not managed properly, can adversely affect the outcome and may require revision surgery.

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