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Case Report

“Flip lid” type of lateral tibia plateau fracture with a meniscus radial tear: A case report

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ABSTRACT

Case: A 45-year-old woman sustained a unique lateral tibia plateau fracture pattern with a vertically rotated fragment composed of an intact articular surface and subchondral bone. During open reduction and internal fixation (ORIF), a full thickness radial tear of the lateral meniscus was found, which was repaired under direct visualization through arthrotomy. At final follow-up, the patient regained pain-free activity with good meniscus healing, as confirmed with a second-look arthroscopic examination.

Conclusion: This case represents an undescribed fracture pattern that indicates an associated meniscus injury. A thorough evaluation, including Magnetic Resonance Imaging should be considered. One-stage ORIF followed with meniscus repair represents a good treatment option.

Introduction

Tibial plateau fractures are high energy traumas with an incidence of 10.3 per 100,000 annually [1]. These fractures are proximal tibia fractures involving the articular surface that are frequently associated with soft tissue injury and can lead to long-term osteoarthritis [2]. The treatment goal was to restore the articular congruity, maintain limb alignment, provide stable fixation, and repair the meniscal or ligamentous injuries [3]. The fracture pattern influences the treatment and should be determined based on common classifications [4,5].

Here, we report a case with a tibia proximal metaphyseal fracture inducing a relatively intact subchondral bone and vertical displacement of the articular surface of the lateral tibia plateau accompanied by a full thickness radial tear of the lateral meniscus. To the best of our knowledge, this is very rare and has not been discussed in previous studies. One-stage open reduction and internal fixation (ORIF) followed by meniscus repair was successful in treating this patient. This unique pattern caused surgical challenges and required a preoperative evaluation.

The patient was informed that data concerning the case would be submitted for publication, for which she provided consent.

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Case report

A 45-year-old female patient was an assembly-line worker, who suffered from left knee contusion injury during a traffic accident. She was sent to the emergency room, and her knee was in the valgus position at presentation. The knee was swollen with limitation in range of motion (ROM). The distal neurovascular examination was intact. Radiographs demonstrated a genu valgus knee and a lateral tibia plateau fracture with vertically oriented displacement (Fig. 1a). Computed tomography (CT) identified a lateral tibia plateau with a large wedge-shaped osteochondral fragment and comminuted tibia metaphysis (Fig. 1b, c, d, e, and f).

The patient was brought to the operating room for ORIF of the lateral tibia plateau fragment. A lateral approach was made to access these fragments. The main fragment was composed of a relatively intact articular surface and subchondral lateral plateau bone. It had outwardly rotated 90 degrees just medial to the iliotibial band (Fig. 2a). A complete radial tear of the middle lateral meniscus was found after anterolateral arthrotomy. The lateral metaphyseal bony defect was filled with an artificial bone graft (Sinbone, Purzer, Taiwan). The large wedge-shaped osteochondral fragment was turned 90 degrees inwardly sitting on the lateral metaphysis as a reduction through the torn lateral meniscus. The articular surface was managed so as to be on the same level as the medial joint line under fluoroscopy. The fragment contained large lateral edge and thin central part. The large lateral edge was fixed by the most proximal locking screws (Periarticular locking plate system, Zimmer, US), and the thin central part was supported by these screws as the rafting effect (Fig. 2b). During the operation, the stability of knee joint was tested immediately after ORIF, which was acceptable. The lateral meniscus was repaired with an interrupted No. 0 PDS II suture (Ethicon, Johnson & Johnson, US).

Postoperatively, the knee was protected in full extension with a hinged ROM knee brace for 2 weeks, and ROM was limited between 0° and 90° for 2–4 weeks after the surgery. Weight bearing as tolerated was not allowed until 6 weeks postoperatively. After a period of rehabilitation, full weight bearing was achieved. Three months after surgery, grade I laxity was found by the anterior drawer test. Other physical examinations including the posterior drawer test, valgus/varus stress test, and dial test were all negative. Magnetic Resonance Imaging (MRI) was arranged but the anterior cruciate ligament (ACL) was hard to evaluate due to severe metal artifact interference. The fracture achieved union 6 months after surgery (Fig. 3a). She had full ROM of the left knee and was able to perform squatting without pain 7 months postoperatively (Fig. 3b and c). Due to local irritation of the skin, removal of the implants (ROI) was

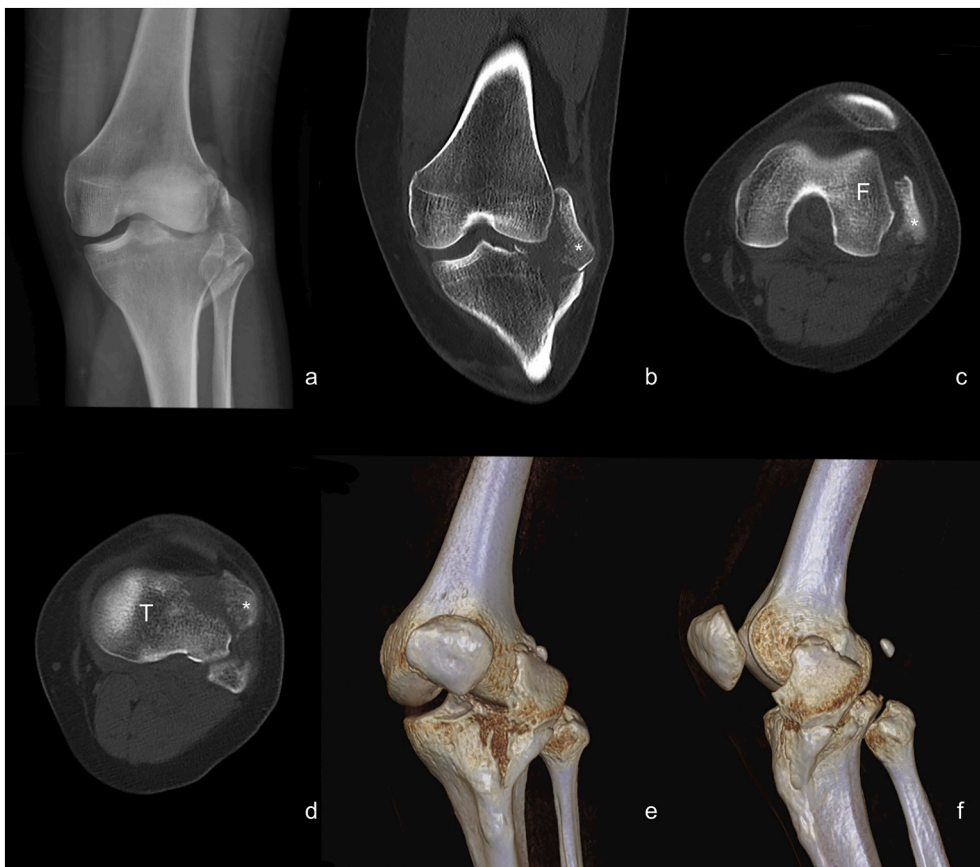


Fig. 1. Preoperative anteroposterior plain film (a), coronal view (b), and axial views (c, d) on computed tomography (CT). Three-dimensional reconstructed CT images (e, f) illustrate vertically-oriented displaced lateral tibia plateau with a relatively intact subchondral bone and articular surface. This fragment contained large lateral edge and thin central part. White asterisk, flip-lid fragment; F, femoral condyle; T, tibia plateau.

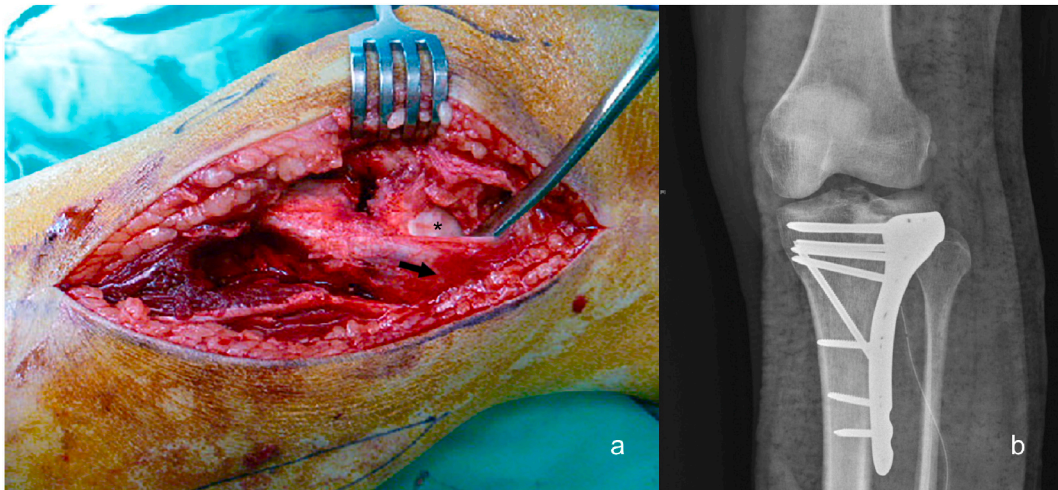


Fig. 2. The displaced fragment was just near the iliotibial band (a). Postoperative anteroposterior radiograph showed good reduction (b). The black asterisk, main fragment comprising a relatively intact articular surface and subchondral bone of the lateral plateau; the black arrow, iliotibial band.

performed about 18 months after surgery. During the surgery, ACL partial tear with fibrotic healing of the lateral meniscus was noted during the second-look arthroscopic examination (Fig. 4a, b and c). MRI was repeated 4 months after ROI, which revealed ACL partial tear with intact posterior cruciate ligament, medial collateral ligament, lateral collateral ligament and popliteal tendon (Fig. 4d, e and f). At one year after ROI, the patient was satisfied with the procedure and returned to her previous life without limitations.



Fig. 3. Postoperative anteroposterior radiograph obtained 6 months postoperatively showing reduced articular surface with good maintenance after union (a). Full range of motion and pain-free deep squatting (b, c) 7 months postoperatively.

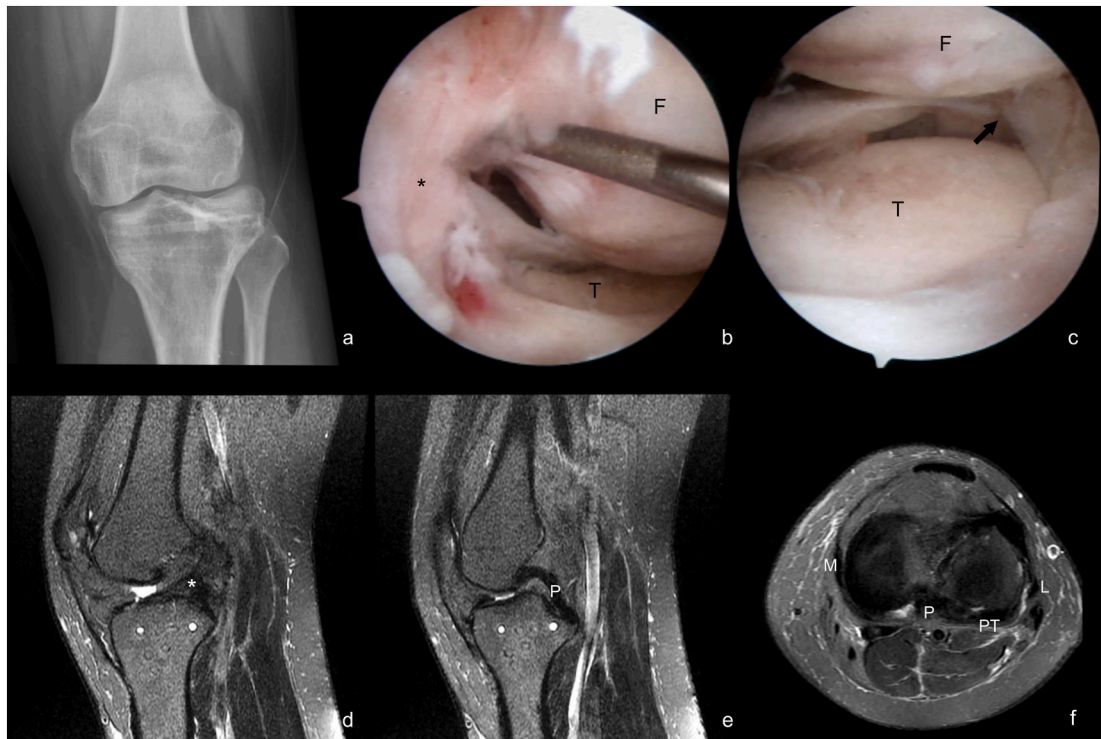


Fig. 4. Postoperative anteroposterior radiograph after removal of the implants (a) and partial tear of the ACL (b) with fibrotic healing of the lateral meniscus under arthroscopic examination (c). MRI was arranged 4 months after removal of the implants, which revealed partial tear of the ACL with intact PCL, MCL, LCL and popliteal tendon (d, e, f). (d, e) Sagittal views and (f) axial view of MRI. The asterisk, ACL; the black arrow, fibrotic healing part of the repaired lateral meniscus; F, lateral femoral condyle; T, lateral tibia plateau; M, MCL; L, LCL; P, PCL; PT, popliteal tendon; ACL, anterior cruciate ligament; MRI, Magnetic Resonance Imaging; PCL, posterior cruciate ligament; MCL, medial collateral ligament; LCL, lateral collateral ligament.

Discussion

Schatzker and AO/OTA classifications are typically used to classify the fracture pattern worldwide. While the Schatzker classification describes medial and lateral column fractures or fracture dislocations, the AO/OTA addresses extra, partial, or complete articular fracture of the tibia plateau using plain films. Since the advantage of three-dimensional reconstructed CT to recognize posterior fragment morphology, an updated three column concept and modified Schatzker classification have been introduced to guide treatment [6]. Different surgical approaches have been invented for optimal fragment reduction and buttress plate placing [7]. However, none of these classifications could be used to describe this case. We created a new term, tibial plateau fracture “flip lid,” to describe this fracture. Our speculation of the trauma mechanism was similar to that of “reverse-Schatzker type IV” fracture, which is caused by instant fracture dislocation with a valgus knee position [8].

The preservation of the anatomic joint line is fundamental when surgically treating tibia plateau fractures [3]. In order to access the displaced fragment around the iliotibial band and the articular surface, an anterolateral approach with arthrotomy was developed. In this case, the concept of subchondral rafting construction using a locking plate and parallel screws provided sufficient support to the main fragment [9]. The flip lid pattern of the large osteochondral fracture raised a challenge for definite fixation. The lateral edge of the wedge-shaped fragment was large and contained sufficient thickness for screw fixation while the central part of the fragment contained only thin subchondral bone. With subchondral rafting, the medial part of the fragment will not sink and the articular reduction can be maintained.

It was previously mentioned that a tibia plateau fracture is frequently accompanied by soft tissue injury. Daniel et al. reported high meniscus injury rate among patients with tibial plateau fractures in 661 patients, where the meniscus was accessed during open arthrotomy. Lateral meniscal tears were found to be significantly related with split depression type fractures in young males. Peripheral and radial tears were mostly observed and up to 30% of the patients required a meniscal repair [10]. Simultaneous meniscus repair during arthroscopic assistance and internal fixation of a tibia plateau fracture was carried out by Miguel et al., who reported good functional outcome and meniscus healing confirmed through second-look arthroscopy during follow-up [11]. Jordanna et al. compared the ROM, pain, and functional outcomes between tibia plateau fractures with and without a meniscus tear. Although they found no significant between-group differences after a primary meniscus repair via direct arthrotomy, it appeared that a one-stage meniscus repair combined with ORIF led to encouraging outcomes [12]. The postoperative rehabilitation program includes a

period of non-weight bearing for 4–8 weeks, followed by partial to full weight bearing. The knee flexion/extension was limited with a ROM knee brace starting with full extension and followed by 0°–90° within 4 weeks postoperatively [11].

The preoperative evaluation may not have been sufficient in this case because we unexpectedly encountered the devastating meniscus tear. Soft tissue injuries are found in 40–60% of tibia plateau fractures, where an MRI can provide an accurate diagnosis [13]. There are several predictors in CT for meniscus injuries that warrant a preoperative MRI evaluation, including split depression type fractures, lateral plateau depression of more than 6.3 mm, widening of more than 5 mm, or an area of lateral plateau depression larger than 112.9mm² [14]. In this case, the large area of the main fragment with the vertical displacement may have indicated the meniscus tear in this case.

Finally, to our best knowledge, this was a rare fracture pattern that had never been reported. When encountered, a preoperative MRI evaluation may be appropriate to determine the most appropriate surgical strategy. We recommend a one-stage meniscus repair after reduction of the articular surface via a lateral approach with arthrotomy followed by a period of non-weight bearing with ROM knee brace protection. Overall, the patient regained pain-free activity after the treatment with satisfactory second-look arthroscopy examination during about 30 months follow up.

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