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Case Report

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Hyperextension type tibial plateau fracture: A case report and literature review

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Abstract

The report presents a case describing a very unusual hyperextension tibial plateau fracture, which is a small collapse of the front articular surface accompanied by injury to the posterior ligament and tendon and popliteal artery. The treatment of this fracture includes implantation of bone materials and anatomical reduction through rigid internal fixation, and symptomatic treatment of vascular injuries. However, ligament and tendon injuries have not been treated. The patient was followed up for one year and found that the fracture had healed, but the affected knee joint was unstable.

***Keywords*:** hyperextension tibial plateau fracture; popliteal artery; posterior ligament.

Introduction

Hyperextension type tibial plateau fracture is a rare type of fracture. Its injury mechanism is that when the knee joint is in a hyperextension position less than 0°, the knee joint was subjected to frontal violence, resulting in a compression fracture of the platform. At the same time, the opposite side knee joint structure was damaged by excessive traction, so it is easy to form a diagonal injury of the knee joint. However, there is no clear classification for hyperextension tibial plateau fractures. In this study, we reported a case of a compression fracture of the anteromedial platform of the left tibial plateau with left quadriceps tendon, posterior cruciate ligament, popliteal tendon, and left meniscus injury, as well as left the lateral popliteal artery is injured and occluded. And conducted a literature review of this disease.

Case report

Informed consent has been obtained for the study. The patient was a 30-year-old male. He was sent to the emergency department for a traffic accident. Computerized tomography (CT) three-dimensional imaging was urgently checked as shown in Figure 1. After admission, check the Computerized tomography angiography (CTA) of both lower limbs as shown in Figure 2. The knee joint Magnetic resonance imaging (MRI) was not checked. Specialist examination showed that the patient refused to

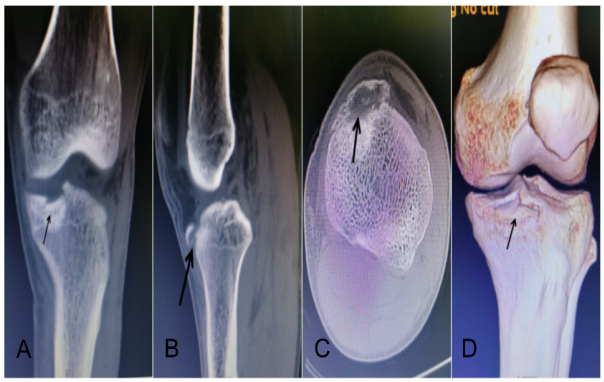

Figure 1: **A**, Front view of the initial injury: the left tibial plateau fractures and collapses. **B**, The initial injury side view shows a fracture of the left tibial plateau with displacement and a small fracture. **C**, CT of the initial injury showing a fracture of the anteromedial edge of the left tibial plateau with displacement. **D**, The three-dimensional reconstruction of the initial injury showing a fracture of the anteromedial edge of the left tibial plateau with displacement. "→ "Indicating damage location.

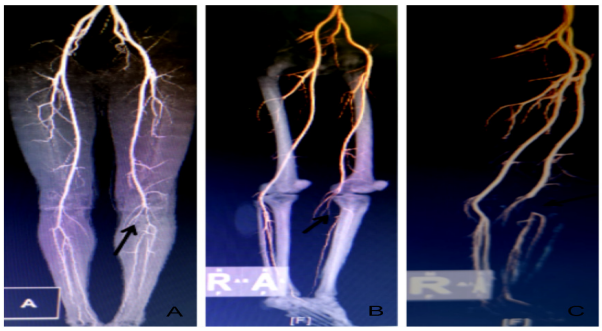

Figure 2: **A**, The front view of CTA before surgery. **B**, **C**, Lateral view of preoperative CTA. All showed local occlusion of the left popliteal artery. "→ "Indicating damage location.

Figure 3: During the operation, the lateral view of the left lower limb of the patient showed that the affected limb was in hyperextension. "→ "Indicating damage location.

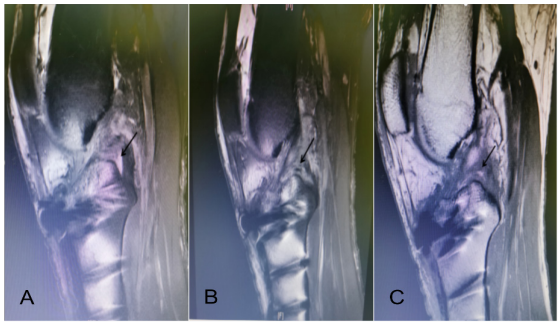

Figure 4: **A**, **B**, and **C**, postoperative left lower limb MRI showed the left quadriceps tendon, posterior cruciate ligament, and popliteal tendon injury in sagittal view. Degeneration of the posterior corner of the medial meniscus and the lateral meniscus of the left knee. "→ "Indicating damage location.

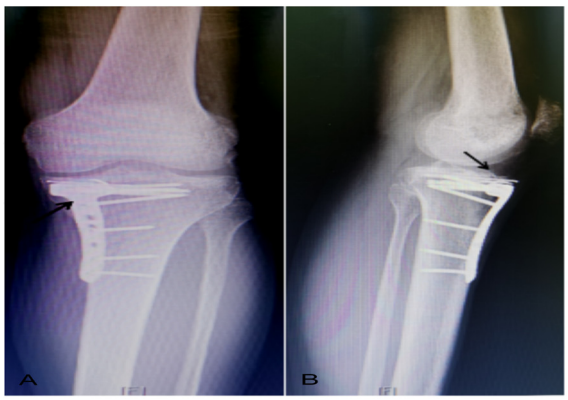

Figure 5: **A**, Front view of the left tibial plateau 1 year after surgery. **B**, Lateral view of the left tibial plateau 1 year after surgery. "→ "Indicating damage location.

cooperate due to pain. Swelling of the left knee joint, obvious tenderness on the inside of the left knee joint and limited mobility. The skin temperature of the left foot is low, the superficial sensation is normal, the dorsal artery of the foot is pulsating weak, and there is no obvious ischemic symptoms in the toes. When the patient's knee swelling was better. Under general anesthesia, we performed open reduction, internal fixation and bone graft surgery for the patient's left tibial plateau. During the operation, 1 pack of allogeneic bone was implanted and fixed with a 6-hole locking plate on the inner side of the proximal tibia. However, during the operation, we found that the patient's lower limbs were in hyperextension as shown in Figure 3, and the knee joint was severely unstable. Therefore, we performed MRI on the affected knee joint on the first postoperative day, as shown in Figure 4. 7days after the operation, the patient was discharged from the hospital. When discharged, the patient was asked to stay in bed for 1 month. Within three months, the left knee joint should avoid weight bearing, and the knee ligament injury can be treated in the sports medicine department. The patient was followed up for one year. The postoperative X-ray showed in Figure 5. After the patient was discharged from the hospital, the posterior cruciate ligament and tendon injury did not have special treatment. During follow-up, it was found that

the left knee joint could not land vertically when jumping, otherwise the knee joint would be unstable, but there was no obvious pain.

Discussion

Hyperextension tibial plateau fractures are rare in clinical practice. Its characteristic manifestations are due to violence, the front articular surface shows compression fractures, and it is easy to be accompanied by severe traction damage to the posterior stable structure. It even causes injury to the posterior popliteal blood vessel and common peroneal nerve [2,3]. In recent years, hyperextension tibial plateau fractures have gradually received the attention of clinicians. There are many classifications of tibial plateau fractures in the world, such as Schatzker, Moore, AO/OTA, but none of these classifications has a clear description of hyperextension tibial plateau fractures [4]. Zhang et al [1] proposed the classification of hyperextension tibial plateau fractures: ① tibial plateau edge avulsion fracture type ② anterior medial platform compression fracture type ③ anterior lateral platform compression fracture type ④ bicondyle fracture type. Chiba et al [5] was the first to report the anteromedial plateau compression fracture. He introduced 12 patients, all of which were compression fractures of the anteromedial tibial plateau. Among them, 8 cases were small-area compression fractures at the edges and 4 cases were large-area compression fractures; however, the author found that the smaller the fracture, the more likely it was to be accompanied by Posterior cruciate ligament (PCL) injury. The incidence of anterior cruciate ligament injury in large-area compression fractures was 75%. The incidence of posterior cruciate ligament injury in small compression fractures was 87.5%. Tomás-Hernández et al [6] also have a similar view. However, most of the previous reports are related to marginal avulsion fractures accompanied by ligament lesions, usually PCL or Anterior cruciate ligament (ACL), and there are few reports of popliteal artery injury and occlusion of the lower limbs. The reported incidence of popliteal artery injury in hyperextension tibial plateau fractures is 12%-23% [7-9].The popliteal artery is at the back of the knee joint, close to the bone and in a fixed position. When the front is compressed and fractured, according to the diagonal injury mechanism, the back is extremely stretched and injured. Therefore, vascular injuries are mostly blunt traction caused by traction rather than vascular rupture. The early symptoms of limb ischemia are not obvious, so the missed diagnosis rate is high [10]. Firoozabadi et al [11] reported that the incidence of popliteal artery injury in hyperextension varus bicondylar fractures was 12%. Because the symptoms of limb ischemia in patients with early vascular injury may not be obvious, but the delayed thrombosis will gradually cause limb ischemia, and the lack of timely and close observation may cause missed diagnosis. Chen et al [10] also reported that 2 of the 16 patients were diagnosed with vascular injury by preoperative angiography, but after only close observation and symptomatic treatment, there was no obvious ischemia in the limbs. He believes that because of the abundant circulation of arterial collaterals around the knee joint, partial blockage of the popliteal artery after injury may not cause obvious ischemia in the limbs. Therefore, emergency vascular exploration surgery is unnecessary, which increases the difficulty and complexity of treatment. The preoperative vascular CTA of this patient showed: thrombosis of the popliteal artery in the left lower limb, and local occlusion of the popliteal artery. It is very likely that the vascular endothelium is damaged due to the traction of the blood vessel, the coagulation mechanism is activated due to the exposure of the vascular endothelium, and the thrombus is formed in the popliteal artery. The patient were given corresponding treatment and monitoring after admission. Therefore, no symptoms such as obvious ischemia of the affected limb occurred during the course of the disease. Whether the injured ligaments and tendons should be repaired in one stage is still controversial. Lu et al [4] reported that the intraoperative examination of the knee joint for stability is an indication for determining whether to repair the ligament. He believes that when the knee joint bone structure is sufficiently stable, there is no need to deal with the injured ligament at the same time. Liu et al [12] emphasized that the principle of "treating soft tissues and bones the same" should be followed. He reported on 11 patients, of which 7 patients underwent ligament repair and stop point reconstruction after the fracture was firmly fixed. Du et al [13] believes that after intraoperative bone structure reconstruction, knee joint stability should be assessed, combined with knee MRI, to determine the injury of the posterior cruciate ligament and posterolateral complex, and it can be reconstructed in two stages. In the patient reported in this case, only the fracture was fixed during the operation, and the ligament was not repaired at the same time. During the follow-up, the lower limbs of the patient were occasionally unstable during exercise. Hyperextension type tibial plateau fractures are severely injured, accompanied by a high incidence of injuries to important soft tissues of the knee joint. Studies have found that the prognosis is worse than other types of knee joint fractures [10,14]. Lin et al [15] believes that hyperextension tibial plateau fractures should be carefully diagnosed, appropriate treatment plans should be developed according to different fracture types, and then adequate bone grafting and stable fixation should be performed. Only in this way is the key to preventing complications after injury. Wu et al [9] found that compared with Schatzker type VI fracture, patients with hyperextension tibial plateau injury had relatively lower postoperative joint range of motion and knee function scores, while the rate of popliteal vascular injury, ligament injury, and complication rates were relatively Higher and Osteoarthritis tends to appear earlier.

Conclusion

For hyperextension tibial plateau fractures, clinicians must not only pay attention to the fracture, but also combine the characteristics of the injury, and highly suspect the possibility of accompanying important structural damage to the rear. Early MRI and CTA examination of lower limbs are very important. At the same time, the knee joint stability should be checked again after intraoperative fracture fixation. If there is obvious instability, the damaged ligament should be repaired. Operate as much as possible to restore the stable type of the patient's knee joint, which is essential for the recovery of the patient's knee joint function after surgery.

Declarations

Conflict of interest: No conflict of interest exits in the submission of this manuscript, and manuscript is approved by all authors for publication. I would like to declare on behalf of my co-authors that the work has not been published previously, and not under consideration for publication elsewhere, in whole or in part. All the authors listed have approved the manuscript that is enclosed

Ethical approval: All procedures of this study conform to the ethical standards of the research committee of this hospital, and conform to the 1964 Helsinki Declaration and its subsequent amendments or similar ethical standards.

Informed consent: The patient gave informed consent to this report.

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