CASE REPORT

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Irreducible fracture-dislocation of the knee

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Dislocation and fracture-dislocation of the knee are serious injuries, often related to high-energy trauma. Irreducibility with closed techniques is an extremely rare and challenging problem that has been described in posterolateral, posterior and lateral knee dislocations. Irreducibility in fracture-dislocations around the knee has only been described twice in the literature and never in association with a tibial plateau fracture. We report a unique case of an irreducible tibial plateau fracture-dislocation in which closed reduction was prevented by incarceration of the medial meniscus within the fracture site. The patient required transfer to our institution due to a concomitant traumatic brain injury. This contributed to a delay of 10 hours from injury to arrival in our resuscitation room. Progressive swelling and absent foot pulses resulted in immediate transfer to the operating theater where open reduction and internal fixation was performed with four-compartmental fasciotomies. The patient made a rapid and full recovery. Where closed techniques have failed, open reduction must then be undertaken in order to prevent the devastating complications of compartment syndrome and neurovascular compromise.

Key words: Closed reduction; fracture-dislocation; irreducible; tibial plateau.

Traumatic knee dislocation is an uncommon and severe injury often associated with a high-energy mechanism. Early closed reduction is achieved readily in the majority of cases, although rare cases of irreducibility have been described in the literature. Such instances usually occur in posterolateral dislocations where reduction is prevented by interposing soft tissue, including the medial capsule and retinaculum,[1,2] vastus medialis,[3,4] adductor magnus[5] and medial meniscus.[6] Fracture-dislocation of the knee is a rare injury. Only two reports have been published in the literature describing irreducibility with closed techniques. In one case, a medial femoral condylar fragment was locked behind the medial tibial plateau preventing reduction.[7] In the other, the patella tendon was incarcerated within a Hoffa fracture.[8] To the best of our knowledge, there have been no cases of irreducible fracture-dislocation involving the proximal tibia described in the literature.

We report a case of a partial-articular tibial plateau fracture-dislocation where incarceration of the medial meniscus within the fracture prevented closed reduction in the emergency room and operating theater.

Case report

A 19-year-old male was involved in a high-speed, head-on collision while driving a heavy goods vehicle. He suffered a dashboard injury to the right knee in addition to a traumatic brain injury. The primary examination revealed no immediate threats to life. Additional examination, supplemented with plain film radiographs (Fig. 1) and computed tomography (CT) (Fig. 2) demon-

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strated an atypical posteromedial fracture-dislocation of the right knee. Initial management at the local hospital consisted of cast immobilization and plans for urgent surgical management. However, concerns were raised over the patient's Glasgow Coma Score (GCS) which fluctuated between 12 and 13. Consultation was made with the Neurosurgery Department at our unit, a major trauma center (MTC). While there was no indication for immediate neurosurgical intervention, the patient was transferred to allow closer observation.

The patient arrived at our MTC 10 hours post-injury with the knee un-reduced in plaster. Examination at this stage revealed gross swelling and deformity of the right knee, which was fixed at 30 degrees of flexion. The extremity was well-perfused but distal pulses were only detectable using Doppler ultrasound. As the patient was intubated and ventilated, an immediate attempt at closed reduction was performed in the resuscitation room. The attempt was unsuccessful. Immediate neurosurgical intervention was deemed unnecessary and the patient was taken to the operating theater immediately for closed reduction and application of a spanning knee external fixator.

Further attempts at closed reduction in the operating theater were unsuccessful and open reduction and internal fixation was performed. A mid-line incision with a lateral parapatellar approach was utilized. The lateral tibial plateau fragment included the intercondylar eminence with intact anterior and posterior cruciate ligaments. This large fragment was congruent with the lateral femoral condyle and both the lateral collateral ligament and lateral meniscus were uninjured. The medial tibial plateau, still attached to the tibial shaft, was dislocated posterior to the medial femoral condyle and

Fig. 1. **(a)** Anteroposterior and **(b)** lateral plain film radiographs demonstrating the injury at presentation.

Fig. 2. **(a)** Coronal, **(b)** sagittal and **(c)** transverse CT images showing the fracture-dislocation.

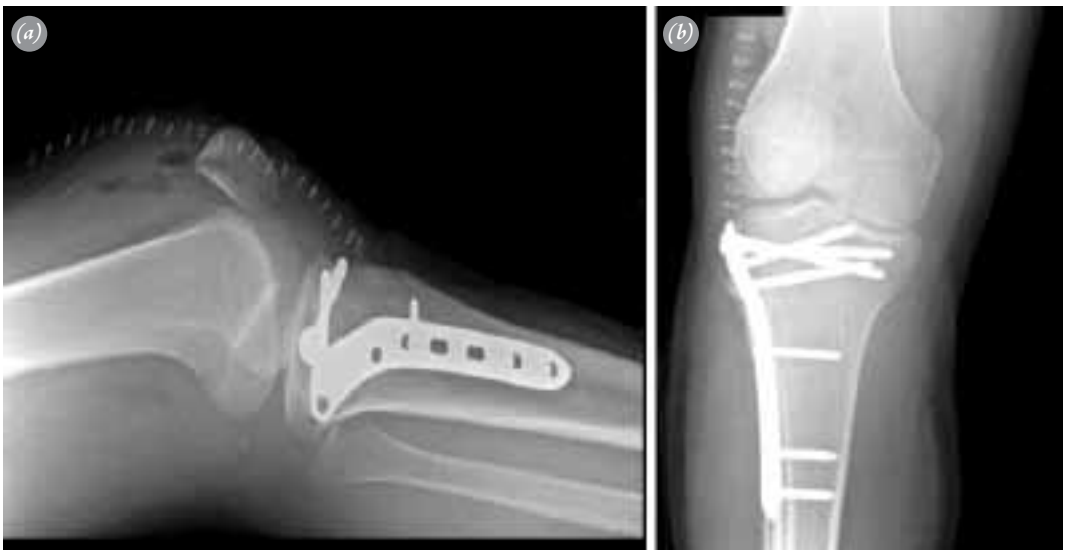

Fig. 3. Postoperative **(a)** lateral and **(b)** anteroposterior plain film radiographs.

had pivoted around the medial collateral ligament. The badly damaged medial meniscus was incarcerated within the fracture site preventing reduction. All chondral surfaces were intact and uninjured. Open reduction was difficult and required extensive dissection of the medial capsule and sacrificing of the medial meniscus. Anatomical reduction was achieved and maintained with a large periarticular reduction forceps. Inter-fragmentary compression using partially threaded cancellous screws and a pre-contoured lateral neutralization plate provided absolute stability (Figs. 3 and 4). The compartments were extremely tight and therefore decompressed through the initial incision and a separate posteromedial incision. The muscles were edematous and dusky initially, but reperfused rapidly and were contractile with stimulation. Palpable pulses returned postoperatively. The fasciotomy wounds were closed secondarily. The patient made a rapid and full recovery without neurovascular complication or knee instability.

Fig. 4. Single coronal CT image demonstrating screws outside the joint.

Discussion

Traumatic knee dislocations and fracture-dislocations are serious injuries that require significant consideration. Initial management entails immediate closed reduction and temporary stabilization by operative or non-operative means. This can often be achieved without difficulty in emergency services or the operating theater. In extremely rare cases, particularly with posterolateral knee dislocations, closed reduction may fail due to soft tissue interposition. Irreducible lateral and posterior knee dislocations have also been described.[9,10] Such cases require emergent open reduction to prevent the complications of compartment syndrome and neurovascular compromise. Robertson et al.'s[11] review article reported that fractures of the distal femur or proximal tibia are present in 16% of knee dislocations. Within this subgroup of fracture-dislocations, only 2 cases of irreducibility have been reported, both occurring in patients with femoral condylar fractures. There are no published reports of irreducible tibial plateau fracture-dislocations of the knee.

Moore[12] reported 132 fracture-dislocations of the knee involving the tibial plateau. He proposed a 5-group classification system, of which ours was a Type 2 lateral fracture-dislocation, and concluded that all types were characteristically associated with joint instability and a high incidence of soft tissue and neurovascular injury. It was highly unusual, therefore, that our patient's cruciates, collaterals and lateral meniscus were all uninjured, as noted during surgery. In 17% of Moore's series, one or both of the menisci required excision.[12]

Our patient had a concurrent traumatic brain injury which necessitated urgent transfer to our MTC. Closed reduction in the peripheral unit had failed and the knee remained dislocated. This transfer contributed to a 10 hour delay from the time of injury to surgical reduction. It was fortunate that the patient's compartments were released before irreversible muscle damage occurred. The incidence of compartment syndrome has been reported as 53% in Moore Type 2 medial injuries by Stark et al.[13] However, the authors did not investigate whether time to reduction was a risk factor. The management of polytrauma patients is complex and each case is unique. Prioritization of life-threatening injuries is paramount and due consideration must be given to the threatened limb. The orthopedic surgeon who encounters an irreducible dislocation or fracture-dislocation of the knee should consider the option of immediate open reduction and spanning external fixation prior to transfer.

In conclusion, with life-threatening injuries permitting, we recommend immediate open reduction in cases where closed attempts have failed. Temporary or definitive skeletal stabilization is then determined by the integrity of the soft tissue envelope and severity of the fracture pattern. Surgeons based in peripheral units who are not confident they can definitively stabilize a more complex periarticular fracture-dislocation should perform urgent open reduction and temporary spanning external fixation prior to transfer.

Conflicts of Interest: No conflicts declared.

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