

Case Report

Irreducible dislocation of the knee joint



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ABSTRACT

Posterolateral knee dislocations are very rare and generally irreducible by closed reduction. It is due to interposition of various portions of medial capsule-ligamentous structure in the knee joint space. In such cases, open reduction is recommended. Only a few cases have been reported in the literature. This article presents an unusual case of irreducible knee dislocation, in which the medial femoral condyle button-holed through the medial retinaculum and capsular structure. Closed reduction attempt was unsuccessful. Open joint reduction was performed. Direct repair of the medial collateral ligament and retinaculum, and arthroscopic assisted posterior cruciate ligament reconstruction were also performed. Arthroscopic-assisted anterior cruciate ligament reconstruction was carried out in staged operation.

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1. Introduction

Knee dislocations are rare and account for <0.5% of incidences of all joint dislocations.¹ The most common knee dislocations are anterior dislocations (40%), followed by posterior (33%), lateral (18%), and medial (4%) dislocations.¹ Posterolateral knee dislocations are rarer and often irreducible. Only a few cases have been reported to date.^{2–6}

Most dislocated knees could be easily reduced by closed manipulation or by spontaneous reduction. However, only a few cases were still irreducible. Most of them are posterolateral dislocations. In such cases, the torn medial collateral ligament (MCL) and capsule may interpose in the tibiofemoral joint and prevent closed reduction. Neurovascular injury is rare.^{4–6} In such cases, open reduction should be considered. Subsequently, reconstruction or repair of both ruptured cruciate ligaments could be performed in staged operation.

We present a case of knee posterolateral dislocation, which was irreducible by closed manipulation. The patient was treated with open reduction and subsequent staged ligament reconstruction.

2. Case report

A 58-year-old woman was struck on the lateral side of the left knee by a motorcycle. She was immediately sent to the emergency department of our hospital. Initial findings showed that the left knee was swelling and locked in a slight flexion position. No dimple sign was noted. The neurovascular status was intact, and the ankle brachial index (ABI) was 0.96. On the anteroposterior and lateral radiographs, the knee medial joint space was open and the proximal tibia condyle was displaced posterolaterally (Figs. 1 and 2). Closed reduction without anesthesia failed and produced more pain to the patient. The knee was then temporarily immobilized in a long leg splint. The patient was sent to the operating room for emergent closed reduction under general anesthesia. However, closed reduction was also unsuccessful. During closed manipulation, something was noted to be incarcerated in the medial knee joint that prevented anatomical reduction. The images in the C-arm monitor always showed partial subluxation (Fig. 3). The incarcerated structure was supposed to be a torn meniscus or the incarcerated ruptured MCL. With the patient's knee slightly flexed, a cylinder cast was applied for temporary immobilization. Because the cylinder cast was much larger in diameter than it usually was, the vascular status would not be compromised by the applied cylinder cast. Subsequent magnetic resonance imaging (MRI) was arranged for the next day for further investigation (Fig. 4). The pulse of the dorsalis pedis artery was regularly checked.

The MRI demonstrated that the medial retinaculum was torn and invaginated in the femoral intercondylar notch, the detached

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Fig. 1. The prereduction anteroposterior radiograph shows lateral dislocation of the knee. Avulsion fracture of lateral collateral ligament on the fibular end is also noted.

MCL was incarcerated in the medial knee joint, and both the anterior cruciate ligament (ACL)/posterior cruciate ligament (PCL) were completely ruptured (Figs. 5–7).

Three days later, open reduction was performed successfully. An 8-cm midline skin incision was made just medial to the patellae. As the wound was open, the medial femoral condyle was exposed directly and noted to buttonhole through the torn medial retinaculum, which was invaginated in the femoral intercondylar notch area. The MCL was detached from its femoral origin and incarcerated in the medial knee joint. The ACL was completely ruptured in the midsubstance, whereas the PCL was detached from its femoral attachment. The joint was reduced anatomically after the removal of all trapped structures. The MCL and the medial retinaculum were repaired primarily. Arthroscopic-assisted PCL reconstruction using ligament advancement reinforcement system (LARS) was successfully performed. During arthroscopic surgery, the wound for open



Fig. 3. The postreduction C-arm image shows increased medial knee joint space, indicating some structures incarcerated in the knee joint.

reduction was partially closed in order to facilitate the normal saline solution to flow out smoothly instead of leaking into the surrounding soft tissue. The tourniquet time was about 90 minutes. After the operation, the knee was protected with a hinged brace, and the range of motion was set from 0° to 30°. The knee range of motion increased by 20° per week. Staged arthroscopic-assisted ACL reconstruction using LARS was carried out 3 weeks later (Fig. 8). Six months after the staged operation, the patient felt no pain and was able to walk with full weight bearing. The knee was relatively stable with grade I instability and the range of motion was 0° to 120°.

3. Discussion

Traumatic knee dislocations are rare but could be limb threatening for the possibility of vascular compromise in the popliteal



Fig. 2. The lateral radiograph prior to closed reduction shows posterior subluxation.

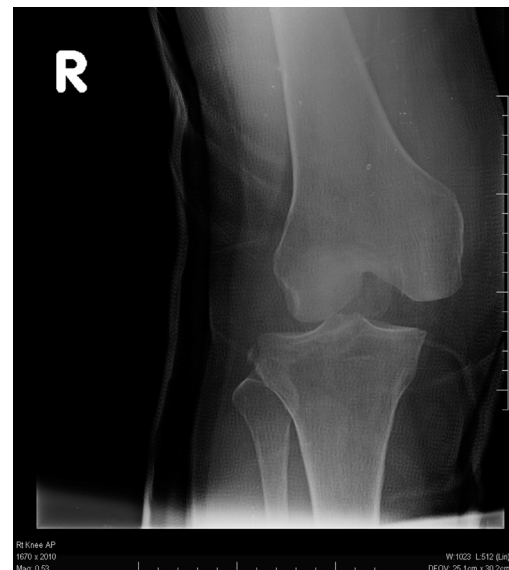


Fig. 4. The postreduction radiograph shows lateral subluxation of the knee joint.



Fig. 5. Coronal T₂-weighted image demonstrates invagination of the torn medial retinaculum (arrowhead) and incarceration of the medial collateral ligament (arrow) in the medial knee joint space. Note the bone marrow edema in the lateral tibia condyle.

fossa.^{1–5} It often occurs in car accidents or in sport injuries, and is considered an orthopedic emergency.^{7,8}

Initially, the dislocated knee may not be recognized because of spontaneous reduction, which will lead the examiner to underestimate the severity of the injury. The clinician must be alert for the possibility of coincidental arterial and neural injuries as well as compartment syndrome. For unreduced cases of knee dislocation, anatomical reduction with a restoration of neurovascular integrity should be done as soon as possible.^{1,2}

Knee dislocation could occur in various directions. Anterior knee dislocation is the most common. It occurs most often from a posteriorly directed force on the anterior aspect of the thigh with the

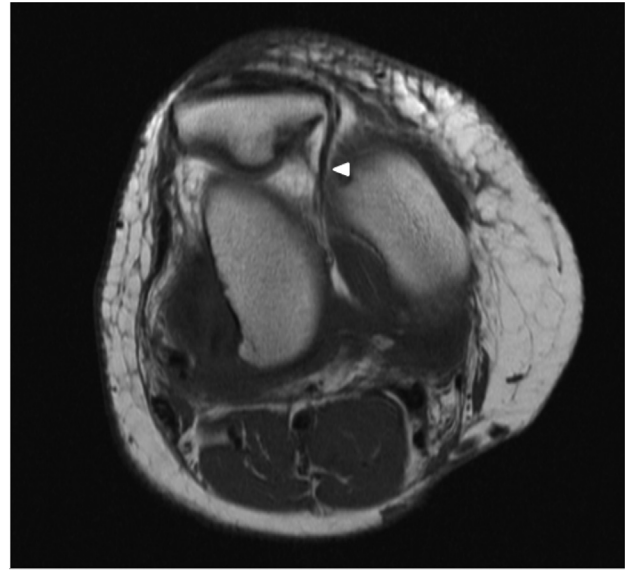


Fig. 7. Axial T₁-weighted image shows that the torn medial retinaculum is invaginated in the femoral intercondylar notch (arrowhead), meaning the medial femoral condyle buttonholed through the torn retinaculum.

knee in hyperextension position.⁹ Posterior knee dislocation often results from a “dashboard injury,” in which a posteriorly direct force is applied to the anterior of the tibia with the knee in flexion position. Lateral or rotary dislocations are even rarer. Rotatory dislocations include posterolateral, posteromedial, anterolateral, and anteromedial dislocations.

Irreducible knee dislocations occur frequently in posterolateral dislocations.^{8,10–12} There is an internal rotatory component, in which medial femoral condyle buttonholes through the medial retinaculum. The mechanism of injury is attributed to the valgus loading of the knee and internal rotation of the tibia with the knee in flexion position. The stretched MCL will be detached from the femoral origin and may be incarcerated in the medial knee joint. Most of the reported cases happened during low energy accidents.

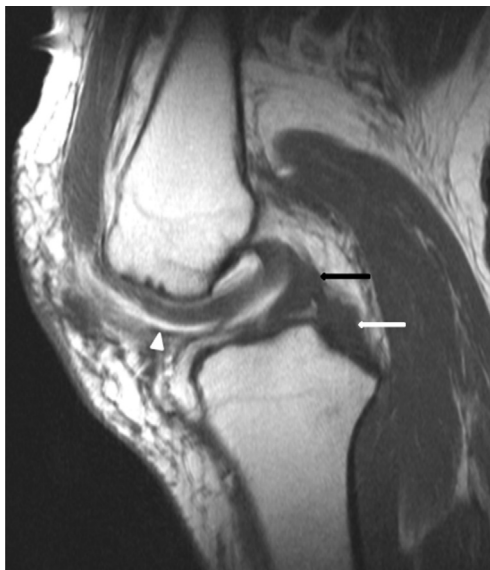


Fig. 6. Sagittal T₂-weighted image demonstrates complete disruption of both the anterior (black arrow) and posterior cruciate ligaments (white arrow) and invagination of the torn medial retinaculum (arrowhead) in the femoral intercondylar notch. The trapped structures did not retract the overlying soft tissue to cause the so-called “dimple sign.”



Fig. 8. After staged anterior cruciate ligament reconstruction, the radiograph shows normal knee alignment.

We think it might be considered a subtype of posterior knee dislocation, which happens in a high energy trauma accident with a similar mechanism.

A full trauma assessment including neurovascular status is important for all patients with knee dislocation. The initial management should be aimed at closed reduction and maintenance of neurovascular integrity. The popliteal artery and peroneal nerve might be injured.^{8,10–14} About 10–25% of dislocated knees had associated common peroneal nerve palsy, and some with long-term residual neurological deficits.¹⁵ The neurovascular status must be regularly monitored. The ABI can accurately predict whether patients with knee dislocations have sustained vascular injury. Mills et al¹⁶ showed that an ABI of <0.9 is highly predictive of major vascular injury. Patients with an ABI <0.90 should undergo arteriography to check for the possibility of vascular injuries.

Many dislocations spontaneously reduce prior to radiographic examination. In such cases, high suspicion is the only clue that could point to the right diagnosis. Hemarthrosis, local swelling, and multidirectional instability could be noted. Closed reduction and splint immobilization should be done as soon as possible. The reduced knee can be immobilized in a slight flexion position.

However, some cases were still irreducible. Most of them were posterolateral dislocations. Under such conditions, the dislocated knee could be temporarily immobilized in a splint. MRI plays an important role in identifying the structures that prevent closed reduction, and ascertaining the injuries of the PCL, ACL, MCL, and/or lateral collateral ligament (LCL). The invaginated medial retinaculum and the incarcerated MCL could also be noted. Misinterpretation of the invagination of medial retinaculum as a torn meniscus should be avoided.¹⁷

The so-called “dimple sign” is characteristic of posterolateral knee dislocations caused by invagination of the skin and soft tissue into medial joint space.¹⁷ It is the only clue that could assist clinicians in making an early and accurate diagnosis. It could be present both during physical examination and in MRI images. Most cases reported the presence of a dimple sign. If a dimple sign is present, early open reduction should be carried out to prevent the overlying skin necrosis. Said et al¹² reported a case of irreducible knee dislocation without a dimple sign. A delayed diagnosis was made 14 months later. Our case did not show a dimple sign both during physical examination and in MRI images (Fig. 6). This could have been due to the loose attachment between the entrapped capsule and the overlying adipose soft tissue. As the neurovascular status was intact, the knee was temporarily immobilized in a cylinder cast for further investigation. Because the dislocated knee was not reduced anatomically, the diameter of the applied cylinder cast was made larger so as not to compromise the vascular integrity. Cylinder splint is a good alternative for immobilization.

Most irreducible knee dislocations have no neurovascular involvement.^{4–6} This can be explained by the fact that the ability to realign the knee depends on the extent of retinacular or capsular tear buttonholed through by the medial femoral condyle. This often happens in low energy trauma. The neurovascular injury caused by the stretching of nerves or vessels is minimal or insignificant.

Open reduction is required to restore the dislocated knee. It is recommended that MCL and LCL be repaired directly during open reduction.¹⁸

The following surgical treatment is primary repair or reconstruction of the injured ACL/PCL ligaments. Although good results were recently achieved with direct repair of ACL/PCL ligaments, surgical reconstruction is now the standard of treatment for most patients.¹⁹ Owens et al¹⁹ published the results of their retrospective review of 25 consecutive patients who sustained knee dislocation and were treated with primary repair of all injured ligaments,

including the ACL and PCL. The mean follow-up period was 48 months (range, 13–82 months). All but two patients were able to return to their previous jobs, with little or no activity modification. However, arthrofibrosis was the most common complication, with five patients requiring arthroscopic lysis of adhesions. The incidence of joint stiffness is as high as 18%. Mariani et al²⁰ performed a level IV retrospective review comparing direct repair of ACL/PCL versus reconstruction for patients who sustained acute knee dislocations. Patients were followed-up for an average of 6.9 years (range, 2–19 years). Improved stability and range of motion were demonstrated in patients with reconstruction of ACL/PCL compared with those who underwent ACL/PCL repairs.

The optimal timing for surgical reconstruction of both ACL and PCL remains controversial, early open reconstruction or delayed staged arthroscopic reconstruction. The advantages of either are theoretical. Because the capsule may be torn, early open reconstruction or repair could be carried out in the first few weeks. Arthroscopy is suggested to be delayed for the possibility of fluid leaking out into the surrounding soft tissue.²¹ The advantages of delayed staged arthroscopic reconstruction of ACL and PCL include better appreciation of concomitant intra-articular pathology (including meniscal tears), less soft tissue dissection trauma, and faster recovery. In most cases, the preferred treatment for both ACL and PCL reconstruction is arthroscopic surgery.

Bin et al²² performed a two-stage treatment in closed knee dislocation with multiple ligament injuries. In the first stage, both the MCL and LCL were repaired. In the second stage, the authors performed arthroscopic-assisted ACL and PCL reconstruction while the knee range of motion was full and free. For performing arthroscopic reconstruction of PCL during the operation of open reduction, we designed a novel protocol to avoid normal saline leaking out of the ruptured capsule. We performed arthroscopic-assisted PCL reconstruction with the open wound not fully closed. Although the loss of normal saline was substantial, the possibility of fluid leaking was minimized. Because the tourniquet time was already 90 minutes, it was risky to continue the arthroscopic-assisted ACL reconstruction. We thus decided to delay the operation for 3 weeks (just long enough for the ruptured capsule to heal).

Stayner et al¹⁸ recommended that ACL reconstruction be performed when the inflammatory response has subsided and the knee range of motion has been regained. They also suggested that PCL reconstruction be performed prior to the ACL reconstruction for the multiple-ligament injured knee after dislocation.¹⁸ After PCL reconstruction, rehabilitation started. The knee range of motion could be regained and the risk of arthrofibrosis is thus reduced.^{23–26}

Reconstruction of ACL/PCL using artificial ligaments provides several benefits over autograft tissues, including absence of donor-site morbidity and less tourniquet time. Additionally, excellent clinical results have been also demonstrated. Pierre et al²⁷ reported 71 dislocated knees with one stage ligaments reconstruction using LARS artificial ligaments. The mean follow-up period was 54 months. More than 90% of knees were stable with grade I or zero instability. Therefore, reconstruction of both ACL and PCL with LARS ligaments is a valid alternative for treating knee dislocations.

An irreducible knee dislocation due to buttonholing of the medial femoral condyle through vastus medialis often requires open reduction. Repair of the MCL and medial retinaculum could be done at the same time. PCL and ACL reconstruction could be performed arthroscopically in staged operation. PCL reconstruction is recommended to be performed prior to ACL reconstruction.

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