

The Irreducible Knee Dislocation

Shahbaz S. Malik, MD, FRCS (Tr&Orth)^{1,2} Peter B. MacDonald, MD, FRCS(C)^{1,2,3}

¹ Department of Sports Surgery, Pan Am Clinic, Winnipeg, Manitoba, Canada

² Pan Am Clinic, University of Manitoba, Winnipeg, Manitoba, Canada

³ Department of Orthopaedics, University of Manitoba, Winnipeg, Manitoba, Canada

Address for correspondence: Shahbaz S. Malik, Department of Sports Surgery, Pan Am Clinic, 75 Poseidon Bay, Winnipeg, Manitoba R3M 3E4, Canada (e-mail: shahb.malik@gmail.com).

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Abstract

Keywords

- ▶ irreducible knee dislocation
- ▶ posterolateral knee dislocation
- ▶ multiligament knee injury
- ▶ MCL
- ▶ ACL
- ▶ PCL

Irreducible knee dislocations are a small subset of acute knee dislocations and are extremely rare. The most common type of irreducible knee dislocation is posterolateral, which can be challenging to diagnose both clinically and on plain radiographs. Vascular injury is uncommon and closed reduction is seldom possible due to medial femoral condyle buttonholing through soft tissues requiring open or arthroscopic reduction. Ligament injuries mostly include medial collateral ligament, anterior cruciate ligament, and posterior cruciate ligament. Literature has numerous case reports with a couple of small series giving short- to mid-term outcomes of posterolateral knee dislocations. There is, however, no consensus on management of ligament injuries with case reports showing good outcomes in early or delayed ligament reconstruction. This article sheds light on previous case reports and describes how to identify irreducible knee dislocations and provides an algorithm on how to manage ligament injuries in posterolateral dislocations.

The incidence of acute knee dislocation is reported to be < 0.02%.¹⁻³ The incidence of irreducible knee dislocation is even rarer. One of the earliest reports of an irreducible knee was in 1900 described by Hull,⁴ whereby the knee was irreducible on presentation and 8 months after the injury. It was treated with “resection of knee joint.” The failure of reduction was due to the patella being fixed near the fibula head.⁴ This of course was at the time when radiographs were not available.

Kennedy⁵ classification is useful in describing the direction of displacement of a dislocated tibia in relation to the femur and therefore aids in reduction of the knee. However, Schenck⁶ described a more anatomical classification based on injured ligaments, presence of fracture, and/or any nerve or vascular injuries that were later modified by Wascher.² Anterior knee dislocations are the most common and are usually associated with popliteal artery injury.⁷ The diagnosis of an irreducible knee can often be difficult to make and therefore requires early orthopaedic input for initial clinical assessment and further treatment planning. A neglected or

chronic knee dislocation can present a huge challenge for an orthopaedic surgeon to correct.

The majority of irreducible knee dislocations are posterolateral (PL) in direction with several case reports⁸⁻²⁹ documented in literature. There were 27 case reports of PL dislocations reported in literature by 1981 according to one paper.⁹ The PL dislocation of tibia is caused by high energy, extreme valgus force to a flexed knee with simultaneous rotation forces to both tibia and femur in opposing directions forcing the medial femoral condyle (MFC) through the anteromedial capsule and retinaculum.^{8,30} Some authors describe internal rotation component of dislocation,^{13,30,31} while others report on external rotation component.^{15,32,33} There are, however, no studies to prove either theory. Although uncommon, these injuries can be sustained from low energy trauma.^{11,15} The irreducible knee dislocation can also be lateral with medial tissue entrapment or with incarceration of the lateral femoral condyle in the PL capsule-ligamentous structures.³⁴

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Examination

A careful clinical examination is important to ascertain whether the knee will be reducible in an emergency department or operating theater. Some clinical signs can be suggestive of an irreducible knee dislocation and should be actively sought by the examiner before attempting closed reduction. These can be a fixed flexion deformity with medial skin bruising and previously described as transverse puckering¹⁵ and more recently as presence of “dimple sign” (►Fig. 1) over the MFC.³⁵ This can represent buttonholing of medial femur through the anteromedial joint capsule and potential block to reduction.^{16,17,19} There are other blocks to prevent a knee from reducing, which have been documented in literature and include vastus medialis,^{19,36} avulsed bone fragment or meniscus,³⁷ torn medial collateral ligament (MCL), medial retinaculum and the capsule,³³ patella tendon,³⁸ MFC bone fragments,¹⁰ and entrapment of the adductor magnus tendon.²³

In an irreducible knee dislocation, the examination should robustly proceed to the assessment of neurological and vascular status of the distal limb. Close attention needs to be paid to soft tissues for any expanding hematoma, active bleeding, and distal ischemia. It is essential to document examination with measurement of ankle-brachial index as normal palpation of dorsalis pedis and posterior tibial artery pulses does not always exclude vascular injury. An ABPI (Ankle-brachial Pressure Index) of >0.9 was proven to be 100% accurate in excluding vascular injury.³⁹ However, vascular injury is less common in PL knee dislocations.⁴⁰

In addition, usual clinical findings such as capillary refill, color of distal limb, should also be documented in a timely manner. Neurological examination involves assessment of motor and sensory functions of common peroneal nerve and tibial nerve. Any attempt at reduction in the dislocated knee should be followed by repeat assessment and documentation of examination. Lastly, an assessment of the leg compartments should be made clinically and invasively monitoring should be performed for those patients who are confused, have head injury, are noncompliant or obtunded patients.



Fig. 1 (A, B). Preoperative clinical photographs. Characteristic skin puckering (Dimple sign) over the medial joint line with ecchymosis (Reprinted with permission from Jang KM, Lee HS, Wang JH. Open reduction of irreducible posterolateral rotatory knee dislocation without sectioning of incarcerated vastus medialis: a case report with video illustration. *The Knee* 2014;582–585).



Fig. 2 Preoperative plain radiographs. (A) Widening of medial joint space with lateral patellar subluxation. (B) Posterior displacement of tibia with inferiorly displaced patella. There is no evidence of ligamentous bony avulsion (Reprinted with permission from Jang KM, Lee HS, Wang JH. Open reduction of irreducible posterolateral rotatory knee dislocation without sectioning of incarcerated vastus medialis: a case report with video illustration. *The Knee* 2014;582–585).

Imaging

A plain radiograph is always quick and easy to obtain to establish the nature of injury and to rule out any associated fractures (►Fig. 2). Interestingly the radiological signs of an irreducible subluxation after dislocation can be subtle, due to rotatory character of dislocations, which means there can be absence of striking displacement to elude to a diagnosis of dislocation. This can result in these patients getting delayed orthopaedic opinion and treatment. Nonetheless, in any knee dislocation, there would be a mal-aligned femur and tibia and joint space enlargement. In PL knee dislocation, widening of medial joint space as well as radiological “dimple sign” should be seen on a plain radiograph.

Magnetic resonance imaging (MRI) is the investigation of choice if available as it allows study of vascular tissues and is



Fig. 3 Sagittal proton density-weighted images confirm incarceration of the vastus medialis muscle in the intercondylar notch area (*yellow arrows*) and complete rupture of anterior (*white arrow*) and posterior (*red arrow*) cruciate ligaments. Note the wrapping of the muscle around the distal femur (Reprinted with permission from Paulin E, Boudabbous S, Nicodème JD, Arditi D, Becker C. Radiological assessment of irreducible posterolateral knee subluxation after dislocation due to interposition of the vastus medialis: a case report. *Skeletal Radiol.* 2015;44:883–888).



Fig. 4 The contour of the medial knee (solid arrow) is indented inward secondary to the invagination of the overlying tissues into the medial joint space resulting in the MR dimple sign. Again, bone marrow edema is visible in the lateral femoral condyle (Reprinted with permission from Harb A, Lincoln D, Michaelson J. The MR dimple sign in irreducible posterolateral knee dislocations. *Skelet Radiol.* 2009;38:1111–1114).

useful in picking up other soft tissue injuries (► **Fig. 3**). The coronal views are reported to be the best to see the “dimple sign” corresponding to medial condyle buttonholing through soft tissues.²⁴ The MR dimple sign is created by concave contour of skin and underlying tissue on the medial aspect (► **Fig. 4**). The torn medial capsule and MCL are incarcerated in the medial joint.²⁴ Magnetic resonance angiography or computed tomography angiography can be done at the same time as MRI and the correlation is 100% with angiogram finding in knees with multiple ligament injuries.⁴¹

Management

An irreducible knee dislocation, knee dislocation with arterial injury, open knee dislocation, and a knee dislocation with compartment syndrome are a surgical emergency. Wand³⁵ suggests an irreducible knee dislocation is an indication for open reduction because of medial soft tissue interposition into joint space. Open reduction can be performed with an arthrotomy, which can either be a mid-line arthrotomy with attention to creating large soft tissue flaps or direct medial approach to identify the medial retinaculum through which the MFC would have breached.⁴² The other option is arthroscopic debridement but even when arthroscopy is attempted, it proves rather difficult to perform due to poor visualization with tissues trapped in the intercondylar notch.¹⁵ However, Dubberley et al¹⁶ were the first to report two cases whereby arthroscopic debridement led to closed reduction in irreducible PL dislocations. They suggested debridement of MCL and capsule until MFC is fully visualized and the knee is reduced. They performed this using the anterolateral portal for camera and anteromedial portal for shaver. Follow-up of these two patients showed laxity with one patient undergoing reconstruction of anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), and MCL, while another underwent debridement of scar tissue in the intercondylar notch. Arthroscopic debridement and reduction were also reported in another case²² where presentation was chronic, 14 months following initial injury. After arthroscopic reduction, open MCL repair was performed followed by ACL and PCL reconstruction 3 months after the initial surgery.

One case has reported closed reduction in “irreducible” PL knee dislocation.²⁸ The knee was flexed to 120° and valgus stress and internal rotation of the lower thigh were applied. The dimple sign had disappeared on reduction.²⁸ They reconstructed PCL arthroscopically and MCL via a direct medial approach.²⁸

Surgical repair or reconstruction of soft tissues and ligaments at the time of open reduction can be performed, although treatment algorithm is variable in the case reports.

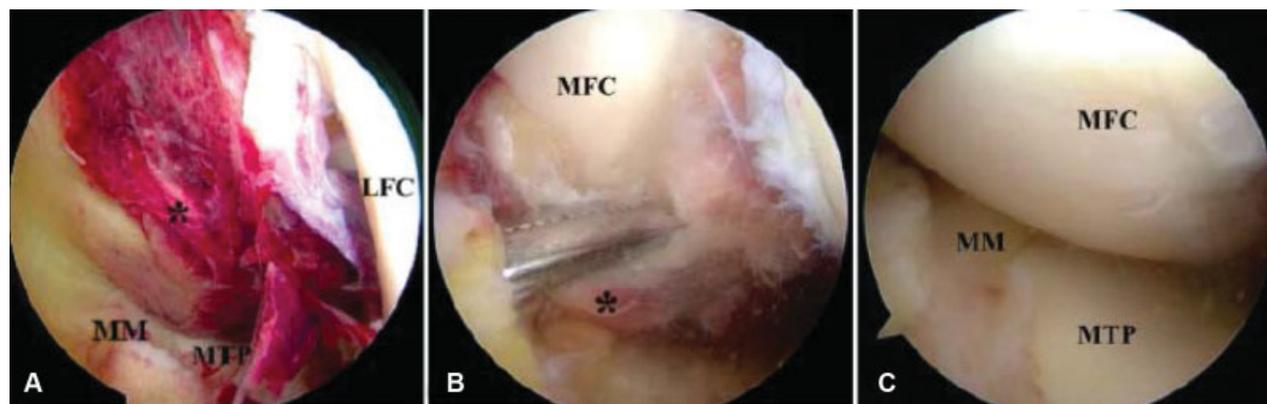


Fig. 5 Arthroscopic reduction in irreducible posterolateral knee dislocation (left knee). (A) The medial retinaculum and capsule (marked by*) had invaginated into the joint and been button-holed by the medial femoral condyle. (B) A pair of hemostatic forceps introduced through the standard anteromedial portal was used to help extract the invaginated soft tissue off the medial femoral condyle. (C) The joint achieved complete reduction. LFC, lateral femoral condyle; MFC, medial femoral condyle; MM, medial meniscus; MTP, medial tibial plateau (Reprinted with permission from Hongwu Z, Li J. One-stage arthroscopic reduction combined with multiligament reconstruction or repair for irreducible posterolateral knee dislocation: a retrospective case series with minimum 2-year follow-up. *J Knee Surg* 2018;31:1015–1021).

This has included open reduction with repair of medial soft tissues,^{12,13,35} open reduction and repair of one ligament,⁴⁴ open reduction and repair of all torn ligaments.^{31–33,35} One of the larger series has reported on outcomes of 13 patients with PL dislocations,⁴⁵ all of whom were treated with one stage arthroscopic reduction (→Fig. 5) combined with multiligament reconstruction or repair. The mean age of cohort was 37.8 years (range: 27–56 years) and the mean time from injury to surgery was 1.84 days (range: 1–3 days). In this series, 10 patients underwent ACL and PCL reconstruction as well as MCL repair; 2 patients underwent ACP, PCL, and MCL reconstruction, while one patient underwent ACL and PCL reconstruction as well as MCL and lateral cruciate ligament (LCL) repair. At a mean follow-up of 32.6 months (range: 24–46 months), the mean range of motion (ROM) was reported $2.69 \pm 5.63^\circ$ to $132.69 \pm 11.66^\circ$. The Lachman and pivot shift test findings were normal in 12 patients and nearly normal in 1 patient and the posterior drawer test was normal in 11 patients and nearly normal in 2 patients. Furthermore, the varus stress test was normal in all patients, while the valgus stress test in 30° of flexion was normal in 11 patients, nearly normal in 1 patient and abnormal in 1 patient. The authors report one complication had a severely limited ROM of 20 to 60° due to heterotopic ossification at 10 months postoperatively. This patient underwent excision of the heterotopic ossification. At 24 months after primary surgery, this patient achieved a nearly normal ROM of 5 to 130° .

In another series,⁴⁶ nine cases of PL dislocation have been described. The mean age was 46 years (range: 16–61 years). Five were acute cases, while four were chronic cases. The chronic cases were from 6 weeks old to 2 years post injury. In the acute group, four cases were treated with open reduction, while one was treated with closed reduction. In the acute injury group, three of the five patients had ACL and PCL reconstructions. In the chronic group, of the four patients, one patient underwent ACL, PCL reconstruction and posterolateral corner (PLC) tightening as well as high tibial osteotomy to correct the varus. One patient

had a fracture dislocation with comminuted fracture of tibial condyle. This young laborer was treated with arthrodesis. The other two patients had ACL and MCL reconstructions previously but dislocated again and underwent open reduction. The mean length of follow-up was 6 years (range: 1–23 years). All but two cases (in chronic group) achieved full ROM. There was no joint laxity in three cases of acute injury group but mild laxity in two cases of chronic injury group.

Chronic irreducible dislocations are extremely uncommon and can be missed due to distracting injuries in a multiple injured patient or poor medical care at initial presentation. Treatment in such rare cases can be challenging and if surgery is considered, it can either be a one stage or two staged procedure. A search of English literature for chronic irreducible knee dislocations yielded only five case reports^{4,22,25,47,48} in addition to case series reported by Gu et al.⁴⁶ The earliest case of chronic dislocation was reported in 1900 where a female fell off a horse and sustained a posterior knee dislocation.⁴ A closed reduction was attempted at the time of injury but was unsuccessful. She was referred 8 months later after struggling to ambulate due to a short leg. She underwent an open knee joint resection after failure of open reduction. The joint was fused and at 2 years follow-up she was walking independently. In the second case, a 14-year-old boy presented 14 months following a PL dislocation that was reduced arthroscopically followed by ligament reconstruction at 3 months after this surgery.²² In the third case, a 18-year-old female⁴⁷ also sustained PL knee dislocation and presented 3 months following this injury. She underwent a single stage open surgery to reduce the knee as well as reconstruction of the ligaments (ACL, PCL, MCL, and LCL). At 12 months follow-up, her ROM was 0 to 100° and knee was stable.⁴⁷ In the fourth case, a 23-year-old male²⁵ presented 3 months following PL knee dislocation sustained in a road traffic accident (RTA). He underwent closed reduction with Ilizarov technique and at 5 months following this he underwent ACL and PCL reconstruction. At 6 weeks follow-up, his ROM was 0 to 100° and the knee was stable in

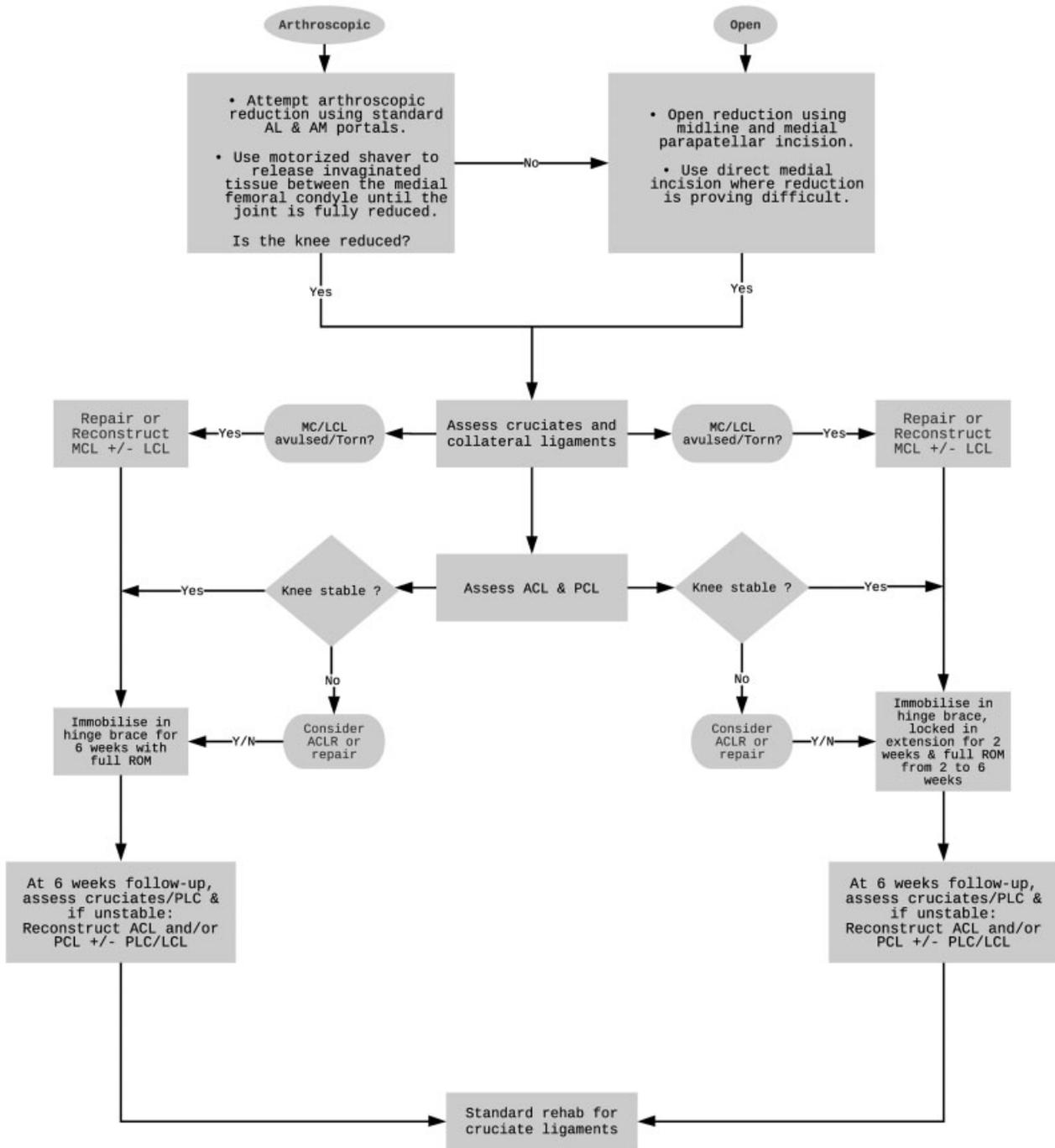


Fig. 6 Algorithm for the management of irreducible posterolateral knee dislocation without any vascular injury. ACL, anterior cruciate ligament; ACLR, ACL reconstruction; AL, anterolateral; AM, anteromedial; LCL, lateral cruciate ligament; MCL, medial collateral ligament; PCL, posterior cruciate ligament; PLC, posterolateral corner; ROM, range of motion.

the anteroposterior direction but had slight varus/valgus instability.²⁵ In the last case, a 53-year-old male was involved in RTA while riding on a motorbike.⁴⁸ He was initially treated by a bonesetter but presented 3 months later as he was unable to ambulate, and a PL dislocation was confirmed on X-ray and MRI. An open reduction was performed with PCL reconstruction at the same time and an external fixator was removed at 6 weeks. At 3 years follow-up, the patient was mobile independently and had ROM 0 to 90°.

Conclusion

The incidence of irreducible knee dislocation, although difficult to quantify, is extremely rare and PL dislocations are the most common types. Furthermore, chronic irreducible knee dislocations are even rarer and only a handful of case reports can be found in the literature. What is certain is that irreducible dislocations can be seldom reduced without surgery, whether arthroscopic or open. In all the cases in literature, there is only

one report²⁸ of closed reduction in an irreducible PL knee dislocation, which by definition does not mean irreducible. Although there is no consensus to the best treatment strategy for acute irreducible knee dislocations, we describe an algorithm (► Fig. 6) that can be used for management of PL knee dislocations when there is no neurovascular injury present.

Note

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Conflict of Interest

None declared.

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