Knee joint dislocation: overview and current concepts

Abstract

Knee joint dislocation is a relatively uncommon injury but its management is important because of the associated high risk of vascular, neurological and multi-ligamentous knee injuries. Clinicians must be aware that not all knee dislocations are diagnosed on plain X-rays; a high index of suspicion is required based on clinical evaluation. Multidisciplinary specialist care is required in all cases to achieve best outcomes. Early one-stage or multiple staged ligament repair and reconstruction offer better outcomes, but most patients have some long-term functional limitation. This article provides insights into the epidemiology and management of this injury and its devastating effects.

Key words: Knee dislocation; Knee joint; Multi-ligamentous knee injury; Neurovascular injury; Tibiofemoral joint dislocation

Submitted: 29 August 2021; accepted following double-blind peer review: 4 October 2021

Fitzgerald C Anazor[1]

Kwaku Baryeh[1]

Neville C Davies[1]

Author details can be found at the end of this article

Correspondence to:
Fitzgerald C Anazor; anazorfitzgerald@yahoo.com

Introduction

A knee dislocation occurs when there is complete loss of articular congruency between the distal femur and proximal tibial articulating surfaces. Multi-ligamentous injuries like bicruciate ligament injuries are also considered knee dislocations because of the mechanism of injury and associated neurovascular injuries (Wascher et al, 1997). Four key ligaments stabilise the knee: the anterior cruciate, posterior cruciate, medial and lateral collateral ligaments.

Dislocation of the native knee is a serious injury with significant neurovascular and multi-ligamentous damage that can be missed, especially in cases of spontaneous relocation (Robertson et al, 2006; McKee et al, 2014; Ng et al, 2020). This can be limb threatening in the acute stage (Medina et al, 2014) and also have significant long-term adverse effects on return to work and recreational activity (Robertson et al, 2006).

Timely diagnosis, early reduction, identification of the associated injuries via imaging and appropriate treatment can help reduce the incidence of serious complications and improve outcomes. Controversies still exist regarding the optimal timing of surgery and the technique of reconstruction of the associated complex multi-ligamentous injuries (Robertson et al, 2006). This article summarises key concepts for this significant but sometimes missed injury.

Epidemiology

Knee dislocations account for <0.02% of all orthopaedic injuries (Rihn et al, 2004), with 17% of these being open and 83% closed (Medina et al, 2014). The incidence of vascular injuries in knee dislocations is 18–32% and for nerve injuries is 25% (Green and Allen, 1977; Medina et al, 2014).

Knee dislocation is more common in men, with 52–65% of cases in men and 35–48% in women (Medina et al, 2014; Moatshe et al, 2017). The mean age of patients is 35 years with an inverse relationship between increasing age and incidence of knee dislocations (Medina et al, 2014).

Injuries to three major ligaments occurred in 52.4% of cases, with meniscal injuries in 37.8% of cases (Moatshe et al, 2017). About 16% of cases are associated with a peri-articular knee fracture (Robertson et al, 2006).

Motor vehicle accidents account for 52% of injuries while sports injuries, falls and multiple trauma account for 32%, 10% and 29% of injuries respectively (Robertson et al,

How to cite this article:
Anazor FC, Baryeh K, Davies NC. Knee joint dislocation: overview and current concepts. Br J Hosp Med. 2021. https://doi.org/10.12968/hmed.2021.0466

2006). Knee dislocations are bilateral in approximately 5% of cases (Robertson et al, 2006). High body mass index and open dislocations increase the risk of vascular injuries in knee dislocations (Weinberg et al, 2016).

There has also been increasing recognition of a cohort of patients who are obese or morbid obese sustaining low energy knee dislocation (Johnson et al, 2018). These patients are at significantly greater risk of vascular injury and the associated complications (Vaidya et al, 2015; Johnson et al, 2018).

Classification

Knee dislocation can be classified based on the direction of displacement of the tibia, using the Kennedy classification (Kennedy, 1963). This is shown in **Figure 1** with the incidence for each type of injury (Harner et al, 2004).

The anterior type (**Figures 2** and **3**) is the most common dislocation and is usually caused by a hyperextension injury. The posterior knee dislocation is usually the result of antero-posteriorly directed force as in dashboard injuries. Other types include medial, lateral (**Figure 4**) and posterolateral dislocations.

The most common sub-type for the Kennedy's posterolateral dislocation is the rotatory dislocation and is often irreducible, as the medial femoral condyle button-holes through the medial soft tissues resulting in a 'dimple or pucker sign' (Gray and Dieudonne, 2018).

The current classification based on the multi-ligamentous injury pattern and associated vascular injury (Schenck, 1994; Robertson et al, 2006) is shown in **Table 1**.

This classification offers more prognostic information to the surgeon. Some injuries may be unclassifiable on X-rays using the Kennedy classification, especially in cases of spontaneous relocation (Robertson et al, 2006). The KD-III injury is the most common type, accounting for 80% of cases. The KD-III injury (**Table 1**) has the highest incidence of associated vascular injury at 32%. For the Kennedy classification, posterior dislocations have the highest incidence of vascular injury at 25% (Medina et al, 2014).

Clinical evaluation

In patients who have sustained high energy injury mechanisms, the presence of knee dislocation is usually obvious and initial emphasis should be on identification and treatment of all life-threatening injuries using the Advanced Trauma Life Support protocol (ATLS Subcommittee et al, 2013). This should be followed by urgent reduction after obtaining plain anteroposterior and lateral X-rays of the knee in the emergency department.

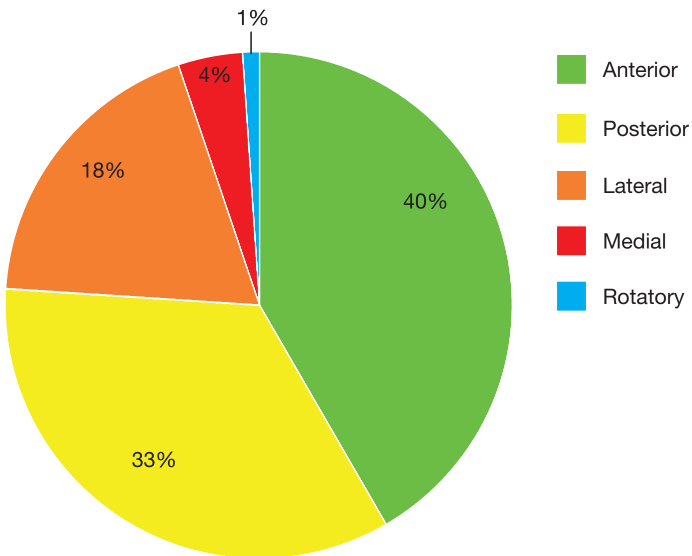

Figure 1. The incidence of each type of knee dislocation based on the Kennedy (1963) classification.

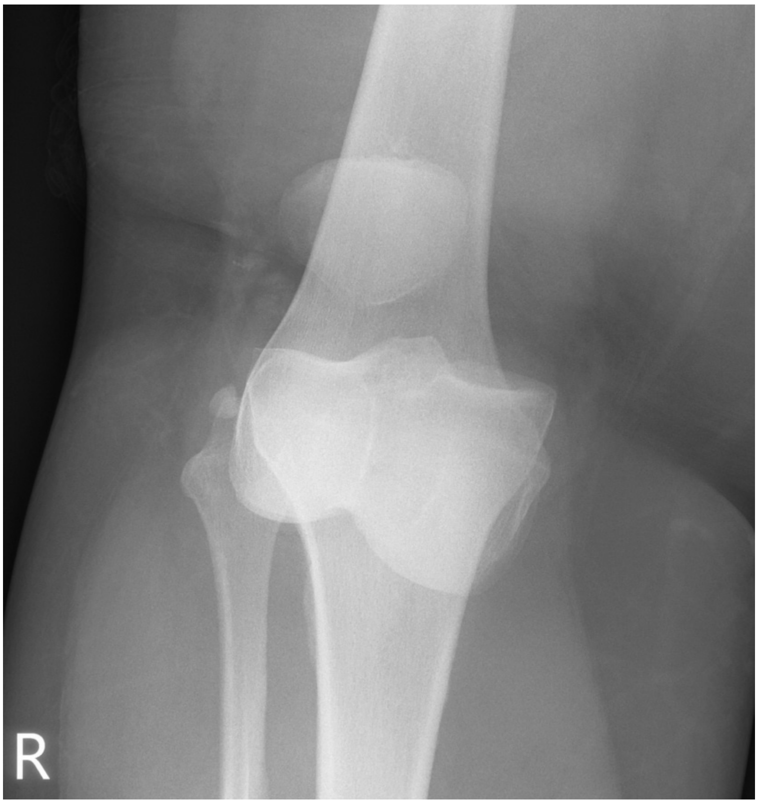

Figure 2. Plain anteroposterior radiograph for an anterior knee dislocation.

Figure 3. Plain lateral radiograph of an anterior knee dislocation.

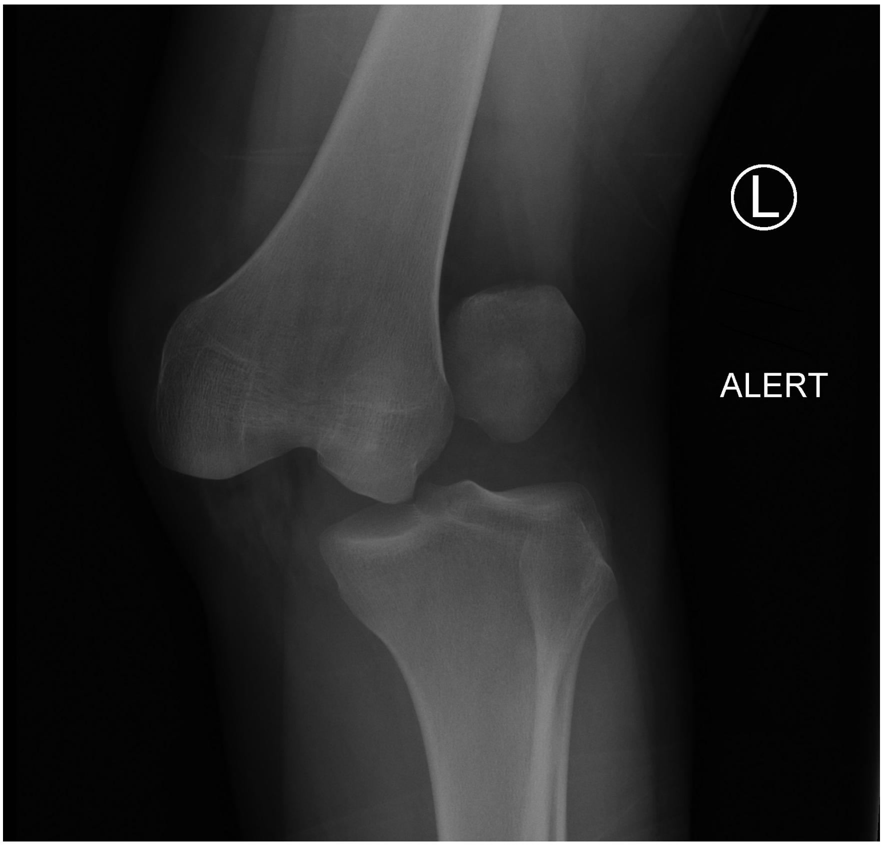

Figure 4. Plain anteroposterior radiograph of a lateral knee dislocation.

However, up to 50% of knee dislocations reduce spontaneously before presentation (Maslaris et al, 2018), and so a high index of suspicion should be maintained, particularly in the face of a multi-ligament knee injury. Low energy knee dislocations are more likely to pose diagnostic difficulty as the mechanism of injury (fall from standing or walking) and the body habitus of patients can mask the injury (Georgiadis et al, 2013). Figure 5 gives a proposed treatment algorithm.

A good history is important to ascertain the mechanism of injury, rule out other associated injuries, and take note of comorbidities and social factors that can affect patient management.

Table 1. Classification of knee joint dislocation based on multi-ligamentous injury pattern, modified from the Schenck classification

Classification		Associated ligamentous injury
KD-I		Dislocation with both cruciate ligaments intact
KD-II		Dislocation with bicruciate disruption only
KD-III		KD-II and posteromedial or posterolateral disruption
KD-IV		KD-II with posteromedial and posterolateral disruption
KD-V		Dislocation with associated fracture
	KD-V1	Dislocation with both cruciate ligaments intact
	KD-V2	Bicruciate dislocation only
	KD-V3M	Bicruciate disruption and posteromedial disruption
	KD-V3L	Bicruciate disruption and posterolateral disruption
	KD-V4	Posteromedial and posterolateral disruption

From Schenck (1994), Robertson et al (2006)

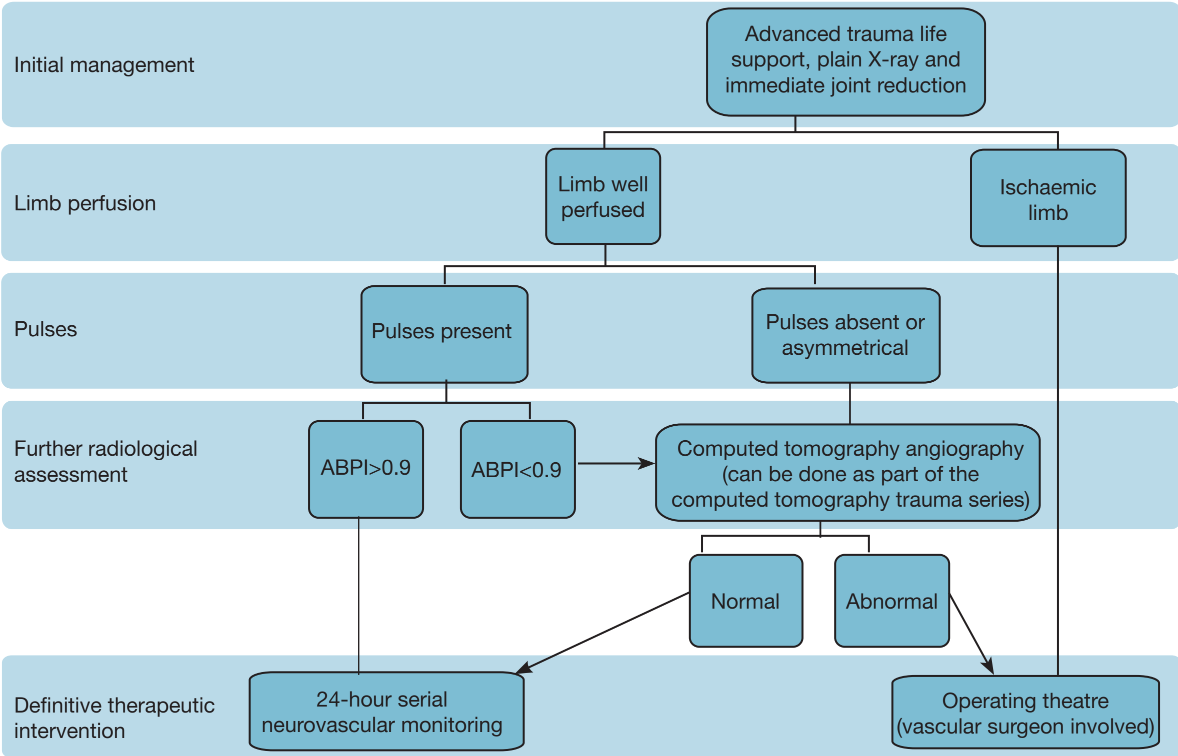

Figure 5. Proposed algorithm for the initial assessment and diagnosis of associated limb vascular injuries in a patient with a high energy knee dislocation presenting to the emergency department. ABPI= ankle–brachial pressure index.

Initial findings on examination of the injured knee include significant bruising, a haemarthrosis and recurvatum noticed when the knee is held in extension (which implies a posterior cruciate ligament injury). The presence of a 'pucker sign' implies a posterolateral dislocation and is usually difficult to reduce closed; this requires urgent open reduction in theatre. More specific tests like the Lachman and drawer tests may be difficult to perform in the acute setting because of severe pain and significant swelling from haemarthrosis.

A thorough examination of the injured limb for signs of vascular compromise (absent or diminished pulses, delayed capillary refill time, cold extremity, an expanding haematoma) should be performed and documented. It should be emphasised that the presence of distal pulses (dorsalis pedis and posterior tibial arteries) does not exclude the presence of a vascular injury, as up to 28% of such patients were subsequently found to have vascular arterial injuries (Weinberg et al, 2016).

All patients should have an ankle–brachial pressure index measured for both the dorsalis pedis and posterior tibial arteries as the combination of a normal ankle–brachial pressure index >0.9 with normal distal pulses has 100% sensitivity for the detection of vascular injury (Mills et al, 2004; Rihn et al, 2004; Weinberg et al, 2016). In practice, as the majority of these injuries are from high energy trauma, it is often easy to obtain a computed tomography angiogram at the same time as a computed tomography trauma series which can help identify any concurrent fracture as well as vascular injury (Schenck et al, 2014).

During the initial examination, the clinician should also assess for the presence of nerve injuries. The common peroneal nerve is more often injured than the tibial nerve (Rihn et al, 2004). About 28% of common peroneal nerve injuries are complete transections requiring surgery, while the rest are usually neuropraxias and can be managed conservatively (Niall et al, 2005).

Treatment

This will be determined by the presence or absence of vascular injury, open vs closed injuries, presence of polytrauma, reducibility of the dislocation in the emergency department, nature of the ligament injuries, presence or absence of nerve injuries, and available resources and expertise.

Patients with a normal triple physical exam (ankle–brachial pressure index, full volume dorsalis pedis and posterior tibial pulses) and no other clinical evidence of a vascular injury to the injured limb can be admitted for serial clinical examination for at least 24 hours, with a low threshold to switch to performing an urgent angiography if clinically indicated.

Patients with an ankle–brachial pressure index of <0.9 or other features that point to a vascular injury should have an urgent computed tomography angiography of the injured limb. This can be performed as part of the computed tomography trauma series in patients with polytrauma. The vascular surgeons should be consulted early as these patients may require emergency vascular surgery.

In all patients with an obviously ischaemic limb on presentation, following initial reduction, splinting and appropriate X-rays, emergency vascular exploration in theatre with or without on table angiogram is required with repair or bypass grafting by the vascular surgeon. To reduce the risk of amputation, there is usually no need to wait for an angiogram as a warm ischaemia time of more than 6–8 hours can result in an amputation in up to 86% of cases with limb ischaemia (Green and Allen, 1977).

Following restoration of the vascular supply to the injured limb in theatre, some knee stability should be restored (Figure 6) either via medial or lateral capsular exploration and repair and/or augmentation or via a bridging external fixator if these do not suffice (Robertson et al, 2006; Angelini et al, 2015). Delayed reconstruction of the cruciate ligaments (in 6–12 months) can be carried out to allow capsular healing so that an arthroscopically-assisted cruciate ligament reconstruction can be performed. This reduces the risk of fluid extravasation and possible compartment syndrome. It also allows time for maturation of the vascular graft so that a tourniquet can be used for the reconstruction procedure (Robertson et al, 2006).

Operative treatment of these ligament injuries usually offers better functional outcomes than non-operative treatment (Werier et al, 1998; Dedmond and Almekinders, 2001; Wong et al, 2004; Samuel et al, 2019). Treatment of these injuries via conservative management with bracing alone is only used in patients who are not fit for surgery because they have complex medical conditions (Venter et al, 2021). Operative treatment for the multi-ligamentous injuries could be early (<3 weeks), delayed (>3 weeks) or staged (Samuel et al, 2019).

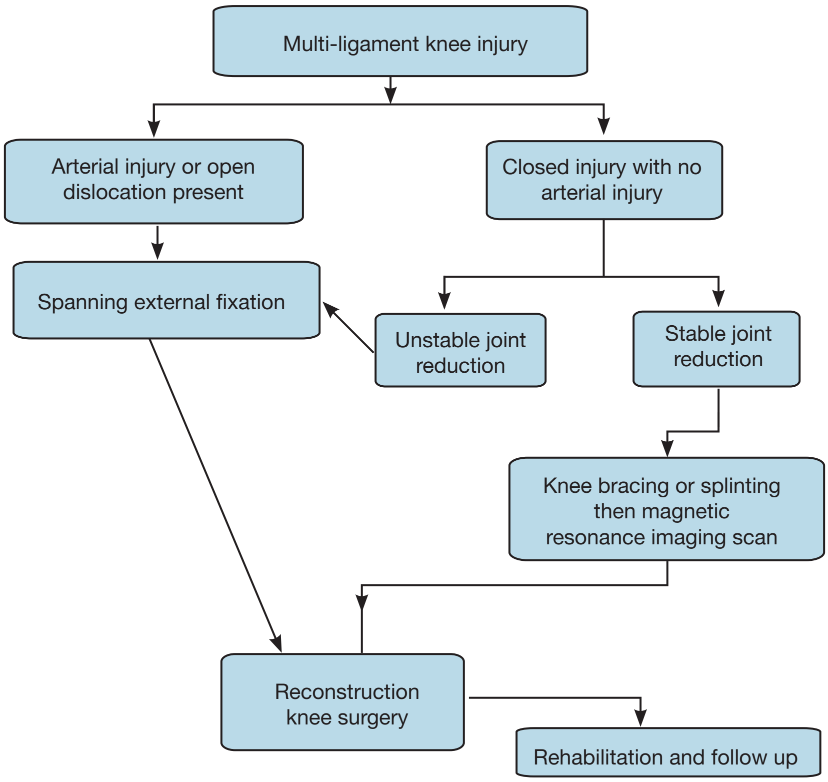

Figure 6. Proposed algorithm for addressing ligament injuries in a patient presenting with a multi-ligament knee injury or acute knee dislocation.

Some evidence suggests early operative treatment of the ligament injuries results in improved functional and clinical outcomes compared with delayed surgery (Levy et al, 2009).

In cases where there is no vascular injury, a single stage reconstruction of the cruciate and collateral ligaments can be undertaken (LaPrade et al, 2019; Goyal et al, 2021). However, multiple stage treatment offers the best clinical results if resources and the surgical expertise are available (Robertson et al, 2006).

Treatments for common peroneal nerve palsy depend on the location of the nerve injury, timing of presentation, associated injuries and the results of electro-diagnostic findings (Mook et al, 2013). The majority of patients with an incomplete palsy will regain full motor recovery while <40% of patients with a complete motor palsy will regain the ability to dorsiflex at the ankle (Woodmass et al, 2015). Treatment options for common peroneal nerve palsy include non-operative treatment via use of an ankle–foot orthosis and physiotherapy or operative treatment via surgery with options including nerve exploration, neurolysis, tendon transfer, nerve transfer and combined tendon–nerve transfer (Mook et al, 2013; Samson et al, 2016; Pardiwala et al, 2017).

Rehabilitation

Counselling patients before surgery about the steps and hurdles to anticipate during rehabilitation helps patients manage expectations and ensures better cooperation (Almekinders and Dedmond, 2000).

Accelerated postoperative rehabilitation with bracing and a cautious supervised regimen of early range of motion exercises reduces the risk of postoperative stiffness. Patients can be mobilised to partial weight-bearing postoperatively in a hinged knee brace for 6 weeks then progress to full weight-bearing for the next 3 months (Robertson et al, 2006).

There is mixed evidence regarding functional outcomes post-rehabilitation for knee dislocation injuries between patients with peroneal nerve injuries and those without (Hirschmann et al, 2010; Krych et al, 2014). Rehabilitation should be patient specific, taking account of comorbidities, pattern of injury, quality of repair or reconstruction, and associated neurovascular injuries (Lynch et al, 2017).

Complications

Despite modern surgical treatment techniques, patients with knee dislocations still have significant disability following treatment (Dedmond and Almekinders, 2001).

The most common complications include persistent pain (25–68% of patients), stiffness from arthrofibrosis (in 5–71% of patients, with 29% of these requiring repeat surgery for adhesiolysis), failure of one or more reconstruction or repair components, and post-traumatic arthritis in up to 50% of patients (Robertson et al, 2006; Pardiwala et al, 2017).

Other significant complications following treatment include some level of persistent instability and limp in 85% and 55% of cases respectively (Ríos et al, 2003). Heterotopic ossification as a complication is seen more commonly following a posterior cruciate ligament reconstruction in a patient with knee dislocation (Whelan et al, 2014).

Conclusions

While occurring infrequently, knee dislocation is associated with severe and potentially lifelong morbidity. Low energy dislocations associated with obesity create some diagnostic difficulties and a high index of suspicion should be maintained to minimise delays to treatment.

Author details

[1]Department of Trauma and Orthopaedics, Royal Berkshire Hospital, Reading, UK

Acknowledgements

Figures 1 and 2 are reproduced courtesy of Dr Henry Knipe, Radiopaedia.org, rID: 52613; Figure 3 is reproduced courtesy of Andrew Murphy, Radiopaedia.org, rID: 48228.

Key points

- Knee dislocation is a relatively uncommon orthopaedic injury but a high index of suspicion by the attending clinician is important to avoid missed diagnosis.
- The Schenck classification offers important prognostic information and acts as a guide to treatment.
- The presence of pedal pulses does not totally exclude vascular injury. Combining clinical examination with the ankle brachial pressure index reliably excludes vascular injuries.
- A multidisciplinary approach by specialists experienced in treating these injuries is vital.
- Early staged operative treatment offers better outcomes.
- Despite advances in treatment, 100% patient satisfaction on follow up is rarely attainable and patients should be counselled in the preoperative period.

Conflicts of interest
The authors declare that they have no conflicts of interest.

References

Almekinders LC, Dedmond BT. Outcomes of the operatively treated knee dislocation. Clin Sports Med. 2000;19(3):503–518. https://doi.org/10.1016/S0278-5919(05)70221-0

Angelini FJ, Helito CP, Bonadio MB et al. Surgical management of knee dislocations with ligament reconstruction associated with a hinged external fixator. Orthop Traumatol Surg Res. 2015;101(1):77–81. https://doi.org/10.1016/j.otsr.2014.11.001

ATLS Subcommittee; American College of Surgeons' Committee on Trauma; International ATLS working group. Advanced trauma life support (ATLS®): the ninth edition. J Trauma Acute Care Surg. 2013;74(5):1363–1366. https://doi.org/10.1097/TA.0b013e31828b82f5

Dedmond BT, Almekinders LC. Operative versus nonoperative treatment of knee dislocations: a meta-analysis. Am J Knee Surg. 2001;14(1):33–38

Georgiadis AG, Mohammad FH, Mizerik KT, Nypaver TJ, Shepard AD. Changing presentation of knee dislocation and vascular injury from high-energy trauma to low-energy falls in the morbidly obese. J Vasc Surg. 2013;57(5):1196–1203. https://doi.org/10.1016/j.jvs.2012.11.067

Goyal T, Paul S, Banerjee S, Das L. Outcomes of one-stage reconstruction for chronic multiligament injuries of knee. Knee Surg Relat Res. 2021;33(1):3. https://doi.org/10.1186/s43019-020-00083-y

Gray SF-M, Dieudonne BE. Pucker sign in irreducible posterolateral knee dislocation. Pan Afr Med J. 2018;30:153. https://doi.org/10.11604/pamj.2018.30.153.15365

Green NE, Allen BL. Vascular injuries associated with dislocation of the knee. J Bone Joint Surg Am. 1977;59(2):236–239

Harner CD, Waltrip RL, Bennett CH et al. Surgical management of knee dislocations. J Bone Joint Surg Am. 2004;86(2):262–273. https://doi.org/10.2106/00004623-200402000-00008

Hirschmann MT, Meier MD, Amsler F, Friederich NF. Long-term outcome of patients treated surgically for traumatic knee dislocation: does the injury pattern matter? Phys Sportsmed. 2010;38(2):82–89. https://doi.org/10.3810/psm.2010.06.1786

Johnson JP, Kleiner J, Klinge SA, McClure PK et al. Increased incidence of vascular injury in obese patients with knee dislocations. J Orthop Trauma. 2018;32(2):82–87. https://doi.org/10.1097/BOT.0000000000001027

Kennedy JC. Complete dislocation of the knee joint. JBJS. 1963;45(5):889–904

Krych AJ, Giuseffi SA, Kuzma SA, Stuart MJ, Levy BA. Is peroneal nerve injury associated with worse function after knee dislocation? Clin Orthop Relat Res. 2014;472(9):2630–2636. https://doi.org/10.1007/s11999-014-3542-9

LaPrade RF, Chahla J, DePhillipo NN et al. Single-stage multiple-ligament knee reconstructions for sports-related injuries: outcomes in 194 patients. Am J Sports Med. 2019;47(11):2563–2571. https://doi.org/10.1177/0363546519864539

Curriculum checklist

This article addresses the following requirements from the general internal medicine training curriculum:

- Managing an acute unselected take
- Managing patients in an outpatient clinic, ambulatory or community setting, including management of long-term conditions
- Managing a multidisciplinary team including effective discharge planning.

Levy BA, Dajani KA, Whelan DB et al. Decision making in the multiligament-injured knee: an evidence-based systematic review. Arthroscopy. 2009;25(4):430–438. https://doi.org/10.1016/j.arthro.2009.01.008

Lynch AD, Chmielewski T, Bailey L, The STaR Trial Investigators et al. Current concepts and controversies in rehabilitation after surgery for multiple ligament knee injury. Curr Rev Musculoskelet Med. 2017;10(3):328–345. https://doi.org/10.1007/s12178-017-9425-4

Maslaris A, Brinkmann O, Bungartz M et al. Management of knee dislocation prior to ligament reconstruction: What is the current evidence? Update of a universal treatment algorithm. Eur J Orthop Surg Traumatol. 2018;28(6):1001–1015. https://doi.org/10.1007/s00590-018-2148-4

McKee L, Ibrahim MS, Lawrence T, Pengas IP, Khan WS. Current concepts in acute knee dislocation: the missed diagnosis? TOORTHJ. 2014;8(1):162–167. https://doi.org/10.2174/1874325001408010162

Medina O, Arom GA, Yeranosian MG, Petrigliano FA, McAllister DR. Vascular and nerve injury after knee dislocation: a systematic review. Clin Orthop Relat Res. 2014;472(9):2621–2629. https://doi.org/10.1007/s11999-014-3511-3

Mills WJ, Barei DP, McNair P. The value of the ankle–brachial index for diagnosing arterial injury after knee dislocation: a prospective study. J Trauma Acute Care Surg. 2004;56(6):1261–1265. https://doi.org/10.1097/01.TA.0000068995.63201.0B

Moatshe G, Dornan GJ, Løken S et al. Demographics and injuries associated with knee dislocation: a prospective review of 303 patients. Orthop J Sport Med. 2017;5(5):232596711770652. https://doi.org/10.1177/2325967117706521

Mook WR, Ligh CA, Moorman CT III, Leversedge FJ. Nerve injury complicating multiligament knee injury: current concepts and treatment algorithm. J Am Acad Orthop Surg. 2013;21(6):343–354. https://doi.org/10.5435/JAAOS-21-06-343

Ng JWG, Myint Y, Ali FM. Management of multiligament knee injuries. EFORT Open Rev. 2020;5(3):145–155. https://doi.org/10.1302/2058-5241.5.190012

Niall DM, Nutton RW, Keating JF. Palsy of the common peroneal nerve after traumatic dislocation of the knee. J Bone Joint Surg Br. 2005;87-B(5):664–667. https://doi.org/10.1302/0301-620X.87B5.15607

Pardiwala DN, Rao NN, Anand K, Raut A. Knee dislocations in sports injuries. Indian J Orthop. 2017;51(5):552–562. https://doi.org/10.4103/ortho.IJOrtho_229_17

Rihn JA, Cha PS, Groff YJ, Harner CD. The acutely dislocated knee: evaluation and management. J Am Acad Orthop Surg. 2004;12(5):334–346. https://doi.org/10.5435/00124635-200409000-00008

Ríos A, Villa A, Fahandezh H, de José C, Vaquero J. Results after treatment of traumatic knee dislocations: a report of 26 cases. J Trauma Acute Care Surg. 2003;55(3):489–494. https://doi.org/10.1097/01.TA.0000043921.09208.76

Robertson A, Nutton RW, Keating JF. Dislocation of the knee. J Bone Joint Surg Br. 2006;88-B(6):706–711. https://doi.org/10.1302/0301-620X.88B6.17448

Samson D, Ng CY, Power D. An evidence-based algorithm for the management of common peroneal nerve injury associated with traumatic knee dislocation. EFORT Open Rev. 2016;1(10):362–367. https://doi.org/10.1302/2058-5241.160012

Samuel LT, Rabin J, Jinnah A et al. Management of the multi-ligamentous injured knee: an evidence-based review. Ann Joint. 2019;4(March 2019)

Schenck RC. The dislocated knee. Instr Course Lect. 1994;43:127–136

Schenck RC, Richter DL, Wascher DC. Knee dislocations: lessons learned from 20-year follow-up. Orthop J Sport Med. 2014;2(5):232596711453438. https://doi.org/10.1177/2325967114534387

Vaidya R, Roth M, Nanavati D, Prince M, Sethi A. Low-velocity knee dislocations in obese and morbidly obese patients. Orthop J Sport Med. 2015;3(4):232596711557571. https://doi.org/10.1177/2325967115575719

Venter S-M, Dey R, Khanduja V, von Bormann RPB, Held M. The management of acute knee dislocations: A global survey of orthopaedic surgeons' strategies. SICOT-J. 2021;7:21. https://doi.org/10.1051/sicotj/2021017

Wascher DC, Dvirnak PC, DeCoster TA. Knee dislocation: initial assessment and implications for treatment. J Orthop Trauma. 1997;11(7): 525–529. https://doi.org/10.1097/00005131-199710000-00011

Weinberg DS, Scarcella NR, Napora JK, Vallier HA. Can vascular injury be appropriately assessed with physical examination after knee dislocation? Clin Orthop Relat Res. 2016;474(6):1453–1458. https://doi.org/10.1007/s11999-016-4730-6

Werier J, Keating JF, Meek RN. Complete dislocation of the knee — the long-term results of ligamentous reconstruction. Knee. 1998;5(4):255–260. https://doi.org/10.1016/S0968-0160(98)00015-5

Whelan DB, Dold AP, Trajkovski T, Chahal J. Risk factors for the development of heterotopic ossification after knee dislocation. Clin Orthop Relat Res. 2014;472(9) :2698–2704. https://doi.org/10.1007/s11999-014-3730-7

Wong C-H, Tan J-L, Chang H-C, Khin L-W, Low C-O. Knee dislocations—a retrospective study comparing operative versus closed immobilization treatment outcomes. Knee Surg Sports Traumatol Arthrosc. 2004;12(6):540–544. https://doi.org/10.1007/s00167-003-0490-4

Woodmass JM, Romatowski NPJ, Esposito JG, Mohtadi NGH, Longino PD. A systematic review of peroneal nerve palsy and recovery following traumatic knee dislocation. Knee Surg Sports Traumatol Arthrosc. 2015;23(10):2992–3002. https://doi.org/10.1007/s00167-015-3676-7