BRITISH JOURNAL OF HOSPITAL MEDICINE

The locked knee

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Abstract

The acute locked knee is an orthopaedic emergency requiring prompt diagnosis and treatment. It can be classified as acute or chronic. The term 'locked knee' refers to a knee that demonstrates fixed flexion or which has a 'block' to complete extension. Some degree of active or passive extension may be achievable, but not full extension. The most frequent causes of a locked knee are a meniscal tear, rupture of the anterior cruciate ligament or loose bodies. Magnetic resonance imaging is the gold standard in diagnostic imaging. Knee arthroscopy is considered the gold standard in management. This article gives an overview of the presentation, assessment and management of the locked knee for core surgical, acute care common stem and emergency medicine trainees.

Key words: Anterior cruciate ligament rupture; Knee; Knee arthroscopy; Locked knee; Meniscal tear; Soft tissue knee

Submitted: 26 April 2022; accepted following double-blind peer review: 20 June 2023

Introduction

The term 'locked knee' in orthopaedics refers to a knee that demonstrates fixed flexion or which has a 'block' to complete extension. Some degree of active or passive extension may be achievable, but not full extension (Allum and Jones, 1986). This phenomenon is often associated with a sporting event but can also occur with relatively little trauma, such as standing up, crouching or even in the absence of injury.

Causes of the locked knee can be mechanical or non-mechanical, referred to as 'pseudo-locking'. This presents similarly to a locked knee but with no mechanical cause found (Allum and Jones, 1986). Meniscal tears are the most frequent mechanical cause, with other mechanical causes including anterior cruciate ligament tears, 'loose bodies' which may be related to previous knee surgery, degeneration, trauma or rarer conditions such as osteochondritis dissecans (Elsworth, 1983; Allum and Jones, 1986; Bansal et al, 2002; Chun et al, 2002).

Pseudo-locking does not usually require surgery and may be present in up to 50% of cases presenting with a locked knee (Allum and Jones, 1986). Adequate pain relief and subsequent muscle relaxation frequently unlocks and thus provides treatment in patients with pseudo-locking.

Magnetic resonance imaging is widely used to assess soft tissue pathology, following knee injuries. It has high sensitivity and specificity for anterior cruciate ligament tears and lesions of the menisci, although there are also false positive results (Cusmano et al, 2000). It has become common practice to obtain a magnetic resonance image in the majority of presentations of the acute locked knee, although clinical assessment remains essential (Abram et al, 2019).

The acute locked knee with a mechanical cause is an orthopaedic emergency, with magnetic resonance imaging the gold standard in diagnosis and arthroscopy the gold standard in treatment.

This article provides an overview of the presentation, assessment and management of the locked knee for core surgical, acute care common stem and emergency medicine trainees.

How to cite this article:
Rhind J-H, Khawar H, Webb M, Guthrie H. The locked knee. Br J Hosp Med. 2024. https://doi.org/10.12968/hmed.2022.0215

Anatomy and biomechanics

The knee is a modified hinge joint which consists of three functional compartments: the medial and lateral tibiofemoral articulations and the patellofemoral articulation.

Motion at the knee is complex with displacements occurring across multiple planes of motion. Joint stability is provided by a combination of passive and active movements of

the ligaments and capsule, the surrounding muscles and the bony geometry of the femur and tibia (Rahnemai-Azar et al, 2017).

The stabilising ligaments of the knee consist of the transverse, arcuate popliteal, oblique popliteal, anterior cruciate ligament, posterior cruciate ligament, medial collateral ligament, lateral collateral ligament, and popliteofibular ligament. All provide stability in a specific direction. The anterior cruciate ligament provides both translational and rotatory constraint, so is one of the most frequently injured ligaments (Abulhasan and Grey, 2017).

Two fibrocartilaginous menisci, the C-shaped medial and O-shaped lateral, are present between the medial and lateral femoral condyles and tibia. They have several important functions: they contribute to stability, load transmission, nutrition, joint lubrication and proprioception. They also increase the congruency of the surface area of tibiofemoral articulation to more evenly distribute body weight and to avoid point loading throughout range of motion. The medial meniscus is less mobile than the lateral, explaining the higher proportion of medial-sided meniscal injuries (Raj and Bubnis, 2021).

Pathoanatomy

Any condition that leads to a loose body or fragment which becomes trapped between the femoral condyle and tibial plateau during extension attempts of the knee, can cause locking. Frequently, this occurs in the notch itself such as in bucket handle meniscal tears, osteochondral fractures or with a ruptured anterior cruciate ligament. In the acute setting, rupture of the anterior cruciate ligament may lead to a locked knee through the associated haemarthrosis while chronically, the residual stump can lead to the development of a 'cyclops' lesion which can cause a fixed flexion deformity (Goh et al, 2008).

Bucket handle meniscal tears are the most frequently recognised cause of a locked knee (Bansal et al, 2002; Mohd Miswan et al, 2019). In younger patients, meniscal injuries are usually related to sporting activity, with twisting movements and hyperflexion causing shear forces across the menisci (Allum and Jones, 1986). Meniscal injuries are classified depending on their location, depth and pattern (Raj and Bubnis, 2021).

Meniscal injury is often associated with injury of the anterior cruciate ligament, most commonly lateral meniscus tears (Cipolla et al, 1995).

In a rupture of the anterior cruciate ligament, there may be a tear of the anterolateral ligament which can lead to a fracture of the lateral tibia plateau known as a segond fracture (Claes et al, 2014). The incidence of segond fractures associated with anterior cruciate ligament injuries ranges from 15% (Slagstad et al, 2020) to 58% (Mansour et al, 2014).

Other rarer causes of locked knee include osteochondral fractures, gouty tophi formation and synovial plicae (Hussin et al, 2014).

Clinical presentation

A patient with a locked knee will be unable to fully extend the knee. It is important to establish whether there is a definite history of traumatic injury that correlates with the clinical presentation (Bansal et al, 2002). It is also important to differentiate in the history if the injury is acute or chronic, as the acute locked knee is an emergency requiring urgent investigation and treatment (Table 1).

These patients may present to the clinician directly after the insult, with a painful swollen knee (haemarthrosis) which is usually associated with significant pathology within the joint (Maffulli et al, 1993), or may present later, after the initial inflammatory response has settled, as a result of ongoing problems with the knee.

Patients with osteoarthritis of the knee may present with a gradual decrease in range of motion of the knee and mobility, unlike the acute locked knee. This can be differentiated through the history, examination and X-rays.

The acute locked knee requires urgent assessment and treatment, as prolonged positioning in flexion may lead to permanent deformity and contractures as a result of tightening of the knee capsule and surrounding muscles such as the hamstrings. Furthermore, weight bearing on the affected limb will result in ineffective load distribution and may promote early osteoarthritis as well as a decreased salvage rate for meniscal tissue (Abram et al, 2019).

Table 1. Key clinical history and examination findings in the locked knee

Diagnosis	History	Clinical examination findings
Meniscal tear	Twisting mechanism, acute onset of pain, pain on movement of knee	■ Episodes of painful or painless locking that occur intermittently (particularly in bucket handle tear) ■ Reduced range of movement ■ Joint line tenderness ■ Positive Apley grind, Thessaly or McMurray test may be present ■ Delayed haemarthrosis
Anterior cruciate ligament rupture	Twisting mechanism, acute onset of pain, pain on movement of knee	■ Challenging to examine in acute setting because of haemarthrosis, acute pain and/or inability to move knee ■ Reduced range of movement ■ Acute haemarthrosis ■ Positive Lachman test, anterior drawer or pivot shift may be present ■ Episodes of painful or painless locking
Loose body	History of trauma may be present, may be painful or painless, may have preceding symptoms	■ Episodes of painful or painless locking that occur intermittently ■ Normal knee examination between acute episodes of locking

The true locked knee must be differentiated from pseudo-locking, where the patient anatomically has normal range of motion of their knee but is unable to fully extend the knee either as a result of pain or muscular spasm (McNally et al, 2002).

Clinical examination

The patient may be unable to mobilise or may only be able to mobilise with difficulty using walking aids and holding their knee in fixed flexion. The patient should be given adequate pain relief and the lower limbs exposed adequately to observe both knees on an examination bed. The knees should be observed for any obvious wounds, scars, swelling (effusion) or deformity (Figure 1).

The entire joint line should be palpated both medially and laterally to establish whether there is joint line tenderness. Joint line tenderness and effusion are the most sensitive clinical predictors of meniscal tears as a mechanical cause of locking (Bansal et al, 2002). To examine clinically for an effusion, a patellar tap, bulge or sweep test may also be performed.

Range of motion of the knee should be examined, both active and passive, and compared to the contralateral side. The range is from 0 to 140° (full flexion), but a small degree of hyperextension in the knee is normal and females have a larger range of motion on average than males (Centers for Disease Control and Prevention, 2022). The degree of fixed flexion and whether active extension is possible should be established (Innes et al, 2018). In the locked knee, further extension after analgesia is usually not possible as there is a mechanical cause, whereas in pseudo-locking there is no mechanical cause and after pain relief further extension is often possible.

Each ligament of the knee should be assessed, if pain allows. The anterior cruciate ligament can be tested with the Lachman or anterior drawer test. An intact anterior cruciate ligament should prevent forward translational movement of the tibia on the femur giving a firm end-feel (Innes et al, 2018).

The menisci should also be examined, if swelling and pain allows. Meniscal provocation tests such as McMurray's, Thessaly or the Apley grind test may help to detect meniscal tears. However, the sensitivity and specificity values of these tests do not allow diagnosis and they should be used in conjunction with the history and other investigations such as magnetic resonance imaging (Karachalios et al, 2005). It is important to forewarn the patient that these tests may cause discomfort, particularly in the acute setting – if pain is significant, the test should be abandoned.

When assessing the knee, it is important to compare clinical findings with those of the contralateral knee to establish abnormal findings.

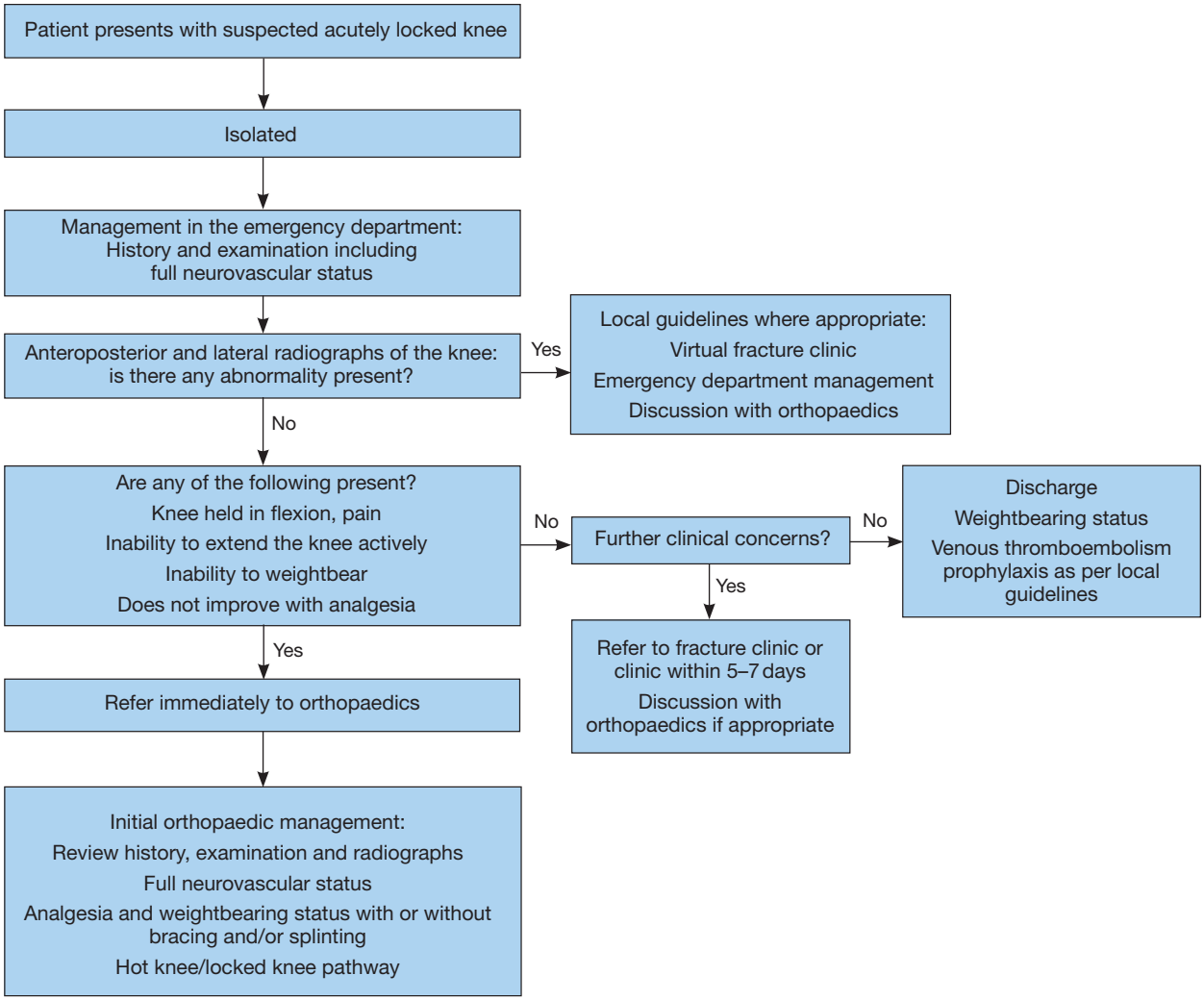

Figure 1. Initial assessment.

Investigations

All patients presenting with a suspected locked knee should have plain X-rays of the affected knee (including an anteroposterior and lateral view) to look for haemarthrosis; fractures and loose bodies may also be seen (Figures 2–4). In patients with a ruptured anterior cruciate ligament, a segond fracture may be seen. Plain X-rays may be normal if there is a purely soft tissue injury to the knee.

Every effort should be made to obtain magnetic resonance imaging which is the gold standard in diagnosis of the locked knee (Abram et al, 2019) (Figure 5). However, this may be difficult in the acute setting as some hospitals may not have access to dedicated musculoskeletal magnetic resonance imaging lists for acute pathology. Some patients may also have contraindications to magnetic resonance imaging such as a pacemaker or morbid obesity. A simple strategy for the emergency management of the patient with an acute locked knee is outlined below.

Treatment in the emergency department

The clinical history should include thorough details of the mechanism of the injury, timings, any preceding symptoms, the presence or absence of knee swelling and whether the locking has been consistent or intermittent.

The patient's comorbidities, medication and social history, including alcohol use, smoking, sport, exercise and activity levels, are important for preoperative preparation and postoperative rehabilitation.

Figure 2. Anteroposterior X-ray of the knee with intra-articular loose body. From Gaillard et al (2022).

Figure 3. Lateral X-ray of the knee with intra-articular loose body. From Gaillard et al (2022).

All patients should have their risk of venous thromboembolism assessed preoperatively and be treated accordingly, following local and National Institute for Health and Care Excellence (2019) guidelines.

The knee should be examined for the signs described above. Analgesia should be given to ensure that the inability to extend is not a result of pseudo-locking. A full neurovascular assessment of the affected limb should be carried out and documented. An accurate range of motion of the knee should be documented and compared to the normal side. For completeness of examination, the joints should also be assessed below and above the area of injury.

Figure 4. 'Notch' X-ray of the knee with intra-articular loose body. From Gaillard et al (2022).

Figure 5. Magnetic resonance imaging T2 sagittal scan of the knee illustrating the 'double posterior cruciate ligament sign' seen in bucket handle meniscal tears commonly associated with the locked knee. From Batta (2014).

Patients should be assessed on a case-by-case basis to see whether to allow weight bearing and to assess range of motion through the knee. Patients should be advised to take regular analgesia, eg paracetamol, which can be supplemented with non-steroidal anti-inflammatory drugs if tolerated. Young patients with an acute locked knee with a mechanical cause do not require blood tests. However, when the diagnosis is not clear or another differential

is suspected they may require further investigation, including full blood count, urea and electrolyte levels and urate. Measurement of inflammatory markers should be considered in patients with atraumatic acute knee pain and swelling to exclude infection.

Management

Acute

Once the diagnosis is confirmed with magnetic resonance imaging, the patient can be taken to theatre urgently in normal working hours, unless they are not a candidate for surgery, in which case they should be given non-operative management and analgesia. In theatre, an examination under anaesthesia may be performed first to establish the degree of range of movement and whether extension is possible under anaesthesia. This will help confirm whether a degree of pseudolocking is present and also acts as a reference point to re-examine post procedure and establish if further extension has been achieved (Bollen, 2000).

A diagnostic knee arthroscopy is performed to assess the entire knee and potential causes of locking as well as other incidental pathology. Meniscal tears are assessed to see whether they are amenable to repair or meniscectomy (partial or full). An anterior cruciate ligament tear should be assessed and may be debrided if this is contributing to locking. Concurrent anterior cruciate ligament reconstruction may be indicated in the setting of the acute locked knee with a meniscal tear as it protects against reinjury of the meniscus (through increased stability and inability to pivot against the meniscus). It is important that the patient has consented and met the operative requirements before undergoing concurrent anterior cruciate ligament reconstruction. It is important to establish that range of motion is regained after removal of the block to extension, failure to improve the range of movement may prompt the surgeon to perform further diagnostic arthroscopy for other possible causes. Osteochondral loose bodies are assessed – either to be repaired or excised if the fragment is too small or chronic. Other rarer causes such as plicae and gouty tophi may be debrided or excised.

Late presentation or diagnosis

When the patient with an acutely locked knee presents late or diagnosis is established late, management options are similar, but the need for urgent treatment is decreased because the likelihood of successful meniscus or osteochondral repair diminishes over time. Tengrootenhuysen et al (2011) demonstrated that meniscal repairs that were performed within 6 weeks of injury had better results (83%) than late repairs (52%).

Conclusions

The locked knee refers to an inability to fully extend the knee actively or passively. It is important to differentiate between true locking and pseudo-locking. There are many causes of the locked knee; meniscal tears are the most common but anterior cruciate ligament rupture and loose bodies are also possible causes. A thorough history and clinical examination and investigations can diagnose true locking. X-rays are a useful initial investigation, but magnetic resonance imaging is the gold standard for diagnosis. Arthroscopic knee surgery is the gold standard of treatment and should be performed urgently in a patient with an acute locked knee.

Key points

- The locked knee may be acute or chronic.
- The acute locked knee should be managed urgently and discussed with orthopaedics.
- Magnetic resonance imaging is the gold standard imaging for an acutely locked knee.
- Knee arthroscopy is the gold standard in treatment for a locked knee with causative pathology on magnetic resonance imaging.

Curriculum checklist

This article covers the following areas from the Acute Care Common Stem and Core Surgical Training curricula:

- Know the anatomy of the axial skeleton and joints
- Common soft tissue knee injuries to the knee (musculoskeletal trauma) – presentation, management and complications
- Be able to recognise which soft tissue knee injuries (musculoskeletal trauma) need an orthopaedic opinion and those that cannot be treated in the emergency department.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

Acknowledgements

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