

*Ministry of Defence*

## **Synopsis of Causation**

### **Internal Derangement of the Knee**

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## **Disclaimer**

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This synopsis has been completed by medical practitioners. It is based on a literature search at the standard of a textbook of medicine and generalist review articles. It is not intended to be a meta-analysis of the literature on the condition specified.

Every effort has been taken to ensure that the information contained in the synopsis is accurate and consistent with current knowledge and practice and to do this the synopsis has been subject to an external validation process by consultants in a relevant specialty nominated by the Royal Society of Medicine.

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# 1. Definition

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- 1.1. Internal derangement of the knee (IDK) is an inclusive term used to indicate (alone or in combination) certain disorders of the joint including (alone or in combination) torn meniscus, loose bodies in the knee, and damaged collateral or cruciate ligaments.
- 1.2. The term does not signify chronic disorders such as chondromalacia patellae, congenital discoid meniscus, meniscal cysts or degenerative processes such as osteoarthritis of the knee.

## 2. Clinical Features

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2.1. The following clinical features are likely to indicate a serious knee injury:

- A significant injuring force
- The patient being aware of a snapping or tearing sensation at the time of the injury
- The development of marked swelling within two hours indicating bleeding into the joint or haemarthrosis
- An immediate sensation of significant instability

2.2. **The Ligaments** The efficiency and mechanical stability of the knee joint depends to a great extent on the ligaments which attach the femur, tibia, and patella to each other. Ligaments may be sprained (and remain intact) or they may be ruptured. They may be injured singly or in combination producing so-called complex injuries. Two sets of knee ligaments are frequently affected by injury; the collateral ligaments (medial and lateral), and the cruciate ligaments (anterior and posterior).

2.2.1. **Collateral ligaments** The collateral ligaments lie outside of the knee joint proper and consist of the [medial](#) collateral ligament which opposes abductive ([valgus](#)) forces, and its counterpart, the [lateral](#) collateral ligament, which limits excessive adductive ([varus](#)) forces. These medial and lateral supporting structures are complex arrangements of ligaments, fascial layers, and tendon insertions. Injuries can therefore range from isolated single-structure injuries to complex injuries. In addition, the nature of the injuries can range from strains or partial tears to complete disruption.

- **Medial collateral ligament tears** The medial collateral ligament of the knee limits [valgus](#) during flexion of the joint, and isolated medial collateral ligament injuries occur during flexion, without any rotational component. However, medial collateral ligament rupture rarely occurs alone and is usually associated with other soft tissue injuries of the knee, such as anterior cruciate ligament and medial meniscal tears.
- **Lateral collateral ligament tears** Isolated injuries of the lateral collateral ligament result from an abnormal [varus](#) stress placed on an [internally rotated](#) knee. Like medial collateral ligament tears, isolated injuries of the lateral collateral ligament are uncommon. They usually occur in association with anterior- or posterior cruciate ligament tears. Complex lateral injuries are often more disabling than injuries of the medial structures because of the greater forces to which lateral structures are subjected during normal gait.

2.2.2. **Cruciate ligaments** The anterior cruciate ligament and the posterior cruciate ligament criss-cross within the joint, and brace against excessive forward and backward movement (i.e. movement in the anteroposterior plane), but are principally concerned

with controlling rotational knee stability on activity.

- **Rupture of the anterior cruciate ligament** is a serious and common knee injury and may occur in a variety of ways. The patient complains of a tearing sensation accompanied by immediate severe pain. Significant swelling occurs within two hours.
- **Posterior cruciate ligament injuries** typically occur when falling on a flexed knee or sustaining a direct blow to the [anterior aspect](#) of the knee for example from a vehicle dashboard. Such an injury rarely occurs without the involvement of other associated structures.

2.3. Grading of ligamentary damage injuries to the ligaments of the knee are usually graded on the following scale.

- **First-degree injury** involves microscopic damage to the ligament, but function is unimpaired and there is no instability. Pain and tenderness are present.
- **Second-degree injury** involves structural damage to the ligament with evident instability. Pain, tenderness, and swelling are more marked than in a first-degree injury.
- **Third-degree injury** involves complete disruption of the ligament. Total loss of function and instability is usually obvious. When more than one structure is injured, the clinical features may be confusing.

2.4. **The menisci** The menisci (the “cartilages”) are two “C”-shaped wedges of cartilage in the knee joint, positioned between the tibia and the femur. They act to deepen the articular surfaces of the otherwise relatively flat tibial plateau to accommodate the femoral condyles. Because the posterior horn of the medial meniscus has the least movement, it is at greatest risk for disruption. The menisci perform an essential role in the transmission of forces, distribution of load, amount of contact force and pressure distribution patterns within the knee.

2.4.1. **Meniscal tears** The nature and severity of symptoms vary according to the type of tear present and whether the medial or lateral meniscus is involved. The types of meniscal tears are:

- longitudinal tears that may take the shape of a bucket-handle if displaced
- radial tears
- flap tears
- horizontal tears (commonly seen in older patients without a history of trauma)
- complex tears that combine variants of the above

A so-called bucket-handle tear may cause the knee to “lock” (the patient is unable to fully extend the knee). These tears are frequently associated with rupture of the anterior cruciate ligament and may cause considerable pain, while a small radial

tear may only cause occasional discomfort.

2.5. The above structures do not act independently but instead work synergistically in ensuring the strength, stability and normal functioning of the knee joint.<sup>1</sup>

### 3. Aetiology

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- 3.1. The various ligamentary and meniscal injuries which are grouped together as internal derangement of the knee may be caused by a diverse range of sporting and athletic activities and work-related and vehicular accidents. Ligament disruption can occur without a fall or direct contact when sudden, severe loading or tension is placed on the ligaments, such as when a running athlete or sportsman plants a foot to suddenly decelerate or change direction.<sup>2</sup>
- 3.2. **Medial collateral ligament injury** A valgus force with or without a rotational stress to the knee is the most usual cause of this injury. The upper leg and body moves or twists in relation to the lower leg, which is held in a fixed position, usually because the foot is firmly planted on the ground and does not swivel, typically because of studded footwear.
- 3.3. **Lateral collateral ligament injury** Isolated lateral collateral ligament injuries are rare, and this structure is usually injured as a component of a complex posterolateral injury of the knee (posterolateral corner injury).<sup>3</sup> A direct blow to the medial aspect of the knee is the usual cause of isolated lateral collateral ligament tears. Injury to the posterolateral structures of the knee arise from a blow to the medial side of the joint with the knee in flexion and rotational forces placed on the knee at the same time.
- 3.4. **Anterior cruciate ligament injuries** These are seen much more frequently than posterior cruciate ligament injuries.
  - The most frequent contact mechanism of injury is a lateral blow to the partially flexed knee, common in soccer players. Coexisting medial collateral ligament injuries and meniscal tears are common
  - Anterior cruciate ligament tears are frequently caused by the non-contact “pivot-shift mechanism”. This usually occurs with cutting or twisting manoeuvres where rapid deceleration results in a [valgus](#) load being applied to the flexed knee, with an element of tibial rotation.
  - Non-contact [hyperextension](#) injury, such as that occurring in a gymnast who mis-times or misses a landing, is another mechanism that may result in anterior cruciate injury.
- 3.5. **Posterior cruciate ligament tears** These are relatively uncommon. They may be caused by a significant posteriorly-directed blow to the proximal tibia in 90 degrees of flexion, such as may occur in frontal impact motorcycle accidents, and occasionally these injuries are associated with a posterior hip dislocation. Posterior cruciate ligament tears may also occur with forced hyperextension while the foot is fixed in dorsiflexion, due, for example, to a heavy soccer or rugby tackle. These injuries are usually complex, resulting in damage to multiple structures at the back of the knee, including the so-called posterolateral corner.

- 3.6. **Tears of the meniscus** These injuries more often involve the medial meniscus than the lateral, in a ratio of more than 3 :1. Mechanisms of injury include rotational movement and repeated squatting, particularly in older individuals. Varus or valgus forces applied to a flexed knee may also cause meniscal injury. Major meniscal injury in young adults is frequently associated with acute ligament rupture and both menisci remain very vulnerable to tearing in a chronically unstable knee, for example where there is an untreated rupture of the anterior cruciate ligament.
- 3.7. The medial meniscus is attached to the capsule of the knee joint much more firmly than the lateral meniscus, hence the greater vulnerability of the medial meniscus to tearing. In the unstable knee however, the ratio of medial to lateral tears moves in favour of the lateral meniscus.
- 3.8. Meniscal tears are a fairly common sports-related injury among young men, particularly in those who play soccer, but occupational activity, adiposity, and joint laxity also appear to play a role.<sup>4</sup> There is a second peak of incidence in individuals over the age of 60; this is due to the vulnerability of the degenerate meniscus to injury when subjected to relatively minor trauma.



## 4. Prognosis

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- 4.1. The prognosis of internal derangement of the knee depends largely on the nature, severity and complexity of the underlying joint disruption, the type of treatment, the rehabilitative facilities available and the compliance of the patient.
- 4.2. Uncomplicated collateral ligament injuries are usually treated conservatively and the outcome is generally satisfactory. Complex collateral ligament injuries (usually associated with rupture of the anterior cruciate ligament and occasionally the posterior cruciate ligament) may result in significant symptomatic instability but in the majority of patients reconstruction surgery is directed at the cruciate ligament rather than the collateral ligament.
- 4.3. Patients with anterior cruciate ligament injury have variable knee instability that is likely to limit pivoting sport activity and may limit normal daily activities. Occasionally anterior cruciate ligament injury consists of avulsion of the bone attachment, in which case satisfactory healing may occur. However, rupture of the substance of the anterior cruciate ligament is unlikely to heal, and long-term functional impairment is common. In addition to symptomatic instability, patients with chronic anterior cruciate ligament rupture are very vulnerable to recurrent tears of one or both of the menisci and the secondary development of osteoarthritis. For this reason most active younger patients are treated with ligament reconstruction surgery.
- 4.4. Isolated posterior cruciate ligament rupture is relatively uncommon and does not usually result in significant symptomatic instability, so that even committed athletes may be able to function quite well at their chosen sport. There is however an increased liability to further injury and the development of osteoarthritic changes. Unlike surgery for anterior cruciate ligament rupture, isolated posterior cruciate ligament reconstruction has a relatively low surgical success rate and is rarely recommended. Complex posterior cruciate and posterior capsular injuries present a considerable challenge as the consequences of instability are usually significant for the patient both in terms of symptomatic instability and the development of late degenerative changes. Consequently the results of what can be very complex surgical reconstruction can be disappointing.
- 4.5. The role of quality rehabilitation, usually supervised by a physiotherapist, must be emphasised both in the post-injury situation and following surgery.
- 4.6. There is an inverse direct relationship between the volume of intact healthy meniscus and the development of osteoarthritis, and therefore all aspects of management of meniscal injury should emphasise a conservative approach. The outer third of the C-shaped meniscus rim is [vascularised](#) with a potential for healing provided the knee is stable, and meniscal suture to achieve a stable repair is an option in these cases. Minor meniscal tears may not require surgery and in those patients in whom arthroscopic surgery is appropriate, only the damaged part of the meniscus should be removed to minimise the risk of osteoarthritis.

## 5. Summary

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- 5.1 Internal derangement of the knee is an inclusive term used to indicate (alone or in combination) meniscal tears, and damaged collateral and cruciate ligaments.
- 5.2 Clinical features, management and prognosis depend on the nature and complexity of the injury. These conditions arise as a result of trauma, involving some combination of horizontal, vertical and rotational forces acting on the joint.
- 5.3 Cruciate ligament injuries and meniscal tears carry an increased risk of osteoarthritis of the joint with advancing age.

## **6. Related Synopses**

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Anterior Knee Pain

Osteoarthritis of the Knee

Chondromalacia Patellae

Knee Ligament Damage

Osteochondritis Dissecans

## 7. Glossary

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anterior	Nearer the front.
anteromedial	The inner aspect of the front of a structure.
dorsiflexion	In the foot: an upward movement at the ankle joint.
external rotation	A movement which rotates the front of the limb outwards, away from the midline.
femoral condyles	The two bony protuberances at the lower end of the femur.
hyperextension of knee	Straightening of the knee beyond its natural range.
internal rotation	A movement which rotates the front of the limb inwards towards the midline.
lateral	Outer; i.e. away from the midline.
medial	Inner; i.e. towards the midline.
meniscus	The “cartilage” of the knee. Hence <i>meniscal</i> .
posterior	Further back in position, or behind.
posterolateral	Behind, and to the outer side.
valgus	A force acting in an inward direction: i.e. towards the midline of the body.
varus	A force acting in an outward direction: i.e. away from the midline of the body.
vascularised	Possessing a blood supply.

## 8. References

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<sup>1</sup> Beynnon BD, Johnson RJ, Coughlin KM. Relevant Biomechanics of the Knee. In: DeLee J, Drez D, editors. DeLee and Drez's orthopaedic sports medicine. 2<sup>nd</sup> ed. Philadelphia: Saunders; 2003. p. 1577-92.

<sup>2</sup> Miller RH. Knee Injuries. In: Canale ST, editor. Campbell's operative orthopaedics. 10<sup>th</sup> ed. St Louis: Mosby Inc; 2003. p. 2165-2325.

<sup>3</sup> Davies H, Unwin A, Aichroth P. The posterolateral corner of the knee. Anatomy, biomechanics and management of injuries. *Injury* 2004;35(1):68-75.

<sup>4</sup> Baker P, Coggon D, Reading I et al. Sports injury, occupational physical activity, joint laxity, and meniscal damage. *J Rheumatol* 2002;29(3):557-63.