Multiple ligament injuries of the knee

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Abstract

Multi-ligament injuries of the knee are complex. A high index of suspicion for knee dislocation having occurred at the time of injury is necessary, as many dislocations spontaneously reduce and are therefore occult. Significant vascular and neurological injuries often occur at the time of injury and need to be diagnosed and managed. Consequently, there should be a low threshold for angiography. MR imaging is a useful aid but careful clinical examination is essential. Non-surgical management is, in general, not advocated but has a role for structures that have a high chance of healing such as the medial collateral ligament. Good results from surgery can be obtained, especially when surgery occurs within 2–3 weeks post-injury, but this is only possible in uncomplicated cases. An osteotomy may be necessary in chronic cases, especially if the posterolateral corner is affected. The patient should be warned of prolonged rehabilitation, which may take up to 2 years before the full result is achieved. With appropriate treatment a majority of patients can return to pre-injury levels of work and daily activity. Higher level function is much less certain.

Keywords knee dislocation; multi-ligament injury

Background

The term 'multi-ligament' injury includes a spectrum of severity of knee injury, ranging from a cruciate ligament rupture plus a minor tear of a collateral ligament to frank dislocation of the tibiofemoral joint. Since most dislocations spontaneously reduce, their incidence is considerably higher than may initially be apparent.[1] Any knee with ruptures of three or more ligaments or a major disruption of two ligaments is likely to have been dislocated at the time of injury. Awareness of this is important because of the risk of neurovascular injury associated with knee dislocation.[2] Although the majority of these severe injuries are associated with major trauma, in the morbidly obese, knee dislocation can occur with relatively minor injury, such as even just tripping.[3–5]

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Acute management

Awareness of the potential for a knee dislocation is important.[1,6] Any knee that has multiple plane laxity may have dislocated, and particularly one in which a tense haemarthrosis is lacking due to leakage of blood into the soft tissues through capsular tears.[7]

Neurovascular injury should be ruled out.[5,8] The author's preference is that all such knees should have an angiogram, as Doppler assessment cannot identify intimal flap tears of the artery that may need surgery. Some authors have however published that following a protocol, with careful clinical examination, selective angiography can also be safe.[9]

If the knee is dislocated at presentation, it should be reduced immediately. Sometimes the knee is irreducible by closed means if the femoral condyle (usually medial) has protruded through a rent in the soft tissues. The initial management for the knee joint is then to maintain congruent reduction. If the posterior cruciate ligament (PCL) is ruptured and posterior subluxation allowed to persist, a fixed posterior subluxed contracture can develop. Regular radiographs to ensure maintenance of congruent reduction are important.

Usually, an adequate brace will suffice, and will allow early joint motion. Combined with ice, this reduces swelling and avoids early contracture formation. Bridging external fixation should only be used to protect arterial repairs or reconstructions. In other circumstances, an external fixator interferes with the ability to treat the soft tissues properly, runs the risk of pin tract infections and frequently holds the joint in a subluxed position. It is only indicated in the absence of vascular injury if the reduction cannot be maintained by bracing/casting.

Plain radiographs are essential to rule out significant fractures. Major fractures occur uncommonly with multi-ligament injuries, but small avulsion fractures are very characteristic. MRI scanning helps to establish the anatomy of the injury, but is no substitute for clinical assessment, which gives greater detail about the severity of any instability.

Surgical management

There are few justifications for non-surgical management of a knee that has dislocated.[10] Non-surgical management can lead to an unfortunate combination of stiffness with instability and rapid deterioration with chondral damage. There is still considerable debate as to whether surgical repair or reconstruction of the injured ligaments should be undertaken within the first 2–3 weeks, or delayed 6–12 weeks. Certain factors may determine the options available. If vascular reconstruction has been undertaken or there has been an open injury, then delayed treatment of the ligaments may well be necessary. The best results from treatment occur when surgery is undertaken around 2 weeks from injury.[11,12] Any time after this, the repair of ruptured soft tissues is often impossible and only reconstructive procedures can be undertaken. In particular, posterolateral injuries are amenable to repair. The results of successful repair are always superior to reconstruction, presumably due to the restoration of normal anatomy with concomitant proprioception. In addition, where the cruciate ligaments are avulsed from bone, they too can be repaired with success. By reconstructing or repairing all injured ligaments simultaneously, there is less risk of overload of each individual

repair or reconstruction undertaken. The provision of congruent joint surfaces and stability throughout the range of motion allows the soft tissue envelope of the joint to heal at appropriate tension, and is protective of the chondral tissues. Early mobilization also aids restoration of neuromuscular control of the limb.

In carefully selected injuries, especially those with no or only a minor PCL injury and associated MCL injury (even severe disruptions), the senior author's experience is that preliminary non-surgical treatment is preferable to early surgery.

Management of ligamentous injuries

These injuries are complex, and particularly if early surgery is required then it is best to involve specialist early in the management of such cases.[13]

Careful pre-operative assessment is crucial in making the necessary surgical plans. Although most multi-ligament injuries associated with dislocation require early surgery, a number of injury patterns involving the MCL and more minor PCL injuries are best treated initially non-surgically, to allow these structures to heal with bracing.[14] This greatly reduces the amount of surgery that is subsequently required.

Clinical evaluation of the knee includes observation of patterns of bruising and clinical tests of ligament laxity, and will establish which structures are injured. Plain radiographs (including long leg alignment films in chronic cases) are essential. MRI scanning is helpful and also highlights significant osteochondral lesions or meniscal pathology. The imaging will not only determine what is injured, but where the injury to the ligaments resides. Arthroscopic evaluation also helps determine where in a ligament the disruption has occurred. It is especially useful to see where the meniscus resides in a joint compartment, and hence it can be seen if the injury is above or below the meniscus or both. To plan surgical strategy, not only is it imperative to know which ligamentous structures need addressing but also at which sites.

Management of each component of the ligament injury

Anterior cruciate ligament

Even with an isolated ACL rupture, the majority of young active patients benefit from reconstructive surgery. Surgical options include reconstruction or repair. In the context of a multiple ligament injury to the knee however, surgical management of the ACL is essential. Due to the restraints of time and complexity of such major surgery, 'double-bundle' techniques are not appropriate.

Posterior cruciate ligament

The most appropriate clinical examination is the posterior drawer test. With the foot (and therefore tibia) in the neutral rotation and the knee at 90 degrees of flexion, the tibia is pushed posteriorly. If a tibiofemoral 'step off' is present but less than the normal side, then this represents Grade 1 laxity. If the tibia is level with the front of the femur (i.e. there is no step off) then this is Grade 2 laxity. If the tibia has sagged behind the distal femur then this represents Grade 3 laxity. If Grade 3 laxity is present then there is virtual certainty of concomitant injury to one or both collateral ligament complexes.

The extra-synovial nature of the PCL means that it does have some capacity to heal.[15] If the other ligament injured is the MCL, which also has significant healing capacity, bracing is appropriate. Bracing many of the combined PCL/MCL injuries (as long as the PCL component is minor) for 6 weeks may restore normal stability, and if not then any subsequent surgery required will be much more minor than if undertaken at the very early stage. Nevertheless, if it is clear at clinical assessment that there is gross disruption of the PCL (in the senior author's practice all cases of Grade 2 PCL laxity or more, and Grade 1 PCL laxity with associated posterolateral ligament complex +/− ACL ruptures), early reconstruction is usually preferable.

Isolated Grade 1 injuries of the PCL should be managed non-surgically, and invariably do well with this. Grade 3 ligament injuries have a poor prognosis and will require early reconstruction/repair (Figure 1). This will invariably involve treatment of at least another ligament disruption. Controversy still reigns regarding the isolated Grade 2 lesions. Patients will often function well with this injury, but there is mounting evidence of significant arthritic damage in the longer term. There is as yet no evidence, however, that early stabilization in this way reduces the long-term risk of arthritis.

The PCL has two functional bundles of fibres, the anterolateral, which is more important, and the posteromedial bundle. Even in cases of complete rupture of both bundles of the PCL, *in vitro* 'bench' testing shows that the addition of a second posteromedial bundle to the reconstruction offers only modest benefit. In the context of acute reconstructions for knee dislocation, most surgeons would only undertake a single bundle reconstruction because of time pressure and a desire not to

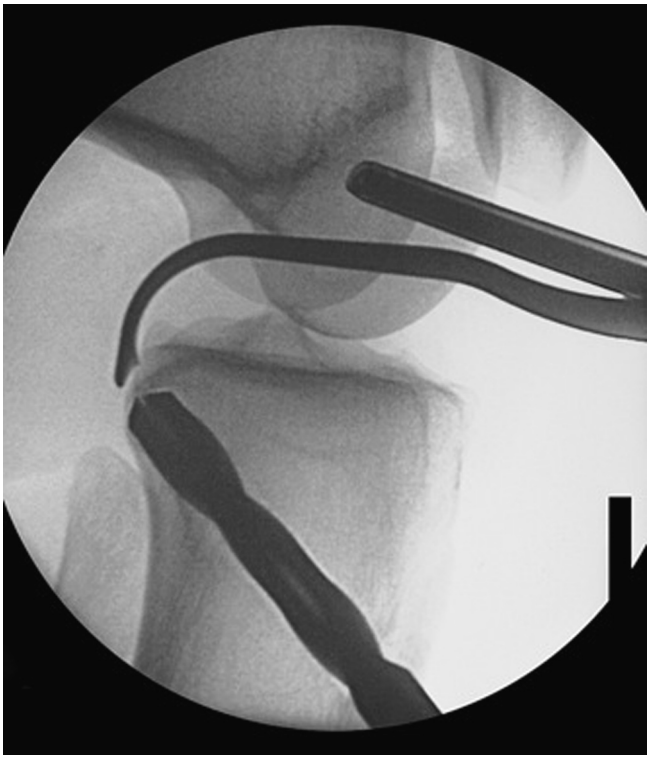

Figure 1 Lateral intra-operative radiograph illustrating tibial tunnel placement for PCL reconstruction.