Knee injuries in football

Knee injuries are particularly common in football.

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Football is one of the most popular sports in the world, with an estimated 240 million (in 2000)[1] to 265 million (in 2006)[2] players participating in the game. The sport involves intermittent walking, jogging, running and sprinting, and has a higher incidence of injuries than rugby, volleyball, field hockey, cycling, boxing, swimming and basketball.[1] In 2001 it was reported to have injury rates of 1 000 times higher than for industrial occupations generally regarded as high risk.[3]

Due to the biomechanical factors inherent in football and it being classified a contact-collision sport, the knee is exposed to both intrinsic and extrinsic forces that make it highly susceptible to injury.[4] Ball size, shoe wear, protective equipment, and playing surface conditions are all mechanical factors that can be potentially modified if implicated in injuries. However, individual playing styles and techniques are less easily controlled.

The knee is particularly susceptible to injury, as it is the centre of the lever of the leg, and sustains greater forces transmitted from the ground through the ankle and foot, as well as from the trunk down through the hip.

Epidemiology

Given the popularity of the sport it is surprising that until recently there have been few well-controlled, long-term prospective studies of football injuries. There are many cohort studies that examine injuries during a season, but due to variations in the definition of injury, the method of data collection and the goals of the studies consistent trends are hard to observe.[5] The prospective studies of injuries occurring during tournaments are better controlled but tend to have a higher incidence of injury reported than those observed in other studies. This may be because even minor injuries are recorded, not just those that result in lost playing time. The knee is particularly susceptible to injury, as it is the centre of the lever of the leg, and sustains greater forces transmitted from the ground through the ankle and foot, as well as from the trunk down through the hip.[1]

The incidence of knee injuries during competition is 15 - 19% of all injuries. Of these, 35 - 37% are strains, 20 - 21% sprains and 16 - 24% contusions. However, knee injuries account for 58% of all major injuries.[6-8]

The three main factors that contribute to an increased risk of knee injury in football are the age of the player, a previous injury and the ligamentous status of the knee.

The three main factors that contribute to an increased risk of knee injury in football are the age of the player, a previous injury and the ligamentous status of the knee.[9] Females sustain more injuries during training than males, whereas males sustain more injuries during competition,[1] and particularly during competition in contact situations, with the tackled player being the more susceptible to injury. The playing environment has a role, with a higher number of injuries in indoor football, of which the majority are non-contact. It is not surprising that foul play was identified as a risk for a major knee injury, with 20% of illegal activity-related knee injuries requiring surgery.

The high incidence of major knee injuries in female players is of great concern, with the incidence of anterior cruciate ligament (ACL) injuries being nearly 7 times higher than previously reported. The majority are non-contact injuries that occur with a change in direction. Many aetiological factors have been considered and include anatomical and structural differences between men and women, muscle strength and neuromuscular activation patterns as well as hormonal influences on knee stability.[10]

Classification

Any classification system should be of prognostic or outcome benefit. Most commonly the injuries are either acute or chronic

Table I. Factors predisposing to injury[4,8,15]

Intrinsic	Extrinsic
Body weight/composition	Playing surface
Gender	Equipment (e.g. shoes)
Lack of flexibility	Climatic conditions
Muscle imbalance	Inadequate warm-up
Muscle weakness	Nutritional factors
Previous injury	Overtraining/undertraining
Podiatric abnormality	Inadequate rehabilitation from previous injury
Muscle fatigue	Level of experience
Spinal abnormality	Faulty technique
Limb length discrepancy	Foul play

Table II. Differential diagnosis of traumatic haemarthrosis[15]

Causes of traumatic knee haemarthrosis

- Major ligament rupture: ACL, PCL
- Patella dislocation
- Intra-articular fracture
- Chrondral injury
- Peripheral teat of meniscus
- Hoffa's syndrome
- Bleeding diathesis

or differentiated by site, being intra- or extra-articular, or by structure (muscle, ligament, cartilage or tendon).

Acute knee injuries

Knee injuries in football are of great concern because they result in substantial physical disability, financial cost and lost playing hours, and may even end a career. Knee injuries are the most common reason for surgery in football and of all injuries observed in football, knee injuries accounted for the most time lost.

General principles of injury management

One of sports medicine's major features is its focus on injury prevention. It is imperative when assessing a patient to first accurately diagnose the presenting condition, but also to identify the underlying cause of the injury so that this too may be addressed as part of the treatment plan, in an attempt to prevent recurrence. Factors predisposing to injury are divided into intrinsic and extrinsic factors, some of which are listed in Table I.

Collateral ligament

Fortunately the majority of knee injuries are strains involving the ligaments. The medial collateral ligament (MCL), which resists valgus and internal rotation, is susceptible to contact and non-contact loads. The MCL is the most commonly injured ligament in the knee.[13] In an audit of soccer injuries in 2004, Price *et al.* found that while the knee only accounted for 18% of soccer injuries, MCL injuries represent 85% of these injuries.[14] Isolated MCL injuries are either grade I or II depending on severity, while a grade III involves the posterior oblique ligament as well. The MCL forms part of the capsule of the knee joint, and is attached to the medial meniscus. Severe injury of the MCL is therefore often associated with a significant effusion and may also be associated with meniscal injury.

X-rays are of value in diagnosing osteoarthritis and fractures, but fractures are only seen in 6 - 11% of X-rays performed on knees.

In half the cases a 'pop' is usually felt. Tenderness is usually palpable over the femoral condyle (58%), joint line (25%) and tibia (17%). Localised swelling is often present, with players complaining of pain with weight bearing and a feeling of instability. ACL injuries may accompany MCL injuries if the causative extrinsic force is sufficient. A combination injury which includes the MCL, ACL and medial meniscus simultaneously is referred to as O'Donoghue's triad or the 'terrible triad'.

Surgery is rarely required except for those cases of multiple ligament injuries. In a recent questionnaire in 2009 to orthopaedic surgeons by the International Society for Arthroscopy, Knee and Orthopaedic Sports Medicine (ISAKOS) 25% of respondents elected to treat the injury with a functional programme including unlimited range of movement, weight bearing to tolerance, physiotherapy, and taping. A brace was used in 69% of cases, most commonly locked in extension for the first few weeks. Results were reported as excellent/good in 95% of injuries although at 3 months 20% still experienced discomfort while playing.[15]

Anterior cruciate ligament

ACL injuries have the highest morbity of knee injuries for football players and result in the most time lost. The incidence of ACL injury ranges from 0.06 to 3.7 per 1 000 hours of active soccer play, with females being 2 - 8 times more likely to sustain non-contact ACL injury than males.[16]

Female players have almost a 2 times higher incidence of ACL injuries than men.[17] ACL injuries occur as a result of a combination of a deceleration and twisting on a planted foot with an extended or near fully extended knee. The result is a varus or valgus strain combined with internal or external rotation of the tibia on a fixed foot, combined with an anterior translation force.[16] The player usually describes a 'popping' feeling with a sensation of giving way. The presence of a knee haemarthrosis (Table II) is positive for an ACL injury in 70% of cases. A clinical diagnosis is made by assessing the increased anterior laxity at both 200 and 900 known as the Lachman and drawer test respectively, with the former being the more definitive. The pivot shift test is an evaluation of the rotary instability experienced by the player. Diagnosis may be difficult in the acute setting due to pain. It is often necessary to request an MRI investigation because of associated meniscal tears (55% - 65%) and chondral lesions (20%). There is no place for performing a 'diagnostic' arthroscopy to determine the nature of the injury. When performed, this is a definitive management intervention (Fig. 1).

The active patient with an ACL-deficient knee is at risk for repeated episodes of instability, meniscal and articular cartilage

Fig. 1. Arthroscopic view of a torn ACL.

injury, early joint degeneration, and a decline in joint function.[18] There is a large variation in the management and rehabilitation approach by surgeons on different continents.[19] Few football players are able to remain competitive with an ACL-deficient knee despite strengthening and bracing, and surgical reconstruction should be recommended for all players wishing to continue the sport. Surgery is usually delayed to start 'pre-habilitation' until the swelling has subsided and near to normal range of motion has been achieved. Reconstruction is performed using an autologous graft with the most common choices being either bone patellar tendon or quadruple hamstring grafts (Fig. 2). The use of allografts is gaining in popularity but is not recommended for high-level athletes due to their higher failure rate.[20]

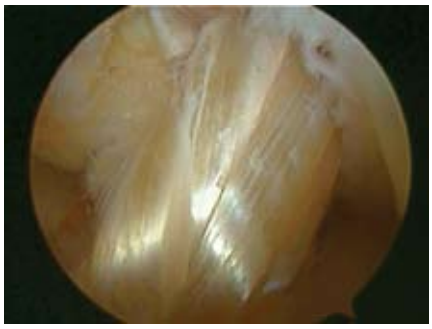

Fig. 2. ACL reconstruction using quadruple hamstring graft.

Successful return to a pre-injury level of football is possible, although the success rates may vary from 50% to 90%.[21-23] Players participating at a higher level of competition tend to have a more successful outcome. Recent studies specific to football have shown that a high percentage of players studied gave up football because of poor knee function or fear of a new injury regardless of the treatment.[22] However, most of these studies in the 1990s were performed using different surgical techniques to those of today. Currently there is a greater understanding of the biomechanics of the ACL and the placement of the graft, the result of which has been shown in recent studies to have superior outcomes. The present understanding of the anatomy of the ACL is that it comprises two separate bundles, which should be individually reconstructed. These double-bundle reconstructions restore the natural biomechanics to the knee but more follow-up is required to see if this occurs in the clinical setting. A full return to football is between 6 and 9 months but full neuromuscular control may take as long as 18 months. The role of neuromuscular control, proprioception and landing error assessment has now been successfully employed in the reduction of ACL injuries through the institution of preventive programmes.[23,24]

ACL injuries have the highest morbidity of knee injuries for football players and result in the most time lost.

Posterior cruciate ligament

The true incidence of posterior cruciate ligament (PCL) injuries is not known but is thought to be very low. The mechanism of injury is often a direct blow to the front of the lower leg in contact or a fall onto the knee causing hyperflexion of the knee. Most injuries are isolated PCL tears, which can be treated conservatively with bracing and rehabilitation. Combined PCL injuries involving either the medial collateral ligament (MCL), ACL lateral collateral ligament (LCL) or posterolateral corner will require surgical reconstruction. The posterolateral corner (PLC) is made up of the fibular collateral ligament, popliteus tendon, and popliteofibular ligament. The PLC ligaments act to stabilise the posterolateral corner of the knee with the opposing convex surfaces of the lateral femoral condyle and lateral tibial plateau. PLC injury is one of the most debilitating ligament injuries of the knee, as patients may have instability even with normal gait and should always be assessed for when cruciate ligament injury is suspected. Recovery following surgical reconstruction is slower than for ACL and return to sport can often only be expected after a year.

Meniscus

The menisci play an extremely important role in the knee, contributing to load transmission, shock absorption, joint stability, cartilage nutrition and joint lubrication. As stated previously they are most commonly injured in association with ACL tears, but injuries do occur in isolation. The medial meniscus tear typically occurs in the older player but it is the first author's experience that tears of the lateral meniscus are more common in football than any other contact sport. Acute tears of the meniscus cause sudden pain and locking of the knee if unstable (Fig. 3). However, degenerate tears often present insidiously without a history of trauma. Joint line tenderness, an effusion, and a positive McMurray (97% specific, but not very sensitive (52%)) and Steinman tests are common signs. MRI investigation is sometimes needed for correlation and to assess the site and severity of the tear as well as the assessment of concomitant chondral injury, which may alter the treatment of the meniscal tear. From the literature it is clear that the menisci are essential components of the normal knee, and that techniques intended to preserve the menisci are both possible and mandatory. As evidence has accumulated from both animal and clinical studies of the frequent development of degenerative changes following meniscectomy, surgeons have become increasingly aggressive in their efforts to conserve as much meniscal tissue as possible.[25,26] Meniscal repair is, however, associated with a lengthy recovery period and frequent repeat surgical procedures (Fig. 4). Despite procedures to enhance healing of the repair, failure can be as high as 40% in isolated meniscal tears. Meniscal transplant using either allograft or collagen substrates requires further investigation and longer follow-up, but appears to be the only option in players who experience pain after previous total meniscectomies.

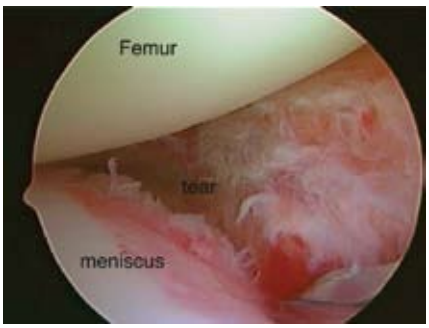

Fig. 3. Acute vertical tear of the medial meniscus.

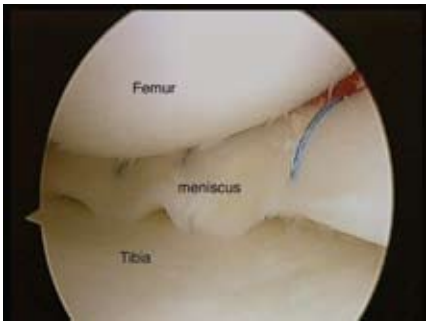

Fig. 4. Meniscal repair of a bucket handle tear.

Articular cartilage

The true incidence of chondral injuries in football is unknown, but they are not infrequent and result from shearing injuries due to pivoting or from hyperextension loading during kicking (Fig. 5). They most commonly involve the femoral condyles and should be suspected when the player complains of persistent effusion and joint line tenderness without the mechanical symptoms of a meniscal injury.[27] If diagnosed acutely and if there is also some underlying bone involvement they can be replaced and fixed with absorbable fixation devices (Fig. 6a, b). Chronic, untreated injuries can be treated by marrow stimulation, a technique called microfracture (Fig. 7), to produce a type of scar cartilage covering of the defect, or mosaicplasty whereby osteochodral plugs are inserted into the defect (Fig. 8a, b), or autologous chondrocyte implantation (ACI). ACI is a technique whereby the player's articular cartilage is harvested for growth in a laboratory and the viable chondrocytes are impregnated onto a collagen membrane before re-implantation into the chondral defect (Fig. 9). ACI has been shown to restore the articular cartilage to close to the normal cartilage, but requires a lengthy period before returning to play (18 months). However, in one study only 33% of all players were able to return to football and of those 83% were high-skill players.[28] The percentage of players who were able to return to play after microfracture and mosaicplasty was higher, but the repair does not appear to be as durable as ACI, with a gradual deterioration in function.

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Overuse injuries

Overuse injuries account for only 8% of all football injuries. The most common overuse syndromes of the knee are iliotibial band friction syndrome, patellar tendinopathy, popliteus tendinopathy and pes anserine bursitis. These conditions can invariably be treated conservatively with rest, non-steroidal anti-inflammatories (NSAIDs), alteration of activity and specific strengthening programmes. The recent introduction of platelet-rich plasma injections and extra-corporeal shock wave therapy has shown encouraging results (Fig. 10). Surgery is sometimes indicated in recalcitrant cases.

The chronic effects of playing football on the knee have been investigated by reviewing radiological changes in veteran football players compared with a control group. In those players who have not had previous meniscus surgery it was concluded that football playing alone contributes to the degenerative changes observed with time.[29]

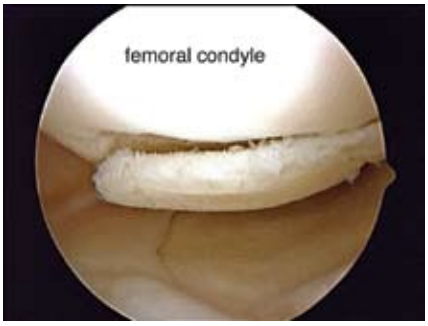

Fig. 5. Delaminating chondral injury of the medial femoral condyle.

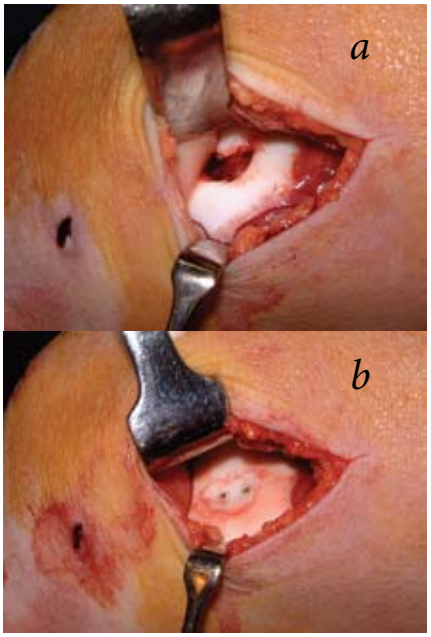

Fig. 6(a). Osteochondral injury of the femoral condyle. (b) Fixation using bio-absorbable pins.

Fig. 7. Microfracture technique. Small perforations are made in the underlying bone in base of the chondral lesion.

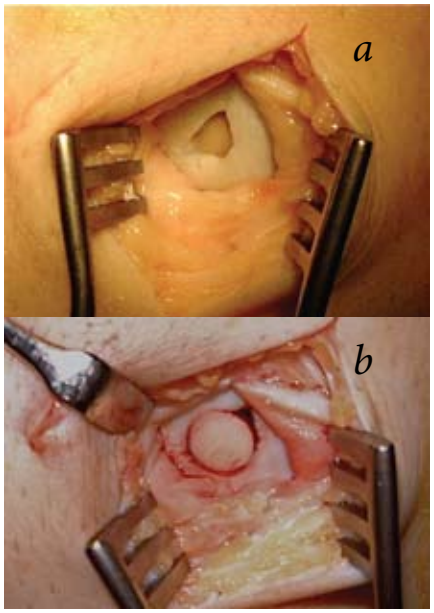

Fig. 8(a). Full-thickness defect in femoral condyle. (b) Osteochondral OATS® plug in place.

Fig. 9. Autogenous chondrocyte implantation sutured into defect.

Fig. 10. Platelet-rich plasma injection under ultrasound guidance.

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In a nutshell

- Knee injuries account for 58% of all major injuries in football.
- The risk of knee injury in football is increased in young players, if the player had a previous injury and if the knee is unstable.
- Accurate clinical assessment is therefore imperative to prevent delays in treatment and rehabilitation. Since clinical assessment is often difficult at the time of injury, re-evaluation after 2 - 3 days may be of value in making a correct diagnosis.
- X-rays are often not indicated in acute knee injuries, and the absence of pathology on X-ray does not exclude significant internal injury of the knee.
- Rest, ice, compression and immobilisation are appropriate treatment modalities for the first few days following most injuries, but if the diagnosis is still unclear thereafter the patient should be referred to an experienced knee specialist for further assessment.
- Females have a significantly higher risk of ACL injuries.
- Untreated ACL injuries result in long-term damage to the knee joint.
- Preventive programmes can be employed to reduce the risk of ACL injury.
- Menisci should at all times be preserved to prevent late sequelae.
- Despite numerous surgical options articular cartilage damage remains problematic for the football player.
- Football playing may contribute to degenerative changes of the knee.