Knee Injuries in American Football: An Epidemiological Review

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Abstract
Football has the highest injury rate amongst popular American sports. Of those injuries that end seasons or careers, the knee is the most common culprit. This is of particular concern because knee injuries are most common in football. This article reviews 4 of the most common knee injuries in American football, with emphasis on epidemiology, risk factors, and treatment outcomes. The injuries reviewed are tears of the anterior cruciate ligament, medial collateral ligament, medial patellofemoral ligament, and posterior cruciate ligament.

Anterior Cruciate Ligament
The ACL is the primary structure preventing anterior tibial translation. It is composed of 2 anatomic bundles: the anteromedial and posterolateral bundles. The ACL originates from the posteromedial portion of the lateral femoral condyle and inserts between and slightly anterior to the tibial intercondylar eminence. The bundles are named for their relative insertions onto the tibia.

Injury to the ACL occurs both through noncontact and contact mechanisms. Typical noncontact mechanism is a forceful valgus collapse with the knee close to full extension with combined external or internal rotation of the tibia. This is often the result of a sudden deceleration prior to a change in direction. Contact injuries to the ACL are the result of a direct blow to the knee causing valgus collapse. The majority of ACL injuries amongst all sports are a result of a noncontact mechanism. However, Dragoo and colleagues found the majority of football ACL injuries (55%-60%) were from contact. As a result, football players are 4 times more likely to sustain ACL injuries than in other sports.

ACL injuries are associated with significant time loss from sport. At the high school level, they are the most likely injury to end a season or career. Of those injuries that end seasons or careers, the knee is the most common culprit. This is of particular concern because knee injuries are most common in football. This article reviews the epidemiology of 4 of the most common knee injuries in American football: tears of the anterior cruciate ligament (ACL), medial collateral ligament (MCL), medial patellofemoral ligament (MPFL), and posterior cruciate ligament (PCL).

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were 219 ACL injuries in the National Football League (NFL) from 2010 to 2013. In addition, 14.2% of retired NFL athletes in one survey reported a history of ACL injury. The most common high-risk positions are running backs and linebackers. Brophy and colleagues found that 9.7% of running backs and 8.9% of linebackers participating in the NFL Combine had a history of ACL injury. This may be because both the running back and linebacker are involved in frequent high-energy collisions and often quickly change direction. Other studies have also identified running backs and linebackers as high risk, in addition to tight ends, wide receivers, and interior linemen.

Treatment of choice for elite level athletes with ACL injury is reconstruction. Of those who undergo ACL reconstruction, the rate of return to play ranges from 63% to 80%. The average time to return to play is 9 to 13 months. The odds of making a successful return hinges on how successful the athlete was prior to injury. Factors such as prior game experience, position on depth chart, being on scholarship, and draft position for NFL athletes have all been shown to have a positive predictive value on a patient’s chance of returning from ACL reconstruction. Players who return have variable levels of success afterwards. In a study of NFL quarterbacks who sustained ACL injuries, 12 out of 13 were able to return to game action with no appreciable dropoff in performance based on in-game production. Carey and colleagues looked specifically at NFL wide receivers and running backs and found an 80% return to play rate with an approximate decrease in production of one-third upon return. Furthermore, in the Multicenter Orthopaedic Outcomes Network (MOON) cohort study, only 43% of participants felt they returned to their preoperative level.

Medial Collateral Ligament
The MCL consists of superficial and deep components. The superficial MCL is the primary restraint to valgus laxity at the knee. The superficial MCL has 1 femoral and 2 tibial attachments. The deep MCL is a thickening of the medial joint capsule and runs deep and parallel to the superficial MCL. The amount of medial joint gaping with a valgus force on examination is used to grade severity of MCL injuries. Grade I is a <5-mm opening; Grade II, 5- to 10-mm opening; and grade III, >10-mm opening.

The MCL is the most common knee injury in high school, collegiate, and professional football. Injuries are typically due to contact when a valgus force is applied to the knee. The annual incidence of MCL injuries amongst high school football players is 24.2 per 100,000 AE. The positions that appear to be at greatest risk for MCL injuries are offensive and defensive linemen. In a review of 5047 collegiate athletes participating in the NFL Combine from 1987 to 2000, 23% of offensive linemen had a history of MCL injury, compared to the overall rate of 16%. In a similar study, Bradley and colleagues performed medical histories on athletes invited to the 2005 NFL Combine and also found offensive linemen had the highest rate of MCL injury at 33%, compared to the overall rate of 22%. They reasonably hypothesized that “chop blocks” and other players “rolling up” on the outside of linemen’s knees were responsible for these injuries. Albright and colleagues found that prophylactic knee braces decreased the incidence of MCL injuries in collegiate offensive lineman. However, additional studies have not been able to reproduce these results and the use of prophylactic knee braces remains controversial.

Treatment of MCL injuries depends upon the grade of injury, associated injuries, and anatomical location of injury. Management of MCL injuries is for the most part nonsurgical. In 1974, Ellsasser and colleagues were the first to publish data on nonoperative management of Grade I and Grade II injuries with immediate motion and rehabilitation instead of cast immobilization. They found 93% of patients returned to football in 3 to 8 weeks. Derscheid and Garrick observed nonoperative treatment of Grade I and II sprains in collegiate football players, with a time loss of 10.6 days and 19.5 days for Grade I and II injuries, respectively. Holden and colleagues evaluated nonoperative management of Grade I and II MCL injuries in collegiate football players and found an average return to play of 21 days.

Grade III injury treatment is more controversial. Indelicato and colleagues demonstrated successful nonoperative management of Grade III MCL injuries in collegiate football players, with an average return to play of 64.4 days. Jones and colleagues had similar success with high school football players, with an average return to play of
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Injuries of the distal medial collateral ligament at its tibial insertion may result in poor healing, as the ligament is displaced away from its insertion. Therefore, some authors recommend surgical management for these injuries.

Medial Patellofemoral Ligament
The patellofemoral joint is a complex structure in which the patella is stabilized within the trochlear groove of the femur by both bony and soft tissue structures. The MPFL is one of the most important soft tissue stabilizers. The MPFL is the primary restraint to lateral patellar translation within the first 20° of knee flexion, contributing to 60% of the total restraining force. The MPFL originates on the medial femoral condyle and inserts on the superomedial aspect of the patella.

Patellar instability is the subluxation or dislocation of the patella out of the trochlear groove. Patellar subluxation and dislocation account for approximately 3% of all knee injuries. Patella dislocations are more common in younger populations with the majority (52%-63%) occurring during sports. According to Swensen and colleagues, PCL injuries (45%-57%) or from sports (33%-40%). However, most studies do not distinguish between traumatic and atraumatic injuries. Because the majority of patellar dislocations in football occur through contact mechanisms, the rate of recurrent instability in these athletes may in fact be less than what is reported in the literature.

First-time patella dislocations are generally treated nonoperatively. Mitchell and colleagues reported that 72.6% of high school athletes with patella subluxation treated conservatively were able to return to sports within 3 weeks, compared to only 34.1% of those with patellar dislocations. In the same study, patellar dislocations were season-ending 37% of the time. Atkin and colleagues followed 74 patients treated conservatively for first-time patellar dislocation and noted 58% at 6 months still had difficulty in squatting, jumping, or cutting.

Those who have failed conservative management and have an additional dislocation are 7 times more likely to redislocate. Therefore, they are usually treated operatively with MPFL reconstruction. Return to sport ranges from 3 to 6 months, with 53% to 77.3% reporting return to their previous functionality. Overall, 84.1% of patients are able to return to sport with 1.2% risk of recurrent dislocation.

Posterior Cruciate Ligament
The PCL is the primary posterior stabilizer of the knee. It consists of the anterolateral and posteromedial bundles, named by their insertion on the posterior tibial plateau. The larger, stronger anterolateral bundle is the primary restraint to posterior tibial translation.

Due to the relative infrequency of PCL injuries, there is a paucity of epidemiological data on sports-related PCL injuries. These injuries in the literature are commonly found due to traffic accidents (45%-57%) or from sports (33%-40%). According to Swensen and colleagues, PCL inju-
ies specify the grades of the injuries. Finally, Patel and colleagues managed 6 NFL athletes with Grade I and II injuries nonoperatively, and all were able to return to sport.

Treatment of isolated Grade III PCL injuries is more controversial, and no consensus exists in the literature. In an epidemiological study, Dick and colleagues found that only 39% of NCAA football athletes underwent surgery for their torn PCLs, compared to 79% of ACL injuries. However, their study makes no mention to the severity of these injuries. Numerous options exist for PCL reconstruction, with no consensus on the preferred method.

Conclusion
Knee injuries are the most common injury in football. Knowledge of the natural history of these injuries, as well as treatment options and expected outcomes, will help treating physicians educate their patients on the optimal treatment and manage return to play expectations.

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