Excessive Pronation and Knee Ligament Injuries

By Mark Charrette, DC

Some active people - especially competitive, but even recreational athletes - suffer traumatic damage to the ligaments of the knees. Such injuries can have a negative impact on athletic performance, occasionally ending participation in a favorite sports activity.

Excessive pronation has been found to be an underlying cause of some knee ligament injuries, and is a contributing factor in many.\(^1\) Poor healing and recurrent knee injury can often be traced to biomechanical problems, including hyperpronation. Both treatment and prevention of knee ligament injuries require the evaluation of the foot and ankle for excessive pronation. But how do foot problems cause knee injuries?

Knee Biomechanics

At heel strike, the knee is normally somewhere between full extension and 20 degrees of flexion, and the forces transmitted from the foot into the knee are high. When either extension or slight flexion is combined with internal rotation of the tibia in relation to the femur, injury to the anterior cruciate ligament (ACL) is more common. We now know that landing at foot strike with the knee extended or in slight flexion and internally rotating the tibia in relation to the femur is by far the most commonly described incident resulting in tears of the ACL.\(^2\) A rapid change in direction while running (or a similar twist of the leg during a fall while skiing) can produce just such an episode.

- Copyright â Stock Photo / Register Mark This is especially true in sports that require the use of shoe spikes (which fix the lower leg to the ground). A study by Arnold, et al., found that 81 percent of athletes with injury to the ACL recalled the moment of injury as having their tibia in internal rotation combined with a sudden change of direction at foot strike.\(^3\)

In fact, epidemiology and frequency studies have demonstrated that the vast majority of acute tears of the ACL occur without any contact or direct trauma to the athlete’s knee.\(^4\) We now know that it is the torque (twisting) forces imposed on the knee joint that cause some ACLs to rupture. Some athletes have knee joints that seem to be more susceptible to these torque forces, and some feet transmit more rotational forces into the knees than others.
**Hyperpronation and the ACL**

A study by Beckett, *et al.*, retrospectively reviewed a group of athletes with acute, non-traumatic ACL ruptures (arthroscopically proven) and compared them to a matched control group. These researchers found excessive pronation of the foot and collapse of the arch during weight-bearing in the injured subjects, and proposed this finding as the mechanism of injury.\(^5\)

In their study, Beckett, *et al.*, reviewed the biomechanics of the foot and ankle, describing how arch collapse and excessive pronation lead to abnormal internal (medial) tibial rotation which "pre-loads" the ACL. The study concluded that "hyperpronation of the foot and ankle complex may increase the risk of injury to the ACL."

Normally, subtalar joint pronation and internal rotation of the tibia occur only during the initial, contact phase of gait. If pronation continues beyond the contact phase, the tibia will remain internally rotated. This abnormal tibial rotation transmits excessive forces upward in the kinetic chain to the knee joint, producing medial knee stresses, force vector changes in the quadriceps muscle, and lateral tracking of the patella.\(^6\)

The Beckett proposal was supported by Copland’s work, which found that passive tibial rotation was statistically greater in hyperpronators than in nonpronators.\(^7\) Another study found that ruptures of the ACL in female athletes (many of whom are at a high risk for ACL rupture) were directly correlated with the amount of arch collapse and hyperpronation.\(^8\) A more recent study of female athletes by Hewett, *et al.*, found that having an increased knee abduction angle (valgus knee) and increased loading were both risk factors for an ACL injury.\(^9\)

**Knee Pathology**

Because the knee is a hinge (ginglymus) joint, it moves primarily in one plane. When excessive pronation at the foot and ankle causes increased medial rotation to be transmitted up the leg, this rotary motion eventually results in knee symptoms. Knee problems are particularly more common in athletes, who experience greater rotational forces.\(^10\) When there is a predisposing tendency to excessive pronation, injuries to the knee ligaments, especially the ACL, are more likely to occur. Other knee problems associated with too much pronation include patellofemoral pain syndrome and chondromalacia patellae (also known as "knee-cap tracking problems"), and capsulitis and pes anserine bursitis.\(^11\)
Preventive Care for the Knees

Fitting athletes with custom-made orthotics to decrease their excessive pronation can have many benefits. The use of corrective orthotics can prevent many overuse problems from developing due to patellar tracking problems. Perhaps more importantly, injuries to knee ligaments, especially the ACL, may be avoided.

Investigation of foot biomechanics is a good idea in all patients, especially those who are recreationally active. Competitive athletes require regular evaluation of feet alignment and function in order to avoid potentially disabling injuries. Preventive measures include wearing well-designed and constructed shoes, and considering orthotic support in patients who are at risk of developing excessive pronation. In doing so, we may be preventing not just arch break-down and biomechanical foot problems, but also acute ruptures of the knee ligaments.

References


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