HAZARD FACTORS OF ACL RUPTURE: NEUROMUSCULAR FACTORS

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Injuries to the anterior cruciate ligament (ACL) of the knee are disabling, often associated with other intra-articular damages and increase the risk of early onset of osteoarthritis. It is very probable that multiple risk factors act in combination to influence injury risk. It is important to have a comprehensive understanding of these ACL risk factors, whose neuromuscular factors, even if investigations on neuromuscular factors reported to date do not provide a complete understanding of ACL injury risk.

According to several recent studies, the neuromuscular control of joint biomechanics during a specific activity seems to represent a predicting factor of an ACL injury, by quantifying the intersegmental forces and moments generated about the tibio-femoral joint. Laboratory studies have shown that landing from a jump performs cutting and pivoting maneuvers with less knee and hip flexion, increases knee valgus and internal rotation of the hip coupled, with increased external rotation of the tibia and quadriceps muscle activation (especially in women). It has been hypothesized that these movement patterns increase the strain in the ACL during activity and that the large difference in knee injury incidence rates between males and females (1/4.5) may be attributed to neuromuscular differences and resultant mechanics. Although studies have shown that the position of the knee and the magnitude and sequence of muscle contraction can increase ACL strain values, it is hard to exactly correlate these movements to what occurs during activity and sport and at the time of ACL injury.

Recently, a simpler assessment tool has been validated and is able to be administered in a clinic-based testing environment Consequently, the screening for ACL injury risk could be performed on a more widespread population.

Athletes who went on to a primary ACL injury also demonstrated significant side to side differences in lower extremity biomechanics as well as reduced relative lower extremity flexor activation relative to an uninjured control population during the vertical drop jump. Similar mechanisms of injury risk have been identified in athletes medically cleared to return to sport after ACL reconstruction. These seminal findings indicate that these abnormal and asymmetrical biomechanical and neuromuscular control profiles are likely both residual to, and exacerbated by, the initial injury.

A study revealed that a fatigue-induced protocol altered the latency as well as the magnitude of reflex responses of the hamstring muscles and the tibial translation only in women. The authors of various studies have suggested that the hamstring muscles play an important role in maintaining knee stability and that they protect the ACL during movements of the tibia relative to the femur. Therefore, decreased reflex responses of the hamstring muscles and in turn an increased the tibial translation might contribute to the pathomechanics of the ACL injuries. It is therefore conceivable that the fatigue-induced decrease of the hamstring neuromuscular function may increase the tibial translation and probably contributes to the higher incidence of ACL injuries, especially in women.

A preventive approach to decrease ACL injuries could integrate muscle imbalances as a risk factor. If it has been scientifically validated than the muscle strength profile determined by an isokinetic testing offers a predictive value on the hamstring lesion occurrence, similar studies have not permitted such a conclusion about ACL injury. The isokinetic assessments after ACL reconstruction have allowed us to observe, on the healthy contralateral knee, a higher frequency of reduced hamstring/quadriceps ratios. A possible pre-existing weakness in the hamstring and the occurrence of an ACL injury is therefore possible but only a difficult prospective approach due to the multifactorial nature of ligament injuries could clarify that point.

In conclusion, a functional analysis of the landing of a jump and an isokinetic muscle strength assessment have been suggested to represent predictive elements of an ACL rupture, but further studies are needed to have a stronger evidence of their predictive qualities of injury.