

# IOC Consensus Statement

## Non-contact ACL injury in the female athlete

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### ACL Injuries in Female Athletes Panel Members

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## The challenge

The incidence of anterior cruciate ligament (ACL) injury remains high, especially in the young, athletic population 14-19 years of age. The incidence of non-contact ACL tears as a function of gender shows that female subjects have a much higher incidence in some sports such as basketball, netball and team handball versus male subjects. In spite of the fact that some successful ACL injury prevention programmes have been introduced, the ACL injury continues to be the largest single problem in Orthopaedic Sports Medicine

IOC President Jacques Rogge stated in 2001 that “the most important goal of the IOC Medical Commission is to protect the health of the athlete”. As the ACL injury especially in young females in sports remains a major problem, there is a need for improved prevention and management. This is the rationale why the IOC Medical Commission invited a group of physicians, physical therapists, biomechanists and other scientists active in this area of research to review and discuss the current state of the art, risk factors, prevention programmes and the need for further research concerning the non-contact ACL injury in the young female athlete.

The IOC expert group recently met and reviewed the knowledge in this field. The conference resulted in a current concept paper which will appear in the June special issue of the British Journal of Sports Medicine. The group reviewed the epidemiology, internal and external risk factors in specific sports, mechanism of injuries with the latest news from video analyses, the natural history of non-operated and operated ligament injuries, outcome scores and outcome of treatment, the newest data from motion analyses, management, including prevention and rehabilitation, and the timing and effects of return to sport. Finally, the structure, function and effect of the current prevention programmes were discussed. We now know that, based on recent studies, there can be a quantifiable reduction in ACL risk for athletes, particularly females, who complete a well designed injury prevention programme. Most of these programmes attempt to alter dynamic loading of the tibiofemoral joint through neuromuscular and proprioceptive training. Emphasis is placed on proper landing technique: landing softly on the forefoot and rolling back to the rearfoot, engaging knee and hip flexion upon landing. Two-feet landing is encouraged where possible. When performing cutting manoeuvres, athletes should avoid excessive dynamic valgus of the knee upon landing and squatting; they should aim to achieve the “knee over toe position”. Intervention programmes have focused on increasing hamstring, gluteus medius and hip abductor strength, and addressing proper deceleration techniques. Successful implementation of these programmes requires the collaboration of governing bodies, sports scientists, physicians, coaches, parents and athletes.

### **Important factors for a successful prevention programme**

- The programme should include strength and power exercises, neuromuscular training, plyometrics and agility exercises
- Design as a regular warm-up programme increases adherence
- Focus on performance- hip-knee-foot line, avoid “kissing knees” (excessive valgus strain)
- Maintenance of and compliance with prevention programmes before, during and after the sports participation season is essential to minimise injuries.

- Drop vertical jump test to find players at risk
- The programme must be well received by coaches and players to be successful
- Evaluation of success or failure of a prevention programme requires large numbers of athletes and injuries

## **Overall summary and future directions**

There is consensus in the literature that females are at increased risk of suffering an ACL injury in comparison to males when they compete in the same sport at the same level of competition. However, many studies have focused on the prevalence of ACL injuries associated with high risk sports; only a limited number have calculated injury incidence based on time at risk and compared males and females competing in similar activities at the same level of competition.

There appears to be mounting evidence that females are at significantly greater risk of ACL injury during the pre-ovulatory phase of the menstrual cycle compared with the post-ovulatory phase. While it remains unclear whether estradiol and progesterone act directly on the ACL in women and increase the likelihood that a subject will sustain an injury, other hormones associated with the menstrual cycle may modulate injury risk. Alternatively, hormones may act on structures other than the ACL. Athletes with a decreased intercondylar notch width, as measured radiographically on a standard notch view, are at increased risk of suffering a non-contact ACL injury. Very little is known about how lower leg alignment variables are related to the likelihood of suffering a knee ligament injury. Anatomic risk factors may not be easy to correct; however, they are important to understand if we are going to identify who is at increased risk of suffering an ACL injury.

Females who developed an increased knee abduction moment (a valgus intersegmental torque) during impact from landing had an increased risk of ACL injury. Female athletes have muscle activation patterns in which the quadriceps predominate and decreased knee stiffness appears to occur. The relative increase of knee stiffness in response to anterior directed perturbation of the knee was much greater in men than that in women. A great deal more research is needed with regard to study of the neuromuscular risk factors related to ACL injury.

Further, very little is known about the effect of sport-specific factors such as rules, referees, coaching, meteorological conditions such as the traction at the shoe-playing surface interface, playing surfaces, and protective equipment on the risk of suffering an ACL injury. These potential risk factors merit further investigation. Very little is known about the effect of age, athleticism, skill level, psychological characteristics and prior knee injury as risk factors for ACL injury.

There is a quantifiable reduction in ACL risk for athletes, particularly females, who complete well designed injury prevention programmes. Proper neuromuscular training can decrease peak landing forces. Training will significantly enhanced hamstring strength and power, and reduce hamstrings-to-quadriceps and side-to-side strength imbalances. It is also important to increase gluteus medius and hip abductor strength, and addressing proper deceleration techniques. Most of these programmes attempt to alter dynamic loading of the tibiofemoral joint through neuromuscular and proprioceptive training. Emphasis is placed on proper landing technique: landing softly on the forefoot and rolling back to the rearfoot, engaging knee and hip flexion upon landing. Two-feet landing instead of one foot if possible. In cutting manoeuvres, avoid excessive dynamic valgus of the knee upon landing and squatting, focusing on the “knee over toe position”.

Successful implementation of these programmes requires the collaboration of governing bodies, sports scientists, physicians, coaches, parents and athletes. Everybody can participate in the fight to prevent the ACL injury, especially in the young female athlete. Increased and substantial support from the sports medicine community as well as from the sporting world is required to ensure success in this battle so that ACL injuries are eradicated, or at least substantially reduced.