

ANTERIOR CRUCIATE LIGAMENT (ACL) INJURY PREVENTION



AOSSM SPORTS TIPS

ACL INJURY RATES

The anterior cruciate ligament (ACL) is one of the most commonly injured ligaments in the knee. Approximately 150,000 ACL injuries occur in the United States each year. Female athletes participating in basketball and soccer are two to eight times more likely to suffer an ACL injury compared to their male counterparts. Recent data from the Women's National Basketball Association indicates white European-American players may be at increased risk for ACL injury compared with African-American, Hispanic or Asian players.

Athletes who have suffered an ACL injury are at increased risk of developing arthritis later on in life, even if they have surgery for the injury. ACL injuries account for a large health care cost estimated to be over half-billion dollars each year.

WHY DO ACL INJURIES OCCUR?

Researchers believe there are **external** and **internal** factors associated with ACL injury. **External** factors include any play where the injured athlete's coordination is disrupted just prior to landing or slowing down (deceleration). Examples of a disruption include being bumped by another player, landing in a pothole, or a ball deflection. Other external factors which have been studied include the effect(s) of wearing a brace, shoe-surface interface (how certain types of athletic footwear perform on different surfaces), and the playing surface itself.

Internal factors include differences in the anatomy of men and women, increased hamstring flexibility, increased foot pronation (flat-footed), hormonal effects, and variations in the nerves and muscles which control the position of the knee. Anatomical differences between men and women, such as a wider pelvis and a tendency towards "knock knee" in women, may predispose women to ACL injury. Differences in ACL injury rates between men and women seem to begin shortly after puberty because the nerve/muscle system (coordination) adapts at a slower pace than the anatomical and hormonal changes. It is possible that the incidence of injuries in women increases at this age because the nerve/muscle system (coordination) adapts to these changes at a slower rate than in men. Women also tend to have knees that are less stiff than men, placing more forces on the ligaments. In addition, the female hormone estrogen may relax or allow stretching of the ACL, thereby predisposing female athletes to ACL injury. Nerve/muscle factors pertain to the interaction and control of the knee by the quadriceps and hamstrings muscles in the legs. Researchers are very interested in studying this particular factor since it may be the easiest to modify.

HOW DO ACL INJURIES OCCUR?

Careful study of videos of athletes tearing an ACL show that approximately 70 percent of these injuries are non-contact and 30 percent occur during contact. The noncontact injuries usually



Figure 1



Figure 2

occur during landing or sharp deceleration. In these cases, the knee at the time of injury is almost straight and may be associated with valgus (inward) collapse (see Figure 1). The athlete often lands with a flat-foot position and the leg is placed in front or to the side of the trunk.

PREVENTION OF ACL INJURY

Several prevention programs have been developed in an attempt to decrease the incidence of noncontact ACL injuries. The focus of current prevention programs is on proper nerve/muscle control of the knee. These programs focus on **plyometrics**, **balance**, and **strengthening/stability** exercises.

Plyometrics is a rapid, powerful movement which first lengthens a muscle (eccentric phase) then shortens it (concentric phase). The length-shortening cycle increases muscular power. An example would be an athlete jumping off a small box and immediately jumping back into the air after contact with the floor.

Balance training commonly involves use of wobble or balance boards. On-field balance exercises may include throwing a ball with a partner while balancing on one leg.

To improve single-leg core **strength and stability**, athletes perform exercises such as jumping and landing on one leg with the knee flexed and then momentarily holding that position.

PLYOMETRIC EXERCISES

High-intensity plyometrics may be key in reducing the number of ACL injuries. To be most successful, plyometric training should be performed more than once per week for a minimum

of six weeks. Athletes are taught proper landing techniques which emphasize landing on the balls of the foot with the knees flexed and the chest over the knees (see Figure 2). The athlete should receive feedback on proper knee position to prevent inward buckling. Many of the newer programs are being adapted by coaches as an integral part of warm-up during practice, such as jumping over a soccer ball and landing in the correct position.

REFERENCES

- Boden BP, Dean GS Feagin JA et al. Mechanisms of anterior cruciate ligament injury. *Orthopedics*. 200;23:573-578.
- Hewett TE, Lindenfeld TN, Riccobene JV et al. The effect of neuromuscular training on the incidence of knee injury in female athletes: A prospective study. *American Journal of Sports Medicine*. 1999;27:699-706.
- Mandelbaum BR, Silvers HJ, Watanabe D et al. Effectiveness of a neuromuscular and proprioceptive training program in preventing anterior cruciate ligament injuries in female athletes: Two year follow up. *American Journal of Sports Medicine*. 2005;33:1003-1010.

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