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ACL Injury Prevention

Intro

Over the past 25 years there has been a wonderful rise in the number of females participating in competitive athletics. You can't turn on the television without seeing a cute ad with little girls playing soccer. Women of all ages are gaining respect and self esteem through their efforts in athletic competition. We have come a long way from the days when "ladies don't sweat, they glow". Women are now sweating with pride.

Unfortunately, this increased activity has been paralleled or exceeded by a rise in serious athletic injuries among women. The most common of these serious injuries involve the anterior cruciate ligament in the knee. Estimates are that 250,000 such injuries occur every year, most commonly among 15 – 25 year old females. Female athletes suffer ACL injuries at a rate two to ten times that of males, depending upon the sport. Female soccer players suffer ACL injuries approximately three times as often as males. Professional women basketball players suffer ACL tears at a rate 10 times that of their male counterparts. Fortunately, there is some good news mixed in with the bad. Early medical research indicates that certain training activities can prevent these serious injuries, both in female and male athletes.

What is an ACL?

The ACL (anterior cruciate ligament) is a short ligament inside the knee connecting upper leg bone (femur) with the larger lower leg bone (tibia). It looks much like a very thick piece of white ribbon with its thin shiny fibers. The ACL maintains knee stability by preventing these bones from moving too far away from each other, either forward or to the side. It can be strained, partially or completely torn. In approximately 1/3 of cases the ACL is completely torn. An intact ACL is very important to knee function in competitive sports like soccer that require a lot of sudden stops, starts and changes of direction. Although athletes who have a torn ACL can sometimes continue to play their sports, their physical ability is markedly reduced because of the instability of that knee. They just can't do the things they used to do. In addition, because of this instability, athletes who have torn an ACL are much more likely to experience another, potentially disabling knee injury. An athlete with a torn ACL must choose between quitting her sport, continuing to play with less ability and the threat of another injury that might permanently disable her or having major surgery hoping to repair the knee. So, tearing an ACL is a serious problem.

Just how serious? We know that ACL injuries are one of the main causes of permanent sports disability. We have new surgical techniques which are much better than a decade ago, when an ACL injury meant the certain end of sports careers for even highly trained and motivated athletes. Unfortunately, these welcome improvements don't erase the problem. The sad fact is that nearly one third of high level competitive female soccer players sustaining ACL injuries give up the sport because of poor function or fear of re-injury. It is even worse for less committed athletes.

How common is the problem?

ACL injuries are more common among female athletes than male athletes, up to eight times as common in some studies. In descending order, ACL injuries are most common in gymnasts, soccer, basketball and

volleyball players. A survey of NCAA athletes from 1989-93 found that female soccer players suffered ACL injuries at a rate three times that of males. ACL injury rates are so high in college female soccer players that they translate (staggeringly) into nearly one ACL injury for every women's NCAA soccer team every year. The only group of college athletes with a greater risk was female gymnasts. The high risk gymnasts face is easy to understand if one imagines a female gymnast with her hyperflexible joints flying through the air at high speeds and then coming to a dead stop with straight legs, as the form of gymnastics requires. It is distressing that female soccer players are so close behind their risk level.

The rate of ACL injuries increases with the level of competition. The highest rates are among the highest level female athletes. However, even among high school athletes, ACL injuries are the most common serious knee injury with approximately 20,000 occurring every year in the United States and UK.

How do ACL injuries occur?

As you might imagine, a thin fibrous band inside a very small space surrounded by constantly moving bones is vulnerable to getting pinched or torn. In a way, it is a small miracle of design that ACLs don't tear every time we bend and turn. Although injuring an ACL seems simple, the specifics of why one player gets injured at a particular time become much more complex and confusing. Probably the easiest way to understand ACL injuries is to divide them into two types of injury. The first type is ACL injuries occurring as a result of contact with another player and the second is those that don't.

Contact ACL injuries occur when a player is hit from behind or on the outside of the knee. They are one reason referees should not hesitate to pull out a card when fouls of this nature occur. It doesn't just look bad and hurt, it can end a player's career. ACL injuries from contact occur at a similar frequency in male and female soccer players.

Non-contact ACL injuries result from sudden changes in direction, particularly while slowing down at the same time, and from landing on a straight knee. Either of these movements can shear the ligament practically instantaneously if performed the wrong way at the wrong time.

Non-contact ACL injuries are the reason for the massive difference in ACL injury rates between male and female soccer players. Nearly 80% of ACL injuries in females occur without contact, while non-contact ACL injuries represent a minority of injuries in males. Some studies have shown as much as a four-fold difference in non-contact ACL injury rates between females and males.

One of the factors believed to increase non-contact ACL injuries is the interaction between soccer shoes and the playing surface. In other words, cleats getting caught in the turf and poorly maintained fields can contribute to these injuries. Indoor soccer has a significantly higher rate of ACL injuries than outdoor soccer. It may be that the tendency of artificial turf to grab onto the shoes could lead to ACL injuries. In that case, the newer indoor surfaces, which appear not to catch players' shoes so easily, may be safer surfaces for indoor play. More research is needed for definitive answers to these questions.

Why are women at greater risk?

This question could stump "Who Wants to be a Millionaire" winners. Faced with an epidemic of serious injuries with long-term consequences, we have been trying to understand what can be done to prevent ACL injuries. Many answers have been proposed and probably all of them play some part.

Angle of knee: Because women's hips are wider, the upper leg bone comes down to the knee at a sharper angle, placing additional stress on the ACL.

Anatomy of the notch inside the knee: Some people have smaller spaces inside the knee, but whether there is a difference between males and females is controversial.

Hormonal variations: Estrogen makes ligaments looser. One small study found a higher rate of ACL tears around mid-cycle (days 10-14) when estrogen levels peak.

Loose ligaments: Women generally have looser ligaments, possibly increasing ACL risk.

Weaker hamstrings: The smart money is riding on this theory as the most important factor. The big leg muscles, the quads in the front of the thigh and the hamstrings in the back, also help stabilize the knee. When the stress is too great these muscles can't counteract the force. If the stress then exceeds the strength of the ligament, it suddenly tears. Men have stronger hamstrings than women. Men use their stronger hamstrings when they land from a jump. This appears to be an important preventive factor because recent studies of a training program, which markedly reduced the rate of ACL injuries, also showed considerable improvement in hamstring strength and knee stability.

The point of all this guesswork about "why" is to help us learn how to prevent ACL injuries. It looks like we are getting there.

How to prevent ACL injuries

The first study of any size to show a reduction in ACL injury rates was conducted with 600 Italian male semi-professional soccer players. They found that proprioceptive training reduced ACL injury rates by over 700%.

Proprioception is the ability to locate the extremities in space without looking. Although it may be surprising, loss of proprioception is an extremely common cause of re-injury following knee and ankle injury. The athlete slightly mis-steps and sprains an ankle or knee, even though the joint is strong. These soccer players spent 20 minutes a day (2-6 days a week) of balance training during 4-6 weeks of preseason. They would balance on a balance board for 2-5 minutes on each leg four times a day. During the season they did this three times every week.

Although they used fancier and much more expensive equipment, you can make an adequate balance board by purchasing a 12" round of plywood and gluing 1/2 of a softball to the middle of it. If you've seen the Ajax youth training videos you'll remember their players practicing by standing on such a board while juggling a soccer ball inside a net (to save the furniture).

The biggest and best studies were recently conducted in the USA by Hewitt on female athletes, including soccer players. Their intervention utilized a six week preseason program of muscles, nerves and coordination, owing much to plyometric jump training. They taught subjects to work on technically perfect jumping landing quietly with a toe to heel rock and bent knees. They also taught the subjects to recoil instantly, preparing for the next jump using images like "straight as an arrow", "light as a feather", "recoil like a spring" and "be a shock absorber." Trained study participants had a rate of ACL injury 3.6 times less than controls. They also found average increases in hamstring strength of 44% and jump height by 1.5 inches. One subject increased her vertical jump by six inches!

Last year I used Hewitt's techniques with my U-10 Class I girls team. I was very interested to observe that the non-dominant leg of each girl would shake on landing. This shaking is a sign of weakness and one of the technical failures Hewitt's group teaches to avoid. You can learn more about Hewitt's program by purchasing their Cincinnati Sportsmetrics video (contact Cincinnati Sportsmedicine Research and Education Foundation).

Another recent study suggests that simply encouraging basketball players to come to a stop over three steps (perhaps too restrictive in soccer) and to keep the knees bent when turning can reduce knee injuries in female athletes.

Finally, because quadricep-hamstring strength imbalance appears so important, athletes must also work to maintain flexibility of both of these muscle groups. As muscles are strengthened, flexibility can be lost unless athletes conscientiously cool down and stretch at the end of the workout..

The bottom line is:

ACL injuries are a big problem

ACL injuries are a bigger problem for females

ACL injuries are preventable

Every serious female soccer player (of ANY age) should

- Practice proprioceptive training

 - (a good idea for competitive male soccer players as well)

- Strengthen hamstrings by

 - Jump training and/or leg curls

- Avoid turning and landing with straight legs

Cool down and stretch after exercise

These measures can help prevent serious injury and will almost certainly improve performance to boot. Sorry about the pun. I just couldn't resist.