

# ACL Tears and the Female Athlete

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**Abstract:** The anterior collateral ligament (ACL) is one of four ligaments in the knee, connecting the tibia and femur and acting as a key stabilizer. Factors influencing these injuries include playing surface, training programs, athlete strength, technique, and gender. Female athletes are at a higher risk of ACL injuries, being four to nine times more likely than males, often due to differences in biomechanics and training patterns. It is important that rehab focuses on both legs, as overworking the injured leg increases the risk of injuries elsewhere. Prevention training, such as proprioceptive-balance and plyometric agility training, has been shown effectiveness in minimizing ACL injuries. Despite some limitations in research, these programs highlight the importance of improved training techniques. Kinesio taping might help reduce pain but lacks strong evidence for preventing ACL tears.

**Keywords:** Female Anatomy, Gender Differences, Kinesio Tape, Injury Prevention

## 1. Introduction

The anterior collateral ligament (ACL) is one of the four ligaments in the human knee; the medial collateral ligament (MCL), lateral collateral ligament (LCL), and posterior collateral ligaments (PCL) along with three main bones, tibia, femur, and patella [1]. The ACL connects to the tibia and femur and is proven to be the primary stabilizer in the knee. The ACL restricts excessive posterior and anterior knee displacement during dynamic movements [2]. There are two types of ACL injuries: non-contact or direct collision. Non-contact is the most common which accounts for about 70% of ACL injuries [1]. These injuries can occur due to pivoting, landing, and change of speed or direction.

There are many different factors that come into play when determining why an injury could have taken place. For example, the playing surface; turf, grass, hardwood court, or sand; the training program; the level of strength, technique and athleticism of the athlete; and gender. When the athlete receives surgery on the ACL, they will be able to choose from the hamstring, patellar, a cadaver, and sometimes the quad; of all four of those options the hamstring tendon (HT) and the patellar tendon (PT) are the most used grafts for primary ACL reconstruction [2]. After surgery the patient will need to do rehab and wait from six to nine months to be cleared fully to play sports again.

**Purpose Statement:** The purpose of this article is to inform the reader of the importance of ACL health and rehabilitations and to provide a practical guideline on ACL strengthening as preventative treatment.

**Medical Overview:** Anterior collateral ligament injuries are associated with risk factors that can be changed and unchangeable variables; for instance, females have a three times higher risk of injuries with ACL than males - biological sex is an unchangeable variable [3]. The age of the athlete also plays a significant role. The peak amount of ACL tears occurs in 16-to 18-year-olds. Beginning intense sports programs or training programs earlier in life and participating in sports more often or at a younger age could affect the likelihood of an ACL tear. The re-tear percentage is about 23% with athletes

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younger than 25-years-old [3]. Retearing of the ACL can happen because either the athlete was not ready to resume 100% full play or sometimes simply stepping wrong can tweak the ligament causing a re-*tear*. Occasionally, when strengthening the repaired ACL, some athletes will not end up working on their other leg, but the negative effect could be that the athlete focuses on their injured leg too much and does not continue to strengthen their non-injured leg which can lead to a tear of the ACL in the opposite leg. There is a 23% chance of tearing the opposite leg when returning to play [4].

## 2. Females Athletes and ACL Tears

Female athletes are four to nine times more likely to have an ACL tear than male athletes who have undergone equivalent training [5]. Injuries previously only seen in male athletes, such as ACL tears, became more prevalent in female athletes as more and more female athletes began to play sports [6]. In a study conducted by Orishimo and colleagues [7], it was determined there is a difference of the female and male's lower biomechanics which can affect the likelihood of females experiencing more injuries than male athletes. One way females and male athletes' genetics are different is the extension of how much the athletes lift and train [8]. The quadriceps and hamstring play an important role in keeping the ACL ligament safe and not impacting too much pressure on the ligament. Ligament dominance happens when the ligament experiences too much pressure from high landings and misalignments due to too much knee or hip adduction [7]. Also, foot placement is a sign to recognize if the athlete has weaker hips, because if their foot placement is not shoulder-width apart, then the athlete is shifting weight between their feet to minimize the forces due to the weaker limb [9]. Further, women's sports like field hockey tend to require a lot of knee flexion; said athletes will have a smaller chance of tearing their ACL due to always moving and bending the knee with higher frequency. Some sports like lacrosse which do not require as much knee flexion (because the ball is being thrown in the air instead of on the ground), there is higher risk of ACL tears because of the knee joint getting cold and getting placed wrong or landed on wrong [10].

One reason research has pointed towards females being at a higher risk than males for ACL injuries is because female athletes end up using more of their quads compared to their hamstring while exercising, which ends up putting more pressure on the anterior tibial [11]. The athlete is not using the hamstrings as much as they should when they participate in the sport, the knee can experience more of an imbalance in the anterior posterior shear forces as the quads cause the anterior translation. The anterior translation would not be counteracted by the posterior translation forces of the hamstring which causes an injury of the ACL. It has been proven that females exhibit a higher activity of the medial hamstring compared to the male athletes [11].

## 3. Rehabilitating and Returning to Sports

After an ACL tear, one will require surgery prior to returning to sport, and without any limitations. Before and after the ACL reconstruction surgery, the athlete must complete an extensive physical therapy (PT) or rehabilitation program and pass several tests to complete or participate in sports again. Data has shown that about 40 to 55% of the athletes have returned to their sport at the same level or at a higher level after surgery and PT [3]. Athletes need to begin rehab immediately following surgery to avoid osteoarthritis [11]. Osteoarthritis occurs when the cartilage in your knee breaks down and allows your bones to rub together. Initially following the injury a magnetic resonance imaging (MRI) will be scheduled to determine if the ACL has torn: unfortunately MRIs are very expensive, so some athletes will option for a landing error scoring system (LESS) - a screening test that can assess jump-landing biomechanics on a larger scale to tell if the ACL is injured; the LESS test less expensive, making it a potentially more particle option for the general public [12].

After surgery, one is very limited on moving one's knee for roughly two weeks [13]. Once the two weeks pass, the person is cleared to start doing approved exercises with their physical therapist (PT). One treatment that therapists like to do on ACL patients is the blood flow restriction therapy (BFR). Blood flow restriction therapy is when the PT puts a specialized cuff on a limb that had the surgery, and the cuff restricts vascular flow to the particular limb [13]. Blood flow restriction therapy can either be used with an automatic compression or manual compression. Blood flow restriction therapy is helpful because while the cuff is restricting blood flow the patient is asked to do low intensity resistance exercises, which is shown to help increase the fatigue and strength of the limb in a comparable manner of a healthy adult doing a high intensity exercise [13]. For example, having the patient wear the BFR cuff and do leg press machines help the limb just as much as a healthy adult does squats. The BFR is beneficial because when the patient starts rehab your leg that had the reconstruction has lost a lot of muscle and this is a good way to help the leg to start gaining back the muscle and endurance [13].

#### 4. Discussion

The purpose of this article was to inform the reader of the importance of ACL health and rehabilitations and to provide a practical guideline on ACL strengthening as preventative treatment. In a recent study coaches were recommended to take into consideration that synthetic pavements and wood surfaces can differ from your joints [14]. Coaches should be more careful on synthetic surfaces while training due to the lower shock absorption capacity can increase an injury risk [14]. Some people have concluded that better training techniques and exercises to prevent the injury could reduce the ACL landing in female athletes [15].

#### 5. ACL Prevention Training

There are two main types of ACL prevention training: proprioceptive-balance training and plyometric agility training [16]. Proprioceptive-balance training is to help improve the person's coordination and balance by performing exercises like balancing on one leg, an unstable platform, or doing tasks involving the upper body while single leg balancing. Plyometric agility training is to help improve the person's agility, dynamic stability and technique while doing dynamic tasks. Some of these exercises can be jumping, landing, and cutting on different levels of playing surfaces and different patterns of speed. A few smaller exercise programs are technique movement awareness training, strength training, and flexibility training [16].

A recent study was performed to explore how effective proprioceptive balance training programs are used observing male amateur and semi-professional soccer players in Italy [16]. Each balance training session lasted around 20 minutes and was executed daily until the start of the season three times a week. At the conclusion of the season, results were analyzed by looking within the joints to determine if the knee was more susceptible to an ACL injury. About 70 of the control group (the group of players that did not go through the testing) were susceptible to an ACL injury; only 10 players in the group that did the training were susceptible [16].

The Padua and Marshall study [16] investigative the effectiveness of plyometric agility training is using 1,263 high school basketball, soccer, and volleyball athletes using three jumping training program groups: female intervention group, female control group, and male control group. In the jumping training program, there were three stages as they progressed throughout the week: week one and two was technique training, week three and four was about strength, power, and agility training, and lastly, week five and six was performing training with a force on maximizing vertical jump height. After all the sports were done with their official season that year, the authors found that there were 14 serious knee injuries throughout all their data collected. Nine of the 14 injuries were non-contact

injuries [16]. The groups had athletes from different sports put together, and in the female intervention group there were mostly volleyball players. There were only 14 major ACL injuries out of three sports seasons that averaged around 1,263 athletes. Reviewing the results of both studies, it appears that prevention programs do assist people to try to prevent ACL injuries from happening even the non-contact injuries.

## 6. ACL Taping

Most injuries can be helped to reduce the pain with a type of taping, like kinesio taping. Kinesio taping is a type of elastic therapeutic tape that is assumed to help with prevention of injuries and decrease pain while increasing proprioception and muscle activity [17]. Unfortunately, there have been few studies to determine if this taping can assist the early prevention that leads to an ACL tear. Of what few studies have been performed, results have been negative [18]. The studies' results did not show much of a difference between the control and test group.

## 7. Call to Action

Overall, the literature represents that females experience more ACL injuries than males because of higher activity of the medial hamstring compared to male athletes [11]. Further, females have wider hips and that can cause misalignment which can cause the ACL to tear easier [9]. In addition, the playing surface; turf, grass, hardwood court, or sand; the training program; the level of strength, technique, and athleticism of the athlete [2]. There are several reputable prevention programs that can help reduce the likelihood of experiencing an ACL injury as well.

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