

Anterior Cruciate Ligament

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With an ever increasing number of people becoming involved with athletic activities, there is an increasing number of injuries occurring which can be devastating for the individual. Most of the injuries that affect athletes occur in one of four structures in the human body: bones, muscles, tendons, or ligaments. Because ligaments attach bone to bone and play a major part in providing stability for joints, the major stabilizing ligament in the knee, the anterior cruciate ligament (ACL), assists in performing everyday actions of the human body including sitting, standing, walking, running, dancing, and participating in other sports. The injury that specifically affects this ligament is very serious and always provides a challenge for the health care provider, in most cases the orthopedic doctor, who is responsible for the correction of the problem. By understanding how to diagnose one of the most common sports injuries, an anterior cruciate ligament (ACL) tear, realizing the causes, and providing the proper treatment, an orthopedic doctor can help a patient minimize his or her risk of experiencing long-term problems that may be associated with this injury.

In order for an orthopedic doctor to diagnose an ACL injury, he or she must first be knowledgeable about the ligament's location and function. The anterior cruciate ligament is located directly in the center of the knee along with another critical ligament known as the posterior cruciate ligament (see Fig. 1).

Fig. 1 (Arthroscopic 1)

The two ligaments cross each other to form an “X” behind the kneecap to provide the most support for the knee joint, where most of a person's body weight is concentrated. Although the ACL, which connects the thighbone (femur) to the shinbone (tibia), is only two inches in length and three-quarter inches in width, it is a critical factor in helping to maintain stability (Scott 73). This short and round ligament, like all other ligaments, prevents slippage within the joint and allows the joint to properly pivot when performing an action (Duff 300). Without this particular ligament, the knees would be fragile and more susceptible to injury. Therefore, it would be impossible to do the simplest movements that are done by humans everyday, like walking and even sitting. This is one reason why many athletes should be aware of the physical indications that arise if they have torn their ACL while participating in athletic activities.

In many cases, the symptoms that the patient feels after the trauma has occurred can help the doctor make his or her diagnosis. Many times a doctor will ask the patient to recall what happened after the injury was sustained. Usually with an ACL injury, the patient will describe a so-called pop or snap that he or she heard during the impact. Pain, which is not terribly excruciating, will immediately follow, and if the individual tries to stand, he or she will be faced with an overwhelming feeling of instability, the leg will buckle under, and the individual will ultimately fall down onto the ground. Although the patient is experiencing pain, he or she cannot point out exactly where the injury has occurred. Garrick states, “some people say that their knee shifts in position – which it actually does” (118). Other symptoms that may arise are stiffness and swelling which may continue for a long period of time. The knee swells because “when ligaments tear, so does the soft tissue capsule that surrounds the joint; and that tissue is laced with tiny blood vessels, which bleed” (Garrick 26). Although the information that is provided by

the patient is very helpful and can assist the doctor in making a diagnosis, the doctor must still perform special stability tests and procedures to insure he or she has made the correct diagnosis.

An orthopedic doctor is able to assess an injury using four different techniques. The doctor can conduct a physical examination, stability tests, an MRI, or an arthroscopy. Many times these techniques can be used in conjunction with each other to determine the severity of the injury. Usually with a physical examination, the doctor will feel around the entire knee and try to locate the area of pain and tenderness. But, because the anterior cruciate ligament (ACL) is an intraarticular ligament, which means it lies deep inside the knee joint and cannot be felt from the outside, the area that is affected by the injury cannot be detected (Scott 69). At this point, the doctor must perform various stability tests to better understand the problem. The first stability test that the orthopedic doctor can perform is the Lachman test. While the leg is in full extension, the doctor will place one hand above the kneecap and one hand below the kneecap. He or she will then begin to pull forward on the lower leg of the injured knee as if they are trying to pull it away from the leg. If the doctor notices that the knee moves to three to five millimeters or more from the normal knee position, it could then signify a torn ACL. A handheld machine called a KT, which is placed on the shinbone, can also be used to quantify the displacement of the knee with the Lachman test. Another test that may be performed is the anterior draw test. For this test, the doctor bends the injured knee ninety degrees and pulls the lower leg forward. The ACL is torn if the knee moves more than five millimeters forward. Another way, besides stability tests, in which an orthopedic doctor can confirm the diagnosis, is to order an MRI (magnetic resonance imaging). "MRI uses a strong magnetic field and radio waves to look inside the body and create images that are analyzed by a computer" (Scott 35). As the patient moves through a long tube, many different pictures from various viewpoints of the knee are taken which

can then be used to reassure the doctor that his or her diagnosis is correct. The last way in which an orthopedic doctor can confirm his or her diagnosis is arthroscopy. With arthroscopy it is possible for the doctor to get a detailed look at the anterior cruciate ligament inside the knee through a very small incision instead of open-knee surgery. A miniature lens and light that magnifies and illuminates the inside of the joint creates images of the anterior cruciate ligament which can then be displayed on a television for better viewing (Scott 37). Through this technique, the doctor can assess the injury with more accuracy.

If an orthopedic doctor wishes to assist in helping the patient understand how the injury occurred, then he or she must first realize that the injury can be caused by two things: activities that involve contact and activities that do not involve contact. There are also problems that increase occurrence and the preventative methods that are used to protect the individual. “The contact injury usually occurs when the individual is hit from behind in the knee or clipped on the outside of the leg by another individual” (Esposito). Many times an ACL will become torn by participating in such sports as football, soccer, and basketball which all require contact with other individuals in order to play the sport. In football the athlete will sometimes receive a blow to the side or the back of the knee, wrenching open the joint, causing the ACL to become damaged. The joint opens because the athlete usually has his or her foot planted in the ground at the time of impact, causing the knee to rotate or pivot in a different direction than the leg. In comparison, soccer players also suffer this kind of knee injury. Duff states that “knee ligament tears are the most serious lower extremity injury in high-school soccer” (9). The same factors that cause an ACL tear in football are also present in soccer. The athlete receives a blow to the side of the knee; his or her cleats are embedded into the ground restricting the range of motion in the knee; the ligament snaps because of over-rotation. The most serious injuries that are

sustained in basketball are knee injuries that include the ligaments. When another individual knocks a basketball player off balance in the air, he or she may come down wrong causing the anterior cruciate ligament (ACL) to tear (Garrick 119). Many times athletic female teenagers who play basketball, soccer, and various other sports are more susceptible than male players to damaging their anterior cruciate ligament which may require ligament surgery. “The ratio of male to female anterior cruciate ligament injuries in the sports of soccer and basketball is three to five” (Esposito interview). When it comes to sustaining a second ACL injury, females are also more likely than males to damage the previously injured knee or even the other knee. (Garrick 119). But, although a torn ACL is mostly caused by physical contact there are times when contact with another athlete or individual is not involved.

In most cases, non-contact ACL injuries involve the sports of running, skiing, and even gymnastics. Most often a non-contact injury occurs when the individual cuts from one direction to another, decelerates quickly (especially if he or she jams their foot out in front of them to stop themselves), or comes down from a jump awkwardly (Garrick 119). When an athlete runs, plants his or her leg, and then pivots quickly, he or she is likely to tear their ACL. The quick twist or pivot pulls on the ligament causing it to stretch or tear. Levy explains that the most severe ACL ruptures he has seen are caused not by severe trauma, but usually by a heavy athlete, such as a football lineman, who runs, plants his foot, and turns ninety degrees to go up the field (103). But, this does not happen with just athletes, because anyone could be running, jogging or even walking when they plant their foot wrong or step in a hole or a ditch and twist the knee to the point in which the anterior cruciate ligament ruptures. Both downhill skiing and water skiing are other examples of some sports that lead to an ACL tear as the result of a twisting fall. When the individual's foot is fixed to the ski during downhill skiing, turning their body or ski to a

position that the rest of the body cannot follow applies a severe rotary force onto the knee. In return, this makes the anterior cruciate ligament more likely to tear when the individual lands on one leg and quickly pivots in the opposite direction (Levy 206). The anterior cruciate ligament is also vulnerable to injury due to the high speed in the sport of skiing and the constant twisting that occurs in the leg. Knee ligament injuries (anterior cruciate tears) are also frequent with the sport of water skiing and can cause long-term problems. Once the knee hits the surface of the water after the fall, the impact is so strong, because of the high speed, that the knee twists and the anterior cruciate ligament tears. By understanding not only the contact activities, but also the non-contact activities that cause this injury, the doctor is only one step away from helping the patient take care of his or her problem.

The risk of sustaining an ACL injury increases with many factors. For instance, as mentioned before, contact, running, and jumping sports can lead to injury. Previous knee injuries, obesity, poor muscle condition, and inadequate protection from sports equipment can also lead to an ACL injury (Griffith 236). Griffith says that the individual should “participate in a strengthening, flexibility, and conditioning program appropriate for his or her sport” (236). The individual should also tape the vulnerable joints together before practice or games to provide support and protection and wear the proper protective shoes because a twist or injury to the foot can affect the individual's knee. Being knowledgeable about the causes, the factors that increase the risk of injury and the preventative methods can help to further develop the medical fields of sports medicine and orthopedics.

In order for the patient to receive proper treatment after a sustained injury, an orthopedic doctor must be knowledgeable about the reconstructive surgery and the patient must realize the amount of rehabilitation it will take to recover. “Surgical treatment of a torn ACL usually

involves an arthroscopic surgical reconstruction of the injured ligament” (Arthroscopic 2). Reconstruction begins with replacing the torn ligament with either a healthy tissue from the patient, a ligament from a cadaver, or a synthetic ligament. The healthy tissue (a graft) that comes from the patient's body is known as an autograft. This type of graft is most commonly used in the reconstructive surgery of the ACL. The graft may come from the patient's patellar tendon, one of the quadriceps, the hamstring, the iliotibial band, or very rarely it may come from the Achilles tendon (Esposito). The two most common types of autografts that are used for ACL reconstruction are bone-patellar tendon-bone and hamstring autografts (Grant 1). The most frequent method used involves the use of a patellar tendon graft to replace the torn ligament.

Anterior cruciate ligament reconstruction has always been considered a major orthopedic procedure. Typically, most ACL reconstructive surgeries last for two to two and a half hours and involve a sequence of complicated and technical steps. Because a great amount of this procedure can be done arthroscopically, it is well-suited to be an out patient procedure. This means that the patient, after he or she has had surgery, is most likely able to walk out of the surgical office, avoiding an overnight stay in a hospital. From start to finish, ACL reconstruction is basically an arthroscopic procedure. In the case of the patellar tendon autograft, an incision must be made on the front of the knee, since autografts come from the patient's own body. Through most surgeries, autografts have proven to have the best success rate. After the autograft is harvested and carefully shaped and prepared for transplantation, the actual graft site is prepared. The old torn ACL tissue is removed or trimmed out of the way using a special shaver device which is inserted through the arthroscopic hole. The shaver is a “steel tube revolving inside another steel tube with a window with sharp edges cut in the end of both tubes” (Brown 4). After the old ACL tissue is removed, the orthopedic surgeon begins to make a more spacious area for the new graft

to fit in by carefully removing a few millimeters of bone. This, in turn, allows for a more accurate placement of the new graft. Brown states that next it is the surgeons' job to carefully make the nine to ten millimeter drill holes into the patient's knee – the first one going up through the joint that lies just above the tibia (the shin bone) and the second one going up into the femur (the large thigh bone) (5). For this step during the procedure, it is best that the knee be placed at a 90 degree angle, allowing for easier access and placement (see Fig. 2).

Fig. 2 (Brown 1)

Placement and attachment of the graft to the re-shaped site are two of the most important steps during the whole surgical process. Sutures are attached to each end of the harvested graft before it is “threaded” through the knee. The sutures at the top end of the graft are looped through a small eye in the pin that is used to pull the graft through the holes. Very carefully, the patellar tendon graft is “pulled through the tibial hole, through the central part of the joint and into the hole in the femur” (Brown 6). Once the graft is in the same location where the old anterior cruciate ligament used to be, it is just a matter of attaching the bone ends of the patellar tendon graft to stabilize the new graft. Bioabsorbable screws are used to fix the graft to the holes made by the drill in the femur and the tibia. After the graft is in place, screws are securely put in to hold the graft in place. The screws are put in place for temporary fixation until the patient's own bone fills in and becomes the permanent anchor for the knee. The joint is then flushed with a saline solution in order to remove any of the excess trimmings that may be left behind after the procedure. The small incisions, which were made on the knee so that the arthroscope could pass through, are then sutured. Finally, the knee is placed in a “compressive dressing with allowance for cryotherapy” (Farr 2).

Rehabilitation is a primary part of the recovery process for any patient who has had anterior cruciate ligament reconstructive surgery. Rehabilitation for ligament reconstruction is usually broken down into four phases. The first phase is called the pre-operative period. This therapy takes place before the surgical procedure is performed and focuses on maintaining as much strength as possible in the quadriceps muscle. This is vital because the quadriceps is susceptible to losing a significant amount of strength after knee surgery, no matter what type. Strength can be improved during this phase by performing such exercises as knee extensions, heel slides, and straight leg raises (Gollogly 2). The second phase includes the first two weeks after ACL surgery is performed. The goal for the patient in phase two is to regain range of motion and to minimize the amount of swelling. To achieve this, the same exercises done in phase one are performed in phase two. Three to five weeks after surgery is when phase three begins. In this phase, the patient will work to “maintain full extension and gradually increase the amount of flexion in the knee” (Gollogly 5). For phase three, the goal switches from strength training to functional training. Phase four, six weeks after surgery, the goal switches back to strength training. Some exercises to do during this phase, when strength is almost back to its original state, are hamstring curls, squats, and leg extensions. After all four phases of rehabilitation are completed, the patient can begin to regularly participate in everyday activities.

In conclusion, as more and more people become involved with athletic activities, more and more people become susceptible to experiencing an injury. This is especially true with football, soccer, and basketball players who may experience various ligament injuries. This is why it is important for an orthopedic doctor to understand how to diagnose one of the most common sports injuries, an anterior cruciate ligament (ACL) tear, realize the causes, and provide

the proper treatment. With the orthopedic doctor's help the patient can have a successful recovery and can be back to his or her athletic lifestyle as soon as possible.

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