What is ACL Injury?

The anterior cruciate ligament (ACL) is one of the most commonly injured ligaments of the knee. In general, the incidence of ACL injury is higher in people who take part in high-risk sports, such as basketball, football, skiing, and soccer.

*Want to learn more about the ligaments of the knee?*

The bone structure of the knee joint is formed by the femur, the tibia, and the patella. The ACL constitutes one of the four main ligaments within the knee connecting the femur to the tibia.

The knee is essentially a central joint that is held together by the medial collateral (MCL), lateral collateral (LCL), anterior cruciate (ACL) and posterior cruciate (PCL) ligaments. The ACL is located in the middle of the knee. Its main function is to prevent the tibia from sliding out in front of the femur and to ensure rotational stability to the knee.

The weight-bearing surface of the knee is covered by a layer of articular cartilage. On both sides of the joint, between the cartilage surfaces of the femur and tibia, are the medial meniscus and lateral meniscus. The menisci act as shock absorbers and participate along with the cartilage in decreasing the stresses between the tibia and the femur.
What causes ACL Injury?

Almost 70 percent of ACL injuries occur through non-contact mechanisms, and only 30 percent result from direct contact with another object. Injury is often caused by cutting, pivoting or sidestepping maneuvers, awkward landings. Studies have shown that female athletes are at a higher risk of suffering ACL injury than male athletes in certain sports. The reason behind these rates is due to differences in physical conditioning, muscular strength, and neuromuscular control.

Other suggested causes of this gender-related difference in ACL injury rates include pelvis and lower extremity (leg) alignment, increased flexibility of the ligaments and the effects of estrogen on ligament properties.

What are the symptoms of ACL Injury?

Approximately 50 percent of ACL injuries are associated with damages to the meniscus, articular cartilage, or other ligaments. In addition, patients may suffer from bone bruises beneath the cartilage surface.

Following an injury, patients usually experience immediate pain, swelling and an unstable knee. After a while, swelling of the knee increases, motion is lost, sensation of pain or tenderness is experienced along the joint line and discomfort while walking.

How is ACL Injury diagnosed?

Specific tests are performed by the physician to identify meniscus tears and injury to other ligaments of the knee. These tests include:

- The Lachman's test to see if the ACL is intact or torn. In case the ACL is torn, the examiner will feel an increased upward or anterior movement of the tibia in relation to the femur followed by a soft, mushy endpoint when this movement ends.

- The pivot shift test. If the ACL is torn, the tibia will be positioned forward when the knee is fully straight and then will shift back into the correct position in relation to the femur when the knee is bent.

How does ACL Injury evolve?
The prognosis of an ACL injury without surgical intervention varies from patient to patient and depends on various factors such as the activity level, degree of injury and instability symptoms.

The improvement for a partially torn ACL is often positive, with the recovery and rehabilitation period that lasts up to 3 months; in some cases, instability symptoms can persist.

Complete ACL ruptures have more serious complications. Patients are unable to participate in cutting or pivoting-type sports, experience instability during regular activities such as walking. Only few individuals can participate in sports without experiencing any symptoms of instability. This variability depends on the severity of the original knee injury as well as the physical demands of the patient.

About half of ACL injuries occur in combination with damage to the meniscus, articular cartilage or other ligaments.

How is ACL Injury treated?

- Surgical and Non-Surgical Options

When a patient with an ACL injury is initially diagnosed, the doctor may also ask for X-rays to look for any possible fractures, MRI (Magnetic Resonance Imaging) scan to evaluate the ACL and to check for evidence of injury to other knee ligaments, meniscus cartilage or articular cartilage.

Treatment options for ACL injuries include both surgical and nonsurgical methods. The torn ACL is generally replaced by a substitute graft made of tendon. The grafts commonly used to replace the ACL include:
  - Patellar tendon autograft (autograft comes from the patient)
  - Hamstring tendon autograft
  - Quadriceps tendon autograft
  - Allograft (taken from a cadaver) patellar tendon, Achilles tendon, semitendinosus, gracilis, or posterior tibialis tendon

In nonsurgical treatment, progressive physical therapy and rehabilitation help restore the knee to a condition close to its pre-injury state and educate the patient on how to prevent instability. This treatment is complimented with the use of a hinged knee brace. However, many people who decide not to undergo surgery may experience secondary injury to the knee due to repetitive instability episodes.
- **Nonsurgical Treatment Benefits and Limits**

  Surgical treatment is usually recommended in cases of combined injuries (ACL tears as well as injuries in the knee). Nonsurgical management of ACL tears is recommended in patients:

  - With partial tears and no instability symptoms
  - With complete tears and no symptoms of knee instability during low-demand sports and are willing to give up high-demand sports
  - Who perform light manual work or live sedentary lifestyles
  - Whose growth plates are still open (children)

- **Surgical Intervention and Considerations**

  Patients treated with surgical reconstruction of the ACL have a higher long-term success. Rare cases of instability and graft failure are seen. The purpose of the ACL reconstruction surgery is to prevent instability, restore the function of the torn ligament and create a stable and strong knee.

  Several factors must be considered before choosing the treatment method. These include:

  **Patient Lifestyle**

  **Active adult patients** involved in sports or jobs that require a high level of motion as well as heavy manual work are encouraged to consider surgical treatment. Activity, not age, should determine if surgical intervention should be considered.

  In young **children or adolescents** with ACL tears, early ACL reconstruction creates a possible risk of growth plate injury, leading to bone growth problems. The surgeon can delay ACL surgery until the child reaches his skeletal maturity.

  A patient suffering from a torn ACL and **functional instability** has a high risk of developing secondary knee damage and should consider ACL reconstruction.

  ACL **injuries are commonly associated** with damage to the menisci, articular cartilage, collateral ligaments, joint capsule, or a combination of the above. The "unhappy triad", frequently diagnosed in football players and skiers, consists of injuries to the ACL, the MCL and the medial meniscus. In cases of combined injuries, surgical treatment is recommended and produces better outcome.

- **Surgical Choices**

  The **patellar tendon autograft**, also known as the "gold standard" for ACL reconstruction, is often recommended for highly active athletes and patients whose jobs do not require constant kneeling, and results in better outcomes in terms of postoperative tests for knee laxity. However, patellar tendon autografts have a greater incidence of postoperative patella femoral pain (pain behind the kneecap), complaints and other complications.
The pitfalls of the patellar tendon autograft are:

- Postoperative pain behind the kneecap
- Pain with kneeling
- Slightly increased risk of postoperative stiffness
- Low risk of patella fracture

The hamstring tendon autograft for ACL reconstruction is associated with fewer problems compared to the patellar tendon autograft including:

- Less problems with anterior knee pain or kneecap pain after surgery
- Less postoperative stiffness problems
- Smaller incision
- Faster recovery

The quadriceps tendon autograft is often used in cases where patients have failed ACL reconstruction. This yields a larger graft area for taller and heavier patients. This type of autograft is highly associated with postoperative anterior knee pain, low risk of patella fracture and is not cosmetically appealing.

Allografts are grafts taken from cadavers and are becoming highly popular. These grafts are used in cases of ACL reconstruction failure and during surgery to repair or reconstruct more than one knee ligament. Advantages of using allograft tissue include elimination of pain due to the extraction of the graft from the patient, decreased surgery time and smaller incisions. However, allografts are associated with a risk of infection, including viral transmission (HIV and Hepatitis C), despite careful screening and processing.

- Surgical Procedure

Before any surgical treatment, the patient is usually sent to physical therapy for evaluation. Patients who have a stiff, swollen knee lacking full range of motion at the time of ACL surgery may have significant problems regaining their mobility after surgery. It usually takes more than three weeks from the time of injury to fully recover. It is also recommended that some ligament injuries be braced and allowed to heal prior to ACL surgery.

The patient, the surgeon and the anesthesiologist select the anesthesia used for surgery. The surgery usually begins with an examination of the patient's knee while the patient is relaxed under the effects of anesthesia. This final examination is used to verify that the ACL is torn, the looseness of the knee ligaments that may need to be repaired during surgery or followed up postoperatively. If the physical exam strongly suggests that the
ACL is torn, the selected tendon is harvested (for an autograft) or thawed (for an allograft) and the graft is prepared to fit the size of the patient.

After the graft has been prepared, the surgeon places an arthroscope into the joint that helps examine the condition of the knee by inducing small incisions called portals.

Meniscus and cartilage injuries are trimmed or repaired and the torn ACL stump is then removed. In the most common ACL reconstruction technique, bone tunnels are drilled into the tibia and the femur to place the ACL graft in identical position as the torn ACL. The graft is held under tension as it is fixed in place. The devices used to hold the graft in place are generally not removed.

Before the surgery is complete, the surgeon will probe the graft to make sure it has good tension, verify that the knee has full range of motion and perform tests such as the Lachman's test to assess graft stability. The skin is closed and dressings (and perhaps a postoperative brace and cold therapy device, depending on surgeon preference) are applied. The patient will usually go home on the same day of the surgery.

### Potential Surgical Complications

The incidence rate of infection following arthroscopic ACL reconstruction ranges between 0.2 to 0.48%. In addition, many cases of deaths were reported due to bacterial infection from allograft tissue in cases of improper procurement and sterilization methods.

Bleeding from acute injury to the popliteal artery and weakness or paralysis of the leg or foot are not common side effects. It is very normal to suffer from temporary or permanent numbness on the outer part of the upper leg next to the incision. Recurrent instability due to rupture or stretching of the reconstructed ligament or poor surgical technique is possible.

Knee stiffness or loss of motion has been reported in 5 to 25% of the cases.

Rupture of the patellar tendon (patellar tendon autograft) or patella fracture (patellar tendon or quadriceps tendon autografts) may occur due to weakening at the site of graft harvest.

In young children or adolescents with ACL tears, early ACL reconstruction creates a possible risk of growth plate injury, leading to bone growth problems. The ACL surgery can be delayed until the child is closer to achieving certain level skeletal maturity. Alternatively, the surgeon may be able to modify the technique of ACL reconstruction to decrease the risk of growth plate injury.

Postoperative anterior knee pain is especially common after patellar tendon autograft ACL reconstruction. The incidence of pain behind the kneecap varies between 4 and 56 percent, whereas the incidence of kneeling pain may be as high as 42 percent after patellar tendon autograft ACL reconstruction.
**What should be done following the treatment?**

- **Rehabilitation/Convalescence**

  **Postoperative development**
  Immediate and rigorous physical therapy is a crucial part of successful ACL surgery. With new surgical techniques and stronger graft fixation, current physical therapy accelerates the course of rehabilitation.
  In the first 10 to 14 days after surgery, the wound must be kept clean and dry, and early emphasis is placed on regaining the ability to fully straighten the knee and restore quadriceps control. The knee is iced regularly to reduce swelling and pain.

  The surgeon may dictate the use of a postoperative brace and the use of a machine to move the knee through its range of motion.

  **Rehabilitation**
  The goals for rehabilitation of ACL reconstruction include reducing knee swelling, maintaining mobility of the kneecap to prevent anterior knee pain problems, regaining full range of motion of the knee, as well as strengthening the quadriceps and hamstring muscles.

  The patient may resume sports when there is no longer pain or swelling, when full knee range of motion has been achieved, and when muscle strength, endurance and functional use of the leg have been fully restored.

  The patient's sense of balance and control of the leg can also be restored through exercises that are followed to improve neuromuscular control.

  This process usually takes between 4 to 6 months.

  The use of a functional brace is not necessary but provides additional security for the patients.