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ACL Injury: Should it be fixed?

The anterior cruciate ligament (ACL) is one of the most commonly injured ligaments of the knee. In the USA the incidence of ACL injuries is currently estimated at approximately 200,000 annually, with 100,000 ACL reconstructions performed each year. In general, the incidence of ACL injury is higher in people who participate in high-risk sports such as rugby union or league, soccer and netball. The ACL is important for twisting and turning particularly at speed.

Anatomy and Pathophysiology

The bone structure of the knee joint is formed by the femur, the tibia, and the patella. The ACL is one of the four main ligaments within the knee that connect the femur to the tibia. The knee is essentially a hinged joint that is held together by the medial collateral (MCL), lateral collateral (LCL), anterior cruciate (ACL) and posterior cruciate (PCL) ligaments. The ACL runs diagonally in the middle of the knee, preventing the tibia from sliding out in front of the femur as well as providing rotational stability to the knee (Figure 1).

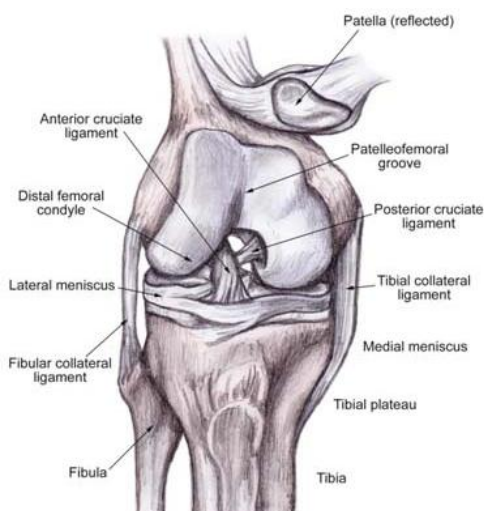


Figure 1

The weight-bearing surface of the knee is covered by a layer of articular cartilage. On either side 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 work with the cartilage to reduce the stresses between the tibia and the femur.



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It is estimated that 70 of ACL injuries occur through non-contact mechanisms while 30 result from direct contact with another player or object. The mechanism of injury is often associated with deceleration coupled with cutting, pivoting or sidestepping manoeuvres, awkward landings or "out of control" play. Several studies have shown that female athletes have a higher incidence of ACL injury than male athletes. It has been proposed that this is due to differences in physical conditioning, muscular strength, and neuromuscular control. Other hypothesized causes of this gender-related difference in ACL injury rates include pelvis and lower extremity (leg) alignment, increased ligamentous laxity and the effects of oestrogen on ligament properties.

Approximately 50 of ACL injuries occur in combination with damage to the meniscus, articular cartilage, or other ligaments. Additionally, patients may have bone bruises of the bone beneath the cartilage surface. These may be seen on an MRI and may indicate injury to the overlying articular cartilage.

Immediately after the injury, patients usually experience pain and swelling and the knee feels unstable. Within a few hours after a new ACL injury, patients often have a large amount of knee swelling, a loss of full range of motion, pain or tenderness along the joint line and discomfort while walking. Patients often use crutches for the first 7-14 days in the initial period after the injury.

Natural History

The natural history of an ACL injury without surgical intervention varies from patient to patient and depends on the patient's activity level, degree of injury and instability symptoms.

After a complete ACL tear, some patients are unable to participate in pivoting-type sports, while others have instability during even normal activities such as walking. There are some rare individuals who can participate in sports without any symptoms of instability. This variability is related to 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.

With repeated instability and collapse further damage can occur and this should be prevented if possible. With chronic instability, up to 90 of patients will have meniscus damage when reassessed 10 or more years after the initial injury. Similarly, the prevalence of articular cartilage lesions increases up to 70 in patients who have a 10-year-old ACL deficiency.



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Surgical and Non-Surgical Options

When a patient with an ACL injury is initially seen for evaluation, X-rays are ordered to look for any possible fractures or other problems. An 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 may also be useful. See picture below



Figure 2 MRI of complete ACL tear

Treatment options for ACL injuries include both operative and non-operative treatments.

The main aim is to achieve a stable knee this can be achieved with or without an operation depending on the patient.

ACL tears do not heal if sewn back together. Therefore, the torn ACL is generally replaced by a substitute graft made of tendon. Typically this is done by using the patient's hamstring tendons.

In non-operative treatment, progressive physiotherapy and rehabilitation can restore the knee to a condition close to its pre-injury state and educate the patient on how to prevent instability.



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Non-Operative Treatment Benefits and Limits

Surgical treatment is usually advised in dealing with combined injuries (ACL tears in combination with other injuries in the knee). However, deciding against surgery is reasonable for select patients. Non-operative management of isolated ACL tears is likely to be successful or may be indicated in patients:

- With partial tears and no instability symptoms
- With complete tears and no symptoms of knee instability during low-demand sports who are willing to give up high-demand sports
- Who do 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 long-term success rates of 82 % to 95%. Recurrent instability and graft failure are seen in approximately 6% of patients. The goal of the ACL reconstruction surgery is to prevent instability and restore the function of the torn ligament, creating a stable knee. This allows the patient to return to sports. There are certain factors that the patient must consider when deciding for or against ACL surgery. The knee may not feel "normal" after a reconstruction even though it may be stable. It is also now known that whilst it is common to return to sport it may not be at the same previous level of participation. (Feller)



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Patient Considerations

Active patients involved in sports or jobs that require pivoting, turning or hard-cutting as well as heavy manual work are encouraged to consider surgical treatment. This includes older patients who have previously been excluded from consideration for ACL surgery. Instability associated with activity, not age, should determine if surgical intervention should be considered.

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

It is common to see ACL **injuries combined** with damage to the menisci (50%), articular cartilage (30%), collateral ligaments (30%), joint capsule, or a combination of the above. As many as 50% of meniscus tears may be repairable and heal better if the repair is done in combination with the ACL reconstruction.

Surgical Choices

The middle third of the patellar tendon of the patient, along with a bone plug from the shin and the knee cap is used in the **patellar tendon autograft** (Figure 7). Patellar

tendon autografts have a greater incidence of postoperative patellofemoral pain (pain behind the kneecap) complaints and other problems.

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 semitendinosus and gracilis hamstring tendons on the inner side of the knee are used in creating the **hamstring tendon autograft for ACL Reconstruction**. This creates a four-strand tendon graft. (See picture)



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Fewer 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 for patients who have already failed ACL reconstruction. The middle third of the patient's quadriceps tendon and a bone plug from the upper end of the knee cap are used. This yields a larger graft for taller and heavier patients. Because there is a bone plug on one side only, the fixation is not as solid as for the patellar tendon graft. There is a high association with postoperative anterior knee pain and a low risk of patella fracture. Patients may find the incision is not cosmetically appealing.

Allografts are grafts taken from cadavers and are becoming increasingly popular. These grafts typically have poorer outcomes than autografts and therefore are usually reserved for revision surgery where suitable autograft is unavailable. These grafts are also used for patients who have failed ACL reconstruction before and in surgery to repair or reconstruct more than one knee ligament.

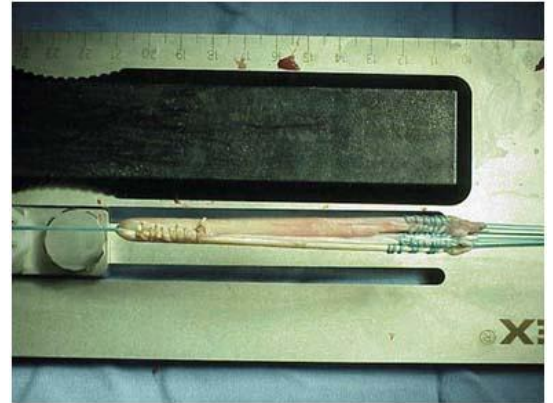


Figure 3 Hamstring tendon Autograft



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Operative Procedure

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

The patient, the surgeon and the anaesthetist select the anaesthesia used for surgery. Patients may benefit from an anaesthetic block of the nerves of the leg to decrease postoperative pain. The surgery usually begins with an examination of the patient's knee while the patient is relaxed due the effects of anaesthesia. This final examination is used to verify that the ACL is torn and also to check for looseness of other knee ligaments that may need to be repaired during surgery or addressed postoperatively. If the physical exam strongly suggests the ACL is torn, the selected tendon is harvested and the graft prepared.

After the graft has been prepared, the surgeon places an arthroscope into the joint. Small (one-centimeter) incisions called portals are made in the front of the knee to insert the arthroscope and instruments and the surgeon examines the condition of the knee.

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 almost the same position as the torn ACL. A long needle is then passed through the femoral tunnel, and then out through the skin of the thigh. The sutures of the graft are placed through the eye of the needle and the graft is pulled into position up through the tibial tunnel and then up into the femoral tunnel.

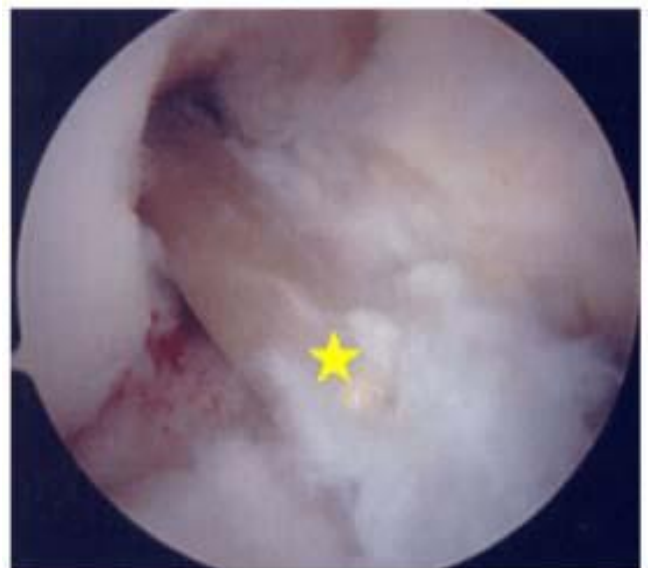


Figure 4 Arthroscopic view of ACL graft

The graft is held under tension as it is fixed in place using interference screws endobuttons or staples. 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



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skin is closed and dressings and a postoperative brace are applied. The patient will usually go home the day following surgery.

Potential Operative Complications

The incidence of infection after arthroscopic ACL reconstruction has a reported range of 0.2 % to 0.48%. There have also been several reported deaths linked to bacterial infection from allograft tissue due to improper procurement and sterilization techniques.

Allografts specifically are associated with risk of viral transmission, including HIV and Hepatitis C, despite careful screening and processing. The chance of obtaining a bone allograft from an HIV-infected donor is calculated to be less than 1 in a million.

Rare risks include bleeding from acute injury to the popliteal artery (overall incidence is 0.01%) and weakness or paralysis of the leg or foot. It is not uncommon to have numbness of the outer part of the upper leg next to the incision, which may be temporary or permanent.

A blood clot in the veins of the calf or thigh is a potentially life-threatening complication. A blood clot may break off in the bloodstream and travel to the lungs, causing pulmonary embolism or to the brain, causing stroke. This risk of deep vein thrombosis is reported to be approximately 0.12 %.

Recurrent instability due to rupture or stretching of the reconstructed ligament or poor surgical technique (reported to be as low as 2.5% and as high as 10%) is possible.

Knee stiffness or loss of motion has been reported at between 5% and 25 %.

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 reaching skeletal maturity. Alternatively, the surgeon may be able to modify the technique of ACL reconstruction to decrease the risk of growth plate injury.



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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% in studies, whereas the incidence of kneeling pain may be as high as 42% after patellar tendon autograft ACL reconstruction.

Rehabilitation

Postoperative course/rehabilitation

Physiotherapy is a crucial part of successful ACL surgery, with exercises beginning immediately after the surgery. Much of the success of ACL reconstructive surgery depends on the patient's dedication to rigorous physiotherapy. With new surgical techniques and stronger graft fixation, current physiotherapy uses an accelerated course of rehabilitation.

In the first 10 to 14 days after surgery, the wound is 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. Patient's are generally allowed to take weight as pain allows and have usually stopped using crutches by two weeks post op and a brace by 2-4 weeks post op.

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 return to 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 must also be restored through exercises designed to improve neuromuscular control. This usually takes 9 to 12 months.