

Division of Orthopaedic Surgery
Anterior Cruciate Ligament (ACL) Injury

The ACL is one of four major ligaments (tissues that connect bone to bone) of the knee joint that coordinate function and promote stability of the knee joint. Athletes who participate in sports such as football, soccer and basketball are more likely to injure their ACL. You may require surgery to regain full function of your knee and prevent early arthritis. This will depend on several factors, such as the severity of your injury. Your doctor will work together with you to develop a plan to restore function and return to activities.

Anatomy

The knee is the largest joint in the body. It is made of up four main things: bones, cartilage, ligaments, and tendons.

Three bones meet to form your knee joint: your thigh bone (femur), shin bone (tibia) and kneecap (patella). Bones are connected to other bones by ligaments, which act like strong ropes to hold the bones together and keep your knee stable.

The collateral ligaments are found on the sides of your knee. The medial collateral ligament (MCL) is on the inside and the lateral collateral ligament (LCL) is on the outside. They control the sideways motion of your knee.

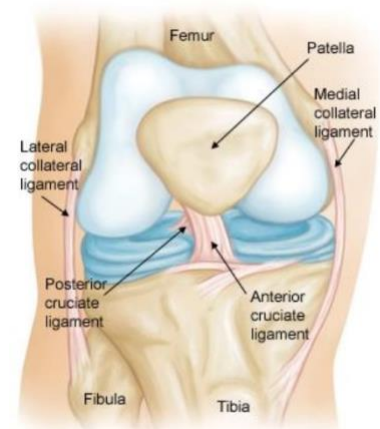


Image: orthointo.aaos.org

The cruciate ligaments are found inside your knee joint. They control the back-and-forth motion of your knee. The anterior cruciate ligament (ACL) connects the back part of the thigh bone (femur) to the front part of the shin bone (tibia). The ACL prevents forward movement of the tibia. It also provides roughly 90 percent of stability in the knee joint. The posterior cruciate ligament (PCL) prevents the shin bone (tibia) from moving backwards too far.

In between the thigh bone and the shin bone, the meniscus, a wedge-shaped cartilage on either side of the knee, acts as a shock absorber to reduce impact, provide cushion, and stabilize the joint.

During childhood, new bone grows from areas near the end of long bones called “growth plates”. In a growing child, up to 1.5cm per year of longitudinal growth can occur from these areas in the leg. Growth disturbances and angular deformities of the knee can result if surgery is performed that does not consider this added level of complexity.

Causes

The ACL can be injured in several ways. The classic ACL injury occurs during a non-contact event usually when decelerating, stopping suddenly, twisting, cutting, or jumping. Often patients will hear or feel a “pop” at the time of injury and sometimes they may report brief a hyperextension of the knee joint. Just after the injury some patients may be able to continue activity; however, most patients are unable

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to continue regular activity. A few hours after injury, the knee will usually swell considerably. The ACL can also be injured when the knee is subjected to a direct blow most commonly, to the lateral side (outside) and other ligaments or meniscus may be injured in addition to the ACL.

Risk Factors

Risk factors include imbalances between quadriceps and hamstrings, weak core strength, improper techniques with landings and decreased proprioception and neuromuscular control.

Several studies have shown that female athletes have a higher incidence of ACL injury than male athletes. There are both genetic and hormonal differences between females and males which may increase the strain on the female knee. These include wider hips, smaller ends of the thigh bone where the ACL connects, higher levels of estrogen, and more laxity (mobility) of the joints.

Symptoms

Symptoms of an ACL injury include:

- Hearing a “popping” noise
- Feeling your knee give out from under you
- Pain with swelling. This will usually go away on its own.
- Loss of full range of motion
- Tenderness along the joint line

Diagnosis & Imaging

Your orthopaedic specialist will talk to you about your symptoms and medical history. Your provider will examine the structures of your injured knee and compare them to your non-injured knee. In addition to a thorough physical examination, your provider will probably obtain additional imaging to assist confirm your diagnosis. Although they will not show an injury to your ACL, x-rays will be completed to rule out a broken bone. Most insurance companies will not authorize a magnetic resonance imaging (MRI) scan without having x-rays completed first. An MRI will be ordered to visualize the structures of the knee such as the ligaments, meniscus, and cartilage.

Treatment

Our specialists will work together with you to tailor a treatment plan for your individual needs and goals.

Nonsurgical Treatment

Nonsurgical treatment may be effective for patients who have good overall stability of the knee and who have a low activity level. Nonsurgical treatments include bracing, crutches, and physical therapy.

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Surgical Treatments

Most commonly, surgery is recommended to repair the ACL and restore knee stability. Without a properly functioning ACL, the meniscus will attempt to stabilize the knee. Overtime, this will cause early degeneration of the meniscus and cartilage, arthritis and increase the probability of needing a knee replacement in early adulthood.

The ACL cannot be stitched back together once torn; the ligament must be reconstructed with the use of a graft. The graft acts as a scaffolding for a new ligament to grow on. There are advantages and disadvantages to uses different types of grafts, your surgeon will discuss each with you and individualize a treatment plan based on your specific needs and goals. Grafts can be autograft (your own tissue) or allograft (from a cadaver, someone who donated tissue after death).

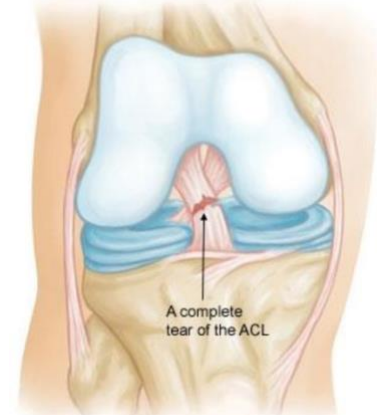


Image: orthoinfo.aaos.org

Types of Grafts include:

1. Bone-tendon-bone grafts (BTB) includes taking small pieces of bone from your kneecap and shin with a small strip of your patellar tendon. Advantages include more predictable healing since you are asking bone to heal bone. Disadvantages include a larger incision in the front of the knee, inability to use it in a growing child, kneecap fracture and a higher incidence of anterior knee pain after surgery.
2. Quadriceps grafts include using a portion of your quadriceps tendon through small incisions in the front of the knee. Advantages to quadriceps graft include smaller incision compared to BTB and decreased anterior knee pain.
3. Hamstring grafts include using 2 of the hamstring tendons in the back of your leg. Hamstring tendons grow back during the period of recovery. Advantages include smaller incisions, no fracture risk, less post-op pain. Disadvantages include slightly less predictable healing since you are asking soft tissue to heal bone and slight decrease in hamstring strength.
4. Cadaver graft includes using a graft from someone who has passed away. Although this technique decreases operating room time, it is rarely used as the sole grafting option because recent studies have shown a 4 times higher failure rate in children compared to using your own tissue.

We will ask several questions to determine which graft is best for your knee. Age and activity level are the most important. If you are still growing, we will use either hamstring or quadriceps tendon graft. If you are done growing, we can use bone tendon bone (BTB) as a graft as well. Sport and activity levels will help us work together to choose the appropriate graft to use. For example, BTB grafts are typically used in athletes who play collision sports such as football and soccer. Athletes who play vertical sports such as basketball may benefit from hamstring grafts.

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As each patient faces the decision of choosing one graft over the other, conversation with the surgeon is important. Selecting the graft type is a personal choice based on each patient's needs, activity level, goals, and preferences. Regardless of the type of graft chosen, regrowth of the ligament takes time, and it will be close to one year before an athlete can return to sports after surgery.

Surgery to reconstruct an ACL is done through minimally invasive arthroscopic technique, using small incisions and small, flexible instruments and camera. Most ACL reconstructions are completed in our surgical center as an outpatient, same day surgery. If your child has certain medical conditions, we may recommend for the child to have surgery at our main hospital campus.

It is important to have as close to normal range of motion of the knee (straightening and bending) before surgery. If you do not have normal flexion and extension before surgery, you are more likely to be stiff after surgery. Your surgeon may recommend formal physical therapy before surgery if your motion is very limited. Please see end of document for some easy range of motion exercises to work on up until surgery.

Preparing for Surgery

Scheduling

Once you and your spine surgeon mutually decide to proceed with surgery, the surgeon will submit a surgical plan of care to their surgery scheduler. The surgery scheduler will obtain approval from your insurance company; this usually takes about one week. Once the authorization for surgery has been obtained, the scheduler will contact you to pick a date that is convenient for you and your surgeon.

Pre-Operative Anesthesia Appointment

You will have an appointment with the Pre-Operative Anesthesia team either in person, through telehealth or phone around one week before surgery. During this appointment, the provider will conduct a health assessment, discuss how your child will go to sleep for surgery, the risks of anesthesia and when to stop eating and drinking before surgery. Bring any medications that your child takes to this appointment. They will advise you when to stop taking your medications before surgery. Every child reacts differently to anesthesia. Many children wake up groggy or confused. Some children develop nausea. Let your Pre-Op Anesthesia provider know if your child or any close blood relatives have a history of previous problems with anesthesia. The pre-op anesthesia nurse will also go over any special bathing instructions for the night before surgery.

Pre-Operative Visit with Orthopaedic Nurse

Your surgeon's nurse will arrange a convenient time through phone or telehealth to go over the surgery again as well as answer any questions you may have about the recovery process. They will order any equipment that you may need after surgery. They will also help to answer any questions you may have about arranging home schooling, letters for school/work, Paid Family Leave/FMLA or handicap placards.

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Equipment ordered for after surgery include a post-op hinged knee brace and crutches.

A machine called a CPM, which stands for continuous passive motion, may be ordered to assist you in starting gentle motion of your leg and helps decrease swelling. This machine will be delivered to your home before surgery. Starting the day after surgery, you will use the CPM for a few hours a day (as much as you can tolerate). You will start at 50-60 degrees of motion and increase between 5-10 degrees per day as you can tolerate until you get to a goal of 90 degrees. You can use the machine with or without your brace on, whichever is more comfortable. If you are using the machine with your brace on, you will need to unlock the brace to use it. Once you reach 90 degrees, you can stop using the machine and call the company to pick it up.

An ice machine is an optional piece of equipment because it is not covered by insurance. If you want an ice machine, we can help arrange one for you to purchase. If you want to borrow an ice machine from someone, we require that you purchase your own sleeve/wrap for the ice machine since sharing increase the risk of skin infection.

The Day Before Surgery

You will receive a phone call from the pre-operative nurse to confirm the time of your arrival to the surgery center/hospital. In general, you will be asked to get to the arrive approximately 1 – 1.5 hours before surgery to allow time for registration and meeting a child life specialist. The pre-op nurse will also confirm instructions on when to stop eating and drinking.

When to Stop Eating and Drinking Before Surgery

Please follow the directions given to you by the pre-operative nurse. If your child does not follow the guidelines, the surgery may be delayed or canceled. These guidelines are in place for your child's safety to prevent complications associated with vomiting during surgery.

As a general guideline, you will not be allowed to have any food or cow's milk after midnight. Clear liquids (clear apple juice, water, Pedialyte only) may be given up to 2 hours before surgery. Absolutely nothing in the mouth within two hours of surgery including ice chips, hard candy or chewing gum.

The Day of Surgery

On the day of surgery, please arrive on time and bring the following information with you:

- Picture ID Card for parents/patients over 18 years
- Child's insurance card
- Proof of guardianship if you are not the birth parent (foster parent papers/court orders/adoption papers)

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The child's caregiver is required to remain at the hospital for the entire procedure. We understand that you know your child the best and want you involved in their care throughout the entire process. Please do not bring other children to the surgery.

All female patients older than 10 years or who have already started their menstrual cycle are required to give a urine sample to check for pregnancy. Please have your daughter pee in any clean container you have at home (Tupperware or glass jar) when she wakes up in the morning. Be sure to bring the urine to the hospital with you.

Pre-Operative Room:

After your register for surgery, you will be taken to the pre-operative room. This is where your child will out on a hospital gown or pajamas, meet with the child life specialist, and meet with the surgeon and anesthesiologist to discuss the procedure and anesthesia and answer any questions that you may have. If your child is anxious or scared, we may give them a pre-medication that will help them relax.

Operating Room (OR)

Your child will have a team working together to maximize safety. The anesthesiologist will decide on the safest way for your child to go to sleep with general anesthesia and usually a local nerve block to help reduce post-op pain. Surgery is done through minimally invasive arthroscopic technique, using small incisions and small, flexible instruments and camera. Tunnels are drilled into the bone to thread the new graft through and dissolving sutures hold the graft into place. Your leg will be wrapped with a couple ace wraps with gentle compression to reduce swelling. When the surgery is complete, your child will be transferred from the OR to the recovery room.

Recovery Room

You will be united with your child once he or she is settled in the recovery unit. The surgeon will come and talk to you about how the procedure went. Your surgeon will give you a specific post-op protocol to follow based on your exact injury and surgery. The recovery team will electronically send prescriptions to your local pharmacy for you to pick up on your way home. The discharge nurse will hand you a paper prescription for a narcotic pain medication to also have filled on your way home. We are unable to electronically fill narcotic prescriptions. Electronic prescriptions may include medications for an antibiotic (to decrease risk of infection), stool softener (to decrease risk of constipation), antinausea (to decrease nausea and vomiting) and aspirin (to decrease the risk of blood clots). Typically, you will use a post-op hinged knee brace, crutches and not put any weight on your leg for 6 weeks after surgery.

Post-Op Recovery

The surgeon will provide a specific post-op protocol based on the surgery completed. It is important to follow the post-op protocol to give you the best outcome after surgery. If you need advice post-op, please do not hesitate to contact your surgeon or their nurse.

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Post-Op Pain

Please watch this video by Dr. Pandya discussing different techniques to manage post-operative pain.
<https://vimeo.com/440510582>

It is normal to have pain, discomfort and swelling in the leg after surgery. Most patients require 4-7 days of stronger narcotic pain medication (hydrocodone/acetaminophen) along with a few weeks of over-the-counter medications such as ibuprofen. You should start taking the narcotic pain medication after surgery. If you feel very comfortable and numb with the nerve block, we still recommend taking the narcotic medication around bed time that first night after surgery in case the nerve block wears off in the middle of the night. Most patients use the narcotic medication around the clock for the first 2-3 days after surgery and then start to wean or spread out the medication as needed. The day after surgery, you should start taking over-the-counter ibuprofen (Motrin, Advil) around the clock. Ibuprofen is an anti-inflammatory medication that works differently than the narcotic (hydrocodone/acetaminophen) to reduce pain related to swelling and inflammation after surgery. As the pain decreases, you may prefer taking ibuprofen during the day for mild pain and taking a narcotic at night before bed for more moderate pain. It is important to note that the narcotic medication (hydrocodone/acetaminophen) has acetaminophen, also known as Tylenol, in it. Because of this, you are not able to take extra doses of Tylenol.

Swelling

It is normal to have an increase in swelling for up to 72 hours after surgery. We recommend that you elevate your leg to reduce swelling. The proper way to elevate is to think of a slide. You want the toes to be higher than the knee and the knee to be higher than the hip. This will use gravity to help the blood flow back up to the heart. You can use pillows or blankets to elevate the calf and ankle but try to avoid placing a pillow directly behind the knee. You should also start moving your foot, ankle and wiggling your toes after surgery, this will also help to reduce swelling. If you notice numbness, tingling, discoloration or intense throbbing to the foot, you can gently remove the brace and ace bandages and re-wrap the ace bandages slightly looser. If the symptoms do not improve with these tips, please contact the orthopaedic team for assistance.

Activity

You will be groggy for the first day after surgery. Most patients typically start to feel like themselves again around day 3-4 after surgery. Most patients need about a week at home without school or work before feeling comfortable enough to return. In order to return to school/work, you can not be taking narcotic pain medication during the day. You may want to arrange with the school, extra time in between classes, an extra set of books or someone to help carry a backpack.

Post-Op Appointment

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At your first post-op appointment, usually 7-10 days after surgery, we will remove your dressings, adjust your brace, and check your motion. After this appointment, you will be allowed to start to shower and you will also start physical therapy.

When to Call the Orthopaedic Surgeon:

- A temperature of 101.5 degrees and without other signs of illness or cold such as runny nose, chills, sore throat, cough, etc.
- Increased redness, swelling, tenderness, pain, or warmth at their incision sites
- Drainage or bad smell at their incision sites
- Open areas along the incision line
- Pain that does not get better with pain medicine
- Numbness or tingling in their arms, legs, or feet
- Change in bowel or bladder control
- Vomiting
- Constipation
- Any questions or concerns about how you feel

Contact Numbers:

Weekdays (8-4:30pm): 510-428-3238 and ask to speak to your surgeon's nurse

After 4:30pm or Weekend/Holidays: 510-428-3000 (main hospital number) and ask to speak to the orthopedic resident on call

Physical Therapy

Regardless of whether your treatment includes surgery or not, physical therapy plays a vital role in getting you back to your daily activities and sports. It is important to do physical therapy at a location that is close to your home and specializes in sports rehabilitation. Our physical therapy program focuses on returning motion to the joint, building strength of the surrounding muscles and gradually increases the stress across the ligament.

The general rehabilitation protocol after an ACL reconstruction includes: You will have a knee brace locked straight (extension) and with toe touch weight bearing with crutches for one week after surgery. After one week, you will begin range of motion from 0 - 90 (with meniscal repair) or full range of motion (if no meniscal repair). At 6 weeks, the brace and crutches will be discontinued. At 4 months, you will begin straight line running. At 6 months, you will begin cutting and pivoting activities, and at 9 months after surgery will be allowed to return to some sporting activities.

Our Approach to ACL Tear

UCSF is committed to helping patients with ACL tears return to the highest level of activity possible, whether that means a daily walk or collegiate/professional athletes. Our team includes orthopedic surgeons, primary care physicians trained in sports medicine, physician assistances, nurses, physical



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therapists, and athletic trainers. These specialists work together to tailor a treatment plan to each patient's needs and goals.

Additional Resources:

Dr. Pandya presents Pediatric ACL Injuries: Workup and Management

https://www.youtube.com/watch?v=MXoPXDv_XTg

American Academy of Orthopedic Surgery:

<https://orthoinfo.aaos.org/en/diseases--conditions/anterior-cruciate-ligament-acl-injuries/>

UCSF Benioff Children's Hospital Oakland: Patient's Guide to Using Crutches (English)

<https://www.youtube.com/watch?v=7X-mOkiMS0A>

UCSF Benioff Children's Hospital Oakland: Patient's Guide to Using Crutches (Spanish)

<https://www.youtube.com/watch?v=NaxNXbf3N4A>

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Pre-Op ACL Physical Therapy Exercises

Long Sitting Quad Set

REPS: 10	SETS: 1	HOLD: 10	DAILY: 1
WEEKLY: 7			



Setup

Begin sitting upright on the floor with one leg laying straight and your other knee bent.

Movement

Straighten your leg, pushing your knee toward the floor, and hold.

Tip

Make sure to keep your back straight during the exercise.

Isometric Quadriceps Activation

SETS: 3	REPS: 10	HOLD: 10	DAILY: 1
WEEKLY: 7			



Setup

Begin sitting on the ground or a bed with one leg straight and your opposite leg bent.

Movement

Squeeze the muscles in the top of your thigh, gently pressing your knee down toward the bed. Hold, then relax and repeat.

Tip

Sit tall during the movement and keep your knee straight. Focus on squeezing the thigh muscles closer to your knee.

Straight Leg Raise

REPS: 20	SETS: 1	HOLD: 5	DAILY: 1
WEEKLY: 7			



Setup

Begin lying on your back with one leg bent and your opposite leg straight.

Movement

Keeping your leg straight, raise your leg up until your thigh is at the same height of your bent knee. Slowly return to the starting position and repeat.

Tip

Make sure to not let your leg or pelvis rotate to either side and do not arch your back.

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Sitting Heel Slide with Towel

REPS: 10	SETS: 1	HOLD: 10	DAILY: 1
WEEKLY: 7			



Setup

Begin sitting with your knees straight and a towel looped around one foot, holding the ends in both hands.

Movement

Use the towel to gently bend your knee until a stretch is felt. Hold, and then slide your heel forward into the starting position and repeat.

Tip

Make sure that your leg does not rotate in or out as you bend your knee.

Supine Bridge

REPS: 10	SETS: 2	DAILY: 1	WEEKLY: 7
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Setup

Begin lying on your back with your arms resting at your sides, your legs bent at the knees and your feet flat on the ground.

Movement

Tighten your abdominals and slowly lift your hips off the floor into a bridge position, keeping your back straight.

Tip

Make sure to keep your trunk stiff throughout the exercise and your arms flat on the floor.

Sidelying Hip Extension in Abduction

REPS: 10	SETS: 2	HOLD: 5	DAILY: 1
WEEKLY: 7			



Setup

Begin lying on your side

Movement

Slightly raise your leg toward the ceiling, then lift it backward behind you. Hold briefly, then bring your leg forward and repeat.

Tip

Make sure to keep your core engaged and do not let your hips roll forward or backward during the exercise.

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Squat with Chair Touch

REPS: 10	SETS: 2	DAILY: 1	WEEKLY: 7
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Setup

Begin in a standing upright position in front of a chair.

Movement

Lower yourself into a squatting position, bending at your hips and knees, until you lightly touch the chair. Return to the starting position and repeat.

Tip

Make sure to maintain your balance during the exercise and do not let your knees bend forward past your toes.



Disclaimer: This program provides exercises related to your condition that you can perform at home. As there is a risk of injury with any activity, use caution when performing exercises. If you experience any pain or discomfort, discontinue the exercises and contact your health care provider.