What is the ACL?
The Anterior Cruciate Ligament (ACL) is one of 2 strong and very important ligaments that cross in the center of your knee which provide stability to your knee - especially pivoting activities that involve turning, jumping or twisting.

How Does the ACL Tear?
Usually the ligament tears during sudden & forceful twisting or pivoting activities. The classic example is cutting or changing direction quickly while playing football. Almost any activity can tear the ACL, I see these most commonly in student athletes playing basketball, volleyball, soccer & skiing - especially when the player lands awkwardly after leaving his/her feet. Often the athlete or teammates hear a loud pop or snap & the injured athlete may feel a tearing sensation within the knee. Most often the initial pain is felt along the outside of the knee until the knee swells, at which point the entire knee feels stiff & quite painful - even at rest.

How is the Torn ACL Diagnosed?
The description of the way the knee is injured usually suggests a torn ACL but the pain & swelling during hands-on examination of the knee often makes diagnosis of the degree of knee instability difficult during the initial Emergency room or Doctor’s office visit. Routine X-rays of the knee do not reveal the torn ligament but are very helpful in diagnosing pre-existing bone abnormalities, assessing the growth plates in teen athletes and looking for associated fractures. An MRI scan may also be ordered to view the ACL itself and to look for associated injuries such as bone bruises, micro fractures, meniscus cartilage tears and other ligament injuries.

What is the Initial Treatment of an ACL Tear?
The initial goal is to relieve the pain & swelling, confirm the ACL injury & diagnose any associated injuries. You will be prescribed crutches, analgesics, anti-inflammatory medication and often a knee immobilizer or brace at your first medical visit (usually the Emergency Room). Once the diagnosis is confirmed, usually you will be prescribed an exercise program to restore normal movement to your injured knee before surgery and you may be permitted to bear full weight on the affected leg as the pain subsides and the leg feels strong. Next follows planning of the definitive treatment of your knee instability. If you have a significant meniscus tear associated with your ACL injury, I will usually schedule your surgery promptly (to maximize the chance of the successful repair & healing of the meniscus tear) even though this slightly increases the risk of knee stiffness after surgery.
If you do not have a significant meniscus tear, I will delay the ACL reconstructive surgery until the initial swelling & pain have subsided & you can fully bend & straighten your knee. This delay will actually speed your eventual recovery since it reduces the stiffness after surgery.
Must I Have ACL Reconstructive Surgery?
The short answer is: Yes! (But it depends very much on your age and activity level). Many people can perform straight line activities such as walking, cycling & even running after tearing their ACL but when they plant their foot and turn (pivot) to the same side as their injured ACL, the knee will give way & feel unstable - often with considerable pain & swelling. These pivoting episodes are very harmful to the knee as they promote tearing of the meniscus cartilage, damage to the bearing surface (articular cartilage) and microfracture of the bone supporting the knee bearing surface. All of these - especially meniscus cartilage tearing, cause premature wear & tear or degenerative arthritis of the knee joint. To prevent these complications, I recommend ACL reconstruction almost universally in young patients as well as older active patients. Older patients who are less active & don’t wish to play pivoting sports may learn to control their instability instinctively. Nevertheless if you feel your knee is not completely stable you should have ACL reconstruction.

What About Bracing?
There are a number of good quality braces available from reputable manufacturers. These braces are expensive, bulky and need to be custom fitted and frequently adjusted, repaired & refurbished if they are to be effective. ACL instability is a rotational problem; it is very difficult to make a brace that grips your leg firmly enough above & below your knee to prevent the pivoting motion and, unfortunately, many patients continue to pivot while wearing them. Only a very few leg shapes allow braces to properly fit and actually prevent pivoting once your ACL is torn. Currently, ACL braces are most often prescribed to football players - usually interior lineman to prevent injury from another player “rolling up their leg” while blocking.

What is ACL Reconstruction?
Your ACL ligament runs through the notch in the end of your femur (thigh) bone -joining it o the tibia (leg) bone. It has a very little tissue covering it and (unlike the collateral ligaments on either side of your knee) almost no capacity to heal itself with scar tissue once torn. Since it usually tears in the middle of its fibers, it cannot heal itself and cannot be surgically repaired. (Imagine a clothes line stretched between two poles; - once the clothes line breaks, there is no way to join the ends together -you need a new piece of line!) The process of building a new ACL with other tissue is called reconstruction. All of the types of reconstruction are similar in that I use the Arthroscope to inspect your knee thoroughly through 3 small incisions and then repair associated injuries to the articular cartilage and meniscus cartilage & remove the remnants of the torn ACL. Then, through additional small incisions, I drill 3/8" holes in the tibia (leg) bone - from the outside into your knee and in the femur (thigh) bone - from the inside out. These holes are carefully situated so that when I thread the new ligament material through them, it replicates the position of your original ligament. There are many different types of ACL reconstruction the variability lies in the type of graft material and how it is attached to the bone above & below your knee. These variations in turn lead to subtle differences in strength, cost, complications & post-operative recovery which I will try to differentiate for you.
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Patellar Bone-Tendon-Bone (PBTB)
This is the original type of ACL reconstruction. It was originally done as an open procedure and is now almost universally performed arthroscopically (although the graft is harvested through an open incision). The patella tendon is the thick, wide tendon that connects your patella (knee cap) to the tibia (shin bone). Through a vertical 3”- 4” skin incision on the very front of your knee, I remove a ½” wide strip of the patella tendon along with a 1” long piece of the attached bone (from the patella and tibia) at each end. This Patella Bone-Tendon-Bone graft is very strong since the natural connections between the bone and the tendon are preserved during harvesting. After shaping the bone plugs at each end of the tendon, I thread the graft through the bone tunnels & use interference-fit screws to fasten the bone plugs to the sides of the bone tunnels of your femur & tibia. This construct gives the most secure initial fixation of the graft to your knee which in turn allows early movement of the knee joint and (at least in theory) rapid rehabilitation protocols. Of course there are some downsides to PBTB ACL reconstruction. The most serious of these is fracture of your patella through the graft harvest site which can occur within the first year of surgery. Some surgeons feel that anterior knee pain and knee cap pain with activity is more noticeable after BTB surgery. Most patients find it painful to kneel directly on their incision since it is directly over the defect from the tibia graft site. The scar is slightly longer and more noticeable with this procedure. Over the years a number of modifications have been developed including: harvesting the graft for the opposite knee (theoretically speeds rehab), using a single incision instead of 2 incisions (most common now), securing the graft to the bone with different methods including toggle bolts, threaded pins, loops & toggles, and multiple materials for the interference fit screws including: metal (usually titanium), plastic, bone (allograft) and bio-absorbable composites. Presently, I perform this type of ACL reconstruction using toggles & Bio-absorbable interference-fit screws in contact sport athletes.

Hamstring Tendon (DLSTG):
The medial or inner hamstring muscles end in long cord-like tendons which attach to the inner aspect of your upper leg conveniently next to the area where we drill the bone tunnels for ACL reconstruction. Both the smaller Gracilis & larger Semitendinosis tendons yield sufficient length to allow looping both tendons up & then down again through the bone tunnels hence the name: Double Looped SemiTendinosis & Gracilis graft. In most patients, these 4 strands provide a very strong replacement for your torn ACL. The advantages of using hamstring grafts include a much smaller incision is over the inner front of the knee away from the area on which we kneel and the elimination of patella fractures. On the negative side, the harvesting of the hamstring tendons leads to some temporary pain, swelling & weakness in the thigh which requires a specific & reasonably rigorous rehabilitation program to reverse. The challenge when this technique was first developed was to get strong enough initial fixation of these slippery tendons to your bone tunnels in such a way that they would heal strongly to the bone yet at the same time allow the rapid rehabilitation protocols that we had developed using Bone-Tendon-Bone Grafts. These days, a large number of devices (buttons, screws, threaded pins, loops & toggles) are available also in a variety of biological, bioabsorbable & man-made materials - each with their own, unique set of advantages & disadvantages. Presently, I perform this type of ACL reconstruction in most patients.
Allograft:
The third type of ACL reconstruction is tendon transplantation from a human donor (allograft). A variety of tissues are now available from reliable human cadaver sources. Allografts come in a number of sizes (various tendons from the human body) and may have bone attached at both ends (PBTB) or at one end (Achilles tendon). Since we are no longer constrained by the size of your host tissues or the deficit left after harvesting material for ACL reconstruction, Allografts are especially useful in revision ACL surgery or where multiple ligaments may be torn.

The advantages of allograft ACL reconstruction as a primary (or first time) procedure are:
- reduced pain & swelling (no graft harvest),
- shorter rehabilitation (no pain, swelling or weakness of the donor muscles),
- smaller scars (usually 1½” over the inner front of your knee).

The main disadvantages of using allograft are:
- higher cost,
- a slightly higher failure rate,
- risk of infection & disease transmission.

Allograft costs are quite variable though they are covered by most insurance plans. Disease transmission & transmitted infection from the human donor remain a concern because we can never completely eliminate that risk. Due to the nature of the material, allograft can be washed & chemically cleaned but it cannot be 100% sterilized after harvest from the donor because the sterilization procedure structurally weakens the tendon too much. Presently we use a reliable, nationally-accredited source for all our allografts and the reported rates of bacterial infection & transmission of diseases such as HIV or Hepatitis remain very low - previously estimated at less than 1:500,000 and probably much lower now. Structural failure of allografts remains more of a theoretical concern at present. All ACL grafts must heal to the host bone and eventually re-acquire a blood supply (revascularize) and become healthy living tissue (this process may take years to complete). Allografts do not contain live cells when they are implanted unlike autologous grafts (tissue harvested from your own body). This is why rejection of the transplanted tissue is quite rare. Some authors feel that because of this, allografts incorporate more slowly and may be more susceptible to injury years later. Since the allografts are generally larger & therefore stronger than autologous grafts to begin with, this may not prove to be a practical issue.

Which Is Better – Allograft, PBTB, or DLSTG ACL Reconstruction?
There is no significant difference in terms of length of procedure, hospital stay (all are out patient procedures) and recovery time between procedures using host-derived (autologous) graft material. Allograft ACL reconstruction shortens the operation by 20-30 minutes, may make the rehabilitation program easier and possibly shortens it too. Allograft ACL reconstruction does not allow earlier return to sport (since it still requires graft incorporation & healing to the host bone & tissues which be slightly slower)!

I recommend using autologous tissue - Patellar Bone Tendon Bone or Double Looped Semitendinosis & Gracilis grafts in adolescents & young patients since there is no risk of disease transmission with your own tissue. I favor PBTB in males playing contact sports - especially football players. I favor DLSTG in young women since they usually prefer the smaller incision allowed by this procedure. In older patients, the graft choice is often driven by the work needs and time off work available for each patient and may be less sport or activity specific. Many of my older patients choose allograft reconstruction if they are comfortable with the disease transmission risks described above. Presently, about half of my patients requiring Primary (1st time) ACL Reconstruction request autologous tissue & half prefer allograft. Many Revision ACL Reconstructions are performed using Allograft.
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Will I Need a Blood Transfusion?
A tourniquet inflated on your upper thigh throughout the arthroscopic procedure. So there is no bleeding during the procedure. After surgery you may notice some modest bleeding from the incisions (especially the ones that do not have sutures) for the first 24 to 48 hours after surgery. This is not severe enough to consider blood transfusion.

What type of Anesthesia Will I Have?
In most cases the surgery is performed under general anesthesia but can easily be performed under spinal anesthesia if you prefer or if your anesthesiologist recommends it for your particular condition. The preoperative preparation for both spinal & general anesthesia is identical which permits your anesthesiologist to safely select either general anesthesia or regional anesthesia at the time of surgery.

Will I Feel Much Pain After My Operation?
After general anesthesia, you will regain movement & feeling of your leg immediately. If you have a spinal anesthetic, the movement usually returns to your legs while you are in the recovery room but it may take several hours before normal feeling returns to your legs. Before the surgery you may be given anti-inflammatory medicines to prevent & reduce swelling & pain after your surgery. Anti inflammatory pain medicine should be continued after your surgery to prevent pain after surgery. During the procedure itself & in the Post Anesthetic Care Unit you may be given intravenous anti-inflammatory drugs and intravenous narcotic pain medicine if needed - most patients are surprised by their level of comfort after the surgery. You will also be given prescriptions for pain pills such as Oxycodone, Hydrocodone, Tramadol & Tylenol which you may take intermittently once you are home.

What is a Nerve Block?
In many cases your anesthesiologist will recommend a Supplementary Nerve Block. This procedure is usually performed before you are anesthetized but may be added to your pain control regimen after the surgery. Long acting numbing medicine is injected around the nerve to the front of your thigh to “block” the nerves to your thigh. While the initial injection may be mildly uncomfortable, it significantly reduces the pain in your leg & knee after your surgery. The local anesthetic often blocks both your ability to feel your thigh as well as your ability to contract your thigh muscles so you must use a knee immobilizer (brace) as well as crutches to prevent falling unexpectedly for the first 24 hours after surgery.

When Will I Be Allowed To Walk (bear weight) On My Knee?
ACL Patients begin their rehabilitation as soon as they leave the recovery room. You are encouraged to start bending and straightening your knee and you may bear your full weight on your operated leg (with crutches or a cane) immediately after surgery. You will be encouraged to get out of bed and walk around on the first day - using a knee immobilizer if you had a Nerve Block. Our goal is for you to be able to sit with your knee bent normally and able to walk 100 feet the third post-operative day. You will be instructed in a simple, effective, exercise program while at the hospital which you must continue when you get home. This will be supplemented by physical therapy until you are walking and moving your knee normally. I use Continuous Passive Motion (CPM) machines only in selected cases - usually only in patients who required immediate surgery for a reparable meniscus injury associated with ACL injury (before the pain & swelling of the initial injury settled).
What Are The Complications Of ACL Reconstruction?

The most common complications are: knee stiffness, persistent swelling, failure or re-injury of the graft, unexplained pain, wound complications including deep infection, blood clots in your legs (and rarely your lungs).

Knee stiffness is the most difficult for me to predict. Most patients regain their normal knee motion within 3-4 weeks of the surgery. A few patients may develop pain & swelling after ACL reconstruction surgery without any apparent underlying cause. These patients may require additional physical therapy, and rarely casting to regain extension or additional arthroscopic surgery to regain flexion.

Swelling is common for the first month or two after surgery. When it persists beyond the usual time frame, it will be necessary to aspirate samples of this fluid for laboratory analysis to look for conditions such as deep wound infection & inflammatory arthritis. Further imaging including MRI may be needed to diagnose other conditions such as a new meniscus tear, re-tearing of a previously repaired meniscus or re-tearing of the ACL graft. Additional arthroscopic surgery is often required to treat these complications. Months or years after ACL Reconstruction, swelling may indicate additional meniscus injury or herald the onset of knee arthritis. Interestingly ACL Reconstruction has not been shown so far to prevent the late onset of knee arthritis.

Without prevention, up to 50% of patients will form blood clots in their leg after major knee surgery (although many of these are microscopic and cause no symptoms). Fatal pulmonary embolism (due to a large clot lodging in the lungs) has been reported in untreated patients after ACL reconstruction. It is currently felt that the reduced soft tissue trauma and the early mobilization program of arthroscopic knee surgery are very important in reducing the formation of blood clots.

During the surgery you will have Sequential Compression Devices (SCDs) wrapped around your legs. These self-inflate every few minutes - gently squeezing your calf muscle from the ankle to the knee. I also recommend daily Aspirin after the surgery in normal risk patients. Unless you have a personal or family history of developing blood clots after surgery, you would not routinely need additional blood thinners. Coumadin (Warfarin) pills or injections of blood thinners such as Lovenox or Arixtra may be prescribed for high risk patients and are available for all patients if they prefer a lower risk of blood clots (and simultaneously accept a slightly higher risk of bleeding and wound infection after surgery). Coumadin requires weekly tests to monitor blood thinning for the recommended 4 weeks of therapy.

Although the risk of deep infection is increased by the use of blood thinners and diseases such as Diabetes, smoking and other chronic conditions, this risk still remains low at about ½ - 1%. Nevertheless, should infection occur, further surgery will be mandatory. In some patients the graft (especially allografts) and the fixation devices may need to be removed followed by at least 6 weeks of intravenous antibiotics before considering repeating the ACL reconstruction.

The development of general medical complications is proportionate to your age, health and lifestyle. My assistant will be pleased to provide you with a copy of our standard consent form for Arthroscopic ACL Reconstruction so that you can read about these general and specific risks in further detail.
When Will I Go Home After ACL Reconstruction Surgery?
Most healthy patients usually undergo ACL Reconstruction on an outpatient basis. For the first two days you will perform a simple home exercise program. On the second or third day you should attend Outpatient Physiotherapy where, you will continue the rehab program started before your surgery. If swelling and stiffness is troublesome I recommend Pool Therapy (with or without a Physiotherapist) as soon as your incisions have healed (usually 7-10 days after surgery). Getting in the pool can help tremendously to reduce swelling and stiffness and improve knee flexibility. Land-based Outpatient Physiotherapy will continue until you are completely rehabilitated but may be combined with a personal trainer or a home or community gym program in the later stages once you have regained a normal range of motion and flexibility.

What Are My Restrictions After ACL Reconstruction?
Generally straight line activities such as running, cycling, swimming, weight training, step machines, ellipticals & rowing are fine as long as these activities don’t provoke swelling or pain. If you have a meniscus repair you will have additional restrictions especially squatting. I restrict cutting, pivoting & jumping sports for at least 6 months after ACL reconstruction. The issue is one of biology. The graft actually weakens temporarily after initial implantation as it acquires a new blood supply & becomes incorporated into your body as a living tissue. Some studies suggest that it may not regain optimum structural strength for 2 years or more after your surgery! I feel that 6 months is pretty much the minimum amount of time required to let the graft heal to the bone tunnels, to let the injured and supporting muscles regain their lost flexibility & strength & to let the important proprioceptive mechanisms (that may protect your graft from re-injury) develop once more. Simply put; proprioception is the sense of trust that you will develop with time - a sense that your leg feels normal again. A crude measure of proprioception is the single leg hop test. Try standing on 1 leg and hop forward as far as you can - landing only on the same leg. It takes many months for most athletes to really feel that they trust their leg when they land the hop test.

What is the Success Rate for ACL Reconstruction?
Most studies show long term success rates of approximately 85%. Even under optimum conditions some grafts simply don’t heal or are resorbed by your body or re-tear early in the rehabilitation process. Of course patients with ACL injuries are a pretty varied group. Many of the associated injuries such as bone bruises, meniscus injuries and articular cartilage (bearing surface) damage affect the long term prognosis of your knee independently of your ACL injury. There may not be such a thing as an “isolated ACL injury” which makes scientific comparison of the outcomes of ACL reconstructive surgery difficult. This leads us to a few conflicting things we do know about ACL Reconstruction: Preventing further meniscus injuries will definitely lower your risk of arthritis. Reconstructing your ACL should reduce the risk of arthritis due to future meniscus injury yet ACL reconstruction has not conclusively shown that it reduces your risk of arthritis in later life - it may be that the risk of late arthritis is determined more by your initial injury than your ACL reconstruction!
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Post-Op Instructions - ACL Reconstruction

WOUND CARE
- Leave the wound open to the air; shower or bathe with ordinary soap & water
- If there is any drainage, cover the wound with dry gauze and call me
- The knee incisions may be pink or red for 1 month & feel warm (even hot) to touch for 2-3 months

LYING DOWN (Knee Extension)
- Lie on your back, straighten your knee, place a pillow under your heel leaving your knee unsupported
  (Gravity will help your knee to straighten as you rest in this position)
- Tighten your thigh muscle, fully straighten your knee and perform the Straight Leg Raising Exercises taught to you in the hospital (10 repetitions performed at least 3 times daily)
- Lie down with your feet elevated instead of sitting if leg swelling is worsening

SITTING (Knee Flexion)
- Sit in a chair with arms to make it easier to get into and out of the sitting position
- Keep your operated foot on the floor as you sit and stand (you should feel your knee stretch)
- Always sit with your knees bent and your feet on the floor
- While watching TV, ease your bottom forward on the seat - keep your feet fixed to the floor
  Hold this stretch (without holding your breath) for 30 seconds or each commercial
- Sit back & relax between commercials
- Use a rocking chair or glider to also promote knee flexion (30 minutes per day if possible)

WALKING
- Put your full weight on the operated leg when standing/walking
- Never walk without support until you can perform the leg raises with your knee fully straight
- Never walk without support until your Femoral nerve Block has completely worn off!
- Use a cane in your hand opposite your new knee for balance
- Continue to use the cane until you can walk comfortably and without a noticeable limp
- Walk frequently each day - it is one of the best exercises to speed recovery!
- Whenever standing, stretch your knee back (fully straight) for 30 seconds 5-10 times daily

SLEEPING
- Lie on your back with your heel on a pillow; or on your side with a pillow between your knees
- You may sleep on your stomach once comfortable
- Lie down in bed with your feet elevated each day to reduce swelling
- Lie down with your feet elevated instead of sitting if leg swelling is worsening

STAIRS
- Step up with your operative leg (using the handrail) as soon as your strength & comfort allows
- Step down with the non-operated leg (also using the handrail) once you trust your knee
  (Walking downstairs normally is much more difficult and may take a month or more)

OTHER EXERCISES
- Swimming/pool exercises should start as soon as your wound heals (usually 10-14 days)
- Use exercise bicycle or treadmill as soon as comfortable (slow speed, short duration at first)
- It may be easier to pedal backwards at first

DRIVING
- Don’t take narcotics before driving
- You can drive safely after knee replacement once you can climb 5 steps almost NORMALLY.
EXERCISES AFTER KNEE SURGERY

As you follow this simple 3 part program, remember that each stretch should be done gently (don’t hold your breath). Each stretch should be held long enough that the swollen/stiff tissue has time to “give” (just like wringing out a mop). 30 second TV commercials are a handy way to time your stretches (and will remind you to repeat them often)!

#1: STRAIGHTEN YOUR KNEE (LYING DOWN)
- Sit on a firm, comfortable surface with your knee as straight as possible
- Contract your quadriceps (feel your kneecap move towards you) and press your knee into the floor
- Hold for 15-30 seconds, then relax
- Repeat 5-10 times, 3 sets/day

#1: STRAIGHTEN YOUR KNEE (STANDING)
- These are best performed after you have warmed up your knee by walking
- Contract your quadriceps and feel your knee straighten as you push it back
- Hold for 15-30 seconds, then relax
- Repeat anytime you are standing!

#2: BEND YOUR KNEE (LYING DOWN)
- Lie on a firm, comfortable surface with your knee straight initially
- Bend your knee & slide your heel towards your buttock
- Hold for 15-30 seconds, then relax
- Once your knee bends 90 degrees, progress to the chair exercises to prevent muscle cramps

#2: BEND YOUR KNEE (SITTING)
- Sit in a firm chair -preferably one with arms
- Sit with your back against the chair back
- Slide both feet back towards you and press them firmly to the floor
- Lift your buttocks off the chair to slide forward until you feel a stretch in your thighs and knees
- Sit and hold for 15-30 seconds, then slide back
- Repeat 5-10 times, 3 sets/day
- A rocking chair or glider may also help

#3: WALKING
- Use your cane until you feel steady on your feet
- Climb stairs normally as soon as you can comfortably (it takes many weeks to descend normally)
- After Rt. Knee surgery, you may drive once you can climb 5 stairs normally and are off pain pills