

All about ACL (Anterior Cruciate Ligament) & Anatomical ACL Reconstruction

What is the function of ACL?

The anterior cruciate ligament, or ACL, is the most important ligament of the knee to **prevent the knee from sliding forward or rotating anterolaterally; thus, providing knee translatory and rotatory stability**. Patients who sustain an ACL tear often have no problem in walking straight forward. More problem comes while jump landing, sudden turn/twists, moving on uneven surfaces or moving downstairs. These movements are common in sports such as football, soccer, skiing, kabaddi. Not only sports person encounter these problems but one needs stable knee for day-to-day activities like coming out from a bus, working in fields, dancing and during recreational sporting activities.

In addition to its stability role in the knee, the ACL also provides protection for the menisci (shock absorbers of knee) and cartilage (tissue at the end of bone to smoothen joint movement) of the knee. When the knee continues to have instability episodes, it is not uncommon to have **either the medial or lateral meniscus tear**. Chronic injury can also lead to **cartilage damage**. However, when menisci tear there is much higher risk of the development of osteoarthritis. Because of this, Dr. IDEE usually recommends ACL surgery and that an ACL reconstruction be performed in young or otherwise active patients and in almost all patients who report instability with twisting or turning activities.

In a patient with ACL insufficiency, major problem is instability. If patient reports of pain as major symptom, one should look for concomitant menisci or cartilage injury.

A correct treatment can be decided after proper history of patient, clinical examination and correlation of all these with investigations such as monopodal weight bearing X-rays, MRI or CT scan.

Description of Anatomical ACL Reconstruction

An ACL surgery requires precise knowledge of the anatomy of the knee, attachment sites of the ACL and knowledge on the other ligaments and structures of the knee. If one fails to replace an anterior cruciate ligament at its **correct attachment** sites (as of native ACL attachments) or if other concurrent injuries are not treated, there is a much higher risk of failure of the ACL graft.

While there are two bundles of the ACL, the anteromedial (AM) and posterolateral (PL) bundles, there is still controversy as to whether both should be reconstructed as a single ligament or as two separate ligament grafts. While the double-bundle ACL reconstruction technique appeared very promising initially, many research studies, have significantly narrowed the indications for double-bundle ACL surgery and found there is very little difference between an anatomical single bundle and double-bundle ACL reconstruction for the vast majority of patients.

The most important technical issue is to have the **ACL reconstruction graft placed in the correct position**. On the tibia (shinbone), the tunnels should be in line with the posterior margin of the anterior horn of the lateral meniscus. On the femur (thigh bone), the reconstruction tunnel should be placed at the midpoint of the attachment bundles of the anteromedial and posterolateral bundles, with the main portion of the reconstruction tunnel being posterior to the lateral intercondylar ridge (resident's ridge).

A large number of ACL reconstruction graft failures are in those patients who have the graft placed too posterior (central) on the tibia with an inability to control rotation of the knee or too anterior on the femur (anterior to resident's ridge) or too central on the femur

(effectively only reconstructing the anteromedial bundle), which leads to either stretching of the reconstruction graft or failure to control knee rotational laxity.

Dr. Inderdeep Singh

Arthroscopic ACL Surgery Technique

The technique of ACL reconstructions has changed dramatically over the last decade in orthopaedics. ACL reconstruction grafts performed prior to 5-10 years ago were usually placed more centrally on both the tibia and femur (transtibial technique) and many of these patients have continued problems with rotational instability. This problem became recognized through extensive clinical and biomechanical research and the surgical technique has currently changed dramatically to where the reconstruction tunnels are now placed more anatomically (transportal technique) to provide better stability to the knee.

Dr. IDee's primary surgical reconstruction technique is an arthroscopic surgery (key hole surgery) using a bone-patellar tendon-bone or hamstring autograft (from the patient's own tissues) during ACL surgery. The reconstruction tunnel is drilled at the anatomic attachment site of the ACL on the tibia and a closed socket tunnel is drilled at the ACL attachment site on the femur. The graft is pulled into the joint and fixed in place with an interference screw (bioabsorbable or titanium)/ loop devices like endobutton. Dr. IDee utilizes one incision for this surgical technique, as well as an autograft to place it in the correct position. The utilization of fewer incisions results in less pain post-operatively for the patient, while the use of the autograft allows the patient to return to activities sooner with a lesser risk of reconstruction graft failure.

Graft option, fixation device usage and surgical technique to be done during surgery is multifactorial and shouldn't be generalized, it needs to be individualized as per one's knee condition and requirements.

Post-Operative Protocol For ACL Reconstruction

It is absolutely essential for a physical therapist to be consulted and to work with one's surgeon post-operatively following ACL surgery. Reactivation of the quadriceps mechanism and hamstrings, edema control, patella mobilization, maintenance of full knee extension and regaining knee motion are absolutely essential to obtaining optimal post-operative outcomes.

In our practice, we strongly suggest and require patients remain in hospital for 2 -3 days and get the exercises done by an expert sports physiotherapist and also learn the exercises so that these can be performed at home in a right way.

Following initial exercises, depending on type of surgery patient will progress from phase I to phase II and then to phase III of exercises. These phases involves set of exercises from low level to higher level of exercises. At the end of all the phases, an assessment of an athlete/patient would be done for return to sports. If athlete/patient clears the assessment part they are allowed to return to sports or else some exercises will be introduced/modified so that patient can return to sports. This is essential part of treatment as it decreases the chances of re-tearing of reconstructed ACL.

Generally, it takes around 8-9 months for returning to pre injury level. Early returning to competitive sports increases the risk of graft failure thus increasing the chances of revision surgeries.

ACL Reconstruction FAQ

Why is ACL reconstruction surgery done?

The ACL is important to prevent rotation of the tibia on the femur. In particular, anterolateral rotation, which can occur with twisting and pivoting activities, occurs after an ACL tear. In addition, the tibia tends to slip forward on the femur when one is ACL deficient, this can cause undue falls. This particularly can be a problem for the posterior horn of the medial meniscus because it sees extra stress and can tear. ACL reconstructions that are performed in patients who note instability, but also in younger patients who may participate in twisting, turning, and pivoting sports to ensure that they do not tear their meniscus and develop osteoarthritis later in their lives.

When to have ACL surgery after injury?

Athletes or patients who have any difficulty with twisting, turning, or pivoting after an ACL tear should consider having their ACL reconstructed. This is because repeated twisting and turning mechanisms can damage both the cartilage in the joint and also the menisci. The medial meniscus is the most at risk to injury with an ACL tear because the medial meniscus takes over a lot of the function of the ACL when it is torn to prevent the knee from slipping forward. In addition, patients who may have a repairable meniscus tear at the time of their ACL tear should consider surgery to prevent the tear from becoming non-reparable. In general, most people who tear their menisci will be developing arthritis and having symptoms within 8-10 years after their ACL tear. Thus, one of the main reasons for the general public to consider having an ACL reconstruction is both to repair any meniscal tears which are repairable, and also to prevent meniscal tears from developing if their knee is unstable.

Does the ACL heal if left untreated?

Enzymes present in the joint do not allow a blood clot to develop. Hence ACL tears don't heal naturally. The ACL also has poor blood supply which, in itself, precludes a good chance of spontaneous healing. Partial tears, however, may heal over time even if not treated. These are not easily predictable in every patient. Healing chances are better in younger individuals than in middle aged or elderly age group of patients.

What is ACL reconstruction surgery?

ACL reconstruction surgery consists of replacing a torn ACL with another ligament or tendon. It is done with an arthroscope or it is a key hole surgery. This can be from one's own body (an autograft) or from a donor (an allograft). In an ACL surgery, tunnels are reamed at the normal attachment site of the ACL on both the femur and tibia and the graft is secured either inside or outside these tunnels. The type of graft from one's own body and whether one should use a cadaver graft tissue or not can depend on multiple factors. This can include the patient's age, if they have hyperlaxity, whether they participate in contact sports, and other factors. We prefer using autograft (tissue from own's body) as long term results are better compared to cadaver graft(allograft)

How is an Anatomical ACL reconstruction done?

An ACL reconstruction is done by replacing the torn ACL with tissue that is placed at the normal attachment sites of the native ACL. This involves reaming a tunnel in the (thigh bone) femur (posterior to the lateral intercondylar ridge) and also in the (leg

bone) tibia (adjacent to the anterior horn of the lateral meniscus) and then securing the graft within those tunnels. There are multiple ways to secure the graft, and this can include fixation within the tunnels with metal or bioabsorbable/plastic screws or through a loop and button placed on the outside of the tunnels. In general, the fixation of the grafts is performed according to the way the surgeon was originally taught, with the gold standard being screws placed within the tunnels for patellar tendon grafts and looped sutures with cortical buttons or screws within tunnels for hamstring ACL reconstruction grafts.

Commonly used grafts:

Hamstring tendon:

The hamstrings are the taut cord like structures present on the inner side of the knee and thigh.

Bone- patellar tendon-bone

This graft includes a part of bone from the knee cap, the tendon on the front of the knee and another bone piece from the shin bone.

Central quadriceps tendon:

It is from a part of the quadriceps tendon on the front of the thigh, just above the knee, with or without a piece of bone from upper part of knee cap.

Peroneus Longus tendon:

It is peroneus longus tendon near our ankle joint.

The decision to use a particular graft is individualized for every patient and is determined by type of sports, associated injury etc.

The graft is prepared and fashioned like ACL. By arthroscopic surgery, tunnels are drilled to place the ACL graft. The graft is then inserted inside the joint. It is fixed to the thigh bone on top and shin bone below, most commonly with button on thigh bone side and biodegradable screws on leg bone but sometimes metal screws or buttons may be used. The biodegradable screws degrade within the bone and do not require removal at a later stage.

Patellar tendon ACL reconstruction versus hamstrings ACL reconstruction

Patellar tendon ACL reconstructions have been considered the gold standard now for almost 30 years. This is because they are the graft of choice for physicians who cover professional teams and for high level athletes; however, hamstrings grafts can also be considered to be appropriate for a large number of patients. Hamstrings grafts would be most appropriate for patients with open growth plates and in those patients who may have lower levels of activity desired after an ACL reconstruction. In general, a patellar tendon ACL reconstruction should not be performed in patients with significant arthritis of their kneecap joint, or may have had a previous patellar tendon harvest.

In general, the large data base series have shown that the rate of re-tear is lower with a patellar tendon reconstruction compared to a hamstrings ACL reconstruction. **However, a well-done ACL reconstruction with either graft can be appropriate for the majority of patients.**

When should an ACL be repaired?

The main time that ACLs can be repaired is when an ACL is torn with a piece of bone, usually off the tibia, which is much more common than when torn off the femur. In this circumstance, if there

is not a lot of intrasubstance stretch within the torn ACL, the bone can be refixed at its normal attachment site and secured such that early motion can be started. In those instances where the tissue is not strong enough to allow early motion, there is a much higher risk of stiffness if immobilization is required after surgery.

In terms of a repair of the ACL, there are perhaps 10% of patients who may have injury only to the attachment site on the femur or tibia and sutures can possibly be placed in to do a repair. In those circumstances, research is still ongoing to try to improve outcomes because attempts at repairs in the literature previously have not shown good outcomes over time. Thus, more research is necessary to define better techniques to perform ACL repairs in those circumstances. **It is important that these techniques be based upon good science and not on marketing by device companies because previous attempts at ACL repairs did not show failures until after two years after surgery.**

What is the operation time for an ACL reconstruction?

The operation time for an ACL reconstruction can be dependent on many factors. If it is just the ACL reconstruction itself and there are no other meniscus tears or other ligament injuries that are being reconstructed, the process involves harvesting and preparation of the graft, drilling the tunnels in the proper positions, and then passing and fixing the graft in the tunnels. It is also important to recognize that the whole knee must be checked to ensure that there are no other injuries present because missing an injury, such as a lateral meniscus root tear, can result in an ACL reconstruction graft failing. **In general, we recommend the use of one's own tissue rather than cadaver tissue for ACL reconstructions.** The use of cadaver tissue would also cut down the operative time because one does not have to harvest the graft from the operative knee, but over time, the failure rate of allografts is much higher than using one's own tissue.

In general, a well-done and efficient ACL reconstruction can take anywhere from 45 minutes to an hour. But total time which includes shifting to operating room and shifting back to recovery room is about 3- 4 hours.

What is the hospital procedure if I plan to undergo ACL reconstruction?

For an ACL reconstruction, admission in the hospital is usually a day prior (preferred) or on day of surgery. After completing the admission procedure, you will be shifted to your allotted room. You will be explained and requested to sign a consent for the surgery. An anesthesiologist will examine you prior to the surgery. ACL reconstruction is usually done under spinal anesthesia, but sometimes general anesthesia is also used. These options will be explained to you and an informed consent obtained for the same. Whatever be the anesthesia choice, be rest assured that your operating room experience will be a tranquil one. Once the operation theatre is ready, you will be shifted there. The surgical time for a typical ACL reconstruction is about 45 minutes, but the total duration in the operation theatre, from anesthesia to recovery is around 3-4 hours.

Bathing after knee surgery

It is crucial to maintain personal hygiene after surgery. This helps in reducing postoperative infection. The surgical incision following your surgery will typically be closed using absorbable sutures. Stitches needs to be removed 12-14 days after surgery. In all cases however, an absorbent water repellent dressing is applied. You may take bath at home after discharge but the dressing must not be made wet. Bath must be taken sitting on a high plastic chair or stool and preferably under shower and dressing needs to be covered with large polythene or commercially available covers. Care must be taken to prevent a slip and fall in the bathroom.

How long is an ACL surgery recovery?

One of the most important things for preventing a re-tear of an ACL reconstruction is to ensure that the patient has gone through the proper recovery phase after surgery. In the past, many surgeons tried to get their patients back to full activities by 5 or 6 months. However, more recent data has suggested that waiting up to 9 months may be more advantageous in that the **rate of re-tear goes down significantly after the 9-month timeframe for a return to activities after ACL surgery**. In general, it is important to make sure that an athlete has a full return of proprioception, strength, agility, and endurance to minimize their risk of re-injury.

Generally, sitting job can be started right after the surgery. Normal return to walking takes around 3 weeks (if there are no associated injuries). If other structures are also repaired/reconstructed then it may take around 6 weeks for unaided walking.

What is the healing process for an ACL reconstruction?

The healing process for an ACL reconstruction graft can depend upon the type of graft. In general, patellar tendon grafts heal into the bone tunnels at 6 weeks. Hamstring tendon grafts may take up to 3 months to heal in the tunnels, whereas cadaver grafts can take 3 months or longer. In terms of the main graft substance healing that is within the joint, it is generally at its weakest point between 3 and 4 months after surgery, and having a good blood supply restored to the tissue can take 9 to 12 months or longer.

When I can run after ACL surgery?

The ability to return to running after an ACL surgery is dependent upon many factors. If the surgery is only the ACL, and there are no

other ligaments or meniscus tears treated, and the cartilage surfaces are intact, then one has to go through a proper rehabilitation program first. In general, we feel that an athlete has to wait a minimum of 4 months after their ACL reconstruction return to running. In addition, they should have appropriate quadriceps strength. Our main goal is to be able to have them perform a single-leg squat with no bending of the knee inwards (valgus collapse) during the single leg squat. In these circumstances, if the patient has a good return of function, good motion, and does not have a valgus collapse when performing a single-leg squat, they are generally able to initiate a return to their running program at about the 3- 4 month timeframe. This allows the quadriceps mechanism to be strong enough to prevent extra stress on the knee which can lead to knee swelling (effusions) and possibly damage the cartilage which would not be noticed until several years later.

When should one use crutches after an ACL reconstruction?

For ACL reconstructions that do not require other concurrent surgeries one do not need to be on crutches for an extended period of time. The general belief is that one should stay on crutches until they can walk without a limp. In general, this usually occurs around the 2-week timeframe for most patients.

How long can I walk after an ACL reconstruction?

For those who have a first-time ACL reconstruction using a standard graft, patients are usually allowed to weight bear as soon as their surgical blocks wear off after surgery. In general, they can then proceed to weaning off of crutches when they can walk without a limp. We have found that most of our patients are able to wean off of crutches at about the 2-week point after surgery. However, some patients may take longer to wean off of crutches and should not use

the timeframe exclusively, and should ensure that they are not limping before they completely discontinue the use of crutches.

When can I return back to work after an ACL reconstruction procedure?

Returning back to work after an ACL reconstruction is a very individualized decision. In those people who have desk jobs, they can often return back to work for partial work days within 7 to 10 days, as long as they can ice and elevate their knee if there is any risk of swelling. For those patients who require the use of ladders, stairs, twisting or turning, or lifting patients, the time can vary from 4 to 7 months after surgery, depending upon the type of graft, associated other surgeries with the ACL reconstruction, and their ability to have their overall strength and endurance return.

When is one allowed to go back to full activities after an ACL reconstruction?

The return to sports and other activities after an ACL reconstruction is generally not time dependent, but we do know that the 9-month timeframe seems to be a time whereby athletes who go back prior to this time have a higher risk of having their graft re-tear. An assessment of whether one uses their own tissue or a cadaver graft, or if one has other ligament reconstructions or meniscus tears, must also be taken into consideration. It is especially important in teenagers to ensure that they have a full return of strength, endurance, agility, and balance prior to returning back to sports because their risk of re-tear can be much higher if they do not pass some type of functional sports assessment.

Which ACL surgery is best for athletes?

There is no defined study which can definitively determine which ACL graft may be best for athletes. In general, it is felt that athletes

put more stress on their knees and have higher demands than non-athletes. For this reason, most surveys of physicians who take care of professional teams recommend a patellar tendon autograft (from the same knee) as their graft of choice in these high-level and high-performing athletes. **The choice of graft and technique also varies with different demand in particular sport.**

What is an anatomic ACL reconstruction?

An anatomic ACL reconstruction means that the reconstruction graft is placed in the same location as a normal ACL is located. On the femur, this means that the graft is placed roughly midline along the lateral intercondylar ridge whereas the tibial reconstruction graft is placed essentially in line with the anterior horn of the lateral meniscus on the tibia. This essentially demands drilling of the femoral socket through **transportal technique**.

What is a BPTB ACL reconstruction?

A BPTB ACL reconstruction is one that uses a patellar tendon graft. It is called a “BTB” graft because it takes bone off the patella, uses a strip of tendon, and then takes a piece of bone off the tibia. This graft has been documented in animal models to be the one that heals the fastest, with most bone plugs healing in their tunnels at around six weeks after surgery.

What is remnant preserving ACL reconstruction?

As the name says the remaining remnant of ACL which is torn is preserved and is re-tensioned along with the graft. The advantages include better proprioception, vascularization of the graft and early ligamentization; hence early return to pre injury level. A natural tissue in the joint provides better biology for graft healing. Dr. IDee

has described a “Remnant envelope technique” of ACL reconstruction which has been published in Arthroscopy technique journal of Arthroscopy Association of North America (AANA).

What is an ACL reconstruction with an internal brace?

The use of an internal brace utilizes a surgical tape to try to augment an ACL reconstruction graft. To date, there are few studies that can determine whether this helps ACL reconstruction graft healing or not. Historically, the use of synthetic devices concurrent with ACL reconstruction grafts, such as the Ligament Augmentation Device, found there were no differences or any benefits in using this time of ACL reconstruction augmentation. **Any device which promises magical results should be used with caution as there can be various marketing benefits of companies and individuals.**

What is a double-bundle ACL reconstruction?

A double-bundle ACL reconstruction is one that uses two separate grafts to reconstruct the anteromedial and posterolateral bundles of the anterior cruciate ligament. Double-bundle ACL reconstructions were very popular about a decade ago, but clinical studies and biomechanical studies have not shown a great deal of difference between placing one graft in the center of the ACL (i.e., single bundle ACL reconstruction) attachment sites in the femur and tibia versus placing two grafts at the different attachment sites of these bundles on the femur and tibia. One of the reasons there may not be a big difference seen between anatomical single and double-bundle ACL reconstructions is that the distance between the two attachment sites is not that great, so placing a graft in the middle may not show a big difference.

What type of ACL reconstruction should be performed for a teenager?

In general, the International Olympic Committee statement notes that teenagers who tear their ACL should have an ACL reconstruction sooner rather than later to protect them against having both cartilage damage and meniscus tears. This can ultimately lead to development of osteoarthritis. One of the most important things to assess in the teenager is if their growth plates are still open or not. If the growth plates are still open, then placement of bone plugs or fixation hardware across the growth plates should be avoided to minimize the risk of a growth plate arrest. Usually, this means that these patients have ACL reconstructions with hamstring grafts. The problem with ACL reconstructions in teenagers is very problematic because we know that multiple studies have reported that the risk of an ACL tear in either the same knee or the opposite knee is roughly 30% before they end their teenage years. In teenagers a live donor graft can be used from either of the parents. Thus, most physicians will ensure that teenagers pass a functional sports test prior to returning back to sport to minimize their risk of having an ACL graft re-tear.

When should ACL surgery be performed for a partial ACL tear or what is ACL augmentation?

A partial ACL tear can involve one of the bundles of the ACL alone. In particular, if the posterolateral bundle of the ACL tears and the patient notices difficulties with twisting, turning, and pivoting activities, then a single-bundle posterolateral bundle reconstruction of the ACL may be indicated. In these circumstances, if the anteromedial bundle is still pretty much intact, it would be

recommended not to take it out and perform a complete reconstruction, but rather to perform a single bundle reconstruction to address the problems with twisting, turning, and pivoting. Partial ACL reconstruction or ACL augmentation should be done by a skilled surgeon as it is technically difficult to perform than a standard ACL reconstruction.

When should an ACL reconstruction be performed with a quadriceps tendon autograft?

The use of a quadriceps tendon autograft for ACL reconstructions is a relatively new graft choice for many people. It is felt to possibly be a better option for some pediatric patients than utilizing the hamstring grafts because the graft volume may be larger. In terms of adults, there is not enough good science presently to decide whether the graft should be used with a bone plug or not, if there should be a full-thickness or partial-thickness graft, and if the rehabilitation protocols should be changed.

Is an ACL reconstruction procedure painful?

An ACL reconstruction procedure requires the harvesting of grafts, drilling of tunnels and bone, and often can have associated meniscus repairs with the procedure. Therefore, we expect most patients to require the use of pain medicines for a minimum of 2 to 7 days after surgery to address this. In general, starting physical therapy early and using ice after surgery can help one to decrease the peri operative pain degrees and can help one to minimize the use of narcotic medications. **Also, use of an ultrasound guided nerve block help reducing the peri operative pain.**

When should one have an ACL reconstruction versus a repair?

Historically, ACL repairs were found to function poorly and therefore ACL reconstructions were developed. More recently, some academic centers have looked at ACL repairs in very select situations. These usually involve tears that are off the femur, that do not have any intrasubstance stretch, and that are treated in the “acute” situation, which can vary anywhere from days to just a few weeks. To date, the outcomes presented at scientific meetings is quite variable with a failure rate of anywhere from 20% to 80%. Therefore, one should be cautious about considering an ACL repair over reconstruction, and unless one is involved in a research study, it can be definitively said that the chances of having a better outcome currently are better using reconstructions instead of repairs.

When should a meniscus repair be performed with an ACL reconstruction?

It is best to perform meniscus repairs concurrently with the ACL reconstruction. This is because the ACL reconstruction will make the knee more stable and not put extra stress on a meniscus repair. In addition, it has been well documented that the drilling of tunnels associated with the ACL reconstruction can also release good growth factors into the knee, which will increase the chance of meniscus repair healing. When meniscus is torn along with ACL, Dr. IDEE will always try to repair whatever tissue is available as this would increase the life of the knee. Thus, preventing early wear and tear.

What is the long-term prognosis for ACL reconstructions?

In general, a well-done ACL reconstruction can function quite well for 20 years or longer. This is some of the longest follow-up data that we have in scientific studies on ACL reconstruction grafts. **The biggest risks for ACL reconstructions long term are in those patients who had their meniscus taken out rather than repaired.** These patients are at a much higher risk for the development of osteoarthritis over the long term.

Why do I have shin pain after an ACL reconstruction?

Some patients can have shin pain after an ACL reconstruction because the surgical tunnel in the tibia has been drilled through the shin to place the graft in the joint. Other causes of shin pain after an ACL reconstruction can include hardware irritation or the development of a cyst around a bioabsorbable ACL fixation device.

Why do I have numbness after an ACL reconstruction procedure?

Almost all patients develop some numbness after an ACL reconstruction procedure. This is because the nerves from the saphenous nerve, especially the infrapatellar branch of the saphenous nerve, cross from the inside over the top to the outside of the knee. Patients with patellar tendon graft incisions and most hamstring incisions therefore will develop numbness over the front of their knee. In addition, patients who may have meniscus repairs to either the medial or lateral meniscus will also develop numbness to some extent around the surgical incisions.

What does “prehab” mean before an ACL reconstruction?

Some patients who tear their ACL will have a very stiff and swollen knee right after their injury. If they do not have a concurrent meniscus or other injury to their knee which requires surgery sooner rather than later, such as a radial tear of the meniscus, a bucket-handle tear of the meniscus, or a posterolateral corner injury, these patients are often sent for “prehab” to try to get their knee motion improved and try to get the swelling down in their knee prior to surgery. This is done because the risk of getting stiff after an ACL reconstruction can be increased if one has a stiff and swollen knee going into surgery. Therefore, having a good physical therapy program around the time of the ACL reconstruction is very important to ensure the best outcomes long term.

When should an ACL reconstruction be performed in patients over age 50?

Patients who are over age 50 who note difficulty with twisting, turning, and pivoting, especially those who ski or play court sports, should consider an ACL reconstruction as long as they do not have significant arthritis in their knee. If they have associated meniscus tears, it would also be recommended to repair these tears to both protect their ACL grafts and to minimize the risk of arthritis over time. In our series, we have found that the outcomes of patients that are older than age 50 are equal to those in the teenage and 20-year-old age range, so age by itself does not mean that someone should not undergo an ACL reconstruction procedure.

When can an ACL reconstruction be performed in those over age 60?

There is no upper age limit to an ACL reconstruction because it is mainly dependent upon the patient's activity levels, other medical problems, and if they have instability. So elderly patient with instability and healthy knee can always be taken up for ACL reconstruction.

What are important recovery tips after ACL reconstruction surgery?

One of the most important recovery tips after an ACL reconstruction surgery is to ensure that one decreases the amount of swelling, they have immediately after surgery so they can advance their rehabilitation protocol. One of the hardest things to do after ACL reconstruction is to regain full extension, so placing a pillow under one's heel and letting gravity straighten out their knee can be an important part of the early rehabilitation program. Placing a pillow under one's knee, while it may help one to feel better, often results in the knee having more blood leak into it and can make the hamstrings go into spasms, so it is difficult to straighten one's knee out. In addition, as one advances in their rehabilitation program, taking baby steps forward to ensure that one does not have pain and swelling is important. Swelling often causes the muscles to atrophy, so avoiding swelling can ensure that one's rehabilitation program advances in a timely fashion over the long term.

When are titanium screws used for ACL reconstruction surgeries?

Titanium screws are considered the gold standard for patellar tendon autograft reconstructions. In addition, they are considered

the gold standard for most grafts that use a bone plug. Bioabsorbable fixation or other type of fixation, such as a cortical button fixation, are most commonly used for soft tissue reconstruction grafts. Titanium screws do not interfere with a future ACL reconstruction postoperative MRI and can be more easily visualized on x-rays to help determine one's graft placement.

What causes knee popping after an ACL reconstruction?

Knee popping in the initial months after an ACL reconstruction can be very common. Most commonly, it is due to some swelling within the knee causing the overall knee viscosity to be decreased. Normal tissues can then have popping and cracking as one flexes and extends their knee. In general, most cases of popping go away with time as one's quadriceps muscles get stronger and the swelling goes down. Nonpainful popping in general is due to normal tissues gliding, whereas painful popping needs an assessment by one's surgeon to determine its cause.

Why can't I straighten my knee after an ACL reconstruction?

There can be many causes of difficulty with straightening one's knee after an ACL reconstruction. These can include difficulty with rehabilitation after surgery where one does not regain full extension, having their ACL graft hypertrophy over time and causing a "cyclops lesion," which can be a ball of tissue which can prevent full extension, or having technical issues with the ACL reconstruction graft whereby the graft is placed too anterior on the femur and one cannot straighten their knee. In general, the treatment for this initially is physical therapy, often using a dynamic extension splint to see if the patient can overcome their lack of full extension. If

therapy does not work, then obtaining an MRI scan to look for a cyclops lesion may be indicated. In addition, surgical treatment can include debridement of a cyclops lesion, a notchplasty, or if it is a postoperative rehabilitation issue, an arthroscopic posterior capsular release may be indicated in some patients to help them regain full extension.

Should one use NSAIDS after ACL reconstruction graft surgery?

In general, we discourage the use of anti-inflammatory medication such as ibuprofen or Naprosyn for the first 3 to 4 months after ACL reconstruction surgery. This is because these medications can interfere with bone healing and also with collagen cross-linking. If one needs a non-narcotic medication, the use of acetaminophen/paracetamol is usually recommended for most patients.

What type of anesthesia can be used for ACL reconstructions?

In general, the decision about what type of anesthesia one has for their ACL reconstruction should be made with an anesthesiologist. As orthopaedic surgeons, we can usually work with an epidural, spinal, or some type of general anesthesia. It is difficult to perform ACL reconstruction grafts under local anesthesia, because the assessment of meniscus tears and the positions that the knee has to be bent into can be compromised if the patient is guarding. It may not allow for all pathologies to be diagnosed and treated appropriately.

What are some ACL reconstruction questions to ask one's surgeon?

There are many questions that one could ask to ensure that they comprehend their ACL reconstruction procedure. First, it is important to determine if the surgeon is going to use their own tissue with an autograft or if they will use a cadaver tissue with an allograft. This can sometimes be the most important factor in determining the success rate of an ACL reconstruction. One can also ask about what type of autograft, which could be a patellar tendon, hamstring, or quadriceps tendon. All of these types of autografts can have specific uses for which they are most beneficial for a patient. And how the surgeon is going to deal with injuries to other structures of the knee (menisci and cartilage).

Can one have an ACL reconstruction in a varus/ valgus knee?

Proper limb alignment both in coronal and sagittal planes plays an important role for knee stability. A malalignment should be corrected when ACL reconstruction is planned. It can be done simultaneously or in a staged manner. It is important to understand this as if malalignment is not corrected with an osteotomy then there are very high chances of graft failure. So your surgeon will look into all the factors pertaining to it and then decide on plan of surgery.

When should one have an ACL reconstruction and an osteotomy?

In some patients that have arthritis of the inside part of their knee and who are bowlegged, it may be difficult to determine if their

problems are coming from their ACL tear, causing instability, or from their bow leggedness and arthritis on the inside part of their knee causing pain. In this circumstance, the use of a proximal tibial osteotomy to unload the medial compartment and shift the alignment into neutral rather than being bowlegged may be beneficial. In patients that may have some arthritis on the inside part of their knee, but they truly have instability, the use of an ACL reconstruction in these patients over an osteotomy may be indicated.

Can an ACL reconstruction fail?

The success rate of ACL reconstructions ranges from 60% to 95%, depending upon the graft used, the surgical technique used, and if all other patient-related pathologies, including their bony geometry have been addressed. In particular, one of the highest risk factors for an ACL graft failure is a patient who has a cadaver graft or artificial graft material, called an allograft, when they are 25 years or less of age. The failure rate for these can be up to 40% or more in some series.

What are the symptoms of ACL reconstruction graft failures?

Patients who have ACL reconstruction graft failures may note difficulty with twisting, turning or pivoting. In addition, they may develop pain along the inside back part of their knee, which could indicate that they have an associated meniscus tear or cartilage lesion because of the knee being unstable. The most definitive way to determine if an ACL reconstruction graft is unstable is to have a physical exam and determine if one has a pivot shift test that is positive. In general, having a positive pivot shift test is associated with a stretched out or torn ACL reconstruction graft, and this test is more definitive than obtaining an MRI scan, whereby a loose ACL reconstruction graft may appear intact on the MRI scan. One may

need to undergo various scans and investigation to determine the cause of graft failure and then treat it accordingly.

What causes ACL reconstruction failure?

The number one cause of ACL reconstruction failure in all of the literature is improperly placed ACL grafts at the initial surgery. This can cause extra stress on an ACL reconstruction graft which can lead to its failure. In addition, a missed other ligament problem at the time of the ACL surgery, such as an MCL or a posterolateral corner (PLC) injury, can also put significant stress on an ACL reconstruction graft, which can lead to its failure. Other factors that can cause an ACL graft to fail can include the lack of the posterior horn of the medial meniscus. This is because the posterior horn of the medial meniscus is the next structure that prevents the knee from sliding forward. In patients who may not have their medial meniscus, the ACL graft generally tends to be looser than in patients who do have their medial meniscus. Thus, in some patients, this can lead to the graft being overloaded and it can cause the ACL graft stretch out over time.

Other factors that can lead to ACL reconstruction failure are patients that have soft tissue grafts, such as hamstrings grafts, that have hyperlaxity. Other factors include patients with a large increase in their posterior tibial slope (sagittal plane tibial slope) which can cause an ACL graft to be overloaded and stretch out over time.

In our practice, where we perform revision ACL reconstructions a year, we find that a properly placed ACL reconstruction is the least common cause of failure. Therefore, patients who have a well-done ACL reconstruction and are exposed to sports activities, are the lowest numbers of athletes that we see that need a revision. Thus, it appears that when an ACL reconstruction is placed in the correct position and the patients appropriately rehabilitate themselves, the risk of an ACL reconstruction graft failure is much lower.

Can an ACL reconstruction be done twice?

ACL revision reconstructions are becoming more common because there are anywhere from 200,000 to 300,000 ACL reconstructions done each year in the United States and almost half the number in India. With all of the many factors that can lead to ACL reconstruction graft failure, anywhere from 20,000 to 40,000 ACL revision reconstructions may be performed per year in the United States. Similarly, the revision surgeries are increasing in India.

Does ACL reconstruction lead to knee replacement?

ACL reconstruction by itself does not lead to the need for a total knee replacement. However, when one does have a knee injury, especially **when one loses their meniscus tissue**, they are at a higher rate for the development of osteoarthritis. In particular, patients who have ACL reconstructions have roughly a 50% chance of developing arthritis 20 years after their ACL reconstruction.

When is bone grafting used for an ACL reconstruction?

Bone grafting for an ACL reconstruction is almost always utilized for a patient that has had a previous failed ACL reconstruction graft. In some of these circumstances, the previous tunnel may become enlarged from the type of graft to the point where one cannot proceed with a revision reconstruction with a new graft without having a high likelihood of having the new graft fail because of a very large tunnel. In these circumstances we would clean out the tunnel arthroscopically and place in bone graft to fill in the tunnels. Once the bone graft heals, one could then proceed with a revision

ACL reconstruction and place the new tunnels in a correct anatomic position. These are the staged surgeries.

When is an ACL reconstruction using an iliotibial band used?

Most ACL reconstructions using an iliotibial band are used in very young patients with open growth plates. In these circumstances, it is important to avoid the growth plates to ensure that growth plate arrest and angular deformities of the knee do not occur. Historically, several decades ago, the ACL was often reconstructed with an iliotibial band. Today, this is mainly utilized in patients with wide open growth plates, commonly in the age 5-10 age group. Physeal sparing ACL reconstruction can also be done in patients with open growth plates.

What are the complications of ACL surgery?

Arthroscopic ACL reconstruction is a safe surgery if the patient is optimized prior. However, every surgical procedure has some risks. General complications like adverse reaction to a drug or anesthetic agent or an acute cardiac event are no greater than for any other surgery. Pneumonia, especially after general anesthesia in the presence of viral respiratory infection, is another remote possibility in a previously healthy individual. Similarly, deep vein thrombosis or clotting in calf vein is unusual after an ACL reconstruction, but possible, especially in smokers and those on oral contraceptive pills.

Specific complications include:

Infection: The incidence after arthroscopic surgery is about 0.5%. though every care is taken in terms of a sterile operating room environment, prophylactic antibiotics before surgery, etc., this

cannot be brought to zero. Superficial infections can be treated with oral antibiotics alone. However, deep infections have to be managed by hospital admission, surgical wash-out and intravenous antibiotics. Prolonged antibiotics for 3-4 weeks and repeat surgery may also be required in some cases.

Bleeding: Bleeding from the joint is uncommon. Excess bleeding is seen in smokers and those on blood thinning medications like aspirin.

Nerve injury: A small nerve, present on the inner side of the leg commonly gets injured while removing the hamstring tendons or patellar tendon. This causes numbness on the lower and outer side of the knee. This does not cause any significant functional problems and gradually recovers over a period of 3-4 months.

Anterior knee pain: This is a possibility especially if a bone patella tendon bone graft is used. It can cause pain on kneeling and gradually resolves over time. Improved techniques have decreased its incidence.

Stiffness: This is very rare after ACL surgery and usually due to non-compliance with rehabilitation. Recovery of motion by dedicated physiotherapy is possible.

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