THE CORE INSTITUTE
Center for Orthopedic Research and Education ®

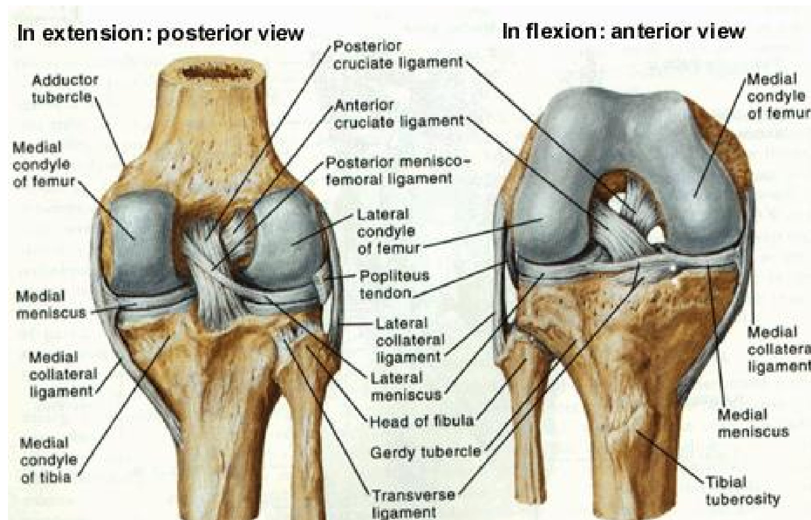
KNEE ARTHROSCOPY

How Does the Knee Get Injured? – The Patho-Mechanics of Knee Injuries

You have injured your knee. Knee injuries are very common among active individuals. It is important for us to understand how your knee was injured. Most knee injuries are associated with a non-contact mechanism (not caused by a collision). Sports such as skiing, basketball, soccer, tennis and football have the highest incidences of knee injuries and ligament tears. However, knee injuries can also occur during trivial falls or for unknown reasons. With most injuries, the foot twists, balance is lost and the knee torques in a direction and position that is not compatible with the normal load potential of the structures within the knee. This results in a force and load that causes failure of the meniscus or the ligament(s) of the knee. The athlete may experience a variety of sounds and sensations during injury, such as pops, clicks, pain and tenderness. Subsequently, there may be swelling, tenderness and painful range of motion in the knee. Again, knee injuries are very common. There are a variety of situations (usually in patients over 30 years old) where there is no recognizable injury. We will now help you to better understand normal and abnormal knee anatomy and function.

Knee Anatomy and Function

The knee is beautifully architected to allow synchronous load and motion. To achieve this, there is a complex relationship between bone, ligament, articular cartilage (the veneer that overlies the bone) and meniscus fibrocartilage. Let us take a closer look at these structures and their functions.



The **femur** is the upper portion of the knee joint. It is covered with a surface of **articular cartilage** that allows weight bearing motion with a very low coefficient of friction. This articulates with the lower portion of the knee which is the **tibia**. The tibia is covered with articular cartilage that has two semilunar fibrocartilages (**medial meniscus** and **lateral meniscus**) that sit on the surfaces. The menisci are resilient structures, but only have blood supply in the outer third region. The menisci function to distribute load, lubricate and to provide additional stability for this articulation. The ligaments work in concert with

these structures to achieve optimal stability through a range of motion. The **anterior cruciate ligament** (ACL) has an attachment to the femur in the back and to the tibia in the front. The major function of the ACL is to prevent the tibia from moving forward or anteriorly. The ACL also provides some stability with side to side motion. Thus, an ACL tear is a major problem for an athlete who desires pivoting, cutting and changing direction as part of their athletic lifestyle. These functions are required for sports such as skiing, soccer, football, basketball, volleyball and racquet sports. The **posterior cruciate ligament** (PCL) attaches the femur and the tibia, and is principally responsible in stabilizing the tibia from moving backward (posteriorly) on the femur. PCL injuries occur during sports when the knee is bent or during motorcycle/motor vehicle accidents. Several studies have demonstrated that it is possible to do quite well in sports even if the PCL is torn. However, this is dependent on the severity of the injury to the other structures in the knee. The **medial collateral ligament** (MCL) and the **lateral collateral ligament** (LCL), are primarily responsible for maintaining side-to-side or varus and valgus stability.

The unique anatomy of the knee allows the forces of compression, tension and shear are distributed effectively. Once the integrity of this system is lost or diminished, there is a resultant functional disability or instability and a higher potential for degeneration of the joint (arthritis). It is here that we must understand the following:

Goals of the sports medicine orthopedic surgeon
- Injury care
- Injury prevention
- Performance maximization

In this situation, our major goals will be
- To restore stability and performance
- To minimize the probability of joint degeneration

In order to accomplish these goals, it is imperative to make an efficient diagnosis leading to an effective treatment.

Making the Diagnosis
You have injured your knee. Each knee problem is associated with a spectrum of pain, decreased range of motion, swelling, stiffness and an inability to perform your activities or sports. You have filled out our knee history survey that allows us to categorize these subjective issues. Objectively, a physical examination will help define your point of maximal tenderness, range of motion and the degree of laxity or instability. X-rays are routinely done to evaluate bone injury and alignment. Using the history, the physical examination and the x-rays we are able to develop a preliminary diagnosis of your problem. At this point we may decide that more information is necessary. Secondary diagnostic techniques include MRI or magnetic resonance imaging, bone scan and CT scan. MRI, a technique developed for the knee in 1984, allows depiction of normal and abnormal anatomy with excellent accuracy (89 to 90 percent). This test is best used to confirm the primary diagnosis. There are times we feel this is necessary and others it is not. These are judgments we will make dependent on the situation. Variables include the type and severity of the issue, as well as cost efficiency. The bone scan is rarely used, but can help define fractures that are not visualized on routine x-rays. The CT scan is best used to define and occult fracture or help understand a difficult fracture pattern. These secondary

tests will have to be scheduled at a later date than the original visit. Once you have had the test, you will return to the office to review the scan and the interpretation with us. At this time we will make the final determination and diagnosis of your injury. It is important that we understand the severity of the injury and the damage to the menisci and other structures. There are two important ramifications of your knee injury. The first is the functional instability and consequent athletic disability. The second is the potential development of articular degeneration and arthritis that can evolve over the years.

What are your Options?

We have determined that you have injured your knee. We have arrived at this diagnosis using a systemic and comprehensive approach. Your initial response to this may be frustration, disbelief, anger or depression. All of these responses are appropriate and expected. Once recognizing your emotional and psychological response, it is important to move forward with a decision-making progression to find out the following:

- First, there is no rush to any decision. Allow this to be an evolution. For some, this is easy; others may find it more difficult. Take a deep breath and allow your judgment to surface.
- Second, you must define your athletic goals for us. Try to define the type of sports to which you wish to return. Where are you on the spectrum from low level recreational to high demand athlete? Only you can define that for us. Remember, it is not appropriate to say, "I am not a professional athlete" to rationalize your objective. Every individual is handled as a separate situation that must be personalized.
- Third, timing is essential. The time of injury care must be matched to your agenda, season, goals and priorities. Once all of these issues are considered, we are ready to evaluate the options.

Treatment Options

Option One – Conservative Nonoperative

- Conditioning and Physical Therapies: The conservative option is best for those individuals who are lower-demand athletes who do not participate in aggressive and pivoting types of sports. The fundamental question only you can answer with our help is whether or not you can co-exist with the problem in relation to your personal goals and objectives. This option starts immediately. As pain decreases and you begin to achieve better motion, conditioning and physical therapy will be initiated. The purpose of conditioning and physical therapy is to gradually improve motion, strength and agility and progressively returning you to functional activities. The bicycle is the best means of exercise as it is gentle and effective. It is best to start cycling for about 10 minutes with minimal resistance then slowly increase cycling time up to 30 minutes with some resistance. In addition, you may be asked to work with a physical therapist who will create a comprehensive exercise program regimen for you. Session will likely be two to three times per week in addition to a home exercise program.

- Nutritional Supplementation:
    - 1500 milligrams of glucosamine sulfate a day and 1200 milligrams of chondroitin sulfate a day has shown to be quite effective in the long and, possibly, short term to decrease pain and improve potential for cartilage healing.
    - Weight loss is critical to facilitate improvement of knee pain and lessen the potential of arthritis over time.

- Viscosupplementation with Orthovisc, Supartz, Hyalagan, Euflezza: This natural gel improves the resilience of the knee while nourishing the cartilage (meniscus). During the execution of this option, you will periodically see us in the clinic to assess your progress. Sometimes, we will have to make course corrections or even select a different option based on your clinical or symptomatic response. Remember, in most circumstances, you can change your option at any time. It is often best that conservative treatment options be exhausted before moving forward with surgical intervention.

Option Two: Knee Arthroscopy with Meniscus and Articular Cartilage Care
This option should be selected for those individuals who have a meniscus tear or an articular cartilage defect. Knee arthroscopy is performed as an outpatient procedure. It entails an examination under anesthesia to objectively determine the severity of instability and laxity, followed by diagnostic arthroscopy. Knee arthroscopy provides us with an exact determination of articular cartilage damage as well as meniscus and ligament tears. Our surgical objective is to preserve and repair all meniscal and articular cartilage defects at all times, methods include:

Meniscus Repair
Sometimes it is best to tack or suture repair the meniscus. Unfortunately, only about 10 percent of meniscus tears are suitable for meniscal repair. Following a meniscus repair, you must remain on crutches for three weeks to aid with healing and to help protect the repair.

Partial Menisectomy
This is performed if the meniscus tear is not amenable to the meniscal repair. A partial menisectomy involves removing the unstable fragments of meniscus (cartilage) and re-contouring the meniscus structure so it can distribute forces appropriately. A partial menisectomy does not include remove of the complete meniscus, and the goal is to preserve as much as possible.

Meniscus Allograft Transplantation
This technique, popularized in the last decade, replaces a lost meniscus and is only performed as a secondary or tertiary procedure. If it is determined that a meniscus allograft transplant is the best procedure, we will discuss the details with you at that time.

Articular Cartilage Repair
- Partial thickness cartilage defects are treated with debridement, which means smoothing it down. Debridement of these defects is aimed at relieving your knee pain and minimizing future arthritis.
- Microfracture is a technique utilized to treat full thickness articular cartilage defects. Small holes are placed in the exposed bone to stimulate a healing response from the marrow that includes the mesenchymal stem cell. In approximately 80 percent of these defects, there is some degree of healing with repair cartilage that is not as good as the original, but may be satisfactory. Following microfracture you will be on crutches for four to six weeks as the repair cartilage forms. During this healing phase you will be asked to ride a bicycle after 10 days. If we find a full thickness defect that is large or one that has not healed to your satisfaction, then secondary methods of repair become viable options.

- Osteochondral grafting is a technique that involves taking plugs of bone and cartilage from a non-weight bearing portion of the knee and transfers it to the defect to resurface the articular cartilage defect.
- Autologous Condrocyte Implantation (ACT) is a relatively new technique (1996) that involves a biopsy of your articular cartilage which is then used to 'clone' 12 million of your chondrocytes (the cells that make up articular cartilage) to implant back into the defect under a patch of periosteum (bone lining tissue). This technique has been used to resurface large defects and is good for selective situations and patients. Individuals with osteoarthritis are not candidates for this procedure.

Prognosis and Expectations

Knee arthroscopy procedures have a 90 percent success rate but exact probability of success depends upon:

- The spectrum on injury
- The complexity of injury and surgery
- Age of the patient
- Presence of articular cartilage injury or degenerative arthritis
- Time since the injury
- Status of muscle tone
- The patient's compliance, discipline and execution of the rehabilitation program

These situations can be challenging. Sometimes in patients over the age of 60, the prognosis decreases because of degenerative articular cartilage changes and wear and tear from arthritis. When the arthroscopy procedure is completed you will review the finding and photos so you fully understand the situation within your knee. Postoperatively, you will begin exercise, conditioning and physical therapy as soon as possible.

What are the Risks of Surgery?

It is our responsibility to make sure you have a realistic understanding of the risks and potential complications of surgery. They are the following:

- Anesthesia risks: As a general rule, all anesthesia options are safe and effective. Regardless of the option selected, complication rates are generally low. The most important issue is making sure you are healthy and there are no underlying medical conditions that can influence your health. In many situations, you will be asked to see your general physician for a preoperative medical history and physical exam that defines these issues. You will review these again with the anesthesiologists.
- Infection: Probability of infection is roughly one in every 1000. To minimize this risk, you will receive preoperative intravenous antibiotics.
- Chronic stiffness: One in every 500.
- Re-operation: Five in every 100 for any reason, which can include pain, decreased range of motion or re-tear of meniscal or articular cartilage surfaces.
- Nerve vein thrombosis (blood clots): One in every 500.
- Nerve and blood vessel injury: One in every 1000.
- Persistence of pain: Anywhere from five to 40 out of 100 people. This is due to the following:
    - Degenerative articular cartilage changes or arthritis that can cause persistent pain, soreness and swelling.
    - Osteonecrosis or avascular necrosis of bone.
    - Other causes of pain in the extremities including:

- Loose bodies
- Gout
- Fibromyalgia
- Reflex Sympathetic Dystrophy

Making Your Decisions

Complete understanding of your knee injury is challenging, and that is why we are here to explain and answer any and all questions. We treat a great number of knee injuries and created this information packet to help you understand your injury and treatment options. As with all surgical decision making, it is important to remember:

- There is no rush to make a decision
- It is important that you understand each option in full detail. If you do not, ask again.
- Timing may be an important issue.

The Timing of Surgery

Once you have decided to proceed with surgery, we must define the optimal time. Exceptions to this rule may include:

- The elite, high-level high school, collegiate or professional athlete. Within these groups, the time from injury to full recovery is vitally important.
- Displaced meniscus tears or large loose fragments in the knee that won't allow a full range of motion.

The Preoperative Visit

The purpose of this visit is to:

- Further help you understand your options
- Review the risks of surgery as stated above and to complete your informed consent forms. Ask and receive answers to any remaining questions you might have
- Review the procedure and likely recovery course
- Provide you with any necessary medical equipment (crutches, sling, etc.)
- To review allergy issues
- Provide prescription medications including:
    - Vicodin: Used to relieve pain, some patients do not require this. If necessary, this is an excellent pain reliever that is a combination of a codeine analogue plus Tylenol. You may take up to two tablets every four to six hours as needed. Since we have been using the present protocol of local and preemptive anesthesia, patients require much lower amounts of Vicodin and in most cases, none.
    - Anti-inflammatory: Naproxen or another anti-inflammatory of your choice may be prescribed. In recent years we may have been using these medications three to four weeks after surgery to help minimize soreness, aching and swelling.
    - Antibiotics: These are reserved for selected circumstances such as revision surgery or if hardware is present. You will receive antibiotics though an IV at the time of surgery.
    - Chondroprotection: Also called cartilage protection therapy, this includes 1500 to 2000 milligrams of glucosamine sulfate a day and 1200 milligrams of Chondroitin sulfate a day. This combination has been effective in the long and short term in decreasing pain and stiffness. They also improve the potential for cartilage healing over time. Recent studies have found the effect of this in the postoperative period is quite significant.

- Make sure we have obtained medical clearance for surgery from your Primary Care Physician (PCP), as well as review any labs or studies that were ordered.
- Provide follow-up appointment dates and times.

Anesthesia Options

- Local with sedation: This option is reserved for individuals who have arthroscopy with meniscus care only. We have been doing this for 15 years. If at any time during this option you need more sedation or choose not to be awake, then we can facilitate that request instantaneously with additional sedation. Most patients are happy with the ease and comfort from this option. You are able to avoid possible side effects of general anesthesia.
- Spinal/epidural: Widely accepted, but rarely used.
- General: Widely accepted, but rarely used as most patients prefer the local with sedation option.

The Day of Surgery- What to Expect

All patients have a level of nervousness in the days prior to surgery. The best thing to do is to talk with friends, family or us. We have a great deal of experience and we want to make your experience as enjoyable as we can. Here are some important rules to follow:

- Do not eat or drink after midnight the night before the surgery.
- Make sure you have someone to take you to the surgical center and pick you up afterward. The staff will review the best times for you.
- Read all the materials we have provided for you once more the night before surgery. Ensure that you understand all logistics, options, risk and benefits in full detail. If you have any questions it is important that you ask them. Remember, the key to an optimal result is information, comfort and confidence.
- Relax. We will take good care of you. We are happy to answer any and all questions at any time.

After Surgery

You will wake up in the recovery room. Your knee will be covered with a surgical dressing and TED hose stockings from foot to thigh. We will also provide you with crutches or a cane to help you walk for the first few days after surgery. It is important that you ice your knee multiple times the day of surgery for 20 to 30 minutes at a time while keeping it elevated. In addition, we ask that you begin an exercise regimen to include the following exercises:

- Straight leg raises: Raise leg 12 inches off the bed, couch or chair. Hold in position for a count of 10 seconds. Do 10 repetitions, five sets per day.
- Knee bends: On your back with your leg straight up in the air, bend your knee pulling it in toward your chest as much as comfort allows. Do 10 repetitions, five sets per day.
- Quad sets: Sitting with your leg straight, pull your toes toward your nose and tighten your thigh (flexing your quadriceps muscles). Hold for a count of 10 seconds. Do 10 repetitions, five sets per day.
- Foot pumps: Sitting with your leg straight, alternate pointing your toes to the floor (‘pushing on the gas pedal’) and pulling your toes toward your nose. Do 30 repetitions, five sets per day.

The Night of Surgery

It is our goal to minimize or eliminate pain with this procedure. We will prescribe the following:

- Vicodin: You may take one to two tablets every four to six hours as you need. We recommend trying to take one tablet every six hours. As much of your pain subsides, we will have you wean off the narcotic pain medications and instead use over-the-counter pain medication such as Tylenol.
- Non-steroidal anti-inflammatory (Naproxen 500mg): You will take one pill twice a day for three weeks after the surgery. If you have ulcers, gastritis or difficulty taking anti-inflammatories, it is imperative that we exercise caution with these medications.

Postoperative Visit

At this visit we will:

- Make sure medications are effective and not causing problems
- Change your dressings and place waterproof dressings over your knee
- Review the basic exercises again, as well as ensure that you are walking okay with your crutches or cane
- Review the operative findings, procedures and photos
- Schedule physical therapy visits if needed. We will give you the referral and appropriate authorizations as needed
- Schedule a follow-up visit in approximately six weeks
- Make sure that you have all the necessary notes and documentation for school or work

Issues and Problems

- Expectations: This is a very subjective and personal issue. Some individuals have unrealistic expectations as to the speed of recovery. We break down this issue to speed factors (youth, elite athletics, high motivation) and slower recovery factors (obesity, age, arthritis, disease and little exercise motivation). We will constantly be assessing your healing progression, but everyone is different. It is important to control the things you can, such as daily commitment to the exercise program which will help things enormously.
- Swelling in the knee: Most cases have swelling. If it is in excess, we will need to remove the fluid in the clinic.
- Bruising: This may occur in the foot when we have operated on the knee. It is not a bruise, but a tracking of blood down the leg to the foot. It is common and will gradually disappear.
- Pain: Most people have little or minimal pain with this procedure. If it is unmanageable, please call us.
- Numbness: Loss of function of the foot or ankle and tremendous swelling of the leg rarely occur, but are always things we need to know about.

Rehabilitative Program: The Principles

It is important to focus on the patient/athlete as a whole, incorporating all dimensions of performance including aerobic and anaerobic fitness, power, strength, agility and specific athletic function. We must have a clear functional objective and develop a program and strategic plan that realistically allows us to achieve that goal. At all levels of rehabilitation, conditioning and return to sport is a progression. We specifically describe this as a step-wise progression. All progressions should be relatively pain-free. In the first

month following surgery, activities such as bicycling can be done for up to one hour. Please do not walk too much. Err on the conservative side – this means no long distance hiking or shopping malls.

During the rehab program, exercise is essential six days a week. It will be stressed that you ride a bicycle six days a week, for at least one hour a day. If you are a professional or elite athlete, you will be expected to cycle for up to two hours a day. Swimming is a perfect sport for cross-training. This can start two weeks after surgery. The freestyle stroke is ideal. Breast stroke (with frog kick) should be avoided due to the additional stresses on the knee. Aqua jogging with a belt or vest and water therapy is also an excellent exercise. Stairmaster, as well as elliptical is acceptable later in the program due to the high potential forces on the knee.

Jogging can start between weeks four and eight, depending on the individual progress and the surgery performed. The running progression starts by walking with no limp, then walking 30 minutes with no limp or pain, then walking five minutes and jogging five minutes, then walking five minutes and jogging ten minutes, then walking for five minutes and jogging for 15 minutes and so forth.

Agility Progressions – The Box

This activity will be started later in your rehabilitation. The box is set up with four cones five yards apart making a box. The box is initially walked slowly, then walked rapidly, then jogged, then sprinted. At first, the box is at five yards, but progresses to 10, 20 and 40 yards. Successful execution of this progression allows you to restore agility, proprioception and functional return to sports.

- The first leg of the box is run forward
- The second leg is side-step left in a counterclockwise direction
- The third leg is back pedal
- The fourth leg is side-step right

Return to Sports- The Ultimate Goal

Every patient/athlete is different. The return to sport is always a progression. It can never occur without attention to the details of the sports progression. Each sport is different and has a specific protocol for that sport. The criteria for release and full return to competitive sports are based upon strength, agility, aerobic and anaerobic fitness, sport specific skills and joint stability. Always remember that all questions are welcomed at any time.