Managing ACL Injuries

Introduction: One of the most common problems involving the knee joint is an anterior cruciate ligament tear. Although not life-threatening, rupture of the anterior cruciate ligament (ACL) can lead to knee joint instability, which can negatively impact and severely impair activities of daily living and quality of life in both athletes and non-athletes. Therefore, prompt and accurate evaluation and appropriate treatment are crucial to the restoration of ACL function.

Approximately 100,000 injuries to the ACL occur annually in the general population of the United States, with 70% occurring during athletic activities. Among those ACL injuries that occur in athletes, females have a higher incidence of this injury compared to males participating in the same sport with similar rules and playing condition.

Anatomy of the Anterior Cruciate Ligament (ACL): The anterior cruciate ligament is one of four ligaments that are critical to the stability of the knee joint. A ligament is made of tough fibrous material and functions to control excessive motion by limiting joint mobility. To better understand the relationship of the ACL to the knee it is critical to understand basic knee anatomy.

Essentially, the femur (thigh bone) sits on top of the tibia (shin bone), and the knee joint allows movement at the junction of these two bones. Without ligaments to stabilize the knee, the joint would be unstable and prone to dislocation. The major function of the ACL is to prevent hyperextension and forward displacement of the knee joint. Additionally it contributes stability to other movements at the knee including the angulation and rotation of the joint.

The ACL is a fan-shaped structure approximately 38mm long (average), and has a width of approximately 2.3 cm (average). It arises from the lateral femoral condyle (femur) and inserts in the interspinous area of the tibia (shin). The other major ligaments of the knee are the posterior cruciate ligament (PCL), and the medial and lateral collateral ligaments (MCL/LCL). Other important components of the knee that may be damaged along with the ACL or as a result of chronic ACL instability include the meniscus and articular cartilage.

When an ACL injury occurs, the knee becomes less stable. The ACL injury is a problem because this instability can make sudden, pivoting movements difficult and it may make the knee more prone to developing arthritis and cartilage tears. When the knee is unstable, patents often complain of a sensation that the knee will “give away” from under them. When this is a result of an ACL injury, the knee joint is sliding too much.

Causes of ACL Injury: In the United States, the majority of these injuries occur during recreational and sporting activities. Each American football team can expect an average of 2.4 ACL injuries per year. Contact or non-contact injuries may both cause ACL injury. A blow to the side of the knee may occur during a

football tackle and may result in an ACL tear. Alternatively, coming to a quick stop, combined with a direction change while running, pivoting, landing from a jump or overextending the knee would be an example of a non-contact injury to the ACL as well. Basketball, soccer, football and skiing are common sports that predispose the athletes to ACL tears. In decreasing frequency of occurrence, the five (5) primary mechanisms of injury are as follows:

1. *"Valgus Stress Injuries"* – Usually due to a blow to the lateral aspect of the knee joint, the proverbial **clipping** injury. This injury can also disrupt the medial collateral ligament (MCL) and/or injure the menisci.

2. *Twisting or Rotational Injuries"* – This mechanism is commonly seen in skiers who get the tip of their ski caught in the snow resulting in extreme rotation at the knee joint.

3. *"Varus Stress Injuries"* – Usually due to a blow to the medial aspect of the knee joint. Much less common than the valgus stress injuries, but can disrupt not only the ACL but the lateral collateral ligament (LCL) and lateral meniscus as well

4. *"Hyperextension Injuries"* – A common mechanism of a posterior cruciate ligament (PCL) injury that can also disrupt the ACL if the stress continues to extremes.

5. "*Dashboard Injuries"* - Due to a direct blow to the front of the upper tibia (shin bone) occurring while the knee is in flexion. This force results in the backward displacement of the shin bone and can also disrupt the PCL

How is the Diagnosis of Anterior Cruciate Ligament Injury Made? Most ACL injures can be detected through a detailed history and physical examination, and selective imaging modalities such as Magnetic Resonance Imaging (MRI).

History – Patients are usually able to relate the position of their knee and the type of activity at the time of their injury. They may say that they "knee gave out" or "it buckled". About 40-50% of patients will state that they heard or felt a "pop".

Physical Examination – Your orthopaedic surgeon will do a thorough musculoskeletal physical examination which will include, range of motion, gait

analysis, muscle and nerve function. Areas of focal tenderness will help to identify other potential ligament or cartilage injuries. An estimated 75% of ACL injuries will develop significant swelling (fluid on the knee) within the first hour after injury, and 92% within 24 hours. Swelling this rapid usually indicates blood in the knee joint.

A preliminary diagnosis can be made after performing various clinical tests which are specific for an anterior cruciate ligament tears.

Imaging Modalities – Plain x-rays are needed on all patients presenting with knee injuries to rule out any obvious fractures or dislocations. *"Remember"* these x-rays do not show ligament injuries by themselves.

Magnetic resonance imaging (MRI's) offers three major advantages: It does not expose the patient to radiation, it is non-invasive and it demonstrates excellent soft tissue pathology such as ACL injury. MRI accuracy for detecting ACL tears is approximately 90%.

What are the Short & Long Term Effects of Anterior Cruciate Ligament Injuries? Pain and other symptoms usually diminish or resolve within 3 weeks after injury. Most patients are able to walk and even run in a straight direction. Abruptly turning corners or negotiating stairs however, can cause a flare-up of symptoms.

When the patient perceives instability, it is usually due to the unnatural movements of the bony support structures of the knee, which can in turn result in "stretching out" or progressive damage to the other secondary restraints of the knee.

These "secondary restraints" include the menisci, articular cartilage and other major ligaments which have been previously discussed.

In the unstable knee, arthritic changes invariably occur and will progressively worsen. For this reason, the ACL deficient knee usually requires treatment and must not be ignored.

Management of Anterior Cruciate Ligament Injuries: The decision to treat an ACL injury with conservative or reconstructive surgical techniques depends on the degree of joint instability, the presence of associated injuries, and the patients' expectations for future sports activity. For example, an adult recreational athlete who has an isolated, partial ACL injury without significant instability will likely benefit from conservative treatment consisting of physical therapy, protective bracing, and other preventive measures whereas, a patient who has considerable instability or who expects to return to a high level of activity will most likely require surgical reconstruction of the ACL.

Timing of surgery is controversial. Some suggest that surgery can be performed

immediately after the injury. Others suggest that physical therapy over 3-4 weeks to allow the patient to regain full range of motion and strength helps prevent postoperative stiffness and immobility. Ultimately, timing of surgery is a decision made between you and your orthopaedic surgeon.

Conservative treatment using physical therapy is conducted in 4 different phases

Phase I aims to regain range of motion and minimize swelling and pain after an acute injury.

Phase II consists of strengthening the quadriceps and hamstrings to parity.

Phase III is heralded by a return of equal strength and range of motion in both legs.

Phase IV begins to introduce sport specific functional training also known as "skill training and includes plyometric and proprioceptive (balance and coordination) activities. At this point the patient can begin to resume competitive sports

Surgical Procedures for the ACL Deficient Knee: Presently, there are a number of reconstruction techniques or options available to repair the disrupted ACL. These include the use of bone-tendon-bone autograft (Patients own tissue is harvested), or allograft (Cadaver tissue is utilized), hamstring autograft, (harvesting the hamstring tendon from the patient), and recently the use of quadriceps (thigh) or anterior tibialis (ankle) allograft tendons have become popular.

The ACL Reconstruction with bone-patellar-tendon-bone autograft involves the harvesting of the central third of the patellar tendon with a bone block at each end of the tendon graft. After performing a diagnostic arthroscopic examination of the knee, the central third of the patellar tendon is harvested. The remaining tendon is then repaired. After harvesting the tissue, drill guides are used to place holes into the tibia (shin bone) and femur (thigh bone). By placing the drill holes at the attachment sites of the original ligament, when the graft is pulled through the drill hole and into the knee, it will be placed in the same position as the original ACL. After pulling the graft through the drill holes and into the joint to replace the torn ACL, the graft is then held in place by bioabsorbable or metallic screws. Fastening the graft in this manner allows new blood vessels to grow into the transferred graft and for healing to occur.

ACL Reconstruction with a hamstring autograft uses the hamstring tendon(s) from the semitendinosis and/or gracilis muscles. These are harvested and then positioned within the knee as a substitute for the lost ACL. A key advantage of this procedure is that the hamstring autograft harvesting is associated with fewer knee cap joint problems which is occasionally encountered with the bone-tendon-bone procedure.

The use of an allograft (cadaver) to reconstruct the ACL is also performed periodically. In this technique, a cadaver graft (either from the hamstring or ankle tendons or a cadaver bone-patellar tendon-bone) is obtained. This removed tissue is then transplanted into the knee of the ACL deficient patient to serve as a substitute ACL. This technique is appealing in that there is no "donor site" problems.

Postoperative Course and What to Expect: Postoperative rehabilitation is essential to help eliminate instability, restore strength and motion and ideally; return the patient to the preinjury level of activity. During the immediate post-injury period, the patient should enter into a rehabilitation program while the decision of whether to do surgery is made.

Postoperatively, it is possible to bear weight on the surgically treated leg by using crutches for the first 7-10 days after surgery. The patient will then progress weight bearing and be weaned from crutches under the close guidance of the physical therapist. Supervised physical therapy is usually started by the second or third postoperative day.In addition, a continuous passive motion device is applied to the injured leg post operatively.

Most patients will use this device for the first several weeks following surgery. It's purpose is to slowly move the knee, thereby decreasing the risk of stiffness and loss of motion. Following an initial 6-10 week period of supervised physical therapy, most patients will progress to a self-directed program of rehabilitation.

When you go home from the hospital, you will be provided a CPM unit (Continuous Passive Motion). You should take your leg out of the brace and get into your CPM about 2-3 hours, 2-3 times per day, starting from 0-30 degrees of knee motion. Increase your flexion 10 degrees a day to 90 degrees until your first post-operative follow-up appointment. (If you have had a meniscus repair you will be advised by your surgeon. In this case you should remain non-weight bearing, not flexing your knee beyond 90 degrees for the first four weeks or so.)

The success of rehabilitation varies between patients. Factors that influence its success include motivation of the individual, availability of proper therapy equipment, and aggressiveness of the rehabilitation protocol. Some patients return to pre-injury levels as early as 4 months, while others may take a year. Until released by your physician, contact sports, racquet sports, skiing, martial arts and any sport that requires rapid direction changes must be avoided. Even with aggressive therapy and medical clearance to return to sports, biologic healing of reconstructed ACL's continues for at least one year.

Knee Bracing: Yes or No? Bracing the knee remains controversial. Some published reports support bracing the reconstructed knee for one year or more whereas, other reports state "no clear evidence for the efficacy of prophylactic

(preventative) bracing" for prevention of knee injury. The decision for bracing is between you and your surgeon and should be tailored to the needs of each individual patient.