Anterior Cruciate Ligament Reconstruction

Surgical Indications and Considerations

Anatomical Considerations: The anterior cruciate ligament (ACL) lies in the middle of the knee. It arises from the anterior intercondylar area of the tibia and extends superiorly, posteriorly, and laterally to attach to the posterior part of the medial side of the lateral condyle of the femur. The ligament is intra-articular but extrasynovial. The ACL is described as being composed of 3 main bundles. These bundles include the anteromedial, posterolateral, and intermediate. The ACL really functions as a continuum, with a portion being tight through all ranges of knee flexion. It acts as the primary restraint to anterior tibial translation and guides the screw-home mechanism associated with knee extension. The ACL acts secondarily to prevent varus and valgus, particularly in the extended knee. Injury leads to abnormal kinematics of the knee. Subluxation episodes occur, creating abnormal shear forces on the meniscus and articular cartilage. Subsequent meniscal injury, therefore, is increased significantly.

The major blood supply for the ACL comes from the synovium and fat pads. The vessels involved are middle geniculate and terminal branches of the inferior medial and lateral geniculate vessels. Sensory receptors and nerve fibers have been identified in the ligament, which suggests some sensory role and possible proprioceptive function.

Pathogenesis: Ligaments tear when the mechanical load exceeds the physiological capacity of the tissue. ACL tears are most commonly due to extrinsic mechanical forces. It may be due to contact injuries where there is a blow to the side of the knee, such as may occur during a football tackle. Alternatively, non-contact ACL injuries can occur by coming to a quick stop combined with a direction change while running, pivoting, landing from a jump, or hyperextension of the knee joint. ACL injuries are often associated with other injuries. The “unhappy triad” is a classic example, in which the ACL is torn at the same time as the MCL and the medial meniscus. Basketball, football, soccer and skiing injuries are common causes of ACL tears.

Epidemiology: Injury of the ACL is the most common ligamentous injury of the knee and accounts for about 30 injuries per 100,000 of the population, with greater than 100,000 new ACL injuries occurring each year. Women are more likely to suffer an ACL tear than men are. Females are at higher risk of ACL injury when considering sports participation numbers. This is believed to be related to both intrinsic factors (increased Q angle, decreased notch width, increased joint laxity, hormonal influences) and extrinsic factors (less muscle strength, different muscle activation patterns, altered cutting and landing patterns). Adults who tear their ACL usually do so in the middle of the ligament or pull the ligament off the femur bone. These injuries do not heal by themselves. Children are more likely to pull off their ACL with a piece of bone still attached, these may heal on their own, or may require the bone to be fixed.

Diagnosis

- Mechanism of injury
- Most patients describe a “pop” sound at the time of injury
- Immediate pain and swelling in knee
- Knee joint instability once swelling and pain resolves
- Limited ROM
- Joint line tenderness
- Positive Lachman Test /or Anterior Drawer Test
- Pivot-Shift or Jerk Tests (to assess rotational instability)
- Radiographs to exclude fracture, tumor, and osteoarthrosis
- Arthroscopy
- CT scan for associated fractures or avulsions of the cruciate
- MRI can be helpful in determining the presence, location, and severity of the tear(s) and to evaluate other injuries to the knee – with 98% accuracy

Nonoperative Versus Operative Management: Surgical repair depends on the extent of instability and level of activity. It is typically recommended for patients who expect to return to relatively high functional activities required of recreational athletics. In chronic cases, the major indication for surgical reconstruction is recurrent instability. Indications for nonoperative management include patients with active infection, soft-tissue abrasion, and reluctance to participate in the complex rehabilitation required. Conservative care includes a comprehensive rehabilitation program, a functional brace for sports, and activity modification.
Relative contraindications are common and include the following: patient is less than 2 weeks from injury, low activity levels, preexisting osteoarthrosis, skeletal immaturity, and inflammatory arthropathy. Some people are able to live and function normally with a torn ACL. However, most people complain that their knee is unstable and may "give out" with attempted physical activity. Unrepaired ACL tears may also lead to early arthritis in the affected knee.

Surgical Procedure: There are several surgical procedures available including mini-arthrotomy open technique, two-incision arthroscopically assisted techniques, and one incision endoscopic technique. Currently, ACL reconstruction is most often performed using an arthroscopically assisted technique. The most frequently used graft types for ACL reconstruction are the patellar tendon (PT) and the combined semitendinosis and gracilis tendons (HT). For the past two decades, the gold standard in ACL reconstructions has been the patellar tendon graft from the middle third of the tendon, but increasingly the hamstring tendon graft has been used. The shift in popularity is due to several reasons, including, concerns about damaging the knee extensor apparatus using the PT and the potential for subsequent anterior knee pain, patella fracture, ligament rupture, and infrapatella contraction. The HT techniques also have potential complications including tunnel widening and fixation and concerns of the affects on the muscle function.

Preoperative Rehabilitation

- Patient education on expectation and likely outcomes of rehab
- Patient education on joint protection, to avoid deep squats and low chairs for 12 weeks
- Instructions on post-operative exercises
- Documentation of pre-operative strength and ROM
- Correction on any deficits in flexibility and soft tissue compliance

POSTOPERATIVE REHABILITATION

Note: The following rehabilitation progression is a summary of the guidelines provided by Bollen, Risberg, Shelbourne. Refer to their publication to obtain further information regarding criteria to progress from one phase to the next, anticipated impairments and functional limitations, interventions, goals, and rationales.

Phase I of Rehabilitation: Weeks 0-2

Note: Contact MD immediately if increasing pain, signs of infection, or signs of DVT.

Goals: Control edema and pain
Achieve full extension and 90° of flexion
Weight bearing as tolerated
Begin regaining muscle strength
Quad activation

Intervention:

- Local treatment of swelling with cryotherapy and elevation
- Soft tissue mobilization to hypomobile tissue in superficial fascia near surgery site
- Passive knee extension (heel propped up on pillows and let knee sag)
- Exercise for 5 minutes/hour to stimulate graft ligamentization
- Maintain flexibility with heel slides or prone hamstring curls
- Closed Kinetic chain exercises: hamstrings and quads strengthening, half squats (20-70 degree), cycling with seat high to avoid too much flexion
- Neuromuscular electrical stimulation (NMES), quad activation exercises
- Tibiofemoral mobilization with rotation, patellar mobilizations
- Begin introducing proprioception training with eyes closed
- Crutch training for the first few days

Phase II of Rehabilitation: Weeks 2-6

Goals: Control any residual symptoms of edema and pain
Full knee extension ROM to almost full flexion
Progress strength training
Normal gait
Progressive weight-bearing
Return to normal ADL

Intervention:

- Increase load to knee with squats and dips
- Cycling, step machine, leg press 0-90 degrees
- Theraband work to improve knee control and proprioception
- Increase hip adductor and abductor strengthening
- Gait training

Phase III of Rehabilitation: Weeks 6-12

Goals: Full range of motion
Increasing functional activity level
Improve proprioception

Intervention:

- Proprioception training on unstable surfaces
- Wobble board work
- Progressive resistive exercises
- Begin open kinetic chain exercises, beginning range at 40-90° of flexion
- Introduce jogging when muscle strength and control allows
- Progress to jogging in and out of cones from about 10 weeks, changes in directions should be smooth vs. sudden

Phase IV of Rehabilitation: Weeks 12-26

Goals: Return to pre-injury level sport/occupation at 6 months
Normal strength and speed
Normal agility
Patient fully educated about the future of the knee

Intervention:

- Progressive sport specific program
- Sport/work specific strength training
- Progressive sport specific agility and speed work (no sudden twisting/turning until 4 months)
- Plyometrics, quality not quantity

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