

Knee – Movement Coordination Deficits

Anterior Cruciate Ligament “ACL Tear”

ICD-9-CM: 844.2 Sprain of cruciate ligament of knee

“ACL Insufficiency”

ICD-9-CM: 717.83 Old disruption of anterior cruciate ligament

Medial Collateral Ligament “MCL Tear”

ICD-9-CM: 844.1 Sprain of medial collateral ligament of knee

Diagnostic Criteria

History: ACL Tear: Trauma or strain - often accompanied by an audible snap or pop, followed by rapid onset of a large effusion/hemarthrosis
 ACL Insufficiency: Episodic giving way, effusion and pain with specific (usually pivoting) activities
 MCL Tear: Trauma involving a valgus stress (e.g., from a fall or a blow to the lateral knee)

Physical Exam: ACL Tear and Insufficiency: Excessive anterior tibial translation with Lachman’s Test
 MCL Tear: Pain - and possibly laxity - with valgus stress test at 30 degrees of knee flexion



Lachman’s Test

Cues: Stabilize femur, pull tibia anteriorly in a line parallel to the tibial plateau - determine the amount of tibial anterior translation (0-2 mm is normal)
 Other tests (e.g., anterior drawer, pivot shift, KT – 2000) may also be used to assess ACL integrity
 Involuntary, protective muscle guarding by the patient lowers sensitivity of these tests



Valgus Stress Test

Cues: Stand facing patient

Allow thigh to rest on table, flex tibia off table

Performing test at 30 degrees of knee flexion is more selective for MCL involvement

Prevent rotational motion of femur and tibia when applying the valgus stress

Medial Collateral Ligament Sprain of the Knee

ICD-9: 844.1 sprain of medial collateral ligament of knee

Description: Tension injury to the medial collateral ligament of the knee commonly from a sudden application of valgus force to the knee. The MCL tenses to the point of micro or macroscopic injury to its structure.

Etiology: The medial collateral ligament can be injured as the result of contact with a direct blow to the lateral aspect of the thigh/leg or noncontact with the sudden application of a valgus torque to the knee. The classic example is a direct blow to the lateral aspect of the athlete's knee while the foot is planted to the ground.

Physical Examination Findings (Key Impairments)

Acute Stage/ Severe Condition

- May have the inability to walk or bear weight without pain in more severe cases
- Minimal to moderate effusion and warmth with an isolated MCL injuries; larger amounts of effusion are associated with ACL and PCL tears which must be ruled out
- Palpation of the MCL produces tenderness
- Knee extension and flexion may be limited due to joint effusion and pain.
- Abnormal laxity and the reproduction of symptoms are identified with valgus stress testing at 30 degrees of knee flexion.
- May have weakness and pain with knee extension and flexion manual muscle testing due to the close anatomical proximity of the MCL to vastus medialis, semitendinosis, and semimembranosis. In a contact injury, lateral structures such as vastus lateralis and biceps femoris may also be affected.

Sub Acute Stage / Moderate Condition

As above with the following differences

- Able to walk with minimal pain and without a significant limp
- Strong and painful knee extension and flexion with manual muscle testing
- Minimal to no effusion at the knee

Settled Stage/ Mild Condition

As above with the following differences

- Knee motion may be limited by stiffness with non-painful spongy end feel or motion may not be limited at all
- May have difficulty with deep squatting, cutting (Zigzags), and sprinting

Intervention Approaches / Strategies

Acute Stage / Severe Condition

Goals: Decrease pain, swelling, and inflammation at the knee

Maintain knee mobility

Restore strength to hamstrings and quadriceps

Encourage weight bearing of involved leg

Maintain general conditioning

- Physical Agents:
 - Ice with compressive wrap or Cryo/Cuff applied to injured knee with elevation
 - Ultrasound
 - Electrical stimulation
- Manual Therapy
 - Friction massage
- External Devices (Taping/Splinting/Orthotics)
 - May use crutches as required to limit pain
 - May consider a Neoprene sleeve or minimally restrictive lateral hinge brace
- Therapeutic Exercises
 - Range of motion exercises of the knee (passive→active assisted→active)
 - Quadriceps setting and straight leg raise exercises (isometric)
 - Upper body ergometer or swimming to maintain general fitness level while MCL is healing
- Patient Education/Re-injury Prevention
 - Avoiding activities that may stress the MCL

Subacute Stage/ Moderate Condition

Goals: Walk unassisted without a limp

Achieve 90° of knee flexion

Increase knee strength

Maintain general conditioning

- Approaches / Strategies listed above
- Therapeutic Exercises
 - Begin isotonic progressive resistive for quadriceps and hamstrings
 - Begin isokinetic exercise if available
 - Begin closed-chain exercises
 - Bicycle ergometer, stair climber
 - Exercises to increase knee flexion to 90°

Settled Stage/ Mild Condition

Goals: Achieve full knee ROM
 Begin running and functional exercise program
 Continue with general conditioning

- Therapeutic Exercise
 - Full active knee motion exercises
 - Improve muscle performance required to participate in desired occupational or recreational activities. For example:
 - Fast speed walking to gentle straight-line jogging
 - Jumping
 - Sprints
 - Zig-zags

Intervention for High Performance / High Demand Functioning in Workers or Athletes

Goals: Return to desired occupational or recreational activities

- Approaches / Strategies listed above
- Therapeutic Exercise
 - Maximize muscle performance to relevant leg muscles required to perform the desired occupational or recreational activities
 - Progress job/sports specific training to increase mechanical demand. Examples of activities for athletes:
 - Sprinting up to full-speed
 - Zig-zags up to full-speed
 - Jogging greater than one mile
 - Figure-eights
 - Noncontact drills to full-contact drills
 - Acceleration/deceleration speed play
- External Devices (Taping/Splinting/Orthotics)
 - May utilize standard MCL taping as needed prior to athletic participation
 - Brace application may be used as needed – may provide psychological benefit

Selected References

Dersheid GL, Garrick JG. Medial collateral ligament injuries in football: nonoperative management of grade I and grade II sprains. *Am J Sports Med.* 1981;9:365-368.

Holden DL, Eggert AW, Butler JE. The nonoperative treatment of grade I and II medial collateral ligament injuries to the knee. *Am J Sports Med.* 1983;11:340-4.

Reider B. Medial collateral ligament injuries in athletes. *Sports Med.* 1996; 21:147-56.

Reider B, Sathy MR, Talkington J. Treatment of isolated medial collateral ligament injuries in athletes with early functional rehabilitation: a five-year follow-up study. *Am J Sports Med.* 1994; 22: 470-477.

Anterior Cruciate Ligament Sprain/Insufficiency

ICD 9: 844.2 sprain of the cruciate ligament of knee - or -
717.83 old disruption of anterior cruciate ligament

Description: The anterior cruciate ligament (ACL) is the most commonly injured ligament in the knee. The ACL extends from the anterior aspect of the tibia to the inner aspect of the lateral femoral condyle and it helps stabilize the knee in the anterior-posterior and rotational planes. The main blood supply is provided by the synovial membrane and the ACL is innervated by the tibial nerve.

Etiology: ACL sprains are caused by sudden decelerations, abrupt changes in direction, hyperextensions, cutting maneuvers on a planted foot, internal tibial rotation, and valgus stresses.

Physical Examinations Finding (Key Impairments)

Acute Stage / Severe Condition

- Pain
- Swelling
- Decreased range of motion
- Decreased strength
- Abnormal laxity produced with Lachman's and anterior drawer tests
- Decreased weight bearing on involved lower extremity

Sub Acute Stage/ Moderate Condition

As above with the following differences:

- Minimal to no effusion at the knee
- Minimal limitations in ROM
- Strength testing of knee extension and flexion in mid range are relatively strong and pain free
- Able to walk with minimal pain and without a significant gait deviations
- Decreased proprioception

Settled Stage / Mild Condition

As above with the following differences:

- Full ROM
- Minimal to no gait deviations
- Difficulty with sport specific activities (i.e., fast change in directions)

Intervention Approaches / Strategies

Acute Stage/ Severe Condition

Goals: Decrease pain, swelling, and inflammation at the knee

Maintain knee mobility

Restore strength to hamstrings and quadriceps

Encourage weight bearing of involved leg

Maintain general conditioning

- Physical Agents
 - Ice with compression and elevation
 - Electrical Stimulation
 - Ultrasound
- External Devices (Taping/Splinting/Orthotics)
 - Assistive device as needed to limit pain
 - Bracing to provide stability and limit anterior tibial torsion
- Therapeutic Exercise*
 - Range of motion exercises of the knee (passive→active assisted→active)
 - Isometric exercises for quadriceps and hamstrings

*Caution: Open chain terminal knee extension exercises (from 60 degrees to 0) with resistance applied to the distal leg, and closed-chain squatting between 60 and 90 degrees may cause increased anterior translation of the tibia and excessive stress to the ACL.

- Patient Education
 - Activity modification, especially avoiding positions that lead to giving way, pain, and effusion.

Sub Acute Stage/ Moderate Condition

Goals: Walk independently without gait deviations

Increase knee strength

Increase proprioception

- Physical Agents:
 - Same as those listed above
- External Devices
 - Functional bracing to increase knee stability
- Therapeutic Exercise
 - Isotonic progressive resistive for quadriceps and hamstrings
 - Isokinetic exercise if available
 - Closed-chain exercises

Stationary bicycle
 Running on treadmill
 Proprioceptive training
 Perturbation exercises

Settled Stage / Mild Condition

Goals: As above

Return to desired recreational activity or sport

- Therapeutic Exercises
 Improve muscle performance required to participate in desired occupational or recreational activities. For example:
 - Fast speed walking to gentle straight-line jogging
 - Jumping
 - Sprints
 - Zig-zags
 - Perturbation training
 - Plyometric and agility training

Selected References

Bagger J, Ravn J, Lavard P, Blyme P, Sorensen C. Effects of functional bracing, quadriceps and hamstrings on anterior tibial translation in anterior cruciate ligament insufficiency: A preliminary study. *J Rehabil Res Dev*. 1992;29(1):9-12.

Colby S, Hintermeister RA, Torry MR, Steadman JR. Lower Limb Stability with ACL Impairment. *J Ortho Sport Phys Ther*. 1999;25(8):444-454.

Cooperman JM, Riddle DL, Rothstein JM. Reliability and Validity of Judgments of the Integrity of the Anterior Cruciate Ligament of the Knee Using the Lachman's Test. *Phys Ther*. 1990;70(4):225-232.

Eastlack ME, Axe MJ, Snyder-Mackler L. Laxity, instability, and functional outcome after ACL injury: copers versus noncopers. *Med Sci Sports Exerc*. 1999;31(2):210-215.

Fitzgerald K, Axe MJ, Snyder-Mackler L. Proposed Practice Guidelines for Nonoperative Anterior Cruciate Ligament Rehabilitation of Physically Active Individuals. *J Ortho Sport Phys Ther*. 2000;30(4):194-203.

Fitzgerald K, Axe MJ, Snyder-Mackler L. The Efficacy of Perturbation Training in Nonoperative Anterior Cruciate Ligament Rehabilitation Programs for Physically Active Individuals. *Phys Ther*. 2000;80(2):128-139.

Roberts D, et al. Proprioception in People with Anterior Cruciate Ligament –Deficient Knees: Comparison of Symptomatic and Asymptomatic Patients. *J Ortho Sport Phys Ther*. 1999;29(10):587-594.