BRIGHAM AND WOMEN'S HOSPITAL

Department of Rehabilitation Services
Physical Therapy

Standard of Care: Non-Operative Management of the ACL Tears

ICD 9 Codes:

717.83 ACL Insufficiency
844.2 ACL Tear

Case Type / Diagnosis: The anterior cruciate ligament (ACL) is a band of dense connective tissue which courses from the femur to the tibia. The ACL is a key structure in the knee joint, as it resists anterior tibial translation and rotational loads. When the knee is extended, the ACL has a mean length of 32 mm and a width of 7-12 mm. There are two components of the ACL, the anteromedial bundle (AMB) and the posterolateral bundle (PLB). They are not isometric with the main change being lengthening of the AMB and shortening of the PLB during flexion. The ACL has a microstructure of collagen bundles of multiple types (mostly type I) and a matrix made of a network of proteins, glycoproteins, elastic systems, and glycosaminoglycans with multiple functional interactions. The complex ultrastructural organization and abundant elastic system of the ACL allow it to withstand multiaxial stresses and varying tensile strains. The ACL is innervated by the posterior articular branches of the tibial nerve and is vascularized by branches of the middle genicular artery.[2]

Knee function after ACL rupture varies considerably. While the majority of patients after ACL injury lack dynamic stability, some seem to have the ability to dynamically stabilize their knee even during pivoting sports activities. The two treatment options include operative and non-operative management. It is a clinical challenge to identify individuals who have the potential to compensate well for ACL deficiency early after injury. This is why decisions for management of a patient after ACL rupture is a team effort involving the patient, surgeon and physical therapist. Lynn Synder and Fitzgerald proposed a classification for patients after ACL rupture as COPERS, NON-COPERS and ADAPTERS.[5,9]

- COPERS are operationally defined as patients who return to pre -injury level of work and sports with no episodes of giving way for at least one year.
- NON-COPERS fail to return to their pre-injury activity level with continued episodes of giving way.
- ADAPTERS are patients who have reduced their work or sport level or changed activities.

The ability to accurately identify patients with potential to succeed with non-operative management would help clinicians counsel their patients with acute ACL rupture.
Dynamic instability is operationally defined as the ability of knee to remain stable when subjected to rapidly changing loads during activity. Being able to take these types of measurements relatively early after injury, may make it possible to establish criteria for

identifying patients who have reasonable chance to succeed in returning to high level physical activity with non-op treatment.

The Delware and Norwegian group proposed an algorithm to classify patients into potential copers and non-copers. The algorithm would be as follows: a patient with a history of an ACL injury would have an MRI to rule out any other ligament injury. If the patient has no other injury, the patient would be referred for physical therapy (PT). The patient would be on a PT program for pain and effusion management, joint mobility, muscle performance, and weight bearing. Once the patient's impairments are resolved, a screening test can be administered. After scoring on the screening test, the patients can be classified as either potential copers or non-copers.[7,8]

Criteria for administering the screening test included: within 6 months post injury, no evidence of knee joint effusion, no evidence of gait abnormalities, full passive range of motion at the knee, no knee lag with active SLR, and tolerance for single leg hopping on the involved limb with no pain.

The screening test includes the Unilateral Hop Tests (single, timed hop test) and self-assessment questionnaires, episodes of knee giving way (with effusion), Knee Outcome Survey ADL Scale, Global Rating of Knee Function.[7,8,9,13]

The proposed algorithm is the latest literature on assessing potential copers vs. non-copers; however, the algorithm had low sensitivity and specificity of 44.1. Of those that were initially classified as potential copers (15 out of 25), 60% were true copers. Out of 25 patients who were potential non copers, only 8 were true non-copers. Hence a negative predictive value of 30%, therefore 70% were classified as potential non copers were true copers. This means that both potential copers and non copers are rehab candidates and a potential non-coper could become a true coper at one year.[13]

Given the differential response to ACL injury, implementation of a clinical decision making algorithm discriminates operative vs non-operative candidates, copers vs non copers, and improves predicting the probability of safe, successful return to pre-injury levels. Screening identifies short-term outcomes.

Other factors to consider in predicting copers vs noncopers:[9,5]

- In comparison to male athletes, female athletes exhibit neuromuscular characteristics that suggest that they may not be able to compensate for ACL deficiency. Females produce less muscle stiffness, recruit quadriceps (ACL antagnist) prior to hamstrings (ACL agonist), and have delayed hamstring reactions in response to anterior stress to the ACL.
- Age related changes in neuromuscular performance have been documented and include decreases in joint position sense, slower response time, slower time to peak torque, and regression in neuromuscular function.
- If the patient has the time to rehab
- Patient goals to return to level I sports
- Patient activity level prior to injury

In conclusion, we still do not have an optimal set of criteria to correctly assign individuals with an ACL tear to the correct treatment after injury. No single outcome measure is sufficient to determine functional status of individuals after an ACL tear. A collaboration of tests is recommended. Treatment options based on screening exam should be done with caution.

Indications for Treatment[1,4,5]:

- Need to return to physically demanding activity in the short term. For example, an Athlete who has exhausted eligibility, who needs to demonstrate worthiness for athletic scholarships or athletes who wish to play through the season.
- Construction workers or laborers who wish to postpone surgery until busy season is over.
- General population who has self elected non-operative management.
- Individuals who are >40 years with low level of activities or those who are willing to modify their activities.

Contraindications / Precautions for Treatment:

- Multidirectional instability, multiple ligament injuries, meniscal tear, full thickness articular cartilage lesions, full thickness chondral defect
- Post injury reaction with an extended inflammatory response

Evaluation:

Medical History: To review the necessary medical history, a thorough inspection of the patient's medical record and the past medical history form should be completed.

History of Present Illness: Discussion should begin with a description of the original trauma and when it occurred. ACL injuries typically will result in immediate swelling over the next 24-48 hours. Does the patient report of continued instability? How many episodes of giving way with resultant increase in edema have occurred since the onset of injury?

Social History: A thorough, in depth review of the patient's current activity level is critical to examination of this patient population. The question must be answered as to what your patient's needs will be from a functional and recreational standpoint. Is your patient sedentary or actively involved in sports? Is there a timeline that must be kept for the patient's participation in sports? Does he or she have any hobbies that have higher physical demands? What type of vocational needs does your patient have? For example, the patient who is a construction worker will have higher physical demands placed on the injured leg than a receptionist. Finally, does the patient's occupation allow them to participate in the demands of a rehabilitation program from a non-operative or an operative standpoint?

Medications: A review of the medication list should be examined on the past medical history form and within the patient's medical record. Within this patient population, attention should be primarily given to the current or past use of anti-inflammatory medication.

Examination

Pain: Pain is typically measured on a visual analogue scale (VAS) from 0 to 10 with 0 representing no pain and 10 representing the worst pain. Information should be gathered on the patient's current, worst, and least pain level. Aggravating and alleviating factors should be identified.

Palpation: Palpation should occur about the entire knee over superficial structures while noting irritability and any presence of edema.

Girth Measurements: circumferential measurements for knee edema and possibly for muscle atrophy.

ROM: Due to the high levels of regional interdependence for the knee and lower extremity, active and passive range of motion should be gathered specifically at the knee and hip. Typically, ROM of the foot and ankle will be screened and only specifically measured if there is a lack of range from the normal limits.

Strength: Lower quarter strength should be measured via manual muscle testing (MMT). For patients with higher levels of strength, hand held dynamometry can be a more objective means of capturing strength and side-to-side differences. A subjective assessment can also be made on the quality of quadriceps contraction (e.g. good, moderate, fair, poor).

Sensation: Lower quarter sensation will typically be measured via light touch.

Balance:

- Single leg stance
- Rhomberg
- Star excursion balance test

Special Tests:

- Step down test
- ACL
  - Lachman
  - Anterior Drawer
  - Pivot Shift
- PCL
  - Posterior Drawer
- MCL/LCL
  - Varus/Valgus stress at 0° and 30° of flexion
- Meniscus
  - Thessaly
  - McMurray

Hop Tests:

- Hop tests are inexpensive, require little time, and use the opposite limb as the control.
- Administered with the patient once she has reached certain milestones including:
  - Full, pain-free ROM
  - No joint effusion
  - Ability to hop on a single leg without pain
  - Quadriceps strength greater than or equal to 75% on uninvolved side[5]
- Patient performs 2 practice trials and 2 test trials on both limbs. The hop tests are performed on a 6-m strip and include:
  - Single leg hop for distance
  - Cross over hop for distance
  - Triple hop for distance
  - 6-m timed hop[7,8]

Functional Outcomes:

KOS-ADLS has been established as a valid and reliable tool for evaluating changes in knee function over time. The ADLS is a 14 item scale that queries patients about how their knee symptoms effect their ability to perform general daily activities (6 items) as well as how their knee condition effects their ability to perform specific functional tasks (8 items). Each item is scored 0-5 with 5 indicating "no difficulty" and 0 representing "unable to perform". The highest possible score is 70. The scores of all items are summed, divided by 70, and then multiplied by 100 to give an overall ADLS percent rating. Higher percentages reflect higher levels of functional ability. This scale would be appropriate for patients who either do not participate in sports or recreational activities or for those who have not yet progressed to performing these activities.

Global rating of knee function is used to assess the patient's overall perception of his or her knee function. Patients rate knee function based on his or her current level of knee function on scale of 0-100%. One could also use the VAS and ask them to rate 0-100%.

Differential Diagnosis:

- PCL tear/rupture
- Meniscal tear
- MCL/LCL sprain or rupture
- Fracture
- Muscle strain

Assessment:

Problem List

- Pain
- Impaired Strength:
  - VMO atrophy or weak quadriceps

    - Hamstrings
    - Hip extensors
    - Hip abductors
    - Hip internal/external rotators
    - Ankle muscles
- Impaired knee ROM
- Impaired Edema
- Impaired Balance/Proprioception: Knee instability
- Impaired Joint Mobility:
    - Patellar joint mobility
    - Tibio-femoral joint mobility
- Impaired muscle length:
    - Quadriceps – positive Ely test
    - Hamstrings – positive 90/90 test
    - Gastrocnemius
    - Iliotibial band
- Gait: Antalgic gait
- Function: Single leg hop testing compared to unaffected limb
- Functional Outcome scales: Knee Outcome Survey Activities of Daily Living Scale (KOS-ADLS), Lower Extremity Functional Scale, The International Knee Documentation Committee Subjective Knee Form (IKDC2000)

Prognosis:

The patient's prognosis depends on a number of factors including concomitant injuries (MCL/PCL/meniscus), level of knee instability/degree of tear, patient goals, activity level, and patient age. Meunier et al[11] found in a 15 year follow-up that individuals following ACL injury initially treated conservatively had significantly more mensici injuries and that status of the meniscus was the most important indicator of developing osteoarthritis. They concluded that ACL repair can reduce risk of secondary meniscus tears. They, however, found no significant difference in osteoarthritis outcome or activity level between groups who got conservative management versus surgical repair. Neuman et al[15] concluded that individuals with ACL injury who are willing to moderate activity level should consider non-operative treatment**.** They additionally concluded that meniscal integrity is a clear risk factor for osteoarthritis. Additional studies looking at non-operative versus operative management of ACL injury have found that there is a good prognosis for individuals treated conservatively in terms of activity level, development of osteoarthritis, and self-reported function.[10,14,6] However, it was concluded that those individuals who did not undergo surgery had modified their activity levels and did continue to have increased knee laxity compared to operative groups.[10,14,12]

Studies have additionally shown that individuals with ACL injury who undergo pre-operative rehabilitation or non-operative management can gain strength and function with a potential for good functional improvement.[13] Eitzen et al[3] found that preoperative quad strength was the most important predictor of knee function 2 years after surgery. Eitzen et al [3] found that a short term progressive exercise program is well tolerated and concluded that it should be included in early ACL rehabilitation to improve knee function prior to surgery or for non-operative management.

Goals (Measurable parameters and specific timelines to be included on eval form)

1. Independent with home exercise program including understanding of open versus closed chain quadriceps strengthening
2. Avoid patella femoral pain
3. Restore muscle strength throughout lower extremity to 5/5 via MMT in 8-12 weeks.
4. Ambulation without a device or deviation 3-4 weeks
5. Full knee A/PROM in 3-4 weeks
6. Single leg hop testing to within 80% of the unaffected limb
7. No edema
8. No pain
9. Function/return to full ADL's in 6 weeks
10. Return to sports activity with or without brace 12 weeks
11. No episodes of knee giving out

Age Specific Considerations:

Longer recovery time can be expected for older individuals secondary to slower healing characteristics in this population. Older individuals are typically not participating in higher-level activities that would require strong knee stability and therefore it may not be necessary to undergo surgical repair. On the other hand, a younger individual who is involved in sports requiring significant knee stability such at cutting and pivoting, may benefit from surgery. In either case, prior activity level and patient goals of returning to those activities should be considered.

Treatment Planning / Interventions

Established Pathway	___ Yes, see attached.	_X_ No
Established Protocol	___ Yes, see attached.	_X_ No

Interventions most commonly used for this case type/diagnosis.

PHASE I: INITIAL PHASE

Goals:

- Control and reduce pain, inflammation, edema and joint effusion
- Restore full active and passive range of motion
- Restore patellar mobility
- Reestablish quadriceps muscle activation
- Improve flexibility
- Restore normal gait on level surfaces
- Eliminate instability
- Educate patient on rehabilitation progression and home exercise program (HEP)

Contraindications / Precautions for Treatment:

- Activities that result in continued locking of the knee
- Continued episodes of giving way
- Continued / worsening of pain and / or edema with progressed physical therapy

Interventions:

Modalities

- Cryotherapy
- Electrical Stimulation
    - TENS for pain control
    - NMES to strengthen the VMO

Gait Training

- Assistive device prescription fitting and training if applicable
- Brace prescription fitting and training if applicable
- Stair training

Range of Motion

Passive, active assistive and active flexion and extension of the knee

Therapeutic Exercises

- Progress from open chain to closed chain
- Stretching
    - Hamstrings
    - Quadriceps
    - Gastrocnemius
    - Iliotibial band
- Quad sets
- Heel slides
- Straight leg raises (SLR) all planes
- Hip abduction supine and sidelying (clamshells)
- Bridging
- Stationary bicycling
- Closed chain
    - Leg press / Total gym
    - Theraband
    - Mini squats
    - Heel raises

Patellar mobilizations

Patient Education

- HEP
- Instruction in pain control, ways to minimize inflammation and edema
- Activity level modification

- Donning and doffing of brace (if applicable to the patient)

Aquatic therapy (if available):

- Ambulation in shallow end
- Deep water aqua jogging

Criteria for advancement to Phase II:

- Good quad set, SLR without extension lag
- Full knee ROM
- Edema and pain well controlled
- No signs of active inflammation
- Normal gait on level surfaces

PHASE II: PROGRESSIVE STRENGTHENING

Goals:

- Maintain ROM and flexibility
- Restore muscle strength
- Increase proprioception and neuromuscular responses
- Restore normal gait with stair climbing

Progressive Therapeutic Exercises:

- Continue with range of motion, stretching and flexibility exercises as appropriate for the patient
- Quadriceps strengthening progress as tolerated:
    - mini squats
    - wall sits
    - squats (BOSU and reverse BOSU)
    - step ups /downs (forward and laterally)
    - lateral step overs
    - leg press / total gym (90 to 20 degrees) progress to unilaterally
    - lunges (forward and reverse)
- Progressive hamstring, hip and calf strengthening
    - Hamstring curls
        - Gradually add resistance to open chain (ankle weights)
        - On Physio ball
    - Lateral gait with theraband
    - Crab walking
    - Monster walks
    - Side lunges
    - Heel raises on leg press machine / Total gym
    - Scooter
    - Single leg balance/proprioception work (progress uneven surfaces)
        - Ball toss
        - Balance beam
        - Mini trampoline

    - Single limb dead lifts
- Stationary bicycling (progress intensity and duration)
- Elliptical machine
- Aquatic therapy if available:
    - Jogging in shallow end (waist deep)

Criteria for advancement to Phase III:

- Tolerance of Phase II exercises without adverse events or swelling
- Sufficient strength and proprioception to initiate agility activities
- No signs of active inflammation
- No episodes of knee buckling

PHASE III: PROGRESSIVE STRENGTHENING, PROPRIOCEPTIVE, PLYOMETRIC AND RETURN TO SPORT TRAINING AND EXERCISE

Goals:

- Progressive strengthening
- Maintain ROM and flexibility
- Restore neuromuscular responses with plyometrics and advanced proprioceptive exercises
- Return to running
- Safe return to work and/or sport activities (with MD clearance if applicable)
- Quadriceps and hamstring strength to 85% of uninvolved leg per isokinetic strength test (if available)
- Single leg hop tests 85% of uninvolved leg
- Patient education with regard to potential limitations and activity modifications
- Patient education regarding sports bracing if applicable

Progressive Therapeutic Exercises:

- Continue with stretching and flexibility exercises as appropriate for the patient
- Progressive quadriceps and hamstring strengthening from phase II

Plyometric Exercises:

- Double leg progressing to single-leg hops and drills with knee over toe position
    - Forward/backward and lateral hops
    - Side to side hops
    - Box jumping (progress height of box)
- Power slide
- Lateral shuffle
- Slalom running: in/out of cones and/or figure of 8 running
- Cutting activities
- Agility ladder drills
- Split lunges
- Karaoke (crossover steps)
- Shuttle running

- Sport specific drills as appropriate for patient

Proprioceptive and Perturbation Exercises:

- Squat progression: Progress from double leg to single leg and from level surface to foam; Dynadisc; BOSU; rocker board; half foam roll etc.
- Single leg stance on foam; BOSU; rocker board; rollerboard; dynadisc. Adding in ball toss (forward and lateral). Progress with weighted ball. Progress with eyes open to closed.
- Star excursions
- Single leg dead lifts with ball (progress weight of ball; progress surface)
- Perturbation training: Double progressing to single leg stance on rocker board and/or roller board (first uninvolved leg on same height platform progressing to single leg stance on roller board.) Manual perturbations added in the medial/lateral, anterior/posterior and diagonal directions. Progress from eyes open to closed.

Frequency & Duration: 1-2 times per week.

Recommendations and referrals to other providers.

Re-evaluation

Standard Time Frame- 30 days or less if appropriate

Other Possible Triggers- A significant change in signs and symptoms, new orthotics may trigger a gait assessment, change in medication for iontophoresis etc.

Discharge Planning

Commonly expected outcomes at discharge:

- Normal muscle strength
- Normal knee ROM
- Normal knee joint mobility
- Improved functional outcome scores
- Patient will return to pre-injury activities with modifications as appropriate. For example, if the patient continues to have some symptoms of knee instability, he/she may have to avoid sports requiring pivoting/cutting activities or compete at a less competitive level. The patient may have to use a functional knee brace for additional support during sport or recreational activities.

Transfer of Care:

- If there is limited improvement, ongoing instability, ongoing swelling, and/or continued pain, return patient to referring physician for further medical management.
- If patient is doing well and has met all goals, discharge to independence with a home exercise program.

Patient's discharge instructions

Educate regarding exercise guidelines and home exercise program. Educate regarding symptom management and activity modifications. If appropriate, educate regarding use of a functional knee brace during higher level activities. If there is return of pain or new pain and/or swelling, return to MD for assessment/evaluation.

Authors:
Saloni Doshi, PT
David Pirani, PT
Heather Ransom, PT
Philip Kidd, PT
December, 2014

Reviewed by:
Jaeson Kawadler, PT
Janice McInnes, PT

Put on ELLUCID on 11 3 15....for created on 12 18 2014...due in 5 years. JMc

Bibliography/Reference List

1. Button K, van Deursen R, Price P. Classification of functional recovery of anterior cruciate ligament copers, non-copers, and adapters. *Br J Sports Med*. 2006;40(10):853-9; 859.

2. Duthon, V. B., Barea, C., Abrassart, S., Fasel, J. H., Fritschy, D., & Menetrey, J. (2006). Anatomy of the anterior cruciate ligament. *Knee Surgery, Sports Traumatology, Arthroscopy*;*14*(3): 204-213.

3. Eitzen, I, Moksnes, H, Snyder-Mackler L, Risberg MA. A Progressive 5-Week Exercise Therapy Program Leads to Significant Improvement in Knee Function Early After Anterior Cruciate Ligament Injury. *Journal of Orthopedic and Sports Physical Therapy*. 2010 Nov; 40(11): 705-721.

4. Fink C, Hoser C, Hackl W, Navarro RA, Benedetto KP. Long-term outcome of operative or nonoperative treatment of anterior cruciate ligament rupture--is sports activity a determining variable. *Int J Sports Med*. 2001;22(4):304-309.

5. Fitzgerald GK, Axe MJ, Snyder-Mackler L. Proposed practice guidelines for nonoperative anterior cruciate ligament rehabilitation of physically active individuals. *J Orthop Sports Phys Ther*. 2000;30(4):194-203.

6. Frobel RB, Roos HP, Roos EM, Roemer FW, Ranstam J, Lohmander LS. Treatment for acute anterior cruciate ligament tear: five year outcome of randomised trial. British Medicine Journal. 2013; 346: 1-12.

7. Hurd WJ, Axe MJ, Snyder-Mackler L. A 10-year prospective trial of a patient management algorithm and screening examination for highly active individuals with anterior cruciate ligament injury: Part 1, outcomes. *Am J Sports Med*. 2008;36(1):40-47.

8. Hurd WJ, Axe MJ, Snyder-Mackler L. A 10-year prospective trial of a patient management algorithm and screening examination for highly active individuals with anterior cruciate ligament injury: Part 2, determinants of dynamic knee stability. *Am J Sports Med*. 2008;36(1):48-56.

9. Kaplan, Y. Identifying individuals with an anterior cruciate ligament-deficient knee as copers and noncopers: a narrative literature review. *Journal of Orthopaedic & Sports Physical Therapy*,2001; *41*(10):758-766.

10. Meuffels, DE, Favejee MM, Vissers MM, Heijboer MP, Reijman M, Verhaar JAN. Ten year follow-up study comparing conservative versus operative treatment of anterior cruciate ligament ruptures. A matched-pair analysis of high level athletes. *British Journal of Sports Medicine*. 2009; 43: 347-351.

11. Meunier A, et al. Long-term results after primary repair or non-surgical treatment of anterior cruciate ligament rupture: a randomized study with a 15 year follow-up. *Scand J Med Sci Sports*. 2007 Jun; 17(3): 230-237.

12. Mihelic R, Jurdana H, Jotanovic Z, Madjarevic T, Tudor A. Long-term results of anterior cruciate ligament reconstruction: a comparison with non-operative treatment with a follow-up of 17-20 years. *International Orthopedics*. 2011 Feb; 35: 1093-1-97.

13. Moksnes H, Snyder-Mackler L, Risberg MA. Individuals with an anterior cruciate ligament-deficient knee classified as noncopers may be candidates for nonsurgical rehabilitation. *J Orthop Sports Phys Ther*. 2008;38(10):586-595.

14. Muaidi Qi, Nicholson LL, Refshauge KM, Herbert RD, Maher CG. Prognosis of Conservatively Managed Anterior Cruciate Ligament Injury: A Systematic Review. Sports Medicine. 2007; 37 (8): 703-716.

15. Neuman P, Englund M, Kostogiannis I, Friden T, Roos H, Dahlberg L. Prevalence of Tibiofemoral Osteoarthritis 15 Years After Nonoperative Treatment of Anterior Cruciate Ligament Injury. *The American Journal of Sports Medicine*. 2008 36(9): 1717-1725.