

KNEE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION POST-OPERATIVE GUIDELINES

The following anterior cruciate ligament reconstruction (ACLR) guidelines were developed by the HSS Rehabilitation. Progression is both criteria-based and patient specific. Phases and time frames are designed to give the clinician a general sense of progression. Progression through the phases may vary in individuals with concomitant injuries/procedures such as graft choice, donor site, chondral injury, meniscal injury, and ligament injury.

These guidelines are specific to bone-tendon-bone grafts. For hamstring grafts, quadriceps tendon grafts, allografts, and concomitant surgeries, see appendix 1.

Follow physician modifications as prescribed.

KNEE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION POST-OPERATIVE GUIDELINES

Pre-Operative Phase

PRECAUTIONS

- Avoid pain with ROM and strengthening exercises
- Modify or minimize activities that increase pain and/or swelling
- Use appropriate assistive device as needed

ASSESSMENT

- Lower Extremity Functional Scale (LEFS)
- International Knee Documentation Committee (IKDC)
- SANE
- ACL RSI
- Numeric pain rating scale (NPRS)
- Swelling
- Quality of quadriceps contraction
- Lower extremity (LE) AROM and PROM
- LE flexibility
- LE strength
- Single limb stance (SLS) if appropriate
- Gait
- Current activity level/demands on LE

TREATMENT RECOMMENDATIONS

- Patient education
 - Post-operative plan of care
 - Edema control
 - Activity modification
 - Gait training with expected post-operative assistive device
 - Basic home exercise program (HEP)
- Ankle pumps, quadriceps sets, gluteal sets
- Knee flexion and extension AAROM
- Straight leg raises in multiple planes
- LE flexibility exercises e.g. supine calf and hamstring stretches
- Passive knee extension with towel roll under heel
- Plantar flexion with elastic band or calf raises

- Gait training with appropriate pre-operative assistive device if needed
- Additional recommendations for patients attending multiple sessions pre-operatively
 - Edema management
 - ROM exercises e.g. knee flexion AAROM, supine knee extension PROM
 - LE flexibility exercises
 - LE progressive resistive exercises
 - Balance/proprioceptive training
 - Stationary bike

GOALS FOR PRE-OPERATIVE PHASE

- Knee PROM: full extension to 120° degrees flexion
- Minimal to no swelling
- Active quadriceps contraction with superior patella glide
- Demonstrates normal gait
- Able to ascend stairs
- Able to verbalize/demonstrate post-operative plan of care

EMPHASIZE

- Familiarization with post-operative plan of care
- Quadriceps contraction
- Control swelling
- Knee ROM with focus on extension unless mechanically blocked

KNEE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION POST-OPERATIVE GUIDELINES

Acute Care (Ambulatory Surgery): Day of Surgery

PRECAUTIONS

- Avoid prolonged sitting, standing, and walking
- Avoid advancing weight bearing (WB) too quickly which may prolong recovery
- Avoid pain with walking and exercises
- Avoid painful activities
- Avoid putting heat on knee
- Avoid weightbearing without brace
- Avoid ambulating without crutches
- Do not put a pillow under the operated knee- keep extended when resting and sleeping

ASSESSMENT

- Mental status: Alert and Oriented x3
- NPRS
- Wound status
- Swelling
- P/AAROM of knee
- Post-anesthesia sensory motor screening
- Functional status including ability to manage brace

TREATMENT RECOMMENDATIONS

- Transfer training
- Gait training WBAT with assistive device on level surfaces and stairs
- Patient education:
 - Edema management
 - Activity modification
 - Brace management
 - Initiate and emphasize importance of HEP
- Quadriceps sets, gluteal sets, ankle pumps,
- Seated knee AAROM
- Straight leg raise with brace locked in extension, if able
- Passive knee extension with towel roll under heel

CRITERIA FOR DISCHARGE

- Independent ambulation with appropriate assistive device on level surfaces and stairs
- Independent brace management
- Independent with transfers
- Independent with HEP

EMPHASIZE

- Control swelling
- Quadriceps contraction
- Independent transfers
- Gait training with appropriate assistive device
- P/AAROM (focus on extension)
- Appropriate balance of activity and rest

KNEE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION POST-OPERATIVE GUIDELINES

Post-Operative Phase 1: Weeks 0-2

PRECAUTIONS

- Do not put a pillow under the operated knee for comfort when elevating LE
- Avoid active knee extension 40° → 0°
- Avoid ambulation without brace locked at 0°
- Avoid heat application
- Avoid prolonged standing/walking
- Avoid ambulating without crutches

ASSESSMENT

- Lower Extremity Functional Scale (LEFS)
- International Knee Documentation Committee (IKDC)
- SANE
- ACL RSI
- NPRS
- Swelling
- Girth measurements
- Neurovascular assessment
- Wound status
- Patellar mobility
- Quality of quadriceps contraction
- LE AROM and PROM
- LE flexibility, where appropriate
- LE strength, where appropriate
- SLR in supine
- Single leg stance, when appropriate
- Gait
- Current activity level

TREATMENT RECOMMENDATIONS

- Passive knee extension with towel under heel
- Quadriceps re-education: quadriceps sets with towel under knee with neuromuscular electric stimulation (NMES) or biofeedback
- Patellar mobilization
- AROM knee flexion to tolerance, AAROM knee extension to 0°
- Straight leg raises (SLR) in all planes
 - With brace locked at 0° in supine
- Hip progressive resistive exercises
- Calf strengthening
 - Unilateral elastic band → bilateral calf raises
- Leg press bilaterally in 80°-5° arc if knee flexion ROM > 90°
- Initiate flexibility exercises
- Proprioception board/balance system (bilateral WB)
- Stationary bicycle:
 - Short (90mm) crank ergometry (requires knee flexion > 85°)
 - Standard crank for ROM and/or cycle (requires 115° knee flexion)
- Upper extremity ergometry, as tolerated
- Gait training with progressive WB
 - Gradual progression with brace locked at 0° with crutches
- Edema management, e.g. cryotherapy (no submersion), elevation, gentle edema mobilization avoiding incision
- Progressive home exercise program

CRITERIA FOR ADVANCEMENT

- Ability to SLR without quadriceps lag or pain
- Knee ROM 0°-90°
- Pain and swelling controlled

EMPHASIZE

- Patellar mobility
- Full PROM knee extension
- Improving quadriceps contraction
- Controlling pain and swelling
- Compliance with HEP and precautions

KNEE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION POST-OPERATIVE GUIDELINES

Post-Operative Phase 2: Weeks 3-6

PRECAUTIONS

- Do not put a pillow under the operated knee- keep extended when resting and sleeping
- Avoid pain with exercises, standing, walking and other activities
 - Monitor tolerance to load, frequency, intensity and duration
- Avoid premature discharge of assistive device - should be used until gait is normalized
- Avoid advancing weight bearing too quickly which may prolong recovery
- Avoid active knee extension 40° → 0°
- Avoid heat application
- Avoid prolonged standing/walking
- Avoid ascending/descending stairs reciprocally until adequate quadriceps control & lower extremity alignment

ASSESSMENT

- LEFS
- IKDC
- SANE
- ACL RSI
- NPRS
- Swelling
- Girth measurements
- Neurovascular assessment
- Wound status
- Patellar mobility
- Quality of quadriceps contraction
- LE AROM and PROM
- LE flexibility, where appropriate
- LE strength, where appropriate
- SLR in supine
- Single leg stance, when appropriate
- Gait
- Current activity level

TREATMENT RECOMMENDATIONS

- Passive knee extension with towel under heel
- Quadriceps re-education: quadriceps sets with towel under knee with neuromuscular electric stimulation (NMES) or biofeedback
- Patellar mobilization
- AROM knee flexion to tolerance
 - Progression from seated to standing (wall slides) to bike ROM
- AAROM knee extension to 0°
- Straight leg raises (SLR) PRE's in all planes
 - With brace locked at 0° in supine until no extension lag demonstrated
 - Brace may be removed in other planes
- Leg press bilaterally in 80°-5° arc if knee flexion ROM > 90°
 - Progression from bilaterally to 2 up/1 down, to unilateral
- Functional strengthening
 - Mini squats progressing to 0°-60°, initiating movement with hips
 - Forward step-up progression starting with 2"-4"
- Terminal knee extension in weight bearing
- Consider blood flow restriction (BFR) program with FDA approved device if patient cleared by surgeon and qualified therapist available
- Hip-gluteal progressive resistive exercises
 - May introduce Romanian Dead Lift (RDL) toward end of phase
- Hamstring strengthening (unless hamstring autograft)
- Calf strengthening
 - Progression from bilateral to unilateral calf raises
- Flexibility exercises
- Proprioception board/balance system
 - Progression from bilateral to unilateral weight bearing
 - Once single leg stance achieved with good alignment and control, progress from stable to unstable surfaces
- Stationary bicycle
 - Standard crank for ROM and/or cycling (requires 115° knee flexion)
- Upper extremity ergometry, as tolerated
- Gait training WBAT- may still have brace locked at 0° and crutches (see appendix 2)
- Edema management, e.g. cryotherapy (no submersion until incision adequately healed), elevation, gentle edema mobilization avoiding incision
- Progressive home exercise program
- Patient education regarding monitoring of response to increase in activity level and weightbearing

CRITERIA FOR ADVANCEMENT

- Knee ROM 0°-130°
- Good patellar mobility
- Minimal swelling
- SLS FWB without pain
- Non-antalgic gait
- Ascend 6" stairs with good control without pain

EMPHASIZE

- Knee ROM
- Patella mobility
- Quadriceps contraction
- Normalizing gait pattern
- Activity level to match response and ability

KNEE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION POST-OPERATIVE GUIDELINES

Post-Operative Phase 3: Weeks 7-12

PRECAUTIONS

- Do not put a pillow under the operated knee- keep extended when resting and sleeping
- Avoid pain with exercises, standing, walking and other activities
 - Monitor tolerance to load, frequency, intensity and duration
 - Avoid too much too soon
- Avoid active knee extension 40° → 0° until post-op week 12

ASSESSMENT

- LEFS
- IKDC
- SANE
- ACL RSI
- NPRS
- Swelling
- Girth measurements
- Neurovascular assessment
- Wound/scar status
- Patellar mobility
- Quality of quadriceps contraction
- LE AROM and PROM
- LE flexibility, where appropriate
- LE strength, where appropriate
- SLR in supine
- Functional assessment, e.g. single leg stance, step ups/downs, squat, gait
- Balance testing, e.g. Star Excursion Test, Biodex Balance System™
- Quadriceps isometrics testing with dynamometer at 60° at 12 weeks

TREATMENT RECOMMENDATIONS

- Patellar mobilization
- AROM knee flexion to tolerance
- AAROM knee extension to 0°
- SLR PRE's in all planes
- Isometric knee extension at 60°

- Open chain knee extension progression
 - At week 12 initiate PRE in limited arc 90°-40°
- Leg press eccentrically
- Functional strengthening
 - Progress squats to 0°-90°, initiating movement with hips
 - Continue forward step-up progression
 - Initiate step-down progression starting with 2"-4"
 - Lateral step-ups, crossovers
 - Lunges
- Continue foundational hip-gluteal progressive resistive exercises
- Continue hamstring and calf strengthening
- Flexibility exercises and foam rolling
- Core and UE strengthening
- Consider BFR program with FDA approved device if patient cleared by surgeon and qualified therapist available
- Proprioception training
 - Continue foundational exercises
 - Progress to perturbation training
- Cardiovascular conditioning
 - Stationary bicycle
 - Elliptical when able to perform 6" step-up with good form
- Gait training WBAT
- Cryotherapy
 - Ice with passive knee extension with towel under heel as needed to maintain ROM
- Progressive home exercise program
- Patient education regarding monitoring of response to increase in activity level

CRITERIA FOR ADVANCEMENT

- Ability to perform 8" step-down with good control and alignment without pain
- Full symmetrical knee ROM
- Symmetrical squat to parallel
- Single leg bridge holding for 30 seconds
- Balance testing and quadriceps isometrics 70% of contralateral lower extremity

EMPHASIZE

- Address impairments
- Functional movement
- Functional strength

KNEE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION POST-OPERATIVE GUIDELINES

Post-Operative Phase 4: Weeks 13-26

PRECAUTIONS

- Initiate return to running/sport only when cleared by physician
- Avoid pain with exercises and functional training
- Monitor tolerance to load, frequency, intensity and duration
- Avoid too much too soon

ASSESSMENT

- LEFS
- IKDC
- SANE
- ACL RSI
- NPRS
- Swelling
- Girth measurements
- Neurovascular assessment
- Scar mobility
- Patellar mobility
- Quality of quadriceps contraction
- LE AROM and PROM
- LE flexibility, where appropriate
- LE strength, where appropriate
- Functional assessment, e.g. single leg stance, step ups/downs, squat, single leg squat, gait
- Balance testing, e.g. Star Excursion Test, Biodex Balance System™
- Quadriceps isometrics or isokinetic testing
- QMA – Quality of Movement Testing

TREATMENT RECOMMENDATIONS

- Open chain knee extension progression
 - At week 12 initiate PRE in limited arc 90°-40°
 - Progress to 90°-30°
 - Progress to 90°-0° by end of phase
- Progress leg press eccentrically

- Functional strengthening
 - Progress squats to 0°-90°, initiating movement with hips
 - Progress to single leg squats
 - Forward step-up and step-down progression
 - Progress lateral step-ups, crossovers
 - Progress lunges
- Initiate running progression (see appendix 3)
- Initiate plyometric progression (see appendix 4)
- Continue foundational hip-gluteal progressive resistive exercises
- Continue hamstring and calf strengthening
- Flexibility exercises and foam rolling
- Core and UE strengthening
- Consider BFR program with FDA approved device if patient cleared by surgeon and qualified therapist available
- Progress proprioception training
 - Continue foundational exercises
 - Incorporate agility and controlled sports-specific movements
- Progress cardiovascular conditioning
 - Stationary bicycle
 - Elliptical
- Cryotherapy and/or compression therapy
- Progressive home exercise program
- Patient education regarding monitoring of response to increase in activity level

CRITERIA FOR ADVANCEMENT

- No swelling
- Normal neurovascular assessment
- Normal scar and patellar mobility
- Normal quadriceps contraction
- Full LE ROM, flexibility and strength
- Quantitative assessments $\geq 85\%$ of contralateral lower extremity
 - Note that uninvolved side may be deconditioned; use pre-injury baseline or normative data for comparison if available

EMPHASIZE

- Return to normal functional activities

KNEE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION POST-OPERATIVE GUIDELINES

Post-Operative Phase 5: Weeks 27 - Discharge

PRECAUTIONS

- Note importance of gradual return to participation with load and volume monitoring under guidance of physical therapist, MD, athletic trainer and coach
- Avoid premature or too rapid full return to sport

ASSESSMENT

- LEFS
- IKDC
- SANE
- ACL RSI
- NPRS
- Swelling
- LE flexibility
- LE strength
- Quadriceps isometrics or isokinetic testing
- Balance testing, e.g. Star Excursion Test, Biodex Balance System™
- Functional tests, e.g. hop testing, QMA – Quality of Movement Testing

TREATMENT RECOMMENDATIONS

- Gradually increase volume and load to mimic load necessary for return to activity
- Progress movement patterns specific to patient's desired sport or activity
- Progression of agility work
- Increase cardiovascular load to match that of desired activity
- Collaborate with ATC, performance coach/strength and conditioning coach, skills coach and/or personal trainer to monitor load and volume as return to participation
- Consult with referring MD on timing return to sport including any recommended limitations

CRITERIA FOR ADVANCEMENT

- Quantitative assessments $\geq 90\%$ of contralateral lower extremity
- Movement patterns, functional strength, flexibility, motion, endurance, power, deceleration and accuracy to meet demands of sport

EMPHASIZE

- Return to participation
- Collaboration with Sports Performance experts

KNEE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION POST-OPERATIVE GUIDELINES

Appendix 1: Modifications Due to Graft Type and/or Concomitant Surgeries

ACLR with Hamstring Autograft

- Weight Bearing (note that status may change per surgeon's preference)
 - Weeks 0-4 PWB
 - Weeks 5-6 WBAT
- Therapeutic Exercise
 - Avoid active knee flexion and isolated loading of hamstrings (e.g. heel slides, leg curls, hamstring strengthening and flexibility exercises) for the first 4-6 weeks

ACLR with Quadriceps Tendon Autograft

- Weight Bearing (note that status may change per surgeon's preference)
 - Weeks 0-4 PWB
 - Weeks 5-6 WBAT

ACLR with Allograft

- Weight Bearing (note that status may change per surgeon's preference)
 - Weeks 0-4 PWB
 - Weeks 5-6 WBAT

ACLR with Osteochondral Allograft (all graft types)

- Weight Bearing (note that status may change per surgeon's preference)
 - Weeks 0-2 PWB
 - Weeks 3-4 WBAT
 - Weeks 5-6 progressive WBAT

ACLR with Meniscal Repair (all graft types)

- Range of Motion
 - ROM without restrictions unless directed by surgeon
 - Generally speaking, do not push flexion

ACLR with Radial or Root Repair

- Weight Bearing (note that status may change per surgeon's preference)
 - Weeks 0-2 PWB
 - Weeks 3-4 WBAT
 - Weeks 5-6 progressive WBAT

KNEE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION POST-OPERATIVE GUIDELINES

Appendix 2: Phase 2 – Gait and Assistive Device

Begin ambulation WBAT with brace locked in full extension with assistive device at all times.

- Encourage slow progression of weight bearing to avoid increased symptoms.
- WBAT should consider pain, quadriceps control and edema both during gait and after.
- Any increase in symptoms should indicate a reduction of WB during gait or standing activities, or decrease in overall volume of WB activities.

Beginning in phase 2 of rehab (week 3), patient may be evaluated for ambulation with unlocked brace.

- Brace may be unlocked for gait when full passive and active knee extension is achieved as demonstrated by a straight leg raise without quad lag for 15 repetitions.
- Brace should not be unlocked unless patient can demonstrate appropriate heel strike and quadriceps control during gait.
- May consider only partially unlocking brace (e.g., if patient has 95° flexion, consider unlocking brace to 90°).
- If flexion ROM deficits persist, brace may need to be unlocked to facilitate return to full ROM while decreasing weight bearing.

Brace will be d/c'ed at the discretion of the physician.

Wean from assistive device with symmetrical gait pattern, full extension and full WB during stance phase.

- Begin with no assistive device around home with progression complete discharge of assistive device.

KNEE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION POST-OPERATIVE GUIDELINES

Appendix 3: Phase 4 – Examples of Running Progression

Example 1

- Week 1
 - Run: 30 seconds
 - Rest/Walk: 30 seconds
 - Reps: 3
- Week 2
 - Run: 1 minute
 - Rest/Walk: 1 minute
 - Reps: 3
- Week 3
 - Run: 2 minutes
 - Rest/Walk: 1 minute
 - Reps: 2
- Week 4
 - Run: 4 minutes
 - Rest/Walk: 2 minutes
 - Reps: 1
- Week 5
 - Run: 4 minutes
 - Rest/Walk: 2 minutes
 - Reps: 2
- Week 6
 - Run: 8 minutes
 - Rest/Walk: n/a
 - Reps: 1

Example 2

1. Retro running 30" on treadmill or Alter-GTM run 30" 80% WB, progressing to 95% WB
2. Treadmill forward running 30", advancing to 1' (note: not jogging, not sprinting, but running)

KNEE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION POST-OPERATIVE GUIDELINES

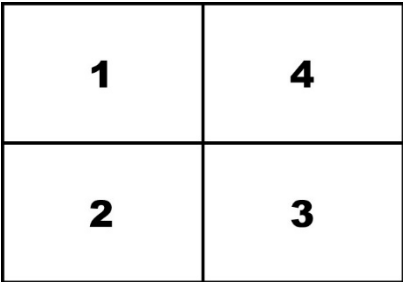
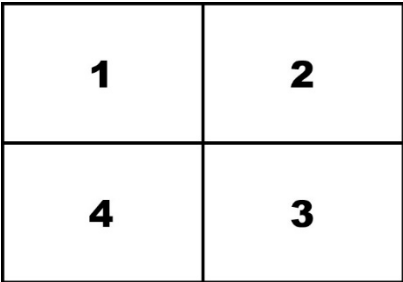
Appendix 4: Phase 4 – Examples of Plyometrics Progression

Example 1

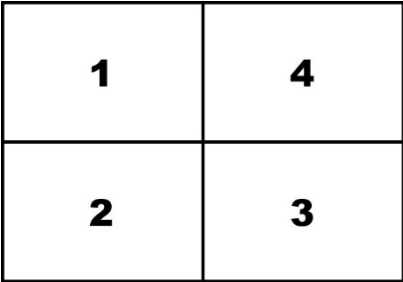
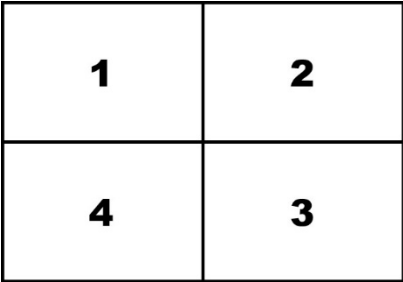
- Week 1: Onto box
- Week 2: In place and jumping rope
- Week 3: Drop jumps
- Week 4: Broad jumps
- Week 5: Side to side hops
- Week 6: Hop to opposite

Example 2

1. Bilateral plyometrics on leg press
2. Bilateral jumps onto a 6” box
3. Bilateral jumps in a cross pattern, e.g., clockwise (below right) and counterclockwise (below left)



4. Bilateral jumps on/off box 6” / 8” / 12”
5. Unilateral jumps in a cross pattern, e.g., clockwise (below right) and counterclockwise (below left)



6. Unilateral jumps on/off box

KNEE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION POST-OPERATIVE GUIDELINES

References

- Ardern CL, Glasgow P, Schneiders A, et al. (2016). 2016 Consensus statement on return to sport from the First World Congress in Sports Physical Therapy, Bern. *Br J Sports Med*, 50:853-864.
- Barber-Westin SD, Noyes FR. (2011). Factors used to determine return to unrestricted sports activities after anterior cruciate ligament reconstruction. *Arthroscopy*, 27:1697–1705.
- Buckthorpe M. (2019). Optimising the late-stage rehabilitation and return-to-sport training and testing process after ACL reconstruction. *Sports Med*, <https://doi.org/10.1007/s40279-019-01102-z>.
- Burgi CR, Peters S, Ardern CL, et al. (2019). Which criteria are used to clear patients to return to sport after primary ACL reconstruction? A scoping review. *Br J Sports Med*, 0:1-10 ,doi:10.1136/bjsports-2018-099982.
- Butler RJ, Lehr ME, Fink ML, Kiesel KB, Plisky PJ. (2013). Dynamic balance performance and noncontact lower extremity injury in college football players. *Sports Health*, 5:417-422.
- Chung KS, Ha JK, Yeom CH, et al. (2015). Are muscle strength and function of the uninjured lower limb weakened after anterior cruciate ligament injury? *Amer J Sports*, 43(12):3013-3020.
- Davies GJ, McCarty E, Provencher M, Manske RC. (2017). ACL return to sport guidelines and criteria. *Curr Rev Musculoskelet Med*, 10:307–314.
- Dingenen B, Gokeler A. (2017). Optimization of the return-to-sport paradigm after anterior cruciate ligament reconstruction: a critical step back to move forward. *Sports Med*, DOI 10.1007/s40279-017-0674-6.
- Escamilla RF, Macleod TD, Wilk KE, Paulos L, Andrews JR. (2015). Anterior cruciate ligament strain and tensile forces for weight-bearing and non-weight-bearing exercises: a guide to exercise selection. *Orthop Sports Phys Ther*, 42(3):208-220.
- Garrison JC, Bothwell JM, Wolf G, Aryal S, Thigpen CA. (2015). Balance test anterior reach symmetry at three months is related to single leg functional performance at time of return to sports following anterior cruciate ligament reconstruction. *Int J Sports Phys Ther*, 10(5):602-611.
- Hartigan E.H., Axe M.J., and Snyder-Mackler L. (2010). Time line for noncopers to pass return-to-sports criteria after anterior cruciate ligament reconstruction. *J Orthop Sports Phys Ther*, 40:141-154.
- Lentz TA, Zeppieri G Jr, Tillman SM, et al. (2018). Return to preinjury sports participation following anterior cruciate ligament reconstruction: contributions of demographic, knee impairment, and self-report measures. *J Orthop Sports Phys Ther*, 42(11):893-901.
- Logerstedt DS, Scalzitti D, Risberg MA, et al. (2017). Knee stability and movement coordination impairments: knee ligament sprain revision. *J Orthop Sports Phys Ther*, 47(11):A1-A47.

- Perriman A, Leahy E, Semciw AI. (2018). The effect of open- versus closed-kinetic-chain exercises on anterior tibial laxity, strength, and function following anterior cruciate ligament reconstruction: a systematic review and meta-analysis. *J Orthop Sports Phys Ther*, 48(7):552-556,B1-B3.
- Plisky PJ, Rauh MJ, Kaminski TW, Underwood FB. (2006). Star excursion balance test as a predictor of lower extremity injury in high school basketball players. *J Orthop Sports Phys Ther*, 36(12):911-919.
- Rambaud AJM, Ardern CL, Thoreux P, Regnaud JP, Edouard P. (2018). Criteria for return to running after anterior cruciate ligament reconstruction: a scoping review. *Br J Sports Med*, 52:1437–1444.
- Shaffer SW, Teyhen DS, Lorenson CL, et al. (2013). Y-balance test: a reliability study involving multiple raters. *Mil Med*, 178(11):1264-1270.
- Shelbourne KD, Barnes AF, Gray T. (2012). Correlation of a single assessment numeric evaluation (SANE) rating With modified Cincinnati Knee Rating System and IKDC subjective total scores for patients after ACL reconstruction or knee arthroscopy. *Amer J Sports Med*, 40(11):2487-2491.
- Webster KE, Feller JA, Lambros C. (2008). Development and preliminary validation of a scale to measure the psychological impact of returning to sport following anterior cruciate ligament reconstruction surgery. *Phys Ther Sport*, 9:9-15.
- Webster KE, Hewett TE. (2019). What is the evidence for and validity of return-to-sport testing after anterior cruciate ligament reconstruction surgery? A systematic review and meta-analysis. *Sports Med*, doi.org/10.1007/s40279-019-01093-x.
- Williams GN, Taylor DC, Gangel TJ, Uhorchak JM, Arciero RA. (2000). Comparison of the Single Assessment Numeric Evaluation Method and the Lysholm Score. *Clin Ortho*, 373:184-192.

Created: 6/2019