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, quadricep 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
  o Edema management
  o ROM exercises e.g. knee flexion AAROM, supine knee extension PROM
  o LE flexibility exercises
  o LE progressive resistive exercises
  o Balance[proprioceptive training
  o 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:
  o Edema management
  o Activity modification
  o Brace management
  o 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  
  o At week 12 initiate PRE in limited arc 90°-40°  
• Leg press eccentrically  
• Functional strengthening  
  o Progress squats to 0°-90°, initiating movement with hips  
  o Continue forward step-up progression  
  o Initiate step-down progression starting with 2”-4”  
  o Lateral step-ups, crossovers  
  o Lunge  
• 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  
  o Continue foundational exercises  
  o Progress to perturbation training  
• Cardiovascular conditioning  
  o Stationary bicycle  
  o Elliptical when able to perform 6” step-up with good form  
• Gait training WBAT  
• Cryotherapy  
  o 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
  o At week 12 initiate PRE in limited arc 90°-40°
  o Progress to 90°-30°
  o Progress to 90°-0° by end of phase
- Progress leg press eccentrically
• Functional strengthening  
  o Progress squats to 0°-90°, initiating movement with hips  
  o Progress to single leg squats  
  o Forward step-up and step-down progression  
  o Progress lateral step-ups, crossovers  
  o 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  
  o Continue foundational exercises  
  o Incorporate agility and controlled sports-specific movements  
• Progress cardiovascular conditioning  
  o Stationary bicycle  
  o 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 ≥ 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 SystemTM
• 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 ≥ 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
  o Run: 30 seconds
  o Rest/Walk: 30 seconds
  o Reps: 3

• Week 2
  o Run: 1 minute
  o Rest/Walk: 1 minute
  o Reps: 3

• Week 3
  o Run: 2 minutes
  o Rest/Walk: 1 minute
  o Reps: 2

• Week 4
  o Run: 4 minutes
  o Rest/Walk: 2 minutes
  o Reps: 1

• Week 5
  o Run: 4 minutes
  o Rest/Walk: 2 minutes
  o Reps: 2

• Week 6
  o Run: 8 minutes
  o Rest/Walk: n/a
  o 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


Created: 6/2019