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, 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
    - 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 SystemTM
- 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 SystemTM
- 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 ≥ 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

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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.

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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)

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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)

1	**2**
4	**3**

1	**4**
2	**3**

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)

1	**2**
4	**3**

1	**4**
2	**3**

6. Unilateral jumps on/off box

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