Healthy Driven™
Edward-Elmhurst
MEDICAL GROUPS

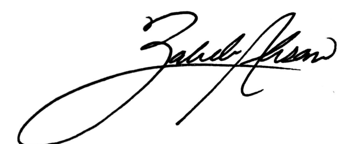
Orthopedics

ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION GUIDELINES

The following anterior cruciate ligament reconstruction (ACLR) guidelines were developed by the Hospital for Special Surgery 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'S MODIFICATIONS AS PRESCRIBED.



ZAHAB S. AHSAN MD
ORTHOPAEDIC SURGERY & SPORTS MEDICINE

Healthy Driven
Edward-Elmhurst
MEDICAL GROUPS

ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION 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	▪ 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

Healthy Driven
Edward-Elmhurst
MEDICAL GROUPS

ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION 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

Healthy Driven
Edward-Elmhurst
MEDICAL GROUPS

ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION 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	▪ 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
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

Healthy Driven
Edward-Elmhurst
MEDICAL GROUPS

ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION 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 o 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	▪ 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
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 o Progression from seated to standing (wall slides) to bike ROM ▪ AAROM knee extension to 0° ▪ Straight leg raises (SLR) PRE's in all planes o With brace locked at 0° in supine until no extension lag demonstrated o Brace may be removed in other planes ▪ Leg press bilaterally in 80°-5° arc if knee flexion ROM > 90° o Progression from bilaterally to 2 up/1 down, to unilateral ▪ Functional strengthening o Mini squats progressing to 0°-60°, initiating movement with hips o 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 o May introduce Romanian Dead Lift (RDL) toward end of phase ▪ Hamstring strengthening (unless hamstring autograft) ▪ Calf strengthening o Progression from bilateral to unilateral calf raises

(over)

ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION GUIDELINES

Post-Operative Phase 2: Weeks 3-6 (continued)

TREATMENT RECOMMENDATIONS (continued)	▪ 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

Healthy Driven
Edward-Elmhurst
MEDICAL GROUPS

ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION 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

- 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
- 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
- Continue hip-gluteal resistive exercises
- Continue hamstring and calf strengthening
- Flexibility exercises and foam rolling
- Core and UE strengthening
- **Continue BFR program**
- Proprioception training
  - Continue foundational exercises
  - Progress to perturbation training

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

Healthy Driven
Edward-Elmhurst
MEDICAL GROUPS

ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION 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	▪ 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 ▪ **Continue BFR program with FDA approved device** ▪ Progress proprioception training ○ Continue foundational exercises ○ Incorporate agility and controlled sports-specific movements ▪ Progress cardiovascular conditioning ○ Stationary bicycle ○ Elliptical
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

Healthy Driven
Edward-Elmhurst
MEDICAL GROUPS

ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION 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	▪ 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 DISCHARGE/RETURN TO SPORT	▪ 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

Healthy Driven
Edward-Elmhurst
MEDICAL GROUPS

ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION GUIDELINES

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

ACLR with Hamstring Autograft

- Weight Bearing
  - Weeks 0-3 PWB
  - Weeks 4-5 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
  - Weeks 0-2 PWB
  - Weeks 3-4 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
  - 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 Meniscus Tear or Meniscus Root Repair

- Weight Bearing
  - ROM 0-90 degrees for 4 weeks
  - Weeks 0-2 PWB
  - Weeks 3-4 WBAT
  - Weeks 5-6 progressive WBAT

Healthy Driven
Edward-Elmhurst
MEDICAL GROUPS

ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION 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 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.

Appendix 3: Phase 4 – Examples of Running Progression

Example 1

Week	Run	Rest/Walk	Reps
1	30 sec	30 sec	3
2	1 min	1 min	3
3	2 min	1 min	2
4	4 min	2 min	1
5	4 min	2 min	2
6	8 min	N/A	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)

Healthy Driven
Edward-Elmhurst
MEDICAL GROUPS

ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION GUIDELINES

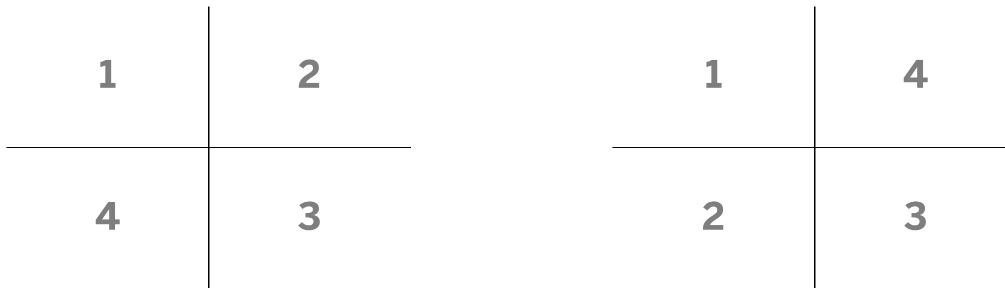
Appendix 4: Phase 4 – Examples of Plyometrics Progression

Example 1

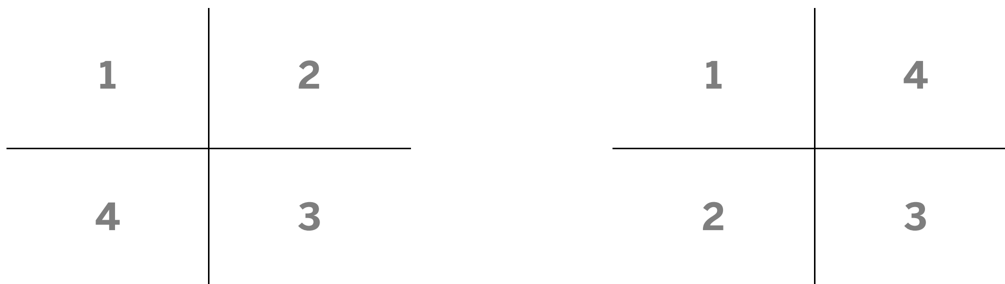
Week	Exercise
Week 1	Onto box
Week 2	In place and jumping rope
Week 3	Drop jumps
Week 4	Broad jumps
Week 5	Side to side hops
Week 6	Hop to opposite

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 and counterclockwise



4. Bilateral jumps on/off box 6" / 8" / 12"
5. Unilateral jumps in a cross pattern, e.g. clockwise and counterclockwise



6. Unilateral jumps on/off box