
ORTHOPAEDICS SPORTS MEDICINE

ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION PROTOCOL *

Preoperative Phase

- Minimal effusion
- AROM 0 to 120 degrees of flexion
- Strength: 20 Straight Leg Raises (SLR's) with no lag
- Normal gait
- Patient education on post-operative exercises and need for compliance
- Educated in ambulation with crutches
- Educated in follow-up expectations

PHASE 1: Immediate Post-operative Phase (Approximate timeframe: Surgery to 2 weeks)

Goals

- Minimize pain
- Minimize swelling
- Full knee extension ROM
- Good quadriceps control (≥ 20 no lag SLR's)
- Normal gait pattern

Brace: Locked in extension for POD#1, then unlocked

Brace is discharged when:

- The patient has full knee extension and $> 90^\circ$ flexion
- The patient does not have a lag with a Straight Leg Raises
- The patient demonstrates normal pain-free walking
- The patient is at least 6 weeks post-op

Weight bearing

- As tolerated with or without crutches
- Eliminate quad avoidance gait
- **Crutch D/C Criteria:**
 - Full active and passive knee extension;
 - Flexion $> 90^\circ$
 - No lag with Straight Leg Raises

Exercises

ROM

- Low load, long duration (~5 minutes) end-range stretching
- *Extension:* heel prop, prone hang (minimizing co-contraction and nociceptors response)
- *Flexion:* seated assisted knee flexion, heel slides, wall slides, bike - rocking for range-of-motion
- Patellar mobilization: medial/lateral mobilization initially followed by superior/inferior directions while monitoring reaction to effusion and ROM

Muscle Activation/Strength

- Quadriceps sets
- Hamstring sets
- Quad/ham co-contractions
- SLR emphasizing no lag
- Electrical stimulation (may discontinue use when able to perform no lag SLR)
- Side-lying hip adduction/abduction (avoid adduction moment in this phase with concomitant grade II-III MCL injury and abduction with concomitant grade II-III LCL injury)
- Prone hip extension
- Double-leg quarter squats (0 - 45)
- Standing TheraBand resisted terminal knee extension (TKE)
- Hamstrings curls
- Ankle pumps with TheraBand
- Heel raises (calf press)

Cardiopulmonary

- UBE or similar exercises is recommended

Scar Massage

- When incision is fully healed

Modalities

- Cryotherapy: Cold with compression/elevation (Iceman, Game Ready)
 - First 24 hours or until acute inflammation is controlled: every hour for 15 minutes
 - After acute inflammation is controlled: 3 times a day for 15 minutes or more as indicated
- Electrical muscle stimulation to quadriceps during voluntary quadriceps exercises as indicated
- Consider Upper extremity Blood Flow Restriction for physiological benefits

CRITERIA FOR PROGRESSION TO PHASE 2

- ROM: no greater than 5° active extension lag, 110° active flexion
- 20 no lag SLR's
- Normal gait
- D/C Crutches

Phase II

Early Postoperative Phase (Postoperative Weeks 3 – 6)

Goals

- Decrease pain and effusion
- Obtain Full ROM
- Normal gait pattern
- Improve muscle strength
- Progress neuromuscular retraining

Brace

- May remove brace when at rest and for exercises
- May discontinue brace after 6 weeks

Weight bearing

- Weight bearing as tolerated with or without crutches

Exercises: Continue Phase I exercises and consider the following

ROM

- Low load, long duration end-range stretching (assisted as needed)
- Heel prop/prone hang (minimize co-contraction/nociceptor response)
- Heel slides/wall slides
- Bike (rocking for range—riding with low seat height)
- Flexibility stretching all major muscle groups

STRENGTHENING

Quadriceps

- Continue phase I exercises as indicated
- Mini-squats/wall-squats (0 – 60)
- Step-ups
- Multi-angle isometrics 90 to 60
- Knee extension from 90° to 60°
- Leg press
- Shuttle (no jumping)
- Closed kinetic chain exercises should be performed in the protected range of 0° – 60° of flexion

Hamstrings

- Hamstring curls (Not for hamstring autografts)
- Resistive SLR with sport cord

Other Musculature

- Hip adduction/abduction: SLR or with equipment
- Standing heel raises: progress from double to single leg support
- Seated calf press against resistance
- Multi-hip machine in all directions with proximal pad placement

Neuromuscular training

- Wobble board
- Rocker board
- Single-leg stance with or without equipment (e.g. instrumented balance system)
- Slide board
- Fitter

Cardiopulmonary

- Bike
- Elliptical
- Stairmaster

Modalities

- Apply ice/compression for 20 minutes and elevate with knee in full extension
- Start Blood Flow Restriction Training after approved by surgeon

CRITERIA FOR PROGRESSION TO PHASE 3

- Minimal effusion/pain
- Full ROM
- Functional strength and control in daily activities

Phase III Strength and Control (Postoperative Weeks 7 – 11)

Goals:

- Minimal pain and effusion
- Full knee range of motion (compared to opposite side)
- 60% quad strength symmetry
- Daily Activities tolerated without pain

Exercises: Continue Phase I/II exercises and consider the following

Strengthening

- Squats
- Leg press
- Hamstring curl
- Knee extension 90° to 0°
- Step-ups/down
- Lunges
- Shuttle
- Sports cord
- Wall squats

Neuromuscular Training

- Wobble board/rocker board/roller board
- Perturbation training
- Instrumented testing system
- Varied surfaces

Cardiopulmonary

- Straight line running on treadmill or in a protected environment (No cutting or pivoting)
- All other cardiopulmonary equipment

Modalities:

- Apply ice as needed for pain and effusion
- Blood Flow Restriction as needed for physiological benefits/muscle atrophy

CRITERIA FOR PROGRESSION TO PHASE 4

- No effusion and minimal pain with daily activities and exercises
- Neuromuscular and strength training exercises without difficulty
- 60% quad strength symmetry

Phase IV Advanced Training Phase (Postoperative Weeks 12 – 16)

Goals:

- Maintain minimal pain and effusion
- Maintain full range of motion
- Improve total lower extremity strength and balance
- Initiate Return to Run test and program
- Begin Functional Screening tests

Functional Screening:

Clearance to Begin Running:

30 Step & Holds	PASS _____	FAIL _____
10 Single Leg Squats	PASS _____	FAIL _____
15 minutes of fast treadmill walking	PASS _____	FAIL _____

Pass Criteria:

- 30 Step & Holds without loss of balance or excessive motion outside of the sagittal plane
- 10 consecutive Single Leg Squats to 45° of knee flexion without loss of balance or excessive motion outside of the sagittal plane
- No abnormal gait patterns while walking as fast as they can on the treadmill
- Group A TEST SUMMARY: PASS FAIL

Run Progression Program:

- Alter-G Treadmill 0.6BW x 5 minutes
 - (Alternative: pool treadmill running)
 - Progress weight bearing to 0.9BW then:
- Treadmill running x 5 minutes
 - Progress to full running pace, then:
- Ground running x 5 minutes
 - Progress time, pace, or distance with each session

Functional Movement Screen

Functional Movement Screen (FMS)	Raw	Final	Comments & Corrective Exercise Prescribed
Deep Squat			
Hurdle Step L step over			
Hurdle Step R			
In Line Lunge L forward			
In Line Lunge R			
Shoulder Mobility L superior			
Shoulder Mobility R			
Active Impingement L			
Active Impingement R			
Active Straight Leg Raise L			
Active Straight Leg Raise R			
Trunk Stability Push Up			
Extension (Lumbar)			
Rotatory Stability L reaching			
Rotatory Stability R			
Flexion (Lumbar)			
TOTAL			

Raw Score: _____

- Score ≥ 15 : PASS/GREEN
- Score 12-14: CONDITIONAL/YELLOW
- Score < 12 : FAIL/RED

Based on deficits noted during FMS screening, corrective exercises should be initiated to guide this phase (see Appendix): Ankle Mobility/Core Mobility/Hip Mobility/Shoulder Mobility

EXERCISE SUGGESTIONS

Aggressive Strengthening

- Squats
- Lunges
- Plyometrics

Agility Drills

- Shuffling
- Hopping
- Carioca
- Vertical jumps
- Introduce initial sports specific drill patterns at 50-75% effort

Neuromuscular Training

- Wobble board/rocker board/roller board
- Perturbation training
- Instrumented testing systems
- Varied surfaces

Cardiopulmonary

- Running progression
- Other cardiopulmonary exercises

Modalities:

- Apply ice as needed for pain and effusion

CRITERIA FOR PROGRESSION TO PHASE 5

- Initiated ground-contact running with minimal pain and discomfort
- FMS Score >12
- 70% quad strength symmetry
- Tolerating initial sports specific drills (e.g. Figure-8 runs) with confidence

Phase V Return to Sport (16 Weeks – No Sooner than 6 Months)

GOALS

- 85% contralateral strength
- 90% contralateral on hop tests
- FMS score ≥ 15
- Deceleration shuttle testing without deficits
- Sports specific training without pain, swelling, or difficulty

Functional Screening:

- Perform the following screening tests at the start of Phase V to develop rehabilitation training protocol to address deficits
- Perform at end of phase or when considering clearing patient for returning to sport-specific training

Strength Testing

Biodex – Flexion/Extension, Con/Con @ 60°

Extension Peak Torque Right	_____	Extension Peak Torque Left	_____	Deficit _____%
Flexion Peak Torque Right	_____	Flexion Peak Torque Left	_____	Deficit _____%
Extension Peak TQ/BW Right	_____	Extension Peak TQ/BW Left	_____	

OR

10-rep maximum on Leg Press	Involved/Uninvolved = _____/_____ = _____
10 Single Leg Squats with weights	Involved/Uninvolved = _____/_____ = _____

Functional Movement Screen

Raw Score: _____

- Score ≥ 15 : PASS/GREEN
- Score 12-14: CONDITIONAL/YELLOW
- Score < 12 : FAIL/RED

Assess progression in deficits from start of Phase IV; based on persistent deficits, adapt corrective exercises to optimize recovery at end of Phase V

(see Appendix): Ankle Mobility/Core Mobility/Hip Mobility/Shoulder Mobility

Deceleration Shuttle Testing

Multiple variation of deceleration testing available

Suggested test iteration:

“Rush” Deceleration/Direction Change Assessment

Set up: None

Test: Patient take 4-5 steps forward while accelerating with each step, comes to a sudden stop, then push-off into a back pedal with the involved leg, back pedal to starting position, then initiate forward run again; repeat 5 times for each leg

Instruct patient to start with a speed that is as fast as they are comfortable, then increase speed with each repetition;

Give cue to correct deficits:

- _____ Maintain constant motion during testing
- _____ Change direction unilaterally
- _____ Display knee flexion during their change of direction
- _____ Maintain a neutral hip, knee, and ankle alignment during transition to back pedal

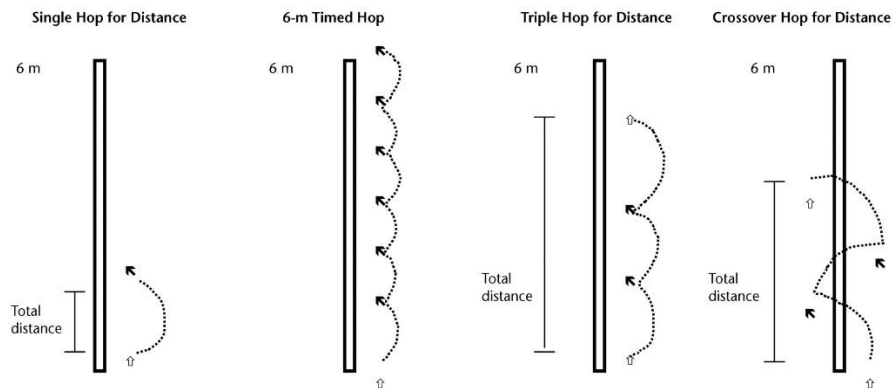
Assessment:

Evaluate for hip and knee stability during quick changes in direction and make corrections for:

- _____ Hip internal rotation
- _____ Knee valgus
- _____ Trendelenburg/Pelvic drop
- _____ Lateral of forward trunk flexion
- _____ Confidence in placing weight on surgical leg

Add/adjust exercises to help correct deficits noted; improved performance during deceleration/direction changes reduces risk of non-contact ACL injury/re-injury

Cincinnati Hop Tests:



	1LH Right	1LH Left	6MTH Right	6MTH Left	1LTHD Right	1LTHD Left	CHFD Right	CHFD Left
1								
2								
Avg								
Injured/ Uninjured								

Hop must be maintained for 2 sec without any of the following: touching down with contra-lateral LE, touching down with either UE, loss of balance, or any additional hops

"Rush" Box Jump Landing to Vertical Jump

Set up: 12 inch plyometric box; mark line ½ the height of patient anterior to box

Test: Patient jumps anterior to the line, lands, then immediately performs a vertical jump with maximum effort, and lands

Assessment:

Repeat until 5 successful trials completed; view from anterior and sagittal positions; give cues to correct form; evaluate squat form (quadriceps force) and valgus knee loading by noting the following:

- _____ Ground contact at same time with both extremities
- _____ Demonstrate at least 30° knee flexion at both landings
- _____ Hip, knee, and ankle in neutral alignment upon landing
- _____ Stance is shoulder width
- _____ Symmetrical weight distribution (viewed anteriorly)

Note deficits and work on re-training by improving plyometric hip and knee control

EXERCISE SUGGESTIONS

Should be guided and directed by deficits noted from the Functional Screening Tests performed at the start of this phase

Aggressive Strengthening

- Squats
- Lunges
- Plyometrics

Sports Specific Activities

- Interval training program
- Running patterns in football
- Sprinting
- Change of direction
- Pivot and drive in basketball
- Kicking in soccer
- Spiking in volleyball
- Skill/biomechanical analysis with strength and conditioning coaches

Modalities

- Cryotherapy as needed
- Dry needling as indicated
- Active Release Therapy as indicated

RETURN-TO-SPORT EVALUATION RECOMMENDATIONS

- FMS > 14
- Isokinetic strength test (60°/second): >85% contralateral side

- Cincinnati Hop Tests: 90% of contralateral side
- Box Jump/Vertical Jump : 5 repetitions without deficit
- Deceleration shuttle test: 5 repetitions without deficit

RETURN-TO-SPORT CRITERIA

- No functional complaints
- Confidence when running, cutting, jumping at full speed
- 90% contralateral values on hop tests

Precautions

- Patellar tendon autograph
 - Be aware of patellofemoral forces and possible irritation with PRE's

PATELLAR TENDINITIS PREVENTION/TREATMENT PROTOCOL

- Use for Bilateral lower extremities
- Can be initiated after 6 weeks from surgery
- Protocol:
 - Open chain knee extension isometrics @ 60 degrees knee flexion
 - 45 second repetitions x 5 sets (in 10 minutes) @ 80% max contraction
 - Start with 10 lbs and progress
- Comments:
 - Initial anterior pain okay as long as it improves throughout the series
 - Load should be perceived as heavy to the patient
 - If leg sags or pain worsens, lower the resistance load
 - Better to initiate this protocol earlier if symptoms develop
- Hamstring tendon autograph
 - No resisted hamstring strengthening until 6 weeks
- Partial meniscectomy
 - No modifications required
- Meniscal repair
 - Weight bearing in full extension with brace x 4 weeks
 - Weight bearing with 45 degrees knee flexion from weeks 4-6
- Concomitant abrasion chondroplasty
 - Weight bearing as tolerated with crutches for 3 to 5 days
 - No modifications required
- Concomitant microfracture (consider location and size of lesion for exercise-specific alterations)
 - Non-weight bearing 6 weeks with crutches
 - Non-weight bearing activities in treatment for 6 weeks
- Chondral repair (osteochondral autograph transfer system)
 - Flat foot-weight bearing 6 weeks with crutches
 - Flat foot bearing activities in treatment for 6 weeks
- Medial collateral ligament injury
 - Restrict motion to sagittal plane until weeks 4 to 6 to allow healing of MCL
 - Consider brace for exercise and activity if severe sprain and/or patient has pain
 - Nonrepaired ROM restrictions: grade I, no ROM restrictions; grade II, 0° to 90° in week 1, 0° to 110° in week 2; grade III, 0° to 30° in week 1, 0° to 90° in week 2, 0° to 110° in week 3.
- Posterior cruciate ligament injury
 - Follow PCL rehabilitation guidelines (not ACL protocol)
- Posterolateral corner repair
 - Minimize external rotation torques and varus stress (6-8 weeks)
 - Avoid hyperextension
 - No resisted knee flexion for 12 weeks

- ACL revision
 - Flat Foot weight-bearing weeks 0-2; partial weight-bearing weeks weight-bearing as tolerated weeks 4-6
 - Brace for 6 weeks full-time; weeks 6-12 when active
 - Delay progression of running, hop testing, agility drills, and return to sport by 4 weeks

Appendix

Corrective Exercises Core Stability

- Draw-in
 - 3 x 5 hold for 5 seconds
 - Coaching keys: breathe, bellybutton to spine, no crunch
- Bridge Series
 - 3 x 5 hold for 5 seconds
 - Glute, plank, right side, and left side
 - Coaching keys: draw-in, fire glutes, breath, stable, head neutral, knees-hips-shoulder in line
- Side Lunge
 - 2 x 5 each direction
 - Coaching keys: stable, trail leg stretch, lead leg firm—knee over middle toe, heels flat
- Reverse Lunge with Twist
 - 2 x 5 each leg
 - Coaching keys: stable, trail leg stretch, lead leg firm—knee over middle toe, rotate hip in
- Scorpion
 - 1 x 10 each leg
 - Coaching keys: shoulders down, fire top glute, leg level with floor, tempo
- Ball Opposites
 - 3 x 5 hold for 5 seconds
 - Coaching keys: draw-in, breath, stable

Corrective Exercise Hip Mobility/Hamstring Flexibility

- Hip Crossover
 - 1 x 6 each right and left
 - Coaching keys: keep feet together, push down with top leg, shoulders flat
- 90 / 90
 - 1 x 6 each right and left
 - Coaching keys: hold top knee down, reach and look away
- Side Lunge (assisted/unassisted)
 - 2 x 6 each right and left
 - Coaching keys: feet straight ahead, draw-in, chest up, stable, get depth, lead knee to middle toe
- Reverse Lunge with Twist
 - 2 x 6 each right and left
 - Coaching keys: draw-in, chest up, trail leg stretch, lead leg firm—knee over middle toe and heel flat
- FABER
 - 2-3 x 15 second hold right and left
 - Coaching keys: Don't overstretch (constrained joint)
- Scorpion
 - 1 x 6 each right and left

- Coaching keys: shoulders down, fire top glute, leg level with floor, tempo
- Active Rope
 - 1 x 6 hold for 2 seconds each right and left
 - Coaching keys: QS/SLR, hold at end range + quad contraction
- Sumo
 - 1 x 6 hold for 2 seconds each right and left
 - Coaching keys: chest up, back flat, lead up with hips
- Roll / Stretch Piriformis
 - 2-3 x 15 seconds each right and left
 - Coaching keys: knee to belly button, pull to opposite shoulder
- Roll ITB / TFL
 - 1 x :60 or as needed
 - Coaching keys: find tender spot, wobble to decrease pain

Corrective Exercises Ankle Mobility

Primary:

- Ankle Rocker Lunge
 - 1 x 10 + 3 second hold
 - Plantarflexion and Dorsiflexion
 - Coaching keys: foot flat, knee over middle toe
- Rope Stretch
 - 2-3 x 15 second hold
 - Knee straight and Knee flexed
 - Coaching keys: foot centered, do not allow foot to rotate

Secondary

- Diagonal Lunge
 - 3-5 each, 4 Diagonals
 - Coaching keys: foot flat, knee over middle toe
- Standing Calf Stretch
 - 2-3 x 15 second hold
 - Coaching keys: foot flat, knee over middle toe, do not allow arch to flatten

Corrective Exercises for Shoulder Mobility/Scapular Stability

- Shrugs
 - 2 x 20 each
 - Coaching keys: shoulders back, squeeze at bottom
- Push Up+ Progression
 - 1 x hold 30 seconds + 10 reps no hold
 - Coaching keys: hold stable, reset, no pecs, breathe
- T, Y & W's
 - 2 x 6 4.2.2 tempo each
 - Coaching keys: shoulders back, thumbs up, progress from table to ball, progress to 1.1 tempo

- Rows to Waist
 - 2 x 6 each 4.2.2 tempo
 - Coaching keys: athletic stance, chest up, thumbs up, progress to 1.1 tempo
- Wall Press
 - 2 x 15 second hold
 - Coaching keys: flat against wall, set scapula, press shoulders/elbows/wrists to wall
- Side-lying Stretch
 - 2 x 15 seconds each right and left
 - Coaching keys: shoulders stabilize scapula on floor, shoulder and elbow at 90
- Door / Corner Stretch
 - 2 x 15 seconds
 - Coaching keys: elbows below shoulders, elbows & hands stabilize on wall, lean in
- Roll T-spine
 - 2 x 15 seconds each parallel and perpendicular to spine
 - Coaching keys: arms to TD, parallel wobble, perpendicular roll each segment
- Roll Lats
 - 2 x 15 seconds each right and left or until pain relieved
 - Coaching keys: wobble painful spot until decreased .80%