



PCL Reconstruction Rehabilitation Guideline

This rehabilitation program is designed to return the individual to their activities as quickly and safely as possible. It is designed for rehabilitation following posterior cruciate ligament reconstruction. Modifications to this guideline may be necessary dependent on physician specific instruction, integrity of repair, concomitant injuries or procedures performed. This evidence-based PCL reconstruction rehabilitation guideline is criterion-based; time frames and visits in each phase will vary depending on many factors- including patient demographics, goals, and individual progress. This guideline is designed to progress the individual through rehabilitation to full sport/ activity participation. The therapist may modify the program appropriately depending on the individual's goals for activity following PCL reconstruction rehabilitation.

This guideline is intended to provide the treating clinician a frame of reference for rehabilitation. It is not intended to substitute clinical judgment regarding the patient's post-operative care based on exam/ treatment findings, individual progress, and/or the presence of concomitant procedures or post-operative complications. If the clinician should have questions regarding post-operative progression, they should contact the referring physician.

General Guidelines/Precautions:

- Expect modified weight-bearing up to 4-6 weeks with a goal of FWB near 6 weeks per MD discretion.
- PROM from 0-90 degrees for first 4-6 weeks.
 - No hyperextension until 12 weeks (if needed to be symmetrical with opposite side).
 - After 2 weeks, flexion ROM increases 15 degrees per week up until reaching 90 degrees at week 6.
 - Flexion ROM will progress slowly up to 4 months.
- Avoid any posterior tibial sag/gliding.
 - Prone passive flexion and supine passive flexion should be used with the support of both hands to avoid posterior directed force.
- No hamstring activity/active knee flexion for first 12 weeks
 - Isolated hamstring strengthening initiated at 14 weeks.
- Drop lock bracing locked in extension for the first 8 weeks; functional brace fitted per physician timeline.
- No kneeling until 16 weeks
- Precautions to certain exercises and timeframes listed for those (IE: Running, squatting, elliptical, swimming, overhead throwing)
- CKC strengthening beginning at 8 weeks in limited range (0-30 degrees)
- Straight line jogging and double leg jump training initiated after adequate Level 1 testing and MD clearance (typically 4-5 months)
- Level 1 testing (see guidelines page) at or near 5 months post operatively.
 - No impact activities until full ROM, no swelling, adequate strength and biomechanics are demonstrated.
 - Progression to running program at 16-20 weeks based on Level 1 testing, physician preference, when able to demonstrate sufficient symmetry and shock absorption with running mechanics and plyometrics.
- Level 2 testing (see guidelines page) at 8 months post-op
 - Return to full sport activities when able to complete Level 2 testing with sufficient biomechanics, strength, balance and confidence. (See guideline and appendix for more specific information).

PCL Reconstruction Rehabilitation Guideline (9 - 12 Months)

PHASE	SUGGESTED INTERVENTIONS	GOALS/MILESTONES FOR PROGRESSION
<p>Phase I Patient Education Phase Pre-Operative Phase</p>	<p>Discuss: Anatomy, existing pathology, post-op rehab schedule, bracing, and expected progressions</p> <p>Pre-Operative Testing: Test contralateral isokinetics at 60/180/300 degrees per sec, introduce to blood flow restriction training</p> <p>Instructions on Pre-Operative Exercises:</p> <ul style="list-style-type: none"> • Quad setting • Straight leg raises • Towel calf stretching • Blood flow restriction (BFR) 	<p>Goals of Phase:</p> <ol style="list-style-type: none"> 1. Regain near normal joint and gait mechanics 2. Reduce fear or anxiety prior to surgery <p>Criteria to Advance to Next Phase:</p> <ol style="list-style-type: none"> 1. No pain or swelling 2. Normal gait and motion 3. Excellent quad activation
<p>Phase II Maximum Protection Phase Weeks 0-4 Expected visits: 4-8</p>	<p>Immediate Post-Operative instructions:</p> <ul style="list-style-type: none"> • No NWB for first 2 weeks • NO Hyperextension • NO active knee flexion or biking • Utilize ice and medication as instructed • Quad setting every hour • Patellar mobility <p>Suggested Treatments:</p> <p>Modalities as Indicated:</p> <ul style="list-style-type: none"> • Edema controlling treatments • NMES for quad activation • BFR with quadriceps exercises <p>Range of Motion:</p> <ul style="list-style-type: none"> • Full extension to 0 within first two weeks • Flexion restricted to 45 degrees passively up to 4 weeks; 0-90 passive by 6 weeks <p>Manual Therapy: Patellar mobilizations, prone knee flexion</p> <p>Exercise Examples:</p> <ul style="list-style-type: none"> • Quad sets (supine and prone), SLR with NMES as needed, BFR • Passive prone knee flexion • Towel calf stretch, static knee extension stretch (prone/supine) • Calf raises, side-lying hip abduction, clamshell <p>Other Activities:</p> <ul style="list-style-type: none"> • Upper body CV training, gait training with crutches, strengthening contralateral leg or proprioceptive exercises 	<p>Goals of Phase:</p> <ol style="list-style-type: none"> 1. Provide environment of proper healing of repair state 2. Prevention of post-operative complications 3. Improve quad activation <p>Criteria to Advance to Next Phase:</p> <ol style="list-style-type: none"> 1. Control of post-operative pain (0-1/10 with ADL's in brace) Prevention of post-operative complications 2. Resolution of post-operative effusion (trace to 1+) 3. Restore PROM 0-90 degrees to prevent arthrofibrosis 4. Independent SLR without brace with no extension lag or posterior sag

(continued on next page)

PCL Reconstruction Rehabilitation Guideline (9 - 12 Months)

<p>Phase III Protected Motion Phase</p> <p>Weeks 4-8</p> <p>Expected visits: 5-10</p>	<p>Specific Instructions:</p> <ul style="list-style-type: none"> • Continue with previous exercise program • Continue weight bearing in locked brace (full extension) until week 6 • Progress WBAT with brace locked; unlocked once full quad control and normalized gait mechanics <p>Suggested Treatments:</p> <p>Modalities: Pain control modalities as needed</p> <p>ROM: Progressive ROM program with progression >90 degrees beginning week 6</p> <p>Manual Therapy: Continue with patellar mobilizations as indicated</p> <p>Exercise Examples:</p> <ul style="list-style-type: none"> • Weight shifts to prepare for gait • Multi-angle quad isometrics • SAQ over bolster from 0-30 degrees • Step-ups (Forward, lateral) • Mini squats (0-30) • Standing TKE (band placed on femur) <p>Other Activities:</p> <ul style="list-style-type: none"> • Upper body CV training, strengthening contralateral leg or proprioceptive activities 	<p>Goals of Phase:</p> <ol style="list-style-type: none"> 1. Prevention of complications through gentle protected motion (symmetrical hyper-extension to approximately 90 degrees flexion) 2. Reduction of post-operative swelling and inflammation (no to trace effusion) 3. Re-education and initiation of quad control with active SLR without extension lag 4. Level ground ambulation with minimal faults by week 5. Continued protection of graft <p>Criteria to Advance to Next Phase:</p> <ol style="list-style-type: none"> 1. Normalized gait in unlocked brace 2. Achieve 0-115 degrees ROM 3. Good knee control and symmetry with strengthening exercises
--	--	---

(continued on next page)

PCL Reconstruction Rehabilitation Guideline (9 - 12 Months)

<p>Phase IV <i>Motion and Muscle Activation Phase</i></p> <p>Weeks 8-12</p> <p>Expected visits: 4-12</p>	<p>Specific Instructions:</p> <ul style="list-style-type: none"> • Continue previous hip and quad strengthening exercises • Initiate hamstring strengthening in high co-activation exercises; no isolated hamstring strengthening • Limit double-leg exercises to 60 degrees of flexion • Weight Bearing: Full, in functional bracing <p>Suggested Treatments:</p> <p>Modalities: As needed</p> <p>ROM: Progression of ROM program to 120 degrees flexion</p> <ul style="list-style-type: none"> • Bike for ROM • Prone P/AROM knee flexion <p>Exercise Examples:</p> <ul style="list-style-type: none"> • Limited depth closed chain quad strengthening (0-60 degrees) avoiding rotation and dynamic valgus stress at knee: <p>Modalities as Indicated:</p> <ul style="list-style-type: none"> • Forward and lateral step ups • Squats progressing with weight shifts eventually to single-leg • Wall squats • Static lunge • Leg press with light resistance 0-30 degrees week 8, 0-45 degrees week 9 • Wall squat 0-30 degrees week 8, 0-45 degrees week 9 • Light resisted open chain knee extension • DL Hip bridge with knee extended • Single leg deadlift with knee extended • Plank progression for core strength and stabilization • Standing fire hydrant holds <p>Other Activities:</p> <ul style="list-style-type: none"> • Bike with light resistance once flexion motion > 115 degrees or 8 weeks • Static proprioception training (double to single leg) with perturbation on variable surfaces (rocker board, airex pads, air discs, etc.) & emphasis on proper hip/knee stability and hip strategy. • Aquatic program (if available) - including pool walking, and closed-chain strengthening/balance consistent with restrictions above-no running/jumping, swimming allowed; straight knee activity only • Light cardiovascular conditioning program which includes: <ul style="list-style-type: none"> • Stationary bike • Level ground walking 	<p>Goals of Phase:</p> <ol style="list-style-type: none"> 1. Progression of ROM program to near full motion (full extension to full degrees flexion) 2. Improve muscular strength and endurance 3. Control of forces on extensor mechanism 4. Normalized level ground ambulation 5. Normalized single leg static balance with proper proximal control (no valgus and hip medial rotation) <p>Criteria to Advance to Next Phase:</p> <ol style="list-style-type: none"> 1. Achieve full degrees PROM 2. Reduction of post-operative swelling and inflammation (no to trace effusion) 3. Tolerate closed-chained strengthening with excellent mechanics
--	---	---

(continued on next page)

PCL Reconstruction Rehabilitation Guideline (9 - 12 Months)

<p>Phase V Advanced strengthening and eccentric control phase</p> <p>Weeks 12-20+</p> <p>Expected visits: 12-24</p>	<p>Specific Instructions:</p> <ul style="list-style-type: none"> Continue previous exercises Structure set and reps for strength and hypertrophy Initiate isolated hamstring exercises; start resisted at 14 weeks <p>Suggested Treatments:</p> <p>ROM: Progression of closed and open chain quad strengthening (0-90 degrees)</p> <p>Exercise Examples:</p> <ul style="list-style-type: none"> Prone; standing hamstring curls Forward step-downs Goblet squat; Offset squat Squat progressions (rocker board, BOSU) Lunge progression (all directions) Progress weight with previous exercises <p>Other Activities:</p> <ul style="list-style-type: none"> Begin Interval Throwing Program or appropriate sport specific interval program <p>Week 14:</p> <ul style="list-style-type: none"> Resisted hamstring strengthening SL RDLs, weight with prone and/or standing hamstring curls <p>Week 18: To prepare for Level 1 testing</p> <ul style="list-style-type: none"> Initiate jumping progression (see appendix) Initiate functional movement progressions (see appendix) <p>Week 20: Level 1 testing (see appendix)</p> <ul style="list-style-type: none"> Reorganize home program to address deficiencies from Level 1 Continued single leg strengthening as needed More advanced strength and power lifts <ul style="list-style-type: none"> 3-4 sets of 2-8 reps for strength (heavy weight, 2-3 min rest) 3-4 sets of 8-15 reps for hypertrophy (moderate weight, 45-60 sec rest) 3-4 sets of 1-5 reps for power (lighter weight, 5-10 min rest) <p>Exercise Examples: To prepare for Level 1 testing</p> <ul style="list-style-type: none"> Continued progression of strength training Deadlift, RDL, etc. Progress into power development (pulling derivatives) <ul style="list-style-type: none"> Clean pull, snatch pull, high pull, jump shrug, etc. <p>Other Activities:</p> <ul style="list-style-type: none"> Aquatic program, resisted bike/elliptical intervals 	<p>Goals of Phase:</p> <ol style="list-style-type: none"> 1. Improve muscular strength, power, and endurance 2. Improve cardiovascular endurance and conditioning 3. Reduce fear and improve confidence in the limb 4. Improved quad strength (80% of contralateral limb) 5. Normalized gluteal strength <p>Criteria to Advance to Next Phase:</p> <ol style="list-style-type: none"> 1. Quad and HS deficit < 30% at 60 deg/sec 2. Back squat to 80% body weight with no compensatory movements 3. Excellent form with RTP movements
--	--	--

(continued on next page)

PCL Reconstruction Rehabilitation Guideline (9 - 12 Months)

<p>Phase VI Advanced Movement and Impact Phase</p> <p>Weeks 18+</p> <p>Expected Visits: 21-24</p>	<p>Specific Instructions:</p> <ul style="list-style-type: none"> • Progression to running program (with appropriate bracing) with training to improve/normalize form and shock absorption (as cleared by MD) • Progression of open and closed chain strengthening for the entire LE chain with emphasis on single limb strengthening. • Progression to higher level activities and sports specific activities as strength and control dictate (as cleared by MD) <p>Exercise Examples:</p> <ul style="list-style-type: none"> • Initiate deceleration and single leg hopping (around 6 months) • Initiate cutting activities (around 6 months) • Initiate agility (floor ladder and cone drills) and sport specific activities (around 6 months) 	<p>Selected Criteria for Discharge:</p> <ol style="list-style-type: none"> 1. <10% strength deficit in quads and gluteals 2. Limb similarity index of 90% or greater on functional hop tests and Y balance tests 3. 45/50 on Biomechanical functional assessment tests (if performed) 4. No pain or complaints of instability with functional progression of sport specific skills
--	--	--

****NOTE:** Progression of functional activities should be performed only as pain and proper biomechanics allow. Emphasis should be on proper shock absorption and control of dynamic valgus stress at knee (hip medial rotation with knee valgus) with each task performed. Progression to single limb-based tasks (deceleration, hopping, and cutting) should not be performed until double limb activities have been mastered. Activities requiring dynamic control of rotational stress at the knee (cutting, multiple plane lunges/jumps/hops) should not be performed until sagittal and frontal plane control has been mastered. Return to sport may occur at any time during this stage as cleared by physician and as progress and goal achievement occurs.

REFERENCES:

1. Senese M, et al. Rehabilitation following isolated posterior cruciate ligament reconstruction: a literature review of published protocols. IJSPT. 2018;13(4):737-751.
2. Pierce CM, O'Brien L, et al. Posterior cruciate ligament tears: functional and postoperative rehabilitation. Knee Surg Sport Tr A. 2013;21(5):1071-84.
3. Pache S, Aman ZS, et al. Posterior cruciate ligament: current concepts review. Arch Bone JT Surg. 2018; 6(1):8-18.
4. Kim JG, Lee YS. et al. Rehabilitation after posterior cruciate ligament reconstruction: a review of literature and theoretical support. Arch Orthop Trauma Surg. 2013;133:1687-1695.
5. Mook WR, Civitarese D, et al. Double-bundle posterior cruciate ligament reconstruction: a biomechanical analysis of simulated early motion and partial and full weight bearing on common reconstruction grafts. Knee Surg Sport Tr A. 2017;25(8):2536-2544.

Interval Sprinting/Running Program

Guidelines

- Increase total distance by 10% per workout
- To be complete with no pain and or swelling
- Repeat 3 times at same distance with no swelling or pain prior to 10% increase

Stage I: Purpose: build up work capacity and improve technique

1. 5 x 20 yds or 5 x $\frac{3}{4}$ court
2. 4 x 50 yds or 4 x 2 full court
3. 5 x 40 yds or 5 x 1 $\frac{1}{2}$ court
4. 2 x 50 yds or 2 x full court
5. 1 x 100 yds or 1 x 3 courts

Stage II: Purpose: work on increased speed and build intensity

1. 5 x 20 yds or 5 x $\frac{3}{4}$ court (63 feet)
2. 4 x 50 yds or 4 x 2 full court (168 feet)
3. 5 x 40 yds or 5 x $\frac{3}{4}$ court (63 feet)
4. 2 x 50 yds or 2 x full court (168 feet)
5. 1 x 100 yds or 1 x 3 courts (252 feet)

Stage III: Purpose is to build into max speed with bias towards sports specific speed/ distance and metabolic demands

(these sprint intervals should be developed based on the needs of the individual patient and the demands of the sport they are planning to return to, the program does not need to be 5 different levels, but intensity should be high)

- 1.
- 2.
- 3.
- 4.
- 5.

Work:Rest Ratio or based on sports specific demands: _____:_____
INTENSITY 90-100%

Plyometric Progressions

Guidelines

- Must be able to perform full, free-weight squat 1.5-2.5 times body weight or squat 60% of body weight five times in five seconds.³
- Add to sessions 1-2x/wk – 3 days between sessions.
- Begin with 30-40 foot contacts per session and increase as able.
- No more than 80-120 foot contacts per session.

Step 1

- Jumping TO box (decreased landing forces)
- 2 legs to 2 legs
- 2 legs to 1 leg
- 1 leg to opposite leg
- 1 leg to same leg

Step 2

- Jumping FROM box
- Landing on 2

Step 3

- Squat jumps
- 1 leg jump -> 2 leg land
- 2 leg jump -> 1 leg land
- Split squat jumps -> scissor jumps
- 1 leg jump -> opposite leg land
- 1 leg jump -> same leg land

Step 4

- Progress to various planes of movement as able.
ie: Double leg broad jumps, single leg lateral hops, skater lateral jumps, bounding, drop jumps to jumps over hurdles forward or lateral, etc.

REFERENCES:

1. Bedoya AA, Milltenberger MR, Lopez RM. Plyometric training effects on athletic performance in youth soccer athletes: a systematic review. JSCR 2015.
2. Performance Enhancement in Rehabilitation: "Bridging the Gap", Dan Lorenz DPT,PT,LAT,CSCS,USAW: March 5-6, 2016.
3. Davies G, Riemann BL, Manske R. Current concepts of plyometric exercise. Int J Sports Phys Ther. 2015;10(6):760-86.
4. Chmielewski TL, George SZ, Tillman SM, et al. Low- Versus High-Intensity Plyometric Exercise During Rehabilitation After Anterior Cruciate Ligament Reconstruction. Am J Sports Med. 2016;44(3):609-17.

Movement Retraining Progressions

Guidelines

- Single skill blocked practice
- Single skill variable practice
- Combination of multiple skills in blocked practice
- Combination of multiple skills in variable practice
- Combination of multiple skills with reactive cueing
- Use sport specific work:rest ratios

Excellent lateral lunge at multiple speeds -> lateral shuffle cone drills

- Progressing to reactive drills

Excellent forward and reverse lunge at multiple speeds -> decelerations

- 3 step walking deceleration cone drill
- Jogging deceleration drills, increasing speed as able
- Reactive deceleration drills

Excellent lateral shuffle and deceleration at multiple speeds -> cutting

- Shallow cuts jogging (45 degrees)
- Deceleration to lateral shuffle cone drills, increasing speed as able
- Deceleration to 90 degrees cuts, increasing speed as able
- Reactive cutting drills

Excellent lateral shuffle, deceleration, cutting, and jumping

- Reactive, variable, combined drills
 - Utilize strobe glasses, resistance cords, cones, sport specifics, varied surfaces, perturbations

