Rehabilitation Protocol for PCL Reconstruction

This protocol is intended to guide clinicians through the post-operative course for PCL reconstruction. This protocol is time based (dependent on tissue healing) as well as criterion based. Specific intervention should be based on the needs of the individual and should consider exam findings and clinical decision making. The timeframes for expected outcomes contained within this guideline may vary based on surgeon's preference, additional procedures performed, and/or complications. If a clinician requires assistance in the progression of a post-operative patient, they should consult with the referring surgeon.

The interventions included within this protocol are not intended to be an inclusive list. Therapeutic interventions should be included and modified based on the progress of the patient and under the discretion of the clinician.

Post-operative considerations
If the patient develops a fever, unresolving numbness/tingling, excessive drainage from the incision, uncontrolled pain or any other symptoms you have concerns about you should contact the referring physician.

PHASE I: IMMEDIATE POST-OP PHASE (0-4 WEEKS AFTER SURGERY)

Rehabilitation Goals	• Protect graft
	• Reduce swelling, minimize pain
	• Restore patellar mobility
	• Restore full extension, gradually improve flexion
	• Minimize arthrogenic muscle inhibition, re-establish quad control, regain full active extension
	• Patient education
	  ○ Keep your knee straight and elevated when sitting or laying down
	  ○ Support the entire limb when extended
	  ○ Do not pivot on your surgical side
	  ○ Return to driving: 6-8 weeks post-op

Weight Bearing	Partial Weight Bearing (PWB) with crutches, braced locked in extension with all ambulation and sleeping
Precautions	• Avoid hamstring activation or guarding • Avoid hyperextension activities • Prevent posterior tibial translation

Intervention	*Swelling Management* • Ice, compression, elevation (check with MD re: cold therapy) • Retrograde massage *Range of motion/Mobility* • Gentle PROM *avoid hamstring guarding • Patellar Mobilizations: superior/inferior and medial/lateral • Seated active-assisted knee flexion *Therapeutic Exercise* • Ankle pumps • Quadriceps sets • Straight leg raise (SLR) • Sidelying and standing hip abduction/adduction • Standing hip extension from neutral • Resisted plantarflexion in long sitting, progressing to standing calf raise with full knee extension • Functional electrical stimulation (as needed for trace to poor quadriceps control)

Criteria to Progress	• Good quadriceps control (no lag with SLR) • Full knee extension • >60 degrees of knee flexion PROM • No signs of active inflammation

PHASE II: PROTECTION PHASE (4-12 WEEKS AFTER SURGERY)

Rehabilitation Goals	• Increase knee ROM, particularly flexion • Normalize gait • Improve quadriceps strength and hamstring flexibility

Weight Bearing	During this phase, the brace is progressively unlocked (when able to perform SLR) and weight bearing increased:
	• **Weeks 4-6:** WBAT with crutches, brace unlocked for gait in controlled environment only
	• **Weeks 6-8**: WBAT with crutches, brace unlocked for all activities
	• **Week 8:** brace discontinued (as allowed by surgeon). Patient may discontinue crutches if they demonstrate the following:
	  ○ No quadriceps lag with SLR
	  ○ Full knee extension
	  ○ Knee flexion AROM 90-100 degrees
	  ○ Normal gait pattern (may use 1 crutch/cane until gait normalized)

Precautions	• Avoid hamstring activation or guarding • Avoid hyperextension activities • Prevent posterior tibial translation
Additional Interventions **Continue with Phase I interventions as indicated*	*Therapeutic Exercise: exercise progressions below should be in respect to timeline of healing as well as patient ability to perform appropriately, if unable to perform with proper form, delay adding to program* *Weeks 4-8*: • Wall slides (0-45 degrees knee flexion) • Leg press (0-60 degrees knee flexion) • Standing 4 way hip exercise for resisted hip flexion, extension, abduction, and adduction. Place resistance above knee for hip abduction and adduction • Sidelying hip external rotation-clamshell • Hooklying transversus abdominus progression *Weeks 8-12*: • Stationary bike (foot placed forward on pedal without use of toe clips to minimize hamstring activity, seat height slightly higher than normal), Elliptical trainer • Gait training over level ground • Closed kinetic chain terminal knee extension using resistance band or weight machine • Mini squats (0-90 degrees knee flexion) • Leg press (0-90 degrees knee flexion) • Seated calf raises *Balance/Proprioception* • Single leg standing balance (knee slightly flexed) static progressed to dynamic and level progressed to unsteady surface
Criteria to Progress	• No effusion/swelling/pain after exercise • Normal gait • ROM equal to contra lateral side

PHASE III: LATE POST-OP (3-6 MONTHS AFTER SURGERY)

Rehabilitation Goals	• Safely progress strengthening • Promote proper movement patterns • Avoid post exercise pain/swelling
Additional Interventions **Continue with Phase I-II Interventions as indicated*	*Strengthening* • Gym equipment: leg press machine, hip abductor and adductor machine, hip extension machine, roman chair, seated calf machine **The following exercises to focus on proper control with emphasis on good proximal stability • Squat to chair • Lateral lunges • Romanian dead lift • Single leg progression: ○ Single leg press, slide board lunges: retro and lateral, step ups with march, lateral step-ups, step downs, single leg squats, single leg wall slides • Knee exercises for additional exercises • Bridges & single leg bridges *Balance/Proprioception* • Lateral step overs • Joint position sense • Progress single limb balance including perturbation training *Conditioning* • Treadmill walking • Jogging in pool with vest or belt • Swimming (no breast stroke or "frog kick")
Criteria to Progress	• Clearance by surgeon to resume full or modified activity • Full, pain-free AROM and PROM, muscle strength and endurance, and proprioception • Quadriceps/HS/Hip strength 80% of uninvolved leg measured with hand-held dynamometer (HHD)

PHASE IV: ADVANCED STRENGTHENING AND EARLY RETURN TO SPORT (6-9 MONTHS AFTER SURGERY)

Rehabilitation Goals	• Safe and gradual return to work or athletic participation • Patient education on possible limitations, with patient demonstrating clear understanding • Maintenance of strength, endurance, and function • Safely initiate sport specific training program

Additional Interventions **Continue with Phase II-III interventions as indicated*	*Therapeutic Exercise*
	• Continue closed kinetic chain exercise progression
	• Interval running program
	  ○ Return to Running Program
	• Progress to plyometric and agility program (with functional brace if prescribed)
	  ○ Agility and Plyometric Program

Criteria to Progress	• Clearance from MD and ALL milestone criteria below have been met
	• Completion jog/run program without pain/effusion/swelling
	• Functional Assessment
	  ○ Quad/HS/glut index ≥90%; HHD mean or isokinetic testing @ 60d/s
	  ○ Hamstring/Quad ratio ≥66%
	  ○ Hop Testing ≥90% compared to contra lateral side, demonstrating good landing mechanics
	• KOOS-sports questionnaire >90%
	• International Knee Committee Subjective Knee Evaluation >93
	• Psych Readiness to Return to Sport (PRRS)

PHASE V: UNRESTRICTED RETURN TO SPORT (9+ MONTHS AFTER SURGERY)

Rehabilitation Goals	• Continue strengthening and proprioceptive exercises • Symmetrical performance with sport specific drills • Safely progress to full sport
Additional Interventions **Continue with Phase II-IV interventions as indicated*	• Multi-plane sport specific plyometrics program • Multi-plane sport specific agility program • Include hard cutting and pivoting depending on the individuals' goals • Non-contact practice→ Full practice→ Full play
Discharge Criteria	Successful completion of all phases of rehabilitation and independent home exercise program/progression established. For the recreational or competitive athlete, return-to-sport decision making should be individualized and based upon factors including but not limited to previous injury history, the level of demand on the lower extremity, contact vs non-contact, and frequency of participation. Close discussion with the referring surgeon is strongly recommended prior to advancing to a return-to-sport rehabilitation program.

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Return to Running Program

This program is designed as a guide for clinicians and patients through a progressive return-to-run program. Patients should demonstrate > 80% on the Functional Assessment prior to initiating this program (after a knee ligament or meniscus repair). Specific recommendations should be based on the needs of the individual and should consider clinical decision making. If you have questions, contact the referring physician.

PHASE I: WARM UP WALK 15 MINUTES, COOL DOWN WALK 10 MINUTES

Day	1	2	3	4	5	6	7
Week 1	W5/J1x5		W5/J1x5		W4/J2x5		W4/J2x5
Week 2		W3/J3x5		W3/J3x5		W2/J4x5	
Week 3	W2/J4x5		W1/J5x5		W1/J5x5		**Return to Run**

Key: W=walk, J=jog

***Only progress if there is no pain or swelling during or after the run*

PHASE II: WARM UP WALK 15 MINUTES, COOL DOWN WALK 10 MINUTES

Week	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	20 min		20 min		20 min		25 min
2		25 min		25 min		30 min	
3	30 min		30 min		35 min		35 min
4		35 min		40 min		40 min	
5	40 min		45 min		45 min		45 min
6		50 min		50 min		50 min	
7	55 min		55 min		55 min		60 min
8		60 min		60 min			

Recommendations

- Runs should occur on softer surfaces during Phase I
- Non-impact activity on off days
- Goal is to increase mileage and then increase pace; avoid increasing two variables at once
- 10% rule: no more than 10% increase in mileage per week

Agility and Plyometric Program

This program is designed as a guide for clinicians and patients through a progressive series of agility and plyometric exercises to promote successful return to sport and reduce injury risk. Patients should demonstrate > 80% on the Functional Assessment prior to initiating this program. Specific intervention should be based on the needs of the individual and should consider clinical decision making. If you have questions, contact the referring physician.

PHASE I: ANTERIOR PROGRESSION

Rehabilitation Goals	• Safely recondition the knee • Provide a logical sequence of progressive drills for pre-sports conditioning
Agility	• Forward run • Backward run • Forward lean in to a run • Forward run with 3-step deceleration • Figure 8 run • Circle run • Ladder

Plyometrics	• Shuttle press: Double leg→alternating leg→single leg jumps
	• Double leg:
	  ○ Jumps on to a box→ jump off of a box→ jumps on/off box
	  ○ Forward jumps, forward jump to broad jump
	  ○ Tuck jumps
	  ○ Backward/forward hops over line/cone
	• Single leg (these exercises are challenging and should be considered for more advanced athletes):
	  ○ Progressive single leg jump tasks
	  ○ Bounding run
	  ○ Scissor jumps
	  ○ Backward/forward hops over line/cone

Criteria to Progress	• No increase in pain or swelling • Pain-free during loading activities • Demonstrates proper movement patterns

PHASE II: LATERAL PROGRESSION

Rehabilitation Goals	• Safely recondition the knee • Provide a logical sequence of progressive drills for the Level 1 sport athlete
Agility **Continue with Phase I interventions*	• Side shuffle • Carioca • Crossover steps • Shuttle run • Zig-zag run • Ladder

Plyometrics
**Continue with Phase I interventions*
	• Double leg:
	  ○ Lateral jumps over line/cone
	  ○ Lateral tuck jumps over cone
	• Single leg (these exercises are challenging and should be considered for more advanced athletes):
	  ○ Lateral jumps over line/cone
	  ○ Lateral jumps with sport cord

Criteria to Progress	• No increase in pain or swelling • Pain-free during loading activities • Demonstrates proper movement patterns

PHASE III: MULTI-PLANAR PROGRESSION

Rehabilitation Goals	• Challenge the Level 1 sport athlete in preparation for final clearance for return to sport
Agility **Continue with Phase I-II interventions*	• Box drill • Star drill • Side shuffle with hurdles
Plyometrics **Continue with Phase I-II interventions*	• Box jumps with quick change of direction • 90 and 180 degree jumps

Criteria to Progress	• Clearance from MD
	• Functional Assessment
	  ○ Quad/HS/glut index ≥90% contra lateral side (isokinetic testing if available)
	  ○ Hamstring/Quad ratio ≥70%
	  ○ Hop Testing ≥90% contralateral side
	• KOOS-sports questionnaire >90%
	• International Knee Committee Subjective Knee Evaluation >93
	• Psych Readiness to Return to Sport (PRRS)