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REHABILITATION PROTOCOL: 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 you develop a fever, intense calf pain, excessive drainage from the incision, uncontrolled pain or any other symptoms you have concerns about you should call your doctor.

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

Rehab Goals	<ul style="list-style-type: none"> ▪ 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 <ul style="list-style-type: none"> ○ Keep your knee straight and elevated when sitting or lying down. Do not rest with a towel placed under the knee ○ Support your surgical side when performing transfers (i.e. sitting to laying down) ○ Do not pivot on your surgical side ○ Return to driving: 6-8 weeks postop
Weight Bearing	<ul style="list-style-type: none"> ▪ Partial Weight Bearing (PWB) with crutches, braced locked in extension with sleeping ▪ Initially brace locked, crutches (per MD recommendation) ▪ May discontinue use of brace after 6-8 wks per MD and once adequate quad control is achieved ▪ When climbing stairs, lead with the non-surgical side when going up the stairs, and lead with the crutches and surgical side when going down the stairs

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Precautions	<ul style="list-style-type: none"> ▪ Avoid hamstring activation or guarding ▪ Avoid hyperextension activities ▪ Prevent posterior tibial translation
Interventions	<p>Swelling Management</p> <ul style="list-style-type: none"> ▪ Ice, compression, elevation (check with MD re: cold therapy) ▪ Retrograde massage ▪ Ankle pumps <p>Range of motion/Mobility</p> <ul style="list-style-type: none"> ▪ Gentle PROM *avoid hamstring guarding ▪ Patellar mobilizations: superior/inferior and medial/lateral ▪ Seated active-assisted knee flexion <p>Strengthening</p> <ul style="list-style-type: none"> ▪ Calf raises ▪ Quad sets ▪ Straight leg raise <ul style="list-style-type: none"> ○ **Do not perform straight leg raise if you have a knee extension lag ▪ 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	<ul style="list-style-type: none"> ▪ Good quadriceps control (no lag with SLR) ▪ Full knee extension ▪ >60 degrees of knee flexion PROM ▪ No signs of active inflammation

PHASE II: INTERMEDIATE POST-OP (4-12 WEEKS AFTER SURGERY)

Rehab Goals	<ul style="list-style-type: none"> ▪ Increase knee ROM, particularly flexion ▪ Normalize gait ▪ Improve quadriceps strength and hamstring flexibility
Weight Bearing	<ul style="list-style-type: none"> ▪ 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: <ul style="list-style-type: none"> ○ No quadriceps lag with SLR ○ Full knee extension

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	<ul style="list-style-type: none"> ○ Knee flexion AROM 90-100 degrees ○ Normal gait pattern (may use 1 crutch/cane until gait normalized)
Precautions	<ul style="list-style-type: none"> ▪ Avoid hamstring activation or guarding ▪ Avoid hyperextension activities ▪ Prevent posterior tibial translation
Additional Interventions *Continue with Phase I interventions	<p>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</p> <p>Weeks 4-8:</p> <ul style="list-style-type: none"> ▪ 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 <p>Weeks 8-12:</p> <ul style="list-style-type: none"> ▪ 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 <p>Balance/Proprioception</p> <ul style="list-style-type: none"> ▪ Single leg standing balance (knee slightly flexed) static progressed to dynamic and level progressed to unsteady surface
Criteria to Progress	<ul style="list-style-type: none"> ▪ No effusion/swelling/pain after exercise ▪ Normal gait ▪ ROM equal to contra lateral side

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

Rehab Goals	<ul style="list-style-type: none"> ▪ Safely progress strengthening ▪ Promote proper movement patterns ▪ Avoid post exercise pain/swelling
Additional Interventions	Strengthening

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<p>*Continue with Phase I-II Interventions</p>	<ul style="list-style-type: none"> ▪ 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 <ul style="list-style-type: none"> ▪ Squat to chair ▪ Lateral lunges ▪ Romanian dead lift ▪ Single leg progression: <ul style="list-style-type: none"> ○ 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 <p>Balance/Proprioception</p> <ul style="list-style-type: none"> ▪ Lateral step overs ▪ Joint position sense ▪ Progress single limb balance including perturbation training <p>Conditioning</p> <ul style="list-style-type: none"> ▪ Treadmill walking ▪ Jogging in pool with vest or belt ▪ Swimming (no breaststroke or “frog kick”)
<p>Criteria to Progress</p>	<ul style="list-style-type: none"> ▪ 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)

<p>Rehab Goals</p>	<ul style="list-style-type: none"> ▪ 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
<p>Additional Interventions *Continue with Phase II-III interventions</p>	<ul style="list-style-type: none"> ▪ Therapeutic Exercise ▪ Continue closed kinetic chain exercise progression ▪ Interval running program <ul style="list-style-type: none"> ○ Return to Running Program ▪ Progress to plyometric and agility program (with functional brace if prescribed)

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	<ul style="list-style-type: none"> ○ Agility and Plyometric Program
Criteria to Progress	<ul style="list-style-type: none"> ▪ Clearance from MD and ALL milestone criteria below have been met ▪ Completion jog/run program without pain/effusion/swelling ▪ Functional Assessment <ul style="list-style-type: none"> ○ Quad/HS/glut index $\geq 90\%$; HHD mean or isokinetic testing @ 60d/s ○ Hamstring/Quad ratio $\geq 66\%$ ○ Hop Testing $\geq 90\%$ 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)

Rehab Goals	<ul style="list-style-type: none"> ▪ Continue strengthening and proprioceptive exercises ▪ Symmetrical performance with sport specific drills ▪ Safely progress to full sport
Additional Interventions *Continue with Phase II-IV interventions	<ul style="list-style-type: none"> ▪ 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
Criteria to Progress	<p>Successful completion of all phases of rehabilitation and independent home exercise program/progression established.</p> <p>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.</p>

**Acknowledgement: This rehab protocol was largely adopted from the protocols at MGH Sports Medicine Physical Therapy, which can be found at <https://www.massgeneral.org/orthopaedics/sports-medicine/physical-therapy/sports-rehab-protocols>*

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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

Day	1	2	3	4	5	6	7
Week 1	Walk 5 min, Jog 1 min x 5 reps		Walk 5 min, Jog 1 min x 5 reps		Walk 4 min, Jog 2 min x 5 reps		Walk 4 min, Jog 2 min x 5 reps
Week 2		Walk 3 min, Jog 3 min x 5 reps		Walk 3 min, Jog 3 min x 5 reps		Walk 2 min, Jog 4 min x 5 reps	
Week 3	Walk 2 min, Jog 4 min x 5 reps		Walk 1 min, Jog 5 min x 5 reps		Walk 1 min, Jog 5 min x 5 reps		Return to Run

**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

Day	1	2	3	4	5	6	7
Week 1	20 min		20 min		20 min		25 min
Week 2		25 min		25 min		30 min	

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Week 3	30 min		30 min		35 min		35 min
Week 4		35 min		40 min		40 min	
Week 5	40 min		45 min		45 min		45 min
Week 6		50 min		50 min		50 min	
Week 7	55 min		55 min		55 min		60 min
Week 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

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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

Rehab Goals	<ul style="list-style-type: none"> ▪ Safely recondition the knee ▪ Provide a logical sequence of progressive drills for pre-sports conditioning
Agility	<ul style="list-style-type: none"> ▪ Forward run ▪ Backward run ▪ Forward lean in to a run ▪ Forward run with 3-step deceleration ▪ Figure 8 run ▪ Circle run ▪ Ladder
Plyometrics	<ul style="list-style-type: none"> ▪ Shuttle press: Double leg alternating leg single leg jumps ▪ Double leg: <ul style="list-style-type: none"> ○ 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): <ul style="list-style-type: none"> ○ Progressive single leg jump tasks ○ Bounding run ○ Scissor jumps ○ Backward/forward hops over line/cone
Criteria to Progress	<ul style="list-style-type: none"> ▪ No increase in pain or swelling ▪ Pain-free during loading activities ▪ Demonstrates proper movement patterns

PHASE II: LATERAL PROGRESSION

Rehab Goals	<ul style="list-style-type: none"> ▪ Safely recondition the knee ▪ Provide a logical sequence of progressive drills for the Level 1 sport athlete
Agility *Continue with Phase I interventions	<ul style="list-style-type: none"> ▪ Side shuffle ▪ Carioca ▪ Crossover steps ▪ Shuttle run

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	<ul style="list-style-type: none"> ▪ Zig-zag run ▪ Ladder
Plyometrics *Continue with Phase I interventions	<ul style="list-style-type: none"> ▪ Double leg: <ul style="list-style-type: none"> ○ Lateral jumps over line/cone ○ Lateral tuck jumps over cone ▪ Single leg (these exercises are challenging and should be considered for more advanced athletes): <ul style="list-style-type: none"> ○ Lateral jumps over line/cone ○ Lateral jumps with sport cord
Criteria to Progress	<ul style="list-style-type: none"> ▪ No increase in pain or swelling ▪ Pain-free during loading activities ▪ Demonstrates proper movement patterns

PHASE III: MULTIPLANAR PROGRESSION

Rehab Goals	<ul style="list-style-type: none"> ▪ Challenge the Level 1 sport athlete in preparation for final clearance for return to sport
Agility *Continue with Phase I-II interventions	<ul style="list-style-type: none"> ▪ Box drill ▪ Star drill ▪ Side shuffle with hurdles
Plyometrics *Continue with Phase I-II interventions	<ul style="list-style-type: none"> ▪ Box jumps with quick change of direction ▪ 90 and 180 degree jumps
Criteria to Progress	<ul style="list-style-type: none"> ▪ Clearance from MD ▪ Functional Assessment <ul style="list-style-type: none"> ○ Quad/HS/glut index $\geq 90\%$ contra lateral side (isokinetic testing if available) ○ Hamstring/Quad ratio $\geq 70\%$ ○ Hop Testing $\geq 90\%$ contralateral side ▪ KOOS-sports questionnaire $>90\%$ ▪ International Knee Committee Subjective Knee Evaluation >93 ▪ Psych Readiness to Return to Sport (PRRS)