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REHABILITATION PROTOCOL: ACL Reconstruction

This protocol is intended to guide clinicians through the post-operative course for ACL 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 of exercises. Therapeutic interventions should be included and modified based on the progress of the patient and under the discretion of the clinician.

Considerations for allograft and hamstring autograft

Early weight bearing and early rehabilitation intervention vary for allograft and hamstring autograft. Please reference specific instructions below. Expectations are the early return to sport phase will be delayed.

Considerations with concomitant injuries

Be sure to follow the more conservative protocol with regards to range of motion, weight bearing, and rehab progression when there are concomitant injuries (i.e. meniscus repair).

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.

Weight bearing considerations:

ACL quadriceps or BTB autograft without meniscus repair = WBAT

ACL Repair = TTWB x 6 weeks

ACL allograft = TTWB x 6 weeks

ACL with meniscus repair = TTWB x 6 weeks

ACL with meniscus root repair = NWB x 4 weeks, TTWB weeks 5-6

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PHASE I: IMMEDIATE POST-OP (0-2 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 ○ Do not actively kick your knee out straight; support your surgical side when performing transfers (i.e. sitting to laying down) ○ Do not pivot on your surgical side
Weight Bearing	<p>Weight Bearing</p> <ul style="list-style-type: none"> ▪ With meniscus repair: TTWB x 6 weeks ▪ Autograft without meniscus repair: WBAT, as below ▪ Allograft: TTWB x 6 weeks <p>Walking</p> <ul style="list-style-type: none"> ▪ Initially brace locked, crutches (per MD recommendation) ▪ May start walking without crutches as long as there is no increased pain, effusion, and proper gait <ul style="list-style-type: none"> ○ Allograft and hamstring autograft continue partial weight bearing with crutches for 6 weeks unless otherwise instructed by MD ▪ May unlock brace once able to perform straight leg raise without lag ▪ May discontinue use of brace after 6 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
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"> ▪ Patellar mobilizations: superior/inferior and medial/lateral <ul style="list-style-type: none"> ○ **Patellar mobilizations are heavily emphasized in the early post-operative phase following patella tendon autograft** ▪ Seated assisted knee flexion extension and heel slides with towel ▪ Low intensity, long duration extension stretches: prone hang, heel prop

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	<ul style="list-style-type: none"> ▪ Standing gastroc stretch and soleus stretch ▪ Supine active hamstring stretch and supine passive hamstring stretch <p>Strengthening</p> <ul style="list-style-type: none"> ▪ Calf raises ▪ Quad sets ▪ NMES high intensity (2500 Hz, 75 bursts) supine knee extended 10 sec/50 sec, 10 contractions, 2x/wk during sessions—use of clinical stimulator during session, consider home units distributed immediate post op ▪ Straight leg raise <ul style="list-style-type: none"> ○ **Do not perform straight leg raise if you have a knee extension lag ▪ Hip abduction ▪ Multi-angle isometrics 90 and 60 deg knee extension
Criteria to Progress	<ul style="list-style-type: none"> ▪ Knee extension ROM 0 deg ▪ Quad contraction with superior patella glide and full active extension ▪ Able to perform straight leg raise without lag

PHASE II: INTERMEDIATE POST-OP (2-6 WEEKS AFTER SURGERY)

Rehab Goals	<ul style="list-style-type: none"> ▪ Continue to protect graft ▪ Restore/Maintain full extension (compared to contralateral side) ▪ Normalize gait
Additional Interventions *Continue with Phase I interventions	<p>Range of motion/Mobility</p> <ul style="list-style-type: none"> ▪ Stationary bicycle ▪ Gentle stretching all muscle groups: prone quad stretch, standing quad stretch, kneeling hip flexor stretch <p>Strengthening</p> <ul style="list-style-type: none"> ▪ Standing hamstring curls ▪ Step ups and step ups with march ▪ Partial squat exercise ▪ Ball squats, wall slides, mini squats from 0-60 deg ▪ Lumbopelvic strengthening: <ul style="list-style-type: none"> ○ bridge & unilateral bridge ○ sidelying hip external rotation clamshell ○ bridges on physioball ○ bridge on physioball with roll-in ○ bridge on physioball alternating ○ hip hike <p>Balance/proprioception</p>

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	<ul style="list-style-type: none"> ▪ Single leg standing balance (knee slightly flexed) static progressed to dynamic and level progressed to unsteady surface ▪ Lateral step-overs ▪ Joint position re-training
Criteria to Progress	<ul style="list-style-type: none"> ▪ No swelling (Modified Stroke Test) ▪ Flexion ROM within 10 deg contra lateral side ▪ Extension ROM equal to contra lateral side

PHASE III: LATE POST-OP (6-8 WEEKS AFTER SURGERY)

Rehab Goals	<ul style="list-style-type: none"> ▪ Continue to protect graft site ▪ Maintain full ROM ▪ Safely progress strengthening ▪ Promote proper movement patterns ▪ Avoid post exercise pain/swelling ▪ Avoid activities that produce pain at graft donor site
Additional Interventions *Continue with Phase I-II Interventions	<p>Range of motion/Mobility</p> <ul style="list-style-type: none"> ▪ Rotational tibial mobilizations if limited ROM <p>Cardio</p> <ul style="list-style-type: none"> ▪ 8 weeks: Elliptical, stair climber, flutter kick swimming, pool jogging <p>Strengthening</p> <ul style="list-style-type: none"> ▪ Gym equipment: <ul style="list-style-type: none"> ○ leg press machine ○ seated hamstring curl machine and hamstring curl machine ○ hip abductor and adductor machine ○ hip extension machine ○ roman chair ○ seated calf machine <ul style="list-style-type: none"> ▪ Hamstring autograft can begin resisted hamstring strengthening at 12 weeks ▪ Progress intensity (strength) and duration (endurance) of exercises <p>**The following exercises to focus on proper control with emphasis on good proximal stability</p> <ul style="list-style-type: none"> ▪ Squat to chair ▪ Lateral lunges ▪ Romanian deadlift ▪ Single leg progression: <ul style="list-style-type: none"> ○ partial weight bearing single leg press ○ slide board lunges: retro and lateral

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	<ul style="list-style-type: none"> ○ step ups and step ups with march ○ lateral step-ups ○ step downs ○ single leg squats ○ single leg wall slides <ul style="list-style-type: none"> ▪ Seated Leg Extension (avoid anterior knee pain): 90-45 degrees with resistance <p>Balance/proprioception</p> <ul style="list-style-type: none"> ▪ Progress single limb balance including perturbation training
Criteria to Progress	<ul style="list-style-type: none"> ▪ No effusion/swelling/pain after exercise ▪ Normal gait ▪ ROM equal to contra lateral side ▪ Symmetrical Joint position sense (< 5-degree margin of error)

PHASE IV: TRANSITIONAL (8-12 WEEKS AFTER SURGERY)

Rehab Goals	<ul style="list-style-type: none"> ▪ Maintain full ROM ▪ Safely progress strengthening ▪ Promote proper movement patterns ▪ Avoid post exercise pain/swelling ▪ Avoid activities that produce pain at graft donor site
Additional Interventions *Continue with Phase II-III interventions	<ul style="list-style-type: none"> ▪ Begin sub-max sport specific training in the sagittal plane ▪ Bilateral PWB plyometrics progressed to FWB plyometrics
Criteria to Progress	<ul style="list-style-type: none"> ▪ No episodes of instability ▪ Maintain quad strength ▪ 10 repetitions single leg squat proper form through at least 60 deg knee flexion ▪ Drop vertical jump with good control ▪ KOOS-sports questionnaire >70% ▪ Functional Assessment <ul style="list-style-type: none"> ○ Quadriceps index >80%; HHD or isokinetic testing 60d/s ○ Hamstrings ≥80%; HHD or isokinetic testing 60 d/s ○ Glut med, glut max index ≥80% HHD

PHASE V: EARLY RETURN TO SPORT (3-6 MONTHS AFTER SURGERY)

Rehab Goals	<ul style="list-style-type: none"> ▪ Safely progress strengthening ▪ Safely initiate sport specific training program ▪ Promote proper movement patterns ▪ Avoid post exercise pain/swelling
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	<ul style="list-style-type: none"> ▪ Avoid activities that produce pain at graft donor site
Additional Interventions *Continue with Phase II-IV interventions	<ul style="list-style-type: none"> ▪ Interval running program <ul style="list-style-type: none"> ○ Return to Running Program (See below) ▪ Progress to plyometric and agility program (with functional brace if prescribed) <ul style="list-style-type: none"> ○ Agility and Plyometric Program (See below)
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

PHASE VI: UNRESTRICTED RETURN TO SPORT (6+ 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-V 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 (~7-9 mo) ▪ Non-contact practice → Full practice → Full play (~9-12 mo)
Criteria to Progress	<ul style="list-style-type: none"> ▪ Functional Assessment <ul style="list-style-type: none"> ○ Quad/HS/glut index $\geq 95\%$; HHD mean or isokinetic testing @ 60d/s ○ Hamstring/Quad ratio $\geq 66\%$ ○ Hop Testing $\geq 95\%$ compared to contra lateral side, demonstrating good landing mechanics ▪ KOOS-sports questionnaire $>90\%$ ▪ International Knee Committee Subjective Knee Evaluation >93 ▪ ACL-RSI

**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	<ul style="list-style-type: none"> ▪ Side shuffle ▪ Carioca ▪ Crossover steps

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*Continue with Phase I interventions	<ul style="list-style-type: none"> ▪ Shuttle run ▪ 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)