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## **REHABILITATION PROTOCOL: Arthroscopic Meniscal Root Repair / Meniscus Transplantation**

This protocol is intended to guide clinicians through the post-operative course for meniscal root repair and meniscus allograft transplantation. 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 the Post-Operative Meniscal Root Repair**

Many different factors influence the post-operative meniscal repair rehabilitation outcomes, including type and location of the meniscal tear and repair. Consider taking a more conservative approach to range of motion, weight bearing, and rehab progression. It is recommended that clinicians collaborate closely with the referring physician regarding intra-operative findings and satisfaction with the strength of the 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.

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

<b>Rehab Goals</b>	<ul style="list-style-type: none"> <li>▪ Protect repair</li> <li>▪ Reduce swelling, minimize pain</li> <li>▪ Restore patellar mobility</li> <li>▪ Restore full extension</li> <li>▪ Flexion &lt; 90 degrees for medial meniscus, &lt;70 degrees for lateral</li> <li>▪ Minimize arthrogenic muscle inhibition, re-establish quad control, regain full active extension</li> <li>▪ Patient education               <ul style="list-style-type: none"> <li>○ Keep your knee straight and elevated when sitting or lying down. Do not rest with a towel placed under the knee.</li> <li>○ Do not actively bend your knee; support your surgical side when performing transfers (i.e. sitting to laying down)</li> <li>○ Do not pivot on your surgical side.</li> </ul> </li> </ul>
<b>Weight Bearing</b>	<p><b>Walking</b></p> <ul style="list-style-type: none"> <li>▪ Brace locked, crutches</li> <li>▪ Non-weight bearing</li> <li>▪ When going up the stairs, make sure you are leading with the non-surgical side, when going down the stairs, make sure you are leading with the crutches and surgical side.</li> </ul>
<b>Interventions</b>	<p><b>Swelling Management</b></p> <ul style="list-style-type: none"> <li>▪ Ice, compression, elevation (check with MD re: cold therapy)</li> <li>▪ Retrograde massage</li> <li>▪ Ankle pumps</li> </ul> <p><b>Range of motion/Mobility</b></p> <ul style="list-style-type: none"> <li>▪ Patellar mobilizations: superior/inferior and medial/lateral</li> <li>▪ Seated assisted knee flexion extension and heel slides with towel               <ul style="list-style-type: none"> <li>○ ***Avoid active knee flexion to prevent hamstring strain on the posteromedial joint</li> </ul> </li> <li>▪ Low intensity, long duration extension stretches: prone hang, heel prop</li> <li>▪ Seated hamstring stretch</li> </ul> <p><b>Strengthening</b></p> <ul style="list-style-type: none"> <li>▪ Quad sets</li> <li>▪ NMES high intensity (2500 Hz, 75 bursts) supine knee extended 10 sec/50 sec, 10 contractions, 2x/week during sessions—use of clinical stimulator during session, consider home units distributed immediate post op</li> <li>▪ Straight leg raise               <ul style="list-style-type: none"> <li>○ **Do not perform straight leg raise if you have a knee extension lag</li> </ul> </li> <li>▪ Hip abduction: side lying or standing</li> </ul>

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	<ul style="list-style-type: none"> <li>▪ Multi-angle isometrics 90 and 60 deg knee extension</li> </ul>
<b>Criteria to Progress</b>	<ul style="list-style-type: none"> <li>▪ Knee extension ROM 0 deg</li> <li>▪ Knee flexion ROM 90 degrees for medial meniscus, 70 degrees for lateral meniscus</li> <li>▪ Quad contraction with superior patella glide and full active extension</li> <li>▪ Able to perform straight leg raise without lag</li> </ul>

**PHASE II: INTERMEDIATE POST-OP (5-6 WEEKS AFTER SURGERY)**

<b>Rehab Goals</b>	<ul style="list-style-type: none"> <li>▪ Continue to protect repair</li> <li>▪ Reduce pain, minimize swelling</li> <li>▪ Maintain full extension</li> <li>▪ Progress to full flexion</li> </ul>
<b>Weight Bearing</b>	<p><b>Walking</b></p> <ul style="list-style-type: none"> <li>▪ 25% partial weight bearing unless directed otherwise by MD</li> <li>▪ Brace 0-90°, can unlock once adequate quad control</li> </ul>
<b>Additional Interventions</b> *Continue with Phase I interventions	<p><b>Range of motion/Mobility</b></p> <ul style="list-style-type: none"> <li>▪ <a href="#">Stationary bicycle</a>; gentle range of motion only (see Phase III for conditioning)</li> </ul> <p><b>Cardio</b></p> <ul style="list-style-type: none"> <li>• Upper body ergometer</li> </ul> <p><b>Strengthening</b></p> <ul style="list-style-type: none"> <li>▪ Calf raises</li> <li>▪ Lumbopelvic strengthening with feet elevated             <ul style="list-style-type: none"> <li>○ <a href="#">bridge</a> with feet elevated</li> <li>○ <a href="#">side lying hip external rotation clamshell</a></li> <li>○ plank</li> </ul> </li> </ul> <p><b>Balance/proprioception</b></p> <ul style="list-style-type: none"> <li>▪ Double limb standing balance utilizing uneven surface (wobble board)</li> <li>▪ Joint position re-training</li> </ul>
<b>Criteria to Progress</b>	<ul style="list-style-type: none"> <li>▪ No swelling (Modified Stroke Test)</li> <li>▪ Flexion ROM 120 degrees</li> <li>▪ Extension ROM equal to contra lateral side</li> </ul>

**PHASE III: LATE POST-OP (6-9 WEEKS AFTER SURGERY)**

<b>Rehab Goals</b>	<ul style="list-style-type: none"> <li>▪ Continue to protect repair</li> <li>▪ Maintain full extension</li> <li>▪ Normalize gait.</li> <li>▪ Flexion within 10 degrees of contralateral side.</li> </ul>
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	<ul style="list-style-type: none"> <li>▪ Safely progress strengthening.</li> <li>▪ Promote proper movement patterns.</li> <li>▪ Avoid post exercise pain/swelling.</li> </ul>
<b>Weight Bearing</b>	<ul style="list-style-type: none"> <li>▪ Progress to weight bearing as tolerated with brace at week 7. Use 2 crutches initially and wean. Patient should be ambulating without crutches by end of week 8.</li> <li>▪ Discontinue brace at week 8 if good quad control.</li> <li>▪ No impact activities or plyometrics</li> <li>▪ Avoid posterior knee pain with deep flexion exercise</li> <li>▪ Avoid single leg squats</li> </ul>
<b>Additional Interventions</b> *Continue with Phase I-II Interventions	<p><b>Range of motion/Mobility</b></p> <ul style="list-style-type: none"> <li>• Supine active hamstring stretch</li> <li>• Gentle stretching all muscle groups: prone quad stretch, standing quad stretch, kneeling hip flexor stretch, standing gastroc stretch and soleus stretch</li> <li>• Rotational tibial mobilizations if limited ROM</li> </ul> <p><b>Cardio</b></p> <ul style="list-style-type: none"> <li>▪ 8 weeks: Elliptical, stair climber, flutter kick swimming, pool jogging</li> </ul> <p><b>Strengthening</b></p> <ul style="list-style-type: none"> <li>• Partial squat exercise 0-60 degrees</li> <li>• Ball squats, wall slides, mini squats from 0-60 deg</li> <li>• Hamstring strengthening: prone hamstring curls, standing hamstring curls</li> <li>• Lumbopelvic strengthening: bridges on physioball, bridge on physioball with roll-in, bridge on physioball alternating, hip hike</li> <li>• Gym equipment:             <ul style="list-style-type: none"> <li>○ Leg press machine</li> <li>○ Standing hip abductor and adductor machine</li> <li>○ Hip extension machine</li> <li>○ Roman chair</li> <li>○ Seated calf machine</li> </ul> </li> <li>• Progress intensity (strength) and duration (endurance) of exercises</li> </ul> <p><b>Balance/proprioception</b></p> <ul style="list-style-type: none"> <li>▪ Single limb balance progress to uneven surface including perturbation training</li> </ul>
<b>Criteria to Progress</b>	<ul style="list-style-type: none"> <li>▪ No effusion/swelling/pain after exercise</li> <li>▪ Normal gait</li> <li>▪ ROM equal to contralateral side</li> <li>▪ Symmetrical Joint position sense (&lt; 5-degree margin of error)</li> </ul>

**PHASE IV: TRANSITIONAL (9-12 WEEKS AFTER SURGERY)**

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<b>Rehab Goals</b>	<ul style="list-style-type: none"> <li>▪ Maintain full ROM</li> <li>▪ Safely progress strengthening</li> <li>▪ Promote proper movement patterns</li> <li>▪ Avoid post exercise pain/swelling</li> </ul>
<b>Additional Interventions</b> *Continue with Phase II-III interventions	<p><b>Cardio</b></p> <ul style="list-style-type: none"> <li>▪ Elliptical, stair climber</li> </ul> <p><b>Strengthening</b></p> <p>**The following exercises to focus on proper control with emphasis on good proximal stability</p> <ul style="list-style-type: none"> <li>▪ Squat to chair</li> <li>▪ Lateral lunges</li> <li>▪ Single leg progression:             <ul style="list-style-type: none"> <li>○ <a href="#">partial weight bearing single leg press</a></li> <li>○ slide board lunges: <a href="#">retro</a> and <a href="#">lateral</a></li> <li>○ <a href="#">step ups</a> and <a href="#">step ups with march</a></li> <li>○ <a href="#">lateral step-ups</a></li> <li>○ <a href="#">step downs</a></li> <li>○ <a href="#">single leg squats</a></li> <li>○ <a href="#">single leg wall slides</a></li> </ul> </li> <li>▪ Gym equipment:             <ul style="list-style-type: none"> <li>○ <a href="#">seated hamstring curl machine</a> and hamstring curl machine</li> </ul> </li> <li>▪ <a href="#">Romanian deadlift</a></li> </ul>
<b>Criteria to Progress</b>	<ul style="list-style-type: none"> <li>▪ No episodes of instability</li> <li>▪ 10 repetitions single leg squat proper form through at least 60 deg knee flexion</li> <li>▪ KOOS-sports questionnaire &gt;70%</li> <li>▪ Functional Assessment             <ul style="list-style-type: none"> <li>○ Quadriceps index &gt;80%; HHD or isokinetic testing 60d/s</li> <li>○ Hamstrings ≥80%; HHD or isokinetic testing 60 d/s</li> <li>○ Glut med, glut max index ≥80% HHD</li> </ul> </li> </ul>

**PHASE V: EARLY RETURN TO SPORT (3-5 MONTHS AFTER SURGERY)**

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

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<b>Criteria to Progress</b>	<ul style="list-style-type: none"> <li>▪ Clearance from MD and ALL milestone criteria below have been met</li> <li>▪ Completion jog/run program without pain/effusion / swelling</li> <li>▪ Functional Assessment               <ul style="list-style-type: none"> <li>○ Quad/HS/glut index <math>\geq 90\%</math>; HHD mean or isokinetic testing @ 60d/s</li> <li>○ Hamstring/Quad ratio <math>\geq 66\%</math></li> <li>○ Hop Testing <math>\geq 90\%</math> compared to contra lateral side, demonstrating good landing mechanics</li> </ul> </li> <li>▪ KOOS-sports questionnaire <math>&gt;90\%</math></li> <li>▪ International Knee Committee Subjective Knee Evaluation <math>&gt;93</math></li> <li>▪ Psych Readiness to Return to Sport (PRRS)</li> </ul>
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**PHASE VI: UNRESTRICTED RETURN TO SPORT (6+ MONTHS AFTER SURGERY)**

<b>Rehab Goals</b>	<ul style="list-style-type: none"> <li>▪ Continue strengthening and proprioceptive exercises</li> <li>▪ Symmetrical performance with sport specific drills</li> <li>▪ Safely progress to full sport</li> </ul>
<b>Additional Interventions</b> *Continue with Phase II-V interventions	<ul style="list-style-type: none"> <li>▪ Multi-plane sport specific plyometrics program</li> <li>▪ Multi-plane sport specific agility program</li> <li>▪ Include hard cutting and pivoting depending on the individuals' goals</li> <li>▪ Non-contact practice → Full practice → Full play</li> </ul>
<b>Criteria to Progress</b>	<ul style="list-style-type: none"> <li>▪ Quad/HS/glut index <math>\geq 90\%</math>; HHD mean preferred (isokinetic testing if available)</li> <li>▪ Hop Testing <math>\geq 90\%</math> compared to contra lateral side</li> </ul>

*\*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"> <li>▪ Safely recondition the knee</li> <li>▪ Provide a logical sequence of progressive drills for pre-sports conditioning</li> </ul>
Agility	<ul style="list-style-type: none"> <li>▪ Forward run</li> <li>▪ Backward run</li> <li>▪ Forward lean in to a run</li> <li>▪ Forward run with 3-step deceleration</li> <li>▪ Figure 8 run</li> <li>▪ Circle run</li> <li>▪ Ladder</li> </ul>
Plyometrics	<ul style="list-style-type: none"> <li>▪ Shuttle press: Double leg alternating leg single leg jumps</li> <li>▪ Double leg:               <ul style="list-style-type: none"> <li>○ Jumps on to a box jump off of a box jumps on/off box</li> <li>○ Forward jumps, forward jump to broad jump</li> <li>○ Tuck jumps</li> <li>○ Backward/forward hops over line/cone</li> </ul> </li> <li>▪ Single leg (these exercises are challenging and should be considered for more advanced athletes):               <ul style="list-style-type: none"> <li>○ Progressive single leg jump tasks</li> <li>○ Bounding run</li> <li>○ Scissor jumps</li> <li>○ Backward/forward hops over line/cone</li> </ul> </li> </ul>
Criteria to Progress	<ul style="list-style-type: none"> <li>▪ No increase in pain or swelling</li> <li>▪ Pain-free during loading activities</li> <li>▪ Demonstrates proper movement patterns</li> </ul>

### PHASE II: LATERAL PROGRESSION

Rehab Goals	<ul style="list-style-type: none"> <li>▪ Safely recondition the knee</li> <li>▪ Provide a logical sequence of progressive drills for the Level 1 sport athlete</li> </ul>
Agility	<ul style="list-style-type: none"> <li>▪ Side shuffle</li> <li>▪ Carioca</li> <li>▪ Crossover steps</li> </ul>

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

**PHASE III: MULTIPLANAR PROGRESSION**

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