

# MULTIPLE LIGAMENT KNEE INJURIES (ACL AND PCL RECONSTRUCTION) CLINICAL PRACTICE GUIDELINE

Progression is time and criterion-based, dependent on soft tissue healing, patient demographics, and clinician evaluation. Contact Ohio State Sports Medicine Physical Therapy at 614-293-2385 if questions arise.

## Background

ACL and PCL Reconstruction occurs after a multi-ligamentous knee injury, most often sustained during a contact force causing a knee dislocation. This accounts for <0.02% of all orthopedic injuries. Surgery may be delayed or staged for optimal outcomes. Surgery uses an allograft or autograft to reconstruct the torn ACL and PCL ligaments, and may repair the MCL, LCL, and/or posterolateral corner of the knee if needed as well. Long-term complications after surgery include chronic pain, knee instability, arthrofibrosis, and loss of knee flexion ROM. Research finds that only 1/3<sup>rd</sup> of athletes return to sport at prior level of function. If return to sport is possible, it is expected to take 9-12 months depending on comorbidities and nature of the sport.

## Summary of Recommendations

<b>Weight Bearing Guidelines</b>	<ol style="list-style-type: none"> <li>1. Non-weight bearing for 2 weeks, brace locked in extension</li> <li>2. TTWB - 25% at 2 weeks, brace locked in extension</li> <li>3. PWB 25-50% at 5-6 weeks, brace locked in extension</li> <li>4. WBAT at 7 weeks, gradually unlock and wean from brace</li> </ol>	
<b>ROM Guidelines</b>	<ol style="list-style-type: none"> <li>1. No knee flexion &gt;90° for 6 weeks</li> <li>2. No active hamstring /OKC flexion exercises for 8 weeks</li> <li>3. No resistive OKC hamstring exercise for 12 weeks</li> <li>4. Do not allow proximal tibia to rest unsupported for 12 weeks</li> </ol>	
<b>Concomitant Pathology</b>	<ol style="list-style-type: none"> <li>1. <u>MCL Repair:</u> <ol style="list-style-type: none"> <li>a. Femoral origin or mid-stance lesion will need more accelerated ROM</li> <li>b. Tibial insertion lesion will need more cautious progression of ROM</li> </ol> </li> </ol>	<ol style="list-style-type: none"> <li>2. <u>LCL/Posterolateral Corner Repair:</u> <ol style="list-style-type: none"> <li>a. No extension past 0° for 12 weeks</li> <li>b. Use slight valgus force during PROM flexion for 12 weeks</li> <li>c. Ensure no hyperextension/varus thrust when return to ambulation</li> </ol> </li> </ol>
<b>Outcome Tools</b>	Collect at least one of the following at initial evaluation, every 6 weeks, and discharge. Be consistent with which outcome tool is collected each time. <ol style="list-style-type: none"> <li>1. IKDC</li> <li>2. KOOS</li> <li>3. ACL-RSI</li> <li>4. Tegner</li> </ol>	
<b>Criteria to Discharge Assistive Device</b>	<ol style="list-style-type: none"> <li>1. <u>ROM:</u> Full active knee extension; no pain on passive overpressure</li> <li>2. <u>Strength:</u> Able to perform strong quad isometric with full tetany and superior patellar glide and able to perform 20 SLR without quad lag</li> <li>3. <u>Effusion:</u> 1+ or less is preferred (2+ acceptable if all other criteria are met)</li> <li>4. <u>Weight Bearing:</u> Demonstrates pain-free ambulation without visible gait deviation</li> </ol>	
<b>Criteria to Discharge NMES</b>	<ol style="list-style-type: none"> <li>1. &lt;20% quadriceps deficit on isometric or isokinetic testing (can use HHD for isometric testing)</li> </ol> <p><b>OR- If testing equipment is not available:</b></p> <ol style="list-style-type: none"> <li>1. 20 SLR without quad lag</li> <li>2. Normal gait</li> <li>3. 10 heel taps to to 60 degrees with good quality</li> <li>4. 10 rep max on LP and similar effort bilaterally</li> <li>5. Inability to break quad MMT</li> </ol>	



<b>Strength Testing</b>	<ol style="list-style-type: none"> <li>1. Isometric testing no earlier than 12 weeks- fixed at 60° knee flexion</li> <li>2. Isokinetic testing no earlier than 16 weeks</li> </ol>
<b>Criteria to Initiate Running and Jumping</b>	<ol style="list-style-type: none"> <li>1. <u>ROM</u>: full, pain-free knee ROM, symmetrical with the uninvolved limb</li> <li>2. <u>Strength</u>: Isokinetic testing 80% or greater for hamstring and quad at 60°/sec and 300°/sec</li> <li>3. <u>Effusion</u>: 1+ or less</li> <li>4. <u>Weight Bearing</u>: normalized gait and jogging mechanics</li> <li>5. <u>Neuromuscular Control</u>: Pain-free hopping in place</li> </ol>
<b>Criteria for Return to Sport</b>	<ol style="list-style-type: none"> <li>1. <u>ROM</u>: full, pain-free knee ROM, symmetrical with the uninvolved limb</li> <li>2. <u>Strength</u>: Isokinetic testing 90% or greater for hamstring and quad at 60°/sec and 300°/sec</li> <li>3. <u>Effusion</u>: No reactive effusion and ≤ 1+ with sport-specific activity</li> <li>4. <u>Weight Bearing</u>: normalized gait and jogging mechanics</li> <li>5. <u>Neuromuscular control</u>: appropriate mechanics and force attenuation strategies with high level agility, plyometrics, and high impact movements</li> <li>6. <u>Functional Hop Testing</u>: LSI 90% or greater for all tests</li> <li>7. <u>Physician Clearance</u></li> </ol>

## Weeks 0-4

<b>Weight Bearing</b>	<ol style="list-style-type: none"> <li>1. Non-weight bearing for 2 weeks, in brace locked in extension</li> <li>2. TTWB - 25% at 2 weeks with brace locked in extension</li> </ol>
<b>ROM</b>	<ol style="list-style-type: none"> <li>1. Begin Passive ROM (no flexion beyond 90° for 6 weeks) <ul style="list-style-type: none"> <li>o Goal of achieving full terminal knee extension (stop at 0° if PLC repaired)</li> <li>o Prone knee flexion with 10# manual anterior drawer force to protect PCL</li> <li>o Use varus/valgus force during PROM to protect MCL/LCL repair if needed</li> </ul> </li> <li>2. Patellar mobilizations</li> <li>3. Edema control</li> <li>4. ROM 6-8 times daily</li> </ol>
<b>Strengthening</b>	<ol style="list-style-type: none"> <li>1. Quad Sets</li> <li>2. Flexion and abduction SLR with brace on; emphasis on eliminating extensor lag</li> <li>3. NO active strengthening with knee flexion for 8 weeks</li> </ol>
<b>NMES Parameters</b>	<ol style="list-style-type: none"> <li>1. NMES pads are placed on the proximal and distal quadriceps</li> <li>2. Patient: Sitting with knee straight in long-sitting position with back supported. Towel roll under proximal tibia to prevent posterior translation.</li> <li>3. The patient is instructed to relax while the e-stim generates at least 50% of their max volitional contraction OR maximal tolerable amperage without knee joint pain</li> <li>4. 10 seconds on/ 50 seconds off x 15 min. 2 second ramp up and down. Frequency= 75pps. Pulse Width= 400microseconds</li> </ol>
<b>Stretching</b>	<ol style="list-style-type: none"> <li>1. Calves</li> </ol>
<b>Goals to Progress to Next Phase</b>	<ol style="list-style-type: none"> <li>1. Able to perform strong quad isometric with full tetany and superior patellar glide</li> <li>2. SLR with no extensor lag</li> <li>3. Good patellar mobility</li> <li>4. PROM 0-70°</li> </ol>



## Weeks 4-6

<b>Weight Bearing</b>	1. WB 25-50% at 5-6 weeks, brace locked in extension
<b>ROM</b>	1. Continue prone PROM; do not force ROM 2. Patellar mobilizations 3. Edema control
<b>Strengthening</b>	1. Continue NMES 2. Increase duration of Quad Sets 3. SLR with eyes open and closed; fast and slow 4. Core, Glutes
<b>Goals to Progress to Next Phase</b>	1. PROM 0-90°: if not achieved refer back to MD 2. Tolerance of partial weight bearing without residual pain or reactive joint effusion 3. ≤ 2+ joint effusion 4. 20 repetitions SLR with no extensor lag

## Weeks 6-8

<b>Weight Bearing</b>	1. WBAT at 7 weeks, gait training and wean from brace if 20 SLR without extensor lag 2. Ensure no knee hyperextension/varus thrust with ambulation
<b>Criteria to Discharge Assistive Device</b>	1. <u>ROM</u> : Full active knee extension; no pain on passive overpressure 2. <u>Strength</u> : Able to perform strong quad isometric with full tetany and superior patellar glide and able to perform 20 SLR without quad lag 3. <u>Effusion</u> : 1+ or less is preferred (2+ acceptable if all other criteria are met) 4. <u>Weight Bearing</u> : Demonstrates pain-free ambulation without visible gait deviation
<b>ROM</b>	1. Gradual advancement of prone passive knee flexion 2. Stationary bicycle avoiding deep knee flexion 3. Maintain passive knee extension
<b>Strength</b>	1. CKC (Shuttle) PWB Eccentrics within protected range (10°-40°) 2. Weights shifts and progression to single leg balance 3. Active OKC Resisted Knee Extension within protected range (60°-30°)
<b>New NMES Parameters</b>	1. NMES pads are placed on the proximal and distal quadricep 2. Patient: Seated with the knee at 60° flexion, shank secured with strap and back support with thigh strap preferred. The ankle pad/belt should be two finger widths superior to the lateral malleoli. 3. If this position creates knee pain, continue NMES in long-sitting 4. The patient is instructed to relax while the e-stim generates at least 50% of their maximal volitional contraction against a fixed resistance OR maximal tolerable amperage without knee joint pain 5. 10 seconds on/ 50 seconds off x 15 min. 2 second ramp up and down. Frequency= 75pps. Pulse Width= 400 microseconds.
<b>Goals to Progress to Next Phase</b>	1. Normalized gait mechanics without assistive device 2. PROM 0-110° 3. Completion of exercises without exacerbation of symptoms or reactive effusion 4. ≤ 2+ joint effusion



## Weeks 8-12

<b>ROM</b>	1. Progress prone flexion to achieve full symmetrical ROM
<b>Strength</b>	<ol style="list-style-type: none"> <li>1. Gradual increased depth of CKC strengthening (0-70°)</li> <li>2. Sub-max knee extension isometrics at 45° if pain-free</li> <li>3. Step ups/downs with correct movement patterns</li> <li>4. Progress single leg stance activities to compliant surfaces</li> <li>5. Proprioceptive training for knee angle replication. Move uninvolved knee into various degrees of flexion and patient has to match angle with involved knee; perform in prone throughout ROM and short sitting (90-30 degrees only if pain-free).</li> <li>6. CKC Hamstring exercises</li> <li>7. Active prone knee flexion for hamstring</li> <li>8. Continue NMES to quadriceps</li> </ol>
<b>Goals to Progress to Next Phase</b>	<ol style="list-style-type: none"> <li>1. Increased strength/stability/proprioception with therapeutic exercise without exacerbation of symptoms</li> <li>2. No reactive instability or effusion with WB activity</li> <li>3. ≤ 1+ joint effusion</li> <li>4. PROM 0-130° <ol style="list-style-type: none"> <li>a. If flexion &lt;125° refer back to MD</li> </ol> </li> <li>5. Ability to perform reciprocal stair ascent and descent without compensation or deficit</li> </ol>

## Weeks 12-16

<b>ROM</b>	<ol style="list-style-type: none"> <li>1. ROM as needed</li> <li>2. Progression to elliptical and stair stepper use with proper mechanics</li> </ol>
<b>Strength</b>	<ol style="list-style-type: none"> <li>1. Progress CKC 0°-90°</li> <li>2. Resisted OKC knee extension 90°-30°</li> <li>3. Progress neuromuscular strength, balance, and stability exercise (Squats, lunges, heel taps, etc)</li> <li>4. Perturbation training (slow to fast and proactive to reactive)</li> <li>5. Initiate landing mechanics exercise and light plyometric activity in PWB</li> </ol>
<b>Criteria to Discharge NMES</b>	<ol style="list-style-type: none"> <li>1. &lt;20% quadriceps deficit on isometric or isokinetic testing (can use HHD for isometric testing)</li> </ol> <p><b>OR- If testing equipment is not available:</b></p> <ol style="list-style-type: none"> <li>1. 20 SLR without quad lag</li> <li>2. Normal gait</li> <li>3. 10 heel taps to to 60 degrees with good quality</li> <li>4. 10 rep max on LP and similar effort bilaterally</li> <li>5. Inability to break quad MMT</li> </ol>
<b>Goals to Progress to Next Phase</b>	<ol style="list-style-type: none"> <li>1. ≤ 1+ joint effusion</li> <li>2. Full symmetrical flexion and extension ROM</li> <li>3. Appropriate landing mechanics and no instability with PWB plyometric activities</li> <li>4. Met criteria to discharge NMES</li> </ol>



## Weeks 16-24 (4-6 months)

<b>Strength</b>	<ol style="list-style-type: none"> <li>1. Increase resistance and endurance with all exercises</li> <li>2. OKC knee flexion exercises (0-90°)</li> <li>3. Resisted OKC knee extension 90°-10°</li> <li>4. Progress landing mechanics to full WB</li> <li>5. Initiate walk-jog progression at 5-6 months if criteria below is met</li> </ol>
<b>Criteria to Initiate Running and Jumping</b>	<ol style="list-style-type: none"> <li>1. <u>ROM</u>: full, pain-free knee ROM, symmetrical with the uninvolved limb</li> <li>2. <u>Strength</u>: Isokinetic testing 80% or greater for hamstring and quad at 60°/sec and 300°/sec</li> <li>3. <u>Effusion</u>: 1+ or less</li> <li>4. <u>Weight Bearing</u>: normalized gait and jogging mechanics with no gross visual compensation</li> <li>5. <u>Neuromuscular Control</u>: Pain-free hopping in place with appropriate landing mechanics</li> </ol>
<b>Criteria to Progress to Next Phase</b>	<ol style="list-style-type: none"> <li>1. Met criteria for running and jumping</li> <li>2. No reactive effusion or instability with FWB plyometrics</li> </ol>

## Weeks 24+ (6-12 months)

<b>Strength</b>	<ol style="list-style-type: none"> <li>1. Increased resistance and endurance with all exercises</li> <li>2. Progress landing mechanics from sagittal to frontal/transverse/diagonal planes</li> <li>3. Begin agility exercises at 50% at 8 months <ul style="list-style-type: none"> <li>○ Side shuffling</li> <li>○ Carioca</li> <li>○ Figure 8</li> <li>○ Cutting</li> <li>○ Backward running</li> <li>○ Ladder drills</li> </ul> </li> <li>4. Sport specific drills- use equipment, shoes, and specific surface</li> <li>5. Incorporate power/acceleration training</li> <li>6. Return to Sport no sooner than 10-12 months if criteria below is met</li> </ol>
<b>Criteria for Return to Sport</b>	<ol style="list-style-type: none"> <li>1. <u>ROM</u>: full, pain-free knee ROM, symmetrical with the uninvolved limb</li> <li>2. <u>Strength</u>: Isokinetic testing 90% or greater for hamstring and quad at 60°/sec and 300°/sec</li> <li>3. <u>Effusion</u>: No reactive effusion and ≤ 1+ with sport-specific activity</li> <li>4. <u>Weight Bearing</u>: normalized running mechanics</li> <li>5. <u>Neuromuscular control</u>: appropriate mechanics and force attenuation strategies with high level agility, plyometrics, and high impact movements</li> <li>6. <u>Functional Hop Testing</u>: LSI 90% or greater for all tests</li> <li>7. <u>Physician Clearance</u></li> </ol>



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