

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

Background

- **ACL and PCL Reconstruction:** Performed after multi-ligament knee injury, often from contact force causing knee dislocation.
- **Frequency:** <0.02% of orthopedic injuries.
- **Surgery:** Uses allograft or autograft; may include repair of MCL, LCL, or posterolateral corner.
- **Complications:** Chronic pain, instability, arthrofibrosis, loss of knee flexion.
- **Return to Sport:** Only 1/3 of athletes return to prior level; takes 9-12 months.

Recommendations

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| Weight Bearing Guidelines | <ul style="list-style-type: none"> • Non-weight bearing: 2 weeks, brace locked in extension. • TTWB (25%): 2 weeks, brace locked. • PWB (25-50%): 5-6 weeks, brace locked. • WBAT: 7 weeks, gradually unlock and wean from brace. |
| ROM Guidelines | <ul style="list-style-type: none"> • No knee flexion >90° for 6 weeks. • No active hamstring flexion exercises for 8 weeks. • No resistive OKC hamstring exercises for 12 weeks. • Do not let proximal tibia rest unsupported for 12 weeks. |
| Concomitant Pathology | <ul style="list-style-type: none"> • MCL Repair: Accelerated ROM for femoral origin/mid-stance lesions; cautious ROM for tibial insertion lesions. • LCL/Posterolateral Corner Repair: <ul style="list-style-type: none"> • No extension past 0° for 12 weeks. • Use slight valgus force during PROM flexion for 12 weeks. • Avoid hyperextension/varus thrust during ambulation. |
| Outcome Tools | Collect at initial evaluation, every 6 weeks, and discharge: IKDC, KOOS, ACL-RSI, Tegner |
| Criteria to Discharge | 1. Assistive Device: |

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| | <ul style="list-style-type: none"> • Full active knee extension; no pain on passive overpressure. • Strong quad isometric with full tetany; 20 SLR without quad lag. • Effusion $\leq 1+$ (2+ if other criteria met). • Pain-free ambulation without gait deviation. <p>2. NMES:</p> <p><20% quadriceps deficit on isometric/isokinetic testing, or</p> <p>20 SLR without quad lag, normal gait, 10 heel taps to 60°, 10 rep max on LP (bilaterally), inability to break quad MMT.</p> |
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Strength Testing

1 **Isometric Testing:** Begin no earlier than 12 weeks at 60° knee flexion.

2 **Isokinetic Testing:** Start no earlier than 16 weeks

Criteria for Running and Jumping

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| ROM | Full, pain-free, and symmetrical knee ROM compared to the uninvolved limb |
| Strength | Isokinetic strength $\geq 80\%$ for both hamstrings and quadriceps at 60°/sec and 300°/sec |
| Effusion | 1+ or less |
| Weight Bearing: | Normal gait and jogging mechanics. |
| Neuromuscular Control | Pain-free hopping in place |

| Criteria for Return to Sport | |
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| ROM | Full, pain-free, and symmetrical knee ROM |
| Strength | Isokinetic strength $\geq 90\%$ for both hamstrings and quadriceps at 60°/sec and 300°/sec. |
| Effusion | No reactive effusion and $\leq 1+$ with sport-specific activities. |
| Weight Bearing | Normal gait and jogging mechanics |
| Neuromuscular Control | Proper mechanics and force control during high-level agility, plyometrics, and impact activities |
| Functional Hop Testing | LSI $\geq 90\%$ for all tests |
| Physician Clearance | Required |

Phase I: Weeks 0-4

| Category | Details |
|------------------------------|--|
| Weight Bearing | <ul style="list-style-type: none"> • Non-weight bearing: 2 weeks, brace locked in extension • TTWB (25%): 2 weeks, brace locked in extension |
| Range of Motion (ROM) | <ul style="list-style-type: none"> • Passive ROM: For 6 weeks: No flexion $>90^\circ$ • Goal: Full knee extension (0° if PLC repaired) • Prone knee flexion with 10# manual anterior drawer force to protect PCL • Varus/valgus force during PROM if MCL/LCL repair needed • Patellar mobilizations • Edema control • Perform ROM exercises 6-8 times daily |
| Strengthening | <ul style="list-style-type: none"> • Quad sets • Flexion and abduction SLR with brace; focus on eliminating extensor lag • No active strengthening with knee flexion for 8 weeks |
| NMES Parameters | <ul style="list-style-type: none"> • Pads on proximal and distal quadriceps |

| Category | Details |
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| | <ul style="list-style-type: none"> • Position: Sitting with knee straight, towel roll under proximal tibia • Relax during e-stim: $\geq 50\%$ max contraction or maximal tolerable amperage without pain • Settings: 10s on/50s off, 15 min, 2s ramp, 75 pps, 400 μs pulse width |
| Stretching | <ul style="list-style-type: none"> • Calves |
| Goals to Progress | <ul style="list-style-type: none"> • Strong quad isometric contraction with full tetany and superior patellar glide • SLR without extensor lag • Good patellar mobility • ROM: 0-70° |

Phase II: Weeks 4-6

| Category | Details |
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| Weight Bearing | <ul style="list-style-type: none"> • WB 25-50% at 5-6 weeks, brace locked in extension |
| Range of Motion (ROM) | <ul style="list-style-type: none"> • Continue prone PROM; avoid forcing ROM • Patellar mobilizations • Edema control |
| Strengthening | <ul style="list-style-type: none"> • Continue NMES • Increase duration of quad sets • SLR with eyes open/closed, fast/slow • Core and glutes exercises |
| Goals to Progress to Next Phase | <ul style="list-style-type: none"> • PROM 0-90° (refer to MD if not achieved) • Tolerate partial weight bearing without pain or reactive effusion • $\leq 2+$ joint effusion • 20 repetitions of SLR with no extensor lag |

Phase III: Weeks 6-8

| Category | Details |
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| Weight Bearing | <ul style="list-style-type: none"> • WBAT at 7 weeks; gait training and wean from brace if 20 SLR without extensor lag • Ensure no knee hyperextension/varus thrust with ambulation |
| Criteria to Discharge Assistive Device | <ul style="list-style-type: none"> • ROM: Full active knee extension; no pain on passive overpressure Strength: Strong quad isometric with full tetany, superior patellar glide, and 20 SLR without quad lag • Effusion: 1+ or less preferred (2+ acceptable if other criteria met) Weight Bearing: Pain-free ambulation without visible gait deviation |
| Range of Motion (ROM) | <ul style="list-style-type: none"> • Gradual advancement of prone passive knee flexion • Use stationary bicycle, avoiding deep knee flexion • Maintain passive knee extension |
| Strengthening | <ul style="list-style-type: none"> • CKC (Shuttle) PWB eccentrics within 10°-40° • Weight shifts and progress to single-leg balance • Active OKC resisted knee extension within 60°-30° |
| New NMES Parameters | <ul style="list-style-type: none"> • Pads: Proximal and distal quadriceps • Position: Seated with knee at 60° flexion, shank secured, or long-sitting if knee pain occurs • Settings: 10s on/50s off, 15 min, 2s ramp, 75 pps, 400 μs pulse width • Relax while e-stim generates ≥50% max contraction or maximal tolerable amperage without knee pain |
| Goals to Progress to Next Phase | <ul style="list-style-type: none"> • Normalized gait mechanics without assistive device • PROM: 0-110° |

| Category | Details |
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| | <ul style="list-style-type: none"> • Complete exercises without exacerbation of symptoms or reactive effusion • $\leq 2+$ joint effusion |

Phase IV: Weeks 8-12

| Category | Details |
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| Range of Motion (ROM) | <ul style="list-style-type: none"> • Progress prone flexion to achieve full, symmetrical ROM |
| Strengthening | <ul style="list-style-type: none"> • Gradually increase depth of CKC strengthening (0-70°) • Sub-max knee extension isometrics at 45° if pain-free • Step ups/downs with correct movement patterns • Progress single leg stance activities to compliant surfaces • Proprioceptive training: replicate knee angles in various degrees of flexion • CKC hamstring exercises • Active prone knee flexion for hamstring • Continue NMES for quadriceps |
| Goals to Progress to Next Phase | <ul style="list-style-type: none"> • Increased strength, stability, and proprioception without exacerbation of symptoms • No reactive instability or effusion with weight-bearing activity • $\leq 1+$ joint effusion • PROM: 0-130° (refer to MD if flexion $< 125^\circ$) • Ability to perform reciprocal stair ascent and descent without compensation or deficit |

Phase V: Weeks 12-16

| Category | Details |
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| Range of Motion | <ul style="list-style-type: none"> • Maintain ROM as needed |

| Category | Details |
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| (ROM) | <ul style="list-style-type: none"> Progress to elliptical and stair stepper with proper mechanics |
| Strengthening | <ul style="list-style-type: none"> Progress CKC strengthening (0°-90°) Resisted OKC knee extension (90°-30°) Increase neuromuscular strength, balance, and stability exercises (e.g., squats, lunges) Perturbation training (slow to fast, proactive to reactive) Initiate landing mechanics exercises and light plyometrics in PWB |
| Criteria to Discharge NMES | <ul style="list-style-type: none"> <20% quadriceps deficit on isometric or isokinetic testing (can use HHD for isometric testing) <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> 20 SLR without quad lag Normal gait 10 heel taps to 60° with good quality 10 rep max on leg press with similar effort bilaterally Inability to break quad MMT |
| Goals to Progress to Next Phase | <ul style="list-style-type: none"> ≤1+ joint effusion Full symmetrical flexion and extension ROM Appropriate landing mechanics with no instability in PWB plyometrics Meet NMES discharge criteria |

Phase VI: Weeks 16-24 (4-6 months)

| Category | Details |
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| Strength | <ul style="list-style-type: none"> Increase resistance and endurance with all exercises OKC knee flexion exercises (0-90°) Resisted OKC knee extension (90°-10°) |

| Category | Details |
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| | <ul style="list-style-type: none"> Progress landing mechanics to full weight-bearing Initiate walk-jog progression at 5-6 months if criteria are met |
| Criteria to Initiate Running and Jumping | <ul style="list-style-type: none"> ROM: Full, pain-free knee ROM, symmetrical with uninvolved limb Strength: Isokinetic testing 80%+ for hamstring and quad at 60°/sec and 300°/sec Effusion: 1+ or less Weight Bearing: Normalized gait and jogging mechanics with no gross visual compensation Neuromuscular Control: Pain-free hopping in place with appropriate landing mechanics |
| Criteria to Progress to Next Phase | <ul style="list-style-type: none"> Met criteria for running and jumping No reactive effusion or instability with full weight-bearing plyometrics |

Phase VII: Weeks 24+ (6-12 months)

| Category | Details |
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| Strength | <ul style="list-style-type: none"> Increased resistance and endurance with all exercises Progress landing mechanics from sagittal to frontal/transverse/diagonal planes Begin agility exercises at 50% intensity at 8 months (e.g., side shuffling, carioca, figure 8, cutting, backward running, ladder drills) Sport-specific drills with appropriate equipment, shoes, and surfaces Incorporate power/acceleration training Return to sport no sooner than 10-12 months if criteria are met |
| Criteria for | <ul style="list-style-type: none"> ROM: Full, pain-free knee ROM, symmetrical with uninvolved |

| Category | Details |
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| Return to Sport | <p>limb</p> <ul style="list-style-type: none"> • Strength: Isokinetic testing 90%+ for hamstring and quad at 60°/sec and 300°/sec • Effusion: No reactive effusion and \leq 1+ with sport-specific activity • Weight Bearing: Normalized running mechanics • Neuromuscular Control: Appropriate mechanics and force attenuation strategies with high-level agility, plyometrics, and high-impact movements • Functional Hop Testing: LSI 90%+ for all tests • Physician Clearance |