POSTERIOR CRUCIATE LIGAMENT (PCL) RECONSTRUCTION CLINICAL PRACTICE GUIDELINE

Disclaimer

The following rehabilitation guidelines are specific to patients who have undergone a posterior cruciate ligament (PCL) reconstruction surgical procedure. Please refer to the Ohio States Sports Medicine website for rehabilitation guidelines specific to other procedures and conditions, as appropriate.

Progression is criterion-based and dependent on soft tissue healing, patient demographics, and clinical evaluation. The time frames identified for each phase of rehabilitation are approximate times for the average patient and not recommended as guidelines for progression for the individual patient. It is recommended that progression is based upon the achievement of functional criteria demonstrating readiness for progression, noted at the end of each phase. If you are working with an Ohio State Sports Medicine patient and questions arise, please contact the author by calling our office at (614) 293-2385.

Background

Posterior cruciate ligament (PCL) injuries are rare in isolation. The PCL restricts posterior translation of the tibia and restricts internal rotation with knee flexion of 90 degrees or greater. The PCL is comprised of two bundles: anterolateral bundle (ALB) and posteromedial bundle (PLB).

PCL injuries more commonly occur with other concomitant injuries, involving possibly the MCL and PLC (posterior lateral corner). A thorough review of operative report is necessary to determine optimal post-surgical course of rehabilitation.

The rehabilitation recommendations below are based upon recent literature review. Progression through each phase is based on the patient demonstrating readiness by achieving functional criteria rather than the time elapsed from surgery. The times frames identified after each phase are approximate times for the average patient, NOT guidelines for progression.

Summary of Recommendations

Precautions	1. No knee flexion >90° for 4 weeks 2. Open kinetic chain knee ***flexion*** progression a. No active hamstring flexion exercises x 8 weeks b. No resisted exercises x 16 weeks 3. Weight Bearing a. WBAT with brace locked in extension for first 6 weeks b. Typically WBing with TROM open x 1-2 weeks prior to discharge **c. *Concomitant collateral ligament intervention may change this progression. Please refer to the "post-op plan" section of the operative note for clarification or contact the surgical team*** 4. No hop testing prior to 6 months *PCL reconstruction often occurs in addition to other concomitant pathology. Refer to operative note for specific post-operative precautions. Contact surgical team for clarification.*	
Risk Factors	• PCL reconstruction requires extensive rehabilitation and can often exhaust insurance approved PT visits. Consider decreasing frequency during middle phase rehab • PCL reconstruction has a tendency toward laxity. Be cautious not to "over-stretch" ***Prevent hyperextension and posterior tibial translation to protect healing PCL graft from elongating***	
Concomitant Procedures	MCL Repair • Proximal/femoral repair trends towards stiffness → more aggressive ROM • Distal/tibial repair trends towards laxity → more cautious ROM progression	LCL/Posterior Lateral Corner (PLC) Repair • No extension past neutral x 12 weeks (no hyperextension) • Use slight valgus force during PROM flexion x 12 weeks • Ensure no hyperextension/varus thrust when returning to ambulation
Weight Bearing	• WBAT with brace locked in extension x6 weeks • Open brace at 6 weeks • Discharge brace by 8 weeks ***Concomitant collateral ligament intervention may change this progression. Please refer to the "post-op plan" section of the operative note for clarification or contact the surgical team***	
Range of Motion	***Prevent hyperextension and posterior tibial translation to protect healing PCL graft from elongating***	
Outcome Tools	Collect the LEFS at each visit *You may choose to include IKDC, KOOS, ACL-RSI, Tegner or other questionnaires specific to your patient's needs*.	
Strength Testing	• Isometric Testing: 8 weeks • Isokinetic Testing: 4, 6, 9, 12 months • Hop testing – at 6 months and once 80% LSI on isokinetic testing is achieved ○ SL hop for distance ○ Triple hop ○ Cross over hop ○ Timed 6m hop **Functional strength testing and hop testing should be reserved for patients returning to high level activity**	

Criteria to Discharge Assistive Device	1. ROM: Full active knee extension; no pain on passive overpressure 2. Strength: Able to perform strong quad isometric with full tetany and superior patellar glide and able to perform 20 SLR without quad lag 3. Effusion: 1+ or less is preferred (2+ acceptable if all other criteria are met) 4. Weight Bearing: Demonstrates pain-free ambulation without visible gait deviation
Criteria to Discharge NMES	<20% quadriceps deficit on isometric or isokinetic testing (can use HHD for isometric testing) **OR- If testing equipment is not available:** 1. 20 SLR without quad lag 2. Normal gait 3. 10 heel taps to 60 degrees with good quality 4. 10 rep max on LP and similar effort bilaterally 1. Inability to break quad MMT
Criteria to Initiate Running and Jumping	1. ROM: full, pain-free knee ROM, symmetrical with the uninvolved limb 2. Strength: Isokinetic testing 80% or greater for hamstring and quad at 60º/sec and 300º/sec ***(Appendix C and D)*** 3. Effusion: ≤ 1+ 4. Weight Bearing: normalized gait and jogging mechanics 5. Neuromuscular Control: Pain-free hopping in place
Criteria for Return to Sport	1. ROM: full, pain-free knee ROM, symmetrical with the uninvolved limb 2. Strength: Isokinetic testing 90% or greater for hamstring and quad at 60º/sec and 300º/sec ***(Appendix D)*** 3. Effusion: No reactive effusion ≤ 1+ with sport-specific activity 4. Weight Bearing: normalized gait and jogging mechanics 5. Neuromuscular control: appropriate mechanics and force attenuation strategies with high level agility, plyometrics, and high impact movements 6. Functional Hop Testing: LSI ≥ 90% for all tests ***(Appendix E)*** 7. Physician Clearance
RTS Expectation	6-12 months

RED/YELLOW FLAGS

Red Flags
 	
Require immediate referral for re-evaluation
	• Signs of DVT→ *Refer directly to ED*
	  ○ Localized tenderness along the distribution of deep venous system
	  ○ Entire LE swelling
	  ○ Calf swelling >3cm compared to asymptomatic limb
	  ○ Pitting edema
	  ○ Collateral superficial veins
	• Lack of full knee extension by 4 weeks post-op→*Refer to surgeon for re-evaluation*
	• Mechanical block or clunk→*Refer to surgeon for re-evaluation*
	• Reported episode of instability→*Refer to surgeon for re-evaluation*

Yellow Flags *Require modifications to plan of care*	• Persistent reactive effusion or pain following therapy or ADLs ○ *Decrease intensity of rehab interventions, continue effusion management, educate patient regarding activity modifications until symptoms resolve*

Phase I: Protection Phase (Post-op– week 6)

Goals	Restore ROM and minimize effusion/pain, while adhering to all post-operative precautions
Pain and Effusion	Effusion management strategies: cryotherapy and compression as appropriate
Weight Bearing	• WBAT with brace locked in extension x6 weeks • Open brace at 6 weeks ***Concomitant collateral ligament intervention may change this progression. Please refer to the "post-op plan" section of the operative note for clarification or contact the surgical team***

ROM	• ***Prevent hyperextension and posterior tibial translation to protect healing PCL graft from elongating***
	• ***Use varus/valgus force during PROM to protect MCL/LCL repair if appropriate***
	
	Weeks 0-2
	• Achieve terminal knee extension; ***stop at 0º - do not push into hyperextension***
	• Flexion: 0-90 º for first 2 weeks using PROM strategies
	  ○ Examples: PROM in prone with clinician support; using uninvolved leg, or using stretch strap OR heel slides with constant anterior pressure in the popliteal fossa during to decrease tension placed through the PCL
	
	Weeks 2-6
	• Achieve terminal knee extension; ***stop at 0º - do not push into hyperextension***
	• Flexion: Progress PROM to AAROM
	  ○ Examples: Knee flexion in seated position using uninvolved limb to flexion support
	  ○ Upright bike can begin at post-op week 3 for ROM only (no resistance)

Suggested Interventions	• Ankle pumps • Quadriceps, hamstring and gluteal isometrics • Diaphragmatic breathing • Effusion management strategies, including RICE • Prone TKE • SLR (4 way) <u>with brace on</u>; emphasis on eliminating extensor lag ○ Perform without brace once able to complete 3x10 without extensor lag • Patellar mobilization in all directions • Gait training as appropriate • Extension ROM: Seated towel stretch, prone hang, bag hang; ***stop at 0º - do not push into hyperextension*** • Flexion ROM: See ROM section for precautions and interventions • SAQ • Clamshell/side steps • Week 2: LAQ (through protected ROM (90-45 degrees)) • Week 2: Shuttle press (0-45 degrees) • NMES in long sitting
NMES Parameters *Appendix B*	1. NMES pads are placed on the proximal and distal quadriceps 2. Patient: Seated in long sitting (knees extended). Progress to seated with the knee in at least 60º 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. The patient is instructed to relax while the e-stim generates at least 50% of their max volitional quadriceps contraction OR maximal tolerable amperage without knee joint pain 4. 20 seconds on/ 50 seconds off x 15 min
Blood Flow Restriction Training *Appendix D*	• Blood Flow Restriction (BFR) training can be initiated as soon as sutures are removed • Ensure patient has no contraindications (Appendix D) and if patient has any listed precautions or are at risk for a DVT, clear with physician before initiating BFR • Use BFR twice weekly for up to 10 weeks; use for 2-3 exercises per session • Can be used with any exercise that is safe for patient to perform depending on time since surgery (ex. SLR 4-way, prone TKE). *BFR should never be performed during a plyometric exercise.* • Training Load: 20-40% 1 RM (Estimated, or use OMNI-RES, see Appendix D) • Limb Occlusion Pressure= 80% (see Appendix D if patient unable to tolerate) • 4 sets for each exercise with reps of 30-15-15-15 (75 total) with a 30 second rest break between sets, keeping cuff inflated the entire duration of each exercise. Deflate between exercises, or every 8 minutes.
Goals to Progress to Next Phase	1. Able to perform strong isometric quadriceps contraction (full tetany with superior patellar glide) 2. SLR with no extensor lag 3. PROM 0-90° 4. Reduced and well-controlled post-operative pain and edema 5. Proficiency with prescribed home exercise program

Phase II: Loading Phase (6-10 weeks)

Goals	Emphasis is placed on normalizing ROM/gait and improving quadriceps, gluteal and core strength
Pain and Effusion	Effusion management strategies: cryotherapy and compression as appropriate
Weight Bearing	• WBAT with brace locked in extension x6 weeks • Open brace at 6 week • Discharge brace by 8 weeks ***Concomitant collateral ligament intervention may change this progression. Please refer to the "post-op plan" section of the operative note for clarification or contact the surgical team***
Range of Motion	• ROM goal: 0-130 degrees • Achieve terminal knee extension; ***stop at 0º - do not push into hyperextension*** • Week 6: Begin stationary bike with minimal to moderate resistance • Week 8: Can begin active heel slides; active prone knee flexion for ROM only • Patellar mobilizations

Suggested Interventions	***No active open kinetic chain resistive hamstring exercises***
	• Continue Phase 1 and 2 interventions
	• Continue effusion management strategies
	• SLR-Flexion progressions
	  ○ Semi-reclined or seated
	  ○ Add ER
	  ○ Perform with eyes closed (cortical training)
	  ○ Speed
	  ○ Isometric holds at end-range
	• SL balance interventions
	• Multiangle isometrics
	• Mini squats (start 0-45 degrees and progress flexion angle as control improves)
	• Step ups
	• Heel taps
	• Week 8: Swiss ball bridges with knees extended
	• Weeks 8-12: initiate active hamstring contraction/OKC flexion **without** resistance
	• Week 10: Cycling (no toe clips)
	• Week 12: Elliptical
	• Trunk stability interventions
	  ○ TrA progression
	  ○ Prone/side planks (modified-> full plank)
	• BFR (continue as in early phase, adding appropriate exercises)

Strength Testing	Isometric testing: 8 weeks
Criteria to Discharge NMES	• <20% quadriceps deficit on isometric testing **OR- If a Biodex machine is not available:** 1. 10 SLR without quad lag 2. Normal gait 3. 10 heel taps to to 60 degrees with good quality 4. 10 rep max on LP and similar effort bilaterally 5. Inability to break quadriceps MMT
Goals to Progress to Next Phase	1. AROM 0-130 degrees; communicate with MD if not achieved 2. Ability to tolerate therapeutic exercise without pain or reactive effusion 3. ≤ 1+ joint effusion (Appendix C) 4. Normal gait pattern 5. Proficiency with prescribed home exercise program

Strength and Power Phase (Months 3-5)

Goals	Goal: to increase lower extremity strength and power and normalize LE mechanics during functional movements
Pain and Effusion	Monitor reactive effusion as progressive loading is performed
ROM	Symmetrical and painfree ROM with no complaints of pain during end-range overpressure
Weight Bearing	FWB with normalized gait pattern
Strength Testing	• Isometric Testing: 8 weeks + • Isokinetic Testing: 4 months + • No hop testing prior to 6 months
Suggested Interventions	***No active open kinetic chain resistive hamstring exercises until week 16*** ***Can progress closed chain knee flexion past 70 degrees after 16 weeks*** Performance of the quadriceps, hamstrings and trunk dynamic stability • Squats, leg extension, leg curl, leg press, deadlifts, lunges (multi-direction), crunches, rotational trunk exercises on static and dynamic surfaces, monster walks • Single-leg squats on BOSU with manual perturbation to trunk or legs, Single-leg BOSU balance, single-leg BOSU Romanian deadlift Once strength criteria have been met, perform the following progression: • PBW jumping on the shuttle (DL → SL) • Full body weight jumping progression Walk-jog program
Criteria to Initiate Running and Jumping	1. ROM: full, pain-free knee ROM, symmetrical with the uninvolved limb 2. Strength: Isokinetic testing 80% or greater for hamstring and quad at 60º/sec and 300º/sec ***(See Appendix C and D)*** 3. Effusion: ≤ 1+ 4. Weight Bearing: normalized gait and jogging mechanics 5. Neuromuscular Control: Pain-free hopping in place
Goals to Progress to Next Phase	1. Normalized gait mechanics without assistive device 2. ROM within normal limits 3. Completion of exercises without exacerbation of symptoms or reactive effusion 4. ≤ 1+ joint effusion 5. No dynamic knee valgus with squat to 90 degrees

Return to Sport (Months 6 – RTS)

Goals	The patient is able to resume all normal functionality and will continue to progress towards return to sport
Pain and Effusion	Effusion may increase with increased activity, ≤1+ and/or non-reactive effusion for progression of plyometrics
ROM	Symmetrical and painfree ROM with no complaints of pain during end-range overpressure
Weight Bearing	FWB with normalized gait pattern

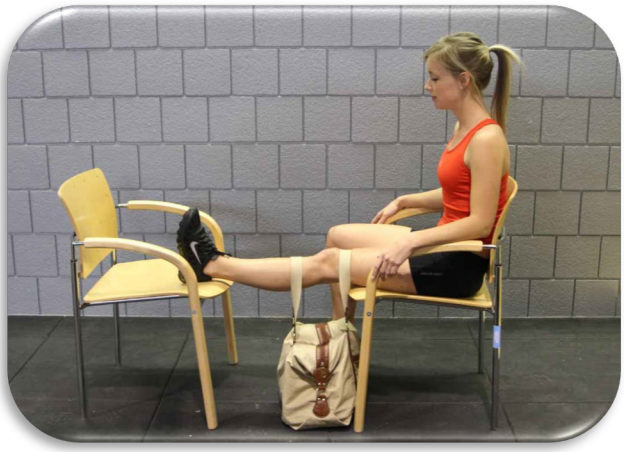
Strength Testing	• Isokinetic Testing: 4, 6, 9, 12 months
	• Hop testing (Appropriate at 6 months and after 80% symmetry achieved on isokinetic testing)
	  ○ SL hop for distance
	  ○ Triple hop
	  ○ Cross over hop
	  ○ Timed 6m hop
	Functional strength testing and hop testing should be reserved for patients returning to high level activity

Suggested Interventions	Continue progressive strength training per previous phases Agility • Begin agility exercises between 50-75% effort (utilize visual feedback to improve mechanics as needed) • Advance plyometrics: Bilateral to single leg, progress by altering surfaces, adding ball toss, 3D rotations, etc. • Side shuffling, Carioca, Figure 8, Zig-zags, Resisted jogging (Sports Cord) in straight planes, backpedaling Plyometrics and sport/position-specific training • Single-leg hop downs from increasing height (up to 12” box), Single-leg hop-holds, Double and single-leg hopping onto unstable surface, Double and single-leg jump turns, Repeated tuck jumps
Criteria for Return to Sport	• ROM: full, pain-free knee ROM, symmetrical with the uninvolved limb • Strength: Isokinetic testing 90% or greater for hamstring and quad at 60º/sec and 300º/sec ***(Appendix D)*** • Effusion: No reactive effusion ≤ 1+ with sport-specific activity • Weight Bearing: normalized gait and jogging 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 ***(Appendix E)*** • Physician Clearance

Appendix A: Bag Hang

Emphasis on low load, long duration stretching

- *Goal: 60 minutes of bag hang time total per day.*
- *Ideally: 4x15 minutes (or greater) per day*



Appendix B: NMES Set Up

2 or 4 pad set-up is appropriate

- NMES pads are placed on the proximal and distal quadriceps
- Patient: Seated with the knee in at least 60º 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
- The patient is instructed to relax while the e-stim generates at least 50% of their max volitional contraction against a fixed resistance OR maximal tolerable amperage without knee joint pain
- 10-20 seconds on/ 50 seconds off x 15 min

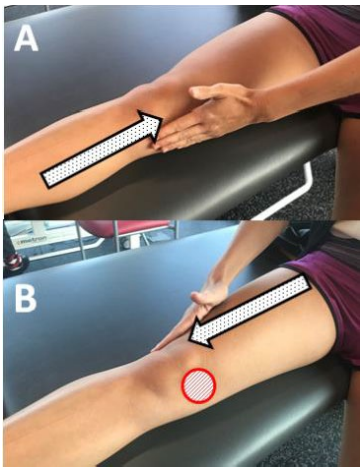
Appendix C: Stoke Test / Swelling Assessment

The Stroke Test

The stroke test is a great way to assess your swelling independently. The results of this assessment will help you decide what exercises are appropriate.

A. Using one hand, gently sweep the inside portion of your knee 2-3 times (pushing toward the hip joint).

B. On the outside portion of the knee, immediately sweep downward (toward the ankle). Watch the inside portion of the knee *(indicated by hashed circle in photo)* for a wave of fluid to appear during the downstroke.



Grading System

(Table adapted from Sturgill L et al, Journal of Orthopaedic & Sports Physical Therapy, 2009)

Test Result	Grade
No wave produced on downstroke	Zero
Small wave on inside aspect of knee with downstroke	Trace
Large bulge on inside aspect of knee with downstroke	1+
Swelling spontaneously returns to inside aspect of knee after upstroke (no downstroke necessary)	2+
So much fluid that it is not possible to move the swelling out of the inside aspect of the knee	3+

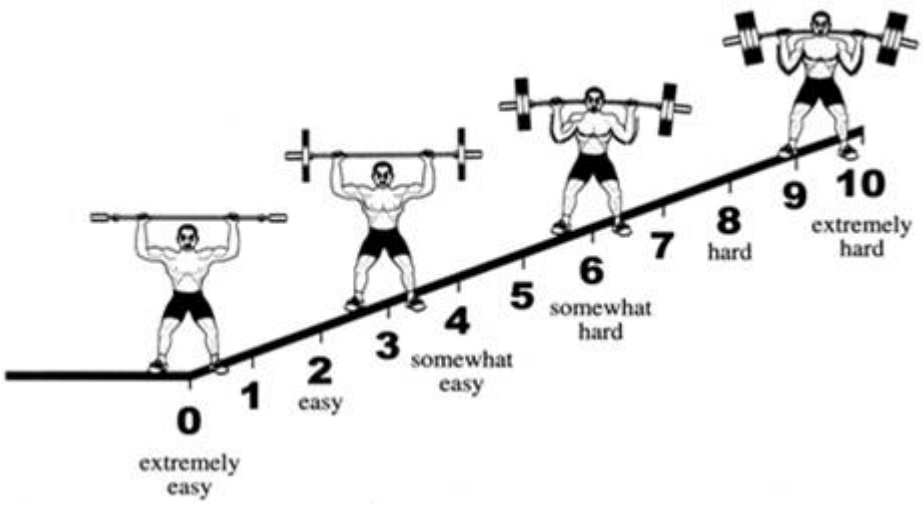
Indications for Activity

3+ or 2+	1+	Trace or Zero
Red Light	**Yellow Light**	**Green Light**
• No running, jumping or cutting or heavy lifting until swelling decreases to 1+ or less • Do not progress program until you speak with your therapist • Utilize swelling management strategies (ice, compression, elevation, NSAIDs)	• Proceed with caution • You may participate in running, jumping and normal lifting routine. • Check effusion before and after workouts • Utilize swelling management strategies (ice, compression, elevation, NSAIDs)	• May participate in running, jumping and normal lifting routine without restriction • Continue to monitor swelling after activity

Appendix D: Blood Flow Restriction Training

Precautions (must get permission from MD)	Contraindications
▪ Patients with poor circulatory systems (Indicators: shining or scaly skin, brittle dry nails, extremity hair loss, increased capillary filling time, and presence of varicose veins) ▪ Patients who are obese or with limb tissue that is loose ▪ Arterial claudification ▪ Abnormal clotting times ▪ Diabetes ▪ Sickle cell trait ▪ Tumor ▪ General infection ▪ Hypertension ▪ Cardiopulmonary conditions ▪ Renal compromise ▪ Clinically significant acid-base imbalance ▪ Atherosclerotic vessels ▪ Taking anti-hypertensive medications	▪ Venous thromboembolism ▪ Impaired circulation or peripheral vascular compromise ▪ Previous revascularization of the extremity ▪ Extremities with dialysis access ▪ Acidosis ▪ Sickle cell anemia ▪ Extremity infection ▪ Tumor distal to the tourniquet ▪ Medications/supplements known to ↑ clotting risk ▪ Open fracture ▪ Increased intracranial pressure ▪ Open soft tissue injuries ▪ Post-traumatic hand reconstructions ▪ Severe crushing injuries ▪ Severe hypertension ▪ Elbow surgery with excessive swelling ▪ Skin grafts in which all bleeding points distinguished ▪ Secondary or delayed procedures after immobilization ▪ Vascular grafting lymphectomies ▪ Cancer

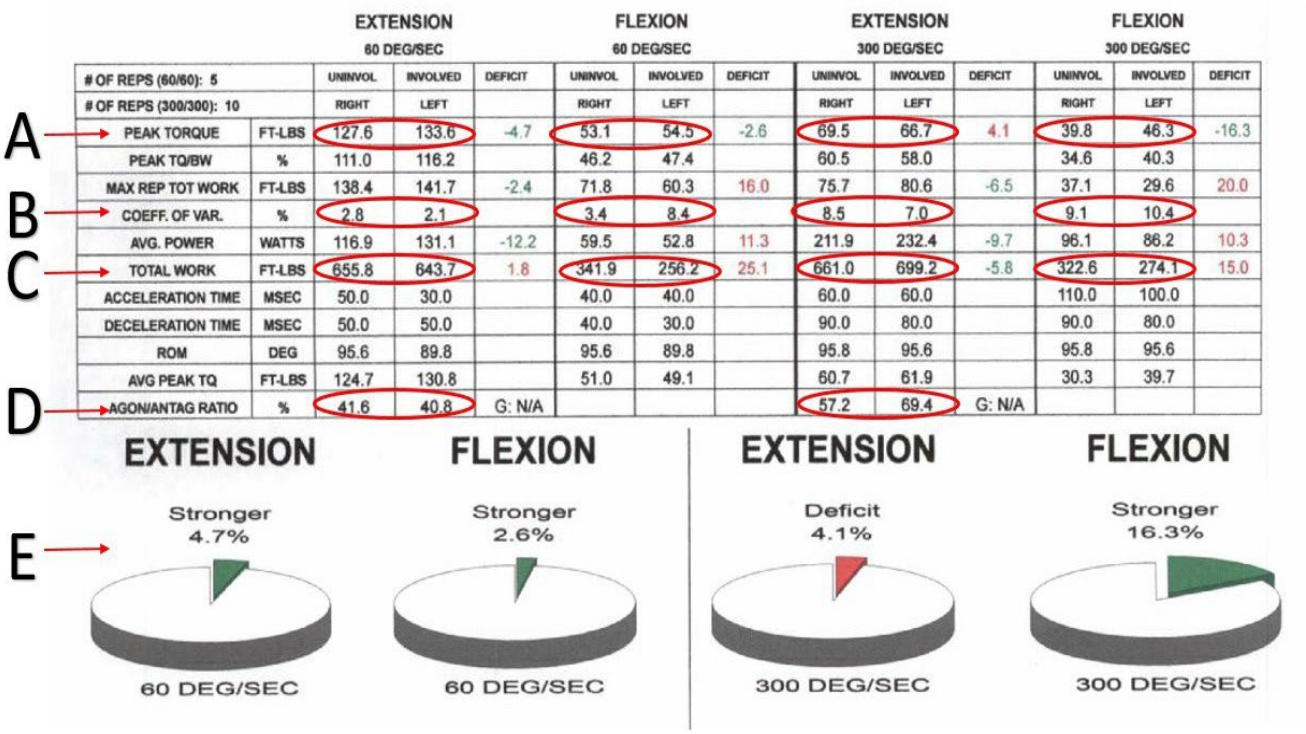
Training Intensity: 20-40% 1RM or use the Omnibus Resistance Exercise Scale (below). Patient chooses weight/resistance that corresponds to 2-3



Exercise Prescription:

- If Patient achieves:
  - 75 repetitions: continue with training, re-assess intensity within 1-3 sessions and change as strength improves
  - 60-74 repetitions: continue with training, but extend rest period between sets 3 and 4 to 45 seconds until 75 repetitions is completed
  - 45-59 repetitions: continue with training, but extend rest period between all sets to 45-60 seconds
  - <44 repetitions: reduce load by approximately 10% until repetitions are achieved
- If patient is forced to stop before 75 repetitions due to undue pain, soreness, or general uncomfortable feeling underneath the cuff→ reduce tourniquet pressure by 10mmHg at each training session until cuff tolerance is achieved. Ramp cuff pressure back up by 10 mmHg to target limb occlusion pressure if patient can tolerate.

Appendix E: Isokinetic Data Interpretation



	EXTENSION 60 DEG/SEC			FLEXION 60 DEG/SEC			EXTENSION 300 DEG/SEC			FLEXION 300 DEG/SEC		
# OF REPS (60/60): 5	UNINVOL	INVOLVED	DEFICIT	UNINVOL	INVOLVED	DEFICIT	UNINVOL	INVOLVED	DEFICIT	UNINVOL	INVOLVED	DEFICIT
# OF REPS (300/300): 10	RIGHT	LEFT		RIGHT	LEFT		RIGHT	LEFT		RIGHT	LEFT	
A → PEAK TORQUE FT-LBS	127.6	133.6	-4.7	53.1	54.5	-2.6	69.5	66.7	4.1	39.8	46.3	-16.3
PEAK TQ/BW %	111.0	116.2		46.2	47.4		60.5	58.0		34.6	40.3	
MAX REP TOT WORK FT-LBS	138.4	141.7	-2.4	71.8	60.3	16.0	75.7	80.6	-6.5	37.1	29.6	20.0
B → COEFF. OF VAR. %	2.8	2.1		3.4	8.4		8.5	7.0		9.1	10.4	
AVG. POWER WATTS	116.9	131.1	-12.2	59.5	52.8	11.3	211.9	232.4	-9.7	96.1	86.2	10.3
C → TOTAL WORK FT-LBS	655.8	643.7	1.8	341.9	256.2	25.1	661.0	699.2	-5.8	322.6	274.1	15.0
ACCELERATION TIME MSEC	50.0	30.0		40.0	40.0		60.0	60.0		110.0	100.0	
DECELERATION TIME MSEC	50.0	50.0		40.0	30.0		90.0	80.0		90.0	80.0	
ROM DEG	95.6	89.8		95.6	89.8		95.8	95.6		95.8	95.6	
AVG PEAK TQ FT-LBS	124.7	130.8		51.0	49.1		60.7	61.9		30.3	39.7	
D → AGON/ANTAG RATIO %	41.6	40.8	G: N/A				57.2	69.4	G: N/A			

		Definition	Clinical Impact	What to do
A	Peak Torque (ft-lbs)	Peak torque during repetitions	Symmetry criteria (see 'E'- this is the data represented in pie charts)	If <80%; continue unilateral, high resistance strength training
B	Coefficient of Variance (%)	Between repetition variability	Goal: < 15%	If >15%, consider retest
C	Total Work (ft-lbs)	Torque over all repetitions	Possible indicator of fatigue	If >10%; consider high volume training
D	Agonist/Antagonist Ratio (%)	Hamstring/Quadriceps Ratio	Goal: >60%	<60%; ensure 1:1 quadriceps:hamstring exercise ratio
E	Limb Symmetry Pie Charts	Strength relative to involved limb	Goal: <10% asymmetry (either direction- deficit OR stronger on involved limb)	If <80%, continue NMES in addition to strength training If <90%, continue unilateral > bilateral strength training emphasis

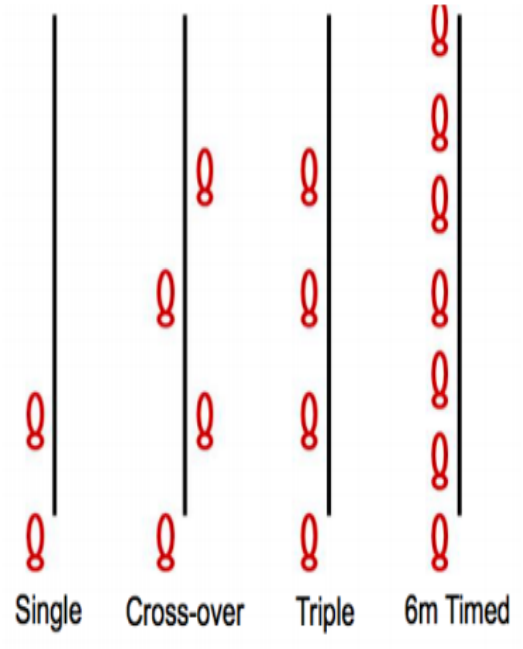
Appendix F: Isokinetic Testing and Appropriate Alternatives

Sinacore, J. A., Evans, A. M., Lynch, B. N., Joreitz, R. E., Irrgang, J. J., & Lynch, A. D. (2017). Diagnostic accuracy of handheld dynamometry and 1-repetition-maximum tests for identifying meaningful quadriceps strength asymmetries. *Journal of orthopaedic & sports physical therapy*, *47*(2), 97-107.

Isokinetic Dynamometry		• Considered the "gold standard" • 60°/sec for strength and power assessment • 300°/second for speed and endurance assessment
Hand Held Dynamometry with Static Fixation at 90°		• Appropriate alternative • Results may overestimate quadriceps strength symmetry: be cautious with data interpretation
SL 1RM Knee Extension Machine: 90°- 45°		• Appropriate alternative • Recommended to decrease stress on PF joint and limit strain on reconstructed ACL for up to 6 months • Results may overestimate quadriceps strength symmetry: be cautious with data interpretation
SL 1RM Leg Press		• Fair alternative • Results in significant overestimation of quadriceps strength symmetry due to compensation from other LE muscle groups
SL 1RM Knee Extension Machine: 90°- 0°		• Fair alternative • May be uncomfortable and/or inappropriate due to PF stress

Appendix G: Single Leg Hop Series

1) **Single hop for distance:** Have the subject line their heel up with the zero mark of the tape measure, wearing athletic shoes. The subject then hops as far as he/she can, landing on the same push off leg, for at least 3 seconds. The arms are allowed to move freely during the testing. Allow him/her to perform 2 practice hops on each leg. Then, have the subject perform 2 testing trial, recording each distance from the starting point to the back of the heel. Average the distanced hopped for each limb. The Limb Symmetry Index: Involved limb distance/Uninvolved limb distance X 100%.
2) **Cross-over hop for distance:** The subject lines their heel up with the zero mark of the tape measure and hops 3 times on one foot, crossing fully over the center line each time. Each subject should hop as far forward as he/she can on each hop, but only the total distance hopped is recorded. The arms are allowed to move freely during the testing. Allow him/her to perform 2 practice hops on each leg. Then, have the subject perform 2 testing trial, recording each distance from the starting point to the back of the heel. Average the distanced hopped for each limb. The Limb Symmetry Index: Involved limb distance/Uninvolved limb distance X 100%.
3) **Triple hop for distance:** The subject lines their heel up with the zero mark of the tape measure and hops 3 times on one foot. Each subject should hop as far forward as he/she can on each hop, but only the total distance hopped is recorded. The arms are allowed to move freely during the testing. Allow him/her to perform 2 practice hops on each leg. Then, have the subject perform 2 testing trial, recording each distance from the starting point to the back of the heel. Average the distanced hopped for each limb. The Limb Symmetry Index: Involved limb distance/Uninvolved limb distance X 100%.
4) **Timed 6-meter hop:** The subject lines their heel up at the zero mark of the tape measure and hops, on cue with the tester, as fast as they can the length of the 6-meter tape. The arms are allowed to move freely during the testing. Allow him/her to perform 2 practice hops on each leg. Then, have the subject perform 2 testing trial, recording each distance from the starting point to the back of the heel. Average the distanced hopped for each limb. The Limb Symmetry Index: Involved limb time/Uninvolved limb time X 100%.



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Reviewer: Caroline Brunst, PT, DPT; Robert Duerr, MD; Robert Magnussen, MD; David Flanigan, MD; Christopher Kaeding, MD
Updated: April 2023

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