

PATELLAR OPEN REDUCTION INTERNAL FIXATION (ORIF)

Background

The following patellar ORIF rehabilitation protocol is specific to patients with an ORIF performed at The Ohio State University Wexner Medical Center.

The rehabilitation recommendations below are based upon the guidance of content experts and evidence-based practice. Progression through each phase is based on the patient demonstrating readiness by achieving functional criteria rather than the time elapsed from surgery. The time frames identified after each phase are approximate times for the average patient, NOT guidelines for progression.

Disclaimer

Progression is time and criterion-based, dependent on soft tissue healing, patient demographics and clinician evaluation. If you are working with an Ohio State Sports Medicine patient and questions arise, please call 614-293-2385.



Summary of Recommendations

<p>Precautions</p>	<ol style="list-style-type: none"> 1. WBAT with brace locked in extension for 6 WEEKS. 2. No flexion ROM for 2 WEEKS. <ol style="list-style-type: none"> a. At 2 WEEKS unlock brace 30 degrees b. Unlock brace an additional 30 degrees every 2 WEEKS 3. Unlock brace for ambulation at 6 WEEKS <ol style="list-style-type: none"> a. AROM and gentle knee strengthening as tolerated b. Avoid forceful flexion PROM unless specifically instructed c. Can begin stationary bike without resistance at 6 WEEKS 4. Open kinetic chain strength progression: <ol style="list-style-type: none"> a. 6 weeks: short arc quad, long arc quad (unloaded), multi-angle isometrics b. 9 weeks: initiate loaded knee extension <ol style="list-style-type: none"> i. Begin 100-60 degrees and progress as tolerated to full, loaded knee extension 5. Closed kinetic chain strength progression: <ol style="list-style-type: none"> a. 6 weeks: initiate weight-bearing closed chain strengthening with progressions as tolerated
<p>Outcome Tools</p>	<p>Collect the Lower Extremity Functional Scale (LEFS) at each visit</p>
<p>Strength Testing</p>	<ol style="list-style-type: none"> 1. Isometric testing no earlier than 9 weeks- fixed at 90° 2. Isokinetic testing no earlier than 16 weeks
<p>Criteria to Discharge Assistive Device</p>	<ol style="list-style-type: none"> 1. <u>Timeline</u>: No earlier than 9 weeks for brace/crutches – defer to surgical team for discharge of crutches earlier than this time 2. <u>ROM</u>: Full active knee extension; no pain on passive overpressure 3. <u>Strength</u>: Able to perform strong quad isometric with full tetany and superior patellar glide and able to perform 2x10 SLR without quad lag 4. <u>Effusion</u>: 1+ or less is preferred (2+ acceptable if all other criteria are met) 5. <u>Weight Bearing</u>: Demonstrates pain-free ambulation without visible gait deviation
<p>Criteria to Initiate Running and Jumping</p>	<ol style="list-style-type: none"> 1. <u>Timeline</u>: No earlier than 16 weeks 2. <u>ROM</u>: full, pain-free knee ROM, symmetrical with the uninvolved limb 3. <u>Strength</u>: Isokinetic testing 80% or greater for hamstring and quad at 60°/sec and 300°/sec (Appendix D) 4. <u>Effusion</u>: 1+ or less 5. <u>Weight Bearing</u>: normalized gait and jogging mechanics 6. <u>Neuromuscular Control</u>: Pain-free hopping in place
<p>Criteria for Return to Sport</p>	<ol style="list-style-type: none"> 1. <u>Timeline</u>: No earlier than 6 months 2. <u>ROM</u>: full, pain-free knee ROM, symmetrical with the uninvolved limb 3. <u>Strength</u>: Isokinetic testing 90% or greater for hamstring and quad at 60°/sec and 300°/sec (Appendix D) 4. <u>Effusion</u>: No reactive effusion ≥ 1+ with sport-specific activity 5. <u>Weight Bearing</u>: normalized gait and jogging mechanics 6. <u>Neuromuscular control</u>: appropriate mechanics and force attenuation strategies with high level agility, plyometrics, and high impact movements 7. <u>Functional Hop Testing</u>: LSI 90% or greater for all tests (Appendix E) 8. <u>Physician Clearance</u>



RED/YELLOW FLAGS

Red flags are signs/symptoms that require immediate referral for re-evaluation. Yellow flags are signs/symptoms that require modification to plan of care.

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



Protection Phase (Post-Patellar ORIF – 6 weeks)

Appointments	Goal: Gradually restore ROM, minimize effusion and pain. Post-operative evaluation should be performed based on surgical team recommendations. Follow-up appointments 1-2x per week, depending on progression towards goals.
Precautions	<ol style="list-style-type: none"> 1. WBAT with brace locked in extension for 6 WEEKS. 2. No flexion ROM for 2 WEEKS. <ol style="list-style-type: none"> a. At 2 WEEKS unlock brace 30 degrees b. Unlock brace an additional 30 degrees every 2 WEEKS 3. No forced flexion x 6 WEEKS
Pain and Effusion	≥ 2+ (using Modified Stroke Test) Cryotherapy and compression (i.e., Donut, ace wrap, limited WB therapeutic exercise)
ROM	<p><u>Extension:</u> Emphasis on achieving full knee extension immediately following surgery. Utilize low load, long duration stretching – See <i>Appendix A</i>. If full extension is not achieved by 4 weeks, contact surgeon regarding ROM concerns.</p> <p><u>Flexion:</u> No flexion ROM x2 weeks. At 2 weeks, brace can be unlocked 30 degrees. Can unlock an additional 30 degrees every 2 weeks. NO forced flexion for 6 weeks.</p>
Therapeutic Exercise	<ul style="list-style-type: none"> • Emphasis on quad activation without gluteal co-contraction • Restore patellar mobility • Symmetrical ROM • Decrease effusion • Ambulation with appropriate joint loading and without obvious gait deviation as able
Suggested Interventions	<ul style="list-style-type: none"> • Extension ROM: bag hangs or prone hangs (<i>Appendix A</i>) • Flexion ROM (beginning WEEK 2): heel slides, wall slides (see precautions) • Patellar mobilization: superior, inferior, medial, lateral • Gentle Quad Isometrics; SLR 4-way <u>IN BRACE</u> • TKE: prone and standing • Weight shifting, SL balance • Neuromuscular re-education using electrical stimulation (NMES) long sitting
NMES Parameters <i>Appendix B</i>	<ul style="list-style-type: none"> • NMES pads are placed on the proximal and distal quadriceps • Patient: long sitting in extension • The patient is instructed to achieve maximal tolerable amperage without knee joint pain • 10-20 seconds on/ 50 seconds off x 15 min
Discharge Criteria	<ul style="list-style-type: none"> • <20% quadriceps deficit on isokinetic testing at both 60 deg/s and 300 deg/s
Blood Flow Restriction Training <i>Appendix D</i>	<ul style="list-style-type: none"> • Blood Flow Restriction (BFR) training can be initiated as soon as sutures are removed • Ensure patient has no contraindications (<i>Appendix D</i>) 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). <i>BFR should never be performed during a plyometric exercise.</i> • Training Load: 20-40% 1 RM (Estimated, or use OMNI-RES, see <i>Appendix D</i>) • Limb Occlusion Pressure= 80% (see <i>Appendix D</i> 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.



Criteria to Progress to Early Loading Phase	<p><u>ROM:</u> ≥ 0-90 degrees</p> <p><u>Strength:</u> Quadriceps set with normal superior patellar translation, SLR x 10 seconds without extensor lag</p> <p>Goals: (Do not limit progression to next phase; however, should be addressed with interventions)</p> <p><u>Effusion:</u> 2+ or less with Modified stroke test (Appendix C)</p> <p><u>Weight Bearing:</u> Able to tolerate weight bearing with brace locked in extension without increased pain and ≤ 2+ effusion</p>
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Early Loading & Return to Function Phase (6-9 weeks)

Appointments	Goal: to improve LE loading symmetry, increase strength and normalize gait mechanics. 1-2 visits per week with emphasis on HEP compliance (2-3 days per week outside of therapy).
Precautions	ROM as tolerated in/out of brace, avoid forceful PROM WBAT with gait aide and gradually unlock brace based on functional strength
Pain and Effusion	Cryotherapy/compression as needed for reactive effusion. Patellar taping to reduce PF symptoms if present
ROM	<ul style="list-style-type: none"> • Monitor and progress knee ROM, patellar mobility, and LE flexibility • ROM as tolerated in/out of brace, avoid forceful PROM • Begin bike for ROM and no resistance • Soft tissue and scar mobilization techniques as tolerated
Suggested Interventions and timelines	<ul style="list-style-type: none"> • Initiate gentle, multi-angle knee isometrics and progress as tolerated • Initiate gentle open chain knee extension exercises <ul style="list-style-type: none"> ○ Begin with short arc quad ○ Progress to long arc quad • Initiate WB quadriceps exercises with emphasis on proper LE mechanics • Progress in gluteal and lumbopelvic strength and stability • Progress single leg balance • NMES seated at 60-90 degrees of knee flexion <ul style="list-style-type: none"> ○ 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 • BFR (continue as in early phase, adding appropriate exercises)
Blood Flow Restriction training	<ul style="list-style-type: none"> • Blood Flow Restriction (BFR) training can be initiated at the 6 week mark for this patient population. • Ensure patient has no contraindications (Appendix F) 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 2-5 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). <i>BFR should never be performed during a plyometric exercise.</i> • Training Load: 20-40% 1 RM (Estimated, or use OMNI-RES, see Appendix F) • Limb Occlusion Pressure= 80% (see Appendix F 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.
Criteria to Progress to Strength Phase	<ol style="list-style-type: none"> 1. <u>ROM</u>: Minimum of 120 degrees flexion, pain free AROM including PF mobility 2. <u>Effusion</u>: 1+ or less 3. <u>Strength</u>: Pain-free SLR FLX 2x10 without lag, pain-free knee extension isometrics and unloaded OKC strengthening 4. <u>Weight Bearing</u>: Able to tolerate CKC exercise program without increased pain or >1+ effusion 5. <u>Neuromuscular Control</u>: Demonstrates proper lower extremity mechanics with all therapeutic exercises (bilaterally)



Strength Phase (9-12 weeks)

Appointments	Goal to increase lower extremity strength 1-2 visits per week with emphasis on patient compliance with resistance training as part of HEP (2-3 days per week outside of therapy).
Precautions	Range of motion as tolerated, including PROM; strengthening as tolerated; no high impact activity
Criteria to Discharge Assistive Device	<ol style="list-style-type: none"> 1. <u>Timeline</u>: 9 weeks 2. <u>ROM</u>: Full active knee extension; no pain on passive overpressure 3. <u>Strength</u>: Able to perform strong quad isometric with full tetany and superior patellar glide and able to perform 2x10 SLR without quad lag 4. <u>Effusion</u>: 1+ or less is preferred (2+ acceptable if all other criteria are met) 5. <u>Weight Bearing</u>: Demonstrates pain-free ambulation without visible gait deviation
Pain and Effusion	Cryotherapy/compression as needed for reactive effusion. Patellar taping to reduce PF symptoms if present
ROM	<ul style="list-style-type: none"> • Monitor and progress knee ROM, patellar mobility, and LE flexibility <ul style="list-style-type: none"> ○ Progress range of motion as tolerated (including passive)
Suggested Interventions and timelines	<ul style="list-style-type: none"> • Work towards normal gait/walking • Gradually increase strengthening/resistance as tolerated • Progress multi-angle knee isometrics • Initiate isotonic open chain knee extensions <ul style="list-style-type: none"> ○ Begin 100-60 degrees and progress as tolerated to full, loaded knee extension • Progress single leg balance
Criteria to Progress to Return to Impact Phase	<ol style="list-style-type: none"> 1. <u>ROM</u>: Maintain full, pain free AROM including PF mobility 2. <u>Effusion</u>: 1+ or less 3. <u>Weight Bearing</u>: Able to tolerate therapeutic exercise program without increased pain or >1+ effusion 4. <u>Neuromuscular Control</u>: Demonstrates proper lower extremity mechanics with all therapeutic exercises (bilaterally) 5. <u>Outcome Tools</u>: $\geq 7/10$ on #10 IKDC Questionnaire



Return to Impact (12 weeks-Return to Sport)

Appointments	Increased frequency from previous stage to initiate plyometric training and return to running program once appropriate
Criteria to initiate Running and Jumping	<ol style="list-style-type: none"> 1. No earlier than 16 weeks 2. <u>ROM</u>: full, pain-free knee ROM, symmetrical with the uninvolved limb 3. <u>Strength</u>: Isokinetic testing 80% or greater for hamstring and quad at 60°/sec and 300°/sec (See Appendix C and D) 4. <u>Effusion</u>: 1+ or less 5. <u>Weight Bearing</u>: normalized gait and jogging mechanics 6. <u>Neuromuscular Control</u>: Pain-free hopping in place (DL and SL hops in place)
Precautions	<p>Criteria to initiate hopping</p> <ul style="list-style-type: none"> • Full, pain free ROM • ≤ 1+ effusion • ≥ 7 /10 on #10 IKDC Questionnaire • ≥ 80% isokinetic strength symmetry (hamstrings and quadriceps) OR ≥ 80% limb symmetry on acceptable isokinetic alternative (See Appendix D) <p>Criteria to initiate jogging (in addition to above criteria)</p> <ul style="list-style-type: none"> • Hop downs with appropriate landing mechanics <ul style="list-style-type: none"> ○ DL (starting at 6-8" and progressing per patient's tolerance), SL (starting at 2-4" and progress per patient's tolerance) • Audible rhythmic strike patterns and no gross visual compensation
Pain and Effusion	Effusion may increase with increased activity, ≤1+ and/or non-reactive effusion for progression of plyometrics
ROM	Full, symmetrical to contralateral limb, and pain-free with overpressure
Therapeutic Exercise	<ul style="list-style-type: none"> • Performance of the quadriceps, hamstrings and trunk dynamic stability • Muscle power generation and absorption via plyometrics • Sport- and position-specific activities • 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. • Endurance: low impact - treadmill walking, stepper, elliptical only if without reactive effusion
Suggested Interventions	<p>Therapeutic Exercise/Neuromuscular Re-education</p> <ul style="list-style-type: none"> • Squats, leg extension, leg curl, leg press, deadlifts, lunges (multi-direction), crunches, rotational trunk exercises on static and dynamic surfaces, monster walks, PWB to FWB jumping <p>Agility</p> <ul style="list-style-type: none"> • Side shuffling, Carioca, Figure 8, Zig-zags, Resisted jogging (Sports Cord) in straight planes, backpedaling <p>Plyometrics</p> <ul style="list-style-type: none"> • 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 • Refer to plyometric guide



**Criteria for
Return to
Sport**

1. No sooner than 6 months
2. ROM: full, pain free knee ROM, symmetrical with the uninvolved limb
3. Strength: Isokinetic testing 90% or greater for hamstring and quad at 60°/sec and 300°/sec
4. Effusion: No reactive effusion \geq 1+ with sport-specific activity
5. Weight Bearing: normalized gait and jogging mechanics
6. Neuromuscular control: appropriate mechanics and force attenuation strategies with high level agility, plyometrics, and high impact movements
7. Functional Hop Testing: LSI 90% or greater for all tests (**Appendix E**)
8. Physician Clearance



Appendix A: Bag Hang

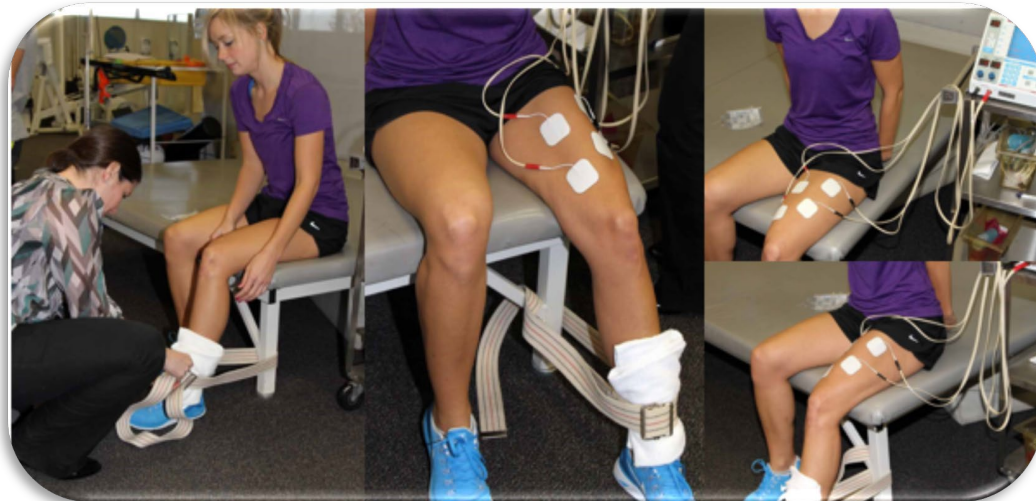
Emphasis on low load, long duration stretching.

Goal: 60 minutes TOTAL per day (4x15 minutes, 2x30minutes, etc)



Appendix B: NMES Set Up

2 or 4 pad set-up is appropriate

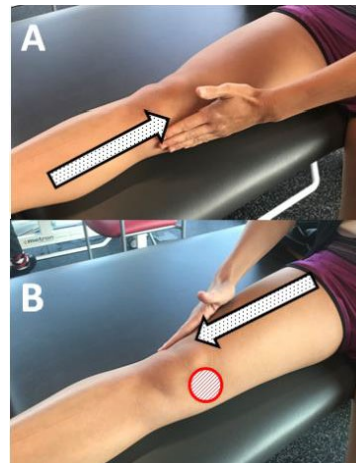


Appendix C: Stoke Test / Swelling Assessment

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 
<ul style="list-style-type: none"> 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) 	<ul style="list-style-type: none"> 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) 	<ul style="list-style-type: none"> May participate in running, jumping and normal lifting routine without restriction Continue to monitor swelling after activity



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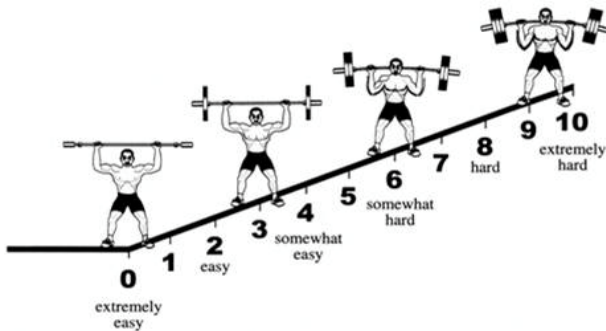
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Appendix D: Blood Flow Restriction Training

Precautions (must get permission from MD)	Contraindications
<ul style="list-style-type: none"> ▪ 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 claudication ▪ Abnormal clotting times ▪ Diabetes ▪ Sick cell trait ▪ Tumor ▪ General infection ▪ Hypertension ▪ Cardiopulmonary conditions ▪ Renal compromise ▪ Clinically significant acid-base imbalance ▪ Atherosclerotic vessels ▪ Taking anti-hypertensive medications 	<ul style="list-style-type: none"> ▪ Venous thromboembolism ▪ Impaired circulation or peripheral vascular compromise ▪ Previous revascularization of the extremity ▪ Extremities with dialysis access ▪ Acidosis ▪ Sick 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

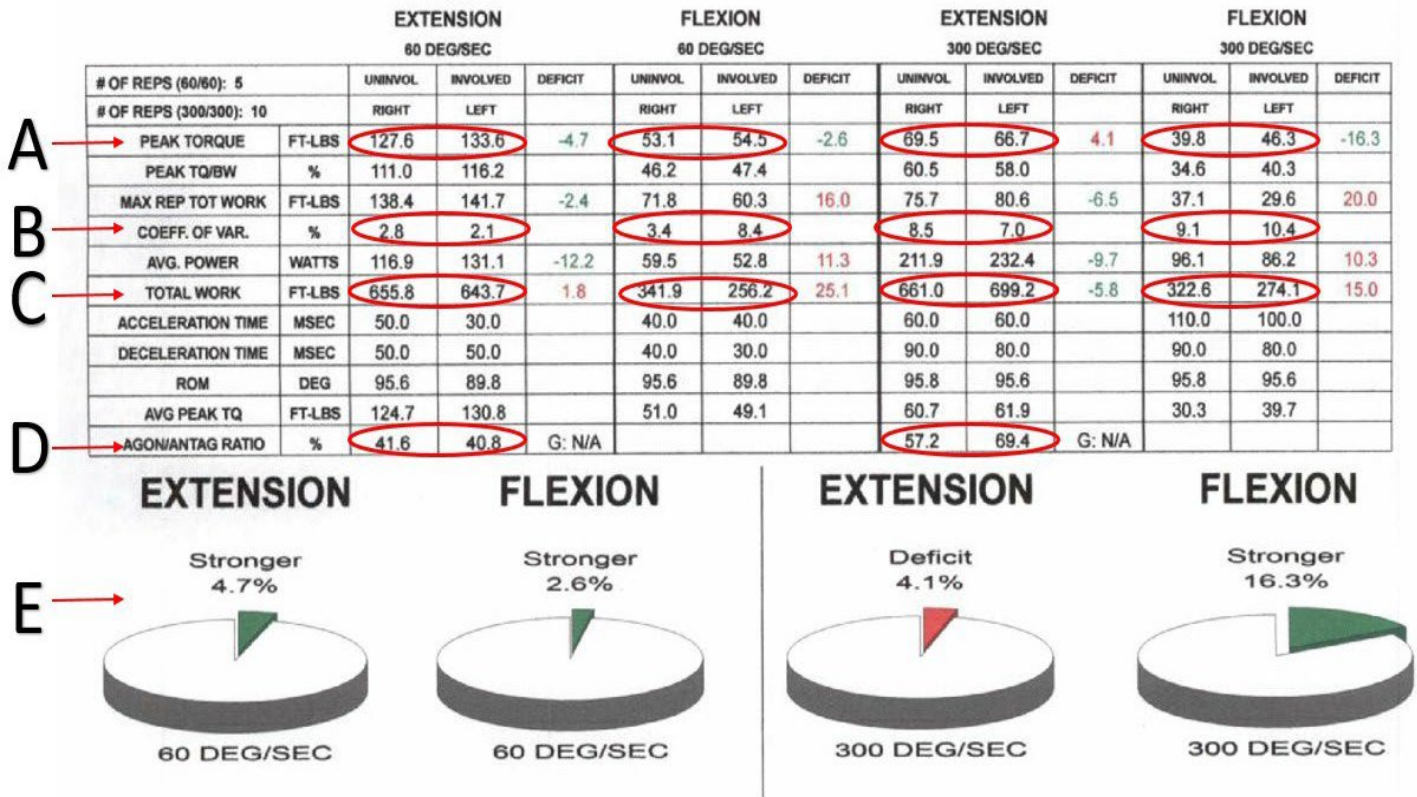


Exercise Prescription:

- 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








		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 Alternatives

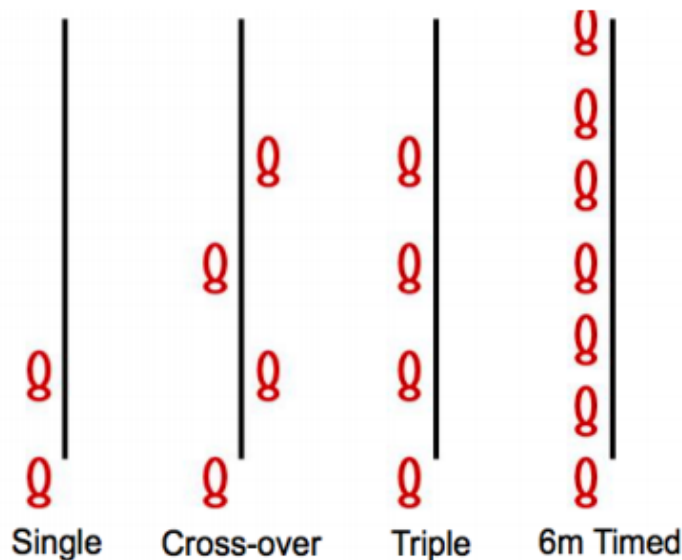
Sinacore, J. A., Evans, A. M., Lynch, B. N., Joreitz, R. E., Irrgang, J. J., & Lynch, A. D. (2017). Diagnostic accuracy of handheld dynamometry and 1-repetition-maximum tests for identifying meaningful quadriceps strength asymmetries. *Journal of orthopaedic & sports physical therapy*, 47(2), 97-107.

<p>Isokinetic Dynamometry</p>		<ul style="list-style-type: none"> • Considered the “gold standard” • 60°/sec for strength and power assessment • 300°/second for speed and endurance assessment
<p>Hand Held Dynamometry with Static Fixation at 90°</p>		<ul style="list-style-type: none"> • Appropriate alternative • Results may overestimate quadriceps strength symmetry: be cautious with data interpretation
<p>SL 1RM Knee Extension Machine: 90° - 45°</p>		<ul style="list-style-type: none"> • 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
<p>SL 1RM Leg Press</p>		<ul style="list-style-type: none"> • Fair alternative • Results in significant overestimation of quadriceps strength symmetry due to compensation from other LE muscle groups
<p>SL 1RM Knee Extension Machine: 90° - 0°</p>		<ul style="list-style-type: none"> • 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: $\text{Involved limb distance} / \text{Uninvolved limb distance} \times 100\%$.
- 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: $\text{Involved limb distance} / \text{Uninvolved limb distance} \times 100\%$.
- 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: $\text{Involved limb distance} / \text{Uninvolved limb distance} \times 100\%$.
- 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: $\text{Involved limb time} / \text{Uninvolved limb time} \times 100\%$.



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