Evidence-Based ACL Reconstruction Rehabilitation Protocol

Matthew Stein, MD

518-489-2663 ext 7206

Criteria-based progression for uncomplicated primary ACL reconstruction. Concomitant meniscus, cartilage, multiligament procedures, graft-specific concerns, or surgeon-specific restrictions supersede this protocol.

Phase	Typical timing*	Goals / advancement criteria	Rehabilitation focus
1. Immediate postoperative	0-2 weeks	Full extension as soon as possible; flexion progressing toward 110-120°+; control pain/effusion; good quadriceps activation; straight-leg raise (SLR) without lag; safe gait.	**Inflammation control:** ice/cryotherapy, compression, elevation and activity modification. Patellar mobilization, heel slides, extension hangs, quad sets, SLR, ankle pumps/calf raises, weight shifts and early closed-chain work as tolerated. Consider NMES when quadriceps activation is poor.
2. Early strength / gait	2-6 weeks	Full extension; flexion approaching full; minimal/trace effusion; normalized gait; no buckling; improving single-leg control.	Bike when ROM permits; squats, leg press, step-ups/downs, bridges, hip/core work, balance/proprioception and calf work. Progress resistance based on symptoms and movement quality.
3. Strength development	6-12 weeks	Full ROM; no reactive effusion; controlled single-leg squat/step-down; progressive quadriceps and hamstring strength.	Progressive resistance: squats, split squats, leg press, RDL/deadlift patterns, step-ups, isolated quadriceps work, hamstrings, calf and single-leg strengthening. Open-chain knee extension may begin in a limited arc (commonly 90-45°) around week 4 and progress as tolerated.
4. Running preparation	~10-16+ weeks	Full extension; ≥95% flexion ROM; no/trace effusion; quadriceps limb-symmetry index (LSI) approximately ≥80%; pain-free hopping/pogos; acceptable landing mechanics.	Plyometric preparation, single-leg loading and graded impact exposure. Begin walk-jog progression only when clinical and strength criteria are met.
5. Running / plyometrics	~3-5 months	Tolerates running without pain or next-day effusion; continued strength gains; controlled bilateral and unilateral landing.	Progress running volume before speed; bilateral to unilateral jumping; acceleration/deceleration; progressive lateral movement and landing mechanics.
6. Agility / sport-specific	~5-8 months	Quadriceps/hamstring strength approaching ≥90% LSI; hop performance ≥90%; good deceleration and change-of-direction mechanics.	Cutting, pivoting, reactive drills, high-speed running, sport-specific conditioning and graded noncontact practice. Assess power/explosiveness and rate of force development, not just strength symmetry, in competitive athletes.
7. Return to unrestricted sport	Usually ≥9 months; often 9-12+ months	No pain/effusion; full ROM; stable exam; strength and hop testing ≥90% and preferably closer to 95-100% for high-demand pivoting athletes; good movement quality; psychological readiness; completion of graded sport progression.	Progress noncontact -> controlled contact -> full practice -> competition. Clearance is criteria-based and should not occur solely because a calendar date has been reached.

*Timelines are guardrails. Advancement should be driven by ROM, effusion, strength, gait, movement quality and functional testing.

Postoperative Brace Progression

• **Initially:** brace locked in full extension for weight bearing and ambulation until adequate quadriceps control is present and the patient can perform an SLR without extensor lag.

• **Unlock:** once a reliable SLR without lag and adequate quadriceps control during gait are demonstrated, the brace may be unlocked for ambulation.

• **Discontinue postoperative brace:** typically at 4-6 weeks when full or near-full extension, good quadriceps control, no SLR lag, stable non-antalgic gait without buckling, and minimal/trace effusion are present.

• **Functional ACL brace:** if planned for athletic return, measure/fit at approximately 4 months so it is available for later running, agility, cutting and sport-specific progression. Functional bracing is an adjunct and does not replace objective return-to-sport criteria.

Meniscus Repair Modification

• **If a concomitant meniscus repair is performed: no weight-bearing knee flexion beyond 90° for the first 6 weeks.** Tear pattern, repair construct and surgeon-specific restrictions may require additional limitations on weight bearing or ROM and should take precedence.

Key Evidence-Based Details

Early motion and weight bearing

For an uncomplicated isolated ACL reconstruction, active knee motion should begin immediately and early progressive weight bearing is generally appropriate as tolerated, subject to surgical restrictions.

Extension is the early ROM priority

Restore full knee extension promptly while gradually recovering flexion. Persistent loss of extension is a major early rehabilitation concern.

Quadriceps activation and strength

Use progressive loading rather than relying only on low-load exercises. NMES can be useful early when arthrogenic muscle inhibition limits quadriceps activation. Blood-flow-restriction training may be considered when heavy loading is not yet tolerated.

Objective strength testing

Use objective testing to standardize progression. Isokinetic dynamometry is preferred when available, commonly including testing at 60°/s and 180°/s. If isokinetic testing is unavailable, handheld dynamometry is an acceptable practical alternative. Evaluate absolute strength in addition to limb symmetry.

Open-chain knee extension

Modern guidance supports open-chain quadriceps strengthening. Limited-range knee extension (commonly 90-45°) may begin around week 4 and then progress in range and resistance while monitoring pain and knee response.

Return to running

Do not clear running solely by postoperative week. Reasonable criteria include full extension, approximately ≥95% flexion ROM, no/trace effusion, quadriceps LSI around ≥80%, pain-free repeated hopping/pogos and acceptable landing control.

Calf strength

Include single-leg calf raise endurance and plantarflexion strength symmetry in later-stage testing, particularly for field and court athletes where repeated propulsion and deceleration demands are high.

Return to sport

Use a continuum of return to participation, return to sport and return to performance. High-demand pivoting athletes should demonstrate excellent strength, hop performance, movement quality, sport-specific conditioning, calf capacity, and psychological readiness. A minimum of approximately 9 months before unrestricted pivoting sport is a useful risk-management benchmark, but time alone is insufficient.

Suggested Return-to-Sport Criteria

• No pain or clinically meaningful effusion.

• Full, symmetrical knee ROM.

• Stable clinical examination.

• Quadriceps and hamstring strength ≥90% LSI, with a goal closer to 95-100% for high-risk pivoting athletes; assess absolute strength as well as symmetry.

• Objective strength testing with isokinetic dynamometry at 60°/s and 180°/s when available; handheld dynamometry may be used when isokinetic testing is unavailable.

• Hop battery ≥90-95% LSI with acceptable movement quality: single hop for distance, triple hop, crossover hop, and 6-meter timed hop.

• Single-leg calf raise endurance and plantarflexion strength approaching side-to-side symmetry.

• Appropriate power, explosiveness and rate of force development for sport demands, particularly in competitive athletes.

• Tolerance of high-speed running, deceleration, jumping, cutting and reactive sport-specific tasks without symptom recurrence.

• Completion of a graded practice progression.

• Acceptable psychological readiness (for example ACL-RSI or comparable assessment when used by the treating team).

References / Evidence Base

1. Kotsifaki R, et al. Aspetar clinical practice guideline on rehabilitation after anterior cruciate ligament reconstruction. Br J Sports Med. 2023;57:500-514.

2. Ardern CL, et al. Return to sport after anterior cruciate ligament reconstruction: Panther Symposium ACL Injury Return to Sport Consensus Group.

3. Grindem H, et al. Simple decision rules can reduce reinjury risk by 84% after ACL reconstruction: the Delaware-Oslo ACL cohort study. Br J Sports Med. 2016.

4. The Formal EU-US Meniscus Rehabilitation 2024 Consensus (ESSKA-AOSSM-AASPT), Part I: rehabilitation management after meniscus surgery.

5. Cong T, et al. Current Practices for Rehabilitation After Meniscus Repair: A Survey of Members of the American Orthopaedic Society for Sports Medicine. Orthop J Sports Med. 2024.

Clinical note: This protocol is intended as a general surgeon/PT framework and should be individualized to the patient, graft, fixation, concomitant procedures, examination findings and sport demands. Surgical restrictions supersede general rehabilitation recommendations.