

PHYSICAL THERAPY PROTOCOL

Patellar / Quadriceps Tendon Repair

Acute Extensor Mechanism Rupture — Primary Repair, With or Without Augmentation

FOR THE PHYSICAL THERAPIST

Overview and Goals

This protocol governs rehabilitation following repair of an acute rupture of the knee extensor mechanism — the quadriceps tendon above the patella or the patellar tendon below it. The rehabilitation principles are the same for both injuries, with tendon-specific callouts noted below, because both repairs face the same mechanical problem: the repaired tendon is the structure that actively extends the knee, so every active quadriceps contraction through an arc of motion loads the repair directly.^{1,2}

Three cardinal principles govern this protocol. First, **protect the repair from active extension** — no active knee extension through an arc of motion for the first 6 weeks. Isometric quadriceps activation in full extension is safe and encouraged from day 1 (the tendon is not loaded through an arc), but the quadriceps must not pull the tibia from flexion into extension until Phase 3.^{1,2} Second, **respect the safe-zone flexion limit set at surgery** — Dr. Roth tests the repair through a range of flexion intraoperatively and communicates the safe zone to the therapist; all early passive flexion stays within it. Third, **early protected motion prevents stiffness** — prolonged immobilization after extensor mechanism repair produces patellar adhesions, flexion loss, patella baja or alta, and persistent weakness, and stiffness is the most common functional complication.^{1,2}

The pacing reflects the evidence. Early functional rehabilitation with full weight-bearing in a locked brace is safe and does not increase re-rupture (Langenhan, n = 66; confirmed in a 2025 multicenter cohort where early rehabilitation predicted better function),^{3,5} while a network meta-analysis of 709 patients found more adverse events with unconstrained early mobilization — which is precisely why the early motion here is bounded by the surgeon-set safe zone rather than left open.⁴ Weight-bearing in full extension is permitted from the start because the repair is under minimal tension with the knee straight; flexion and active extension are what must be staged.

Progression between phases is criterion-based. Time ranges represent typical windows, not gates. Patients who do not meet criteria should remain in the current phase regardless of elapsed time.

READ BEFORE STARTING — GET THE SAFE ZONE, CONFIRM THE CONSTRUCT

The single most important piece of information is Dr. Roth's intraoperative safe-zone flexion limit. It is typically 45°–90° depending on repair robustness and tissue quality. If it has not been communicated, contact the office; if unreachable, default to 45° for Weeks 0–2 and advance ~15° every 2 weeks.¹

- **Flexion begins at the first post-op visit (day 5–10)** — per Dr. Roth's post-operative instructions, the knee stays locked in full extension with no bending until he initiates motion at that visit.
- **Confirm whether the repair was augmented** (suture tape, cerclage, or hamstring autograft) — augmented constructs share load and may progress faster per Dr. Roth's written instruction (see the Augmentation callout).
- **The cardinal restriction: NO active knee extension through an arc of motion for 6 weeks.** No resisted extension, no open-chain extension, no closed-chain exercises with the knee flexed. Quad isometrics in full extension and SLR in the locked brace are safe and essential.

Rehabilitation Phases

PHASE	WEIGHT BEARING	BRACE	ROM GOALS	EXERCISES	CRITERIA TO ADVANCE
PHASE 1 Weeks 0–2 <i>Maximum protection & quad activation</i>	- Weight-bearing as tolerated with the brace locked in full extension, crutches for balance.^{1,3} - The repair is under minimal tension with the knee straight — loading in extension is safe. - A more protective status (50% PWB or TDWB) may be prescribed for poor tissue quality or significant comorbidity — follow Dr. Roth's written instruction.	- Hinged brace locked at 0° at all times, including sleep.¹ - Unlock only for supervised ROM exercises and hygiene. - Never bear weight with the brace unlocked.	- Full passive extension at all times — extension is never restricted. Flexion: - Begins at the first post-op visit (day 5–10), within Dr. Roth's safe zone (typically 45° initially). - Passive heel slides (gravity-assisted) and prone active flexion — the hamstrings bend the knee; this is NOT active extension and is safe. Patella: - Patellar mobilization (superior, inferior, medial, lateral) from the first PT visit — critical to prevent adhesions	Quad activation (the priority): - Isometric quad sets in full extension from day 1 — every waking hour.¹ - SLR in the locked brace once quad lag is eliminated (all 4 planes) - NMES to the quadriceps if significant inhibition Adjunct: - Ankle pumps; hip abduction/adduction/extension (side-lying, prone) - Cryotherapy, compression, elevation Avoid: - Active knee extension through any arc - Passive flexion beyond the safe zone - Resisted extension; squats, lunges, kneeling - Weight-bearing with the brace unlocked	- Pain and effusion controlled - Quad set with visible superior patellar glide - SLR without extensor lag - Passive flexion to the initial safe zone - Minimum 2 weeks elapsed
PHASE 2 Weeks 2–6 <i>Progressive protected motion</i>	- Full weight-bearing with the brace locked in extension.^{1,3} - Wean crutches as gait normalizes and quad control returns (typically Weeks 3–6).	- Locked in extension for all ambulation and sleep through Week 6.¹ - Unlocked for ROM exercises with progressive stops matching the safe-zone advance.	- Advance the safe zone ~15° every 2 weeks: ~60° by Week 4, 90° by Week 6 — the key milestone.^{1,2} - Heel slides, prone active flexion, wall slides within limits Extension: - Full passive extension maintained — heel props / prone hangs	Quad activation (continue): - Quad sets hourly; multi-angle isometrics (30°, 60°) within the safe zone - SLR with progressive ankle weights (1–3 lb), brace locked Proximal / core: - Clamshells, side-lying abduction, prone hip extension - Core stabilization; upper-body ergometer Avoid: - Active extension through an arc (restriction continues through Week 6) - Resisted or open-chain knee extension - Closed-chain work with the knee flexed — no squats, leg press, or step-ups	- Passive flexion ≥ 90° - Full passive extension, no lag with SLR - Normalized gait in the locked brace, off crutches - Pain ≤ 2/10 with all prescribed exercises - Minimum 6 weeks elapsed

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PHASE	WEIGHT BEARING	BRACE	ROM GOALS	EXERCISES	CRITERIA TO ADVANCE
			at the first sign of a lag Patella: - Mobilization at every session Bike: - Stationary bike, seat high, no resistance, from Weeks 4–6 once ~90° is available		
PHASE 3 Weeks 6–12 <i>Active extension transition & early strengthening</i>	Full weight-bearing.	- Unlock fully at Week 6; discontinue for daily activities Weeks 6–8.¹ - No night brace after Week 6. - May continue for high-demand environments through Week 12 if desired.	120° by Week 8; full ROM by Weeks 10–12.¹ - Continue passive stretching and patellar mobilization Escalation gates: - If 90° is not reached by Week 8, intensify flexion work and mobilization; if 120° is not reached by Week 12, contact Dr. Roth's office	Active extension progression — the key transition (begin Week 6): - Short-arc quads 30° → 0° (gravity only) → expand the arc 60° → 0° → 90° → 0° over Weeks 6–8 → full-arc against gravity → add 1–2 lb at Weeks 8–10.¹ Closed chain (from Week 6): - Mini-squats and wall slides 0–45°; leg press 0–45°; step-ups (4-inch) - Deepen to 0–60° by Weeks 8–10 Conditioning & control: - Bike with progressive resistance; pool walking once incisions healed - Single-leg balance (stable → foam), gait and stair training (up with the operative leg, down with the sound leg) Avoid: - Heavy resisted extension until Weeks 10–12 - Squats past 60° until Week 10 - Running, jumping, kneeling	- Full or near-full ROM - Active extension through the full arc without extensor lag - Normalized stairs and gait - Pain ≤ 1/10 with prescribed strengthening - Minimum 12 weeks elapsed
PHASE 4 Weeks 12–24 <i>Advanced strengthening & running</i>	Full.	None.	Full, symmetric ROM — residual deficits addressed aggressively; refer back if flexion plateaus.¹	Eccentric loading (from Week 12 — key for tendon remodeling): - Decline-board squats, eccentric leg press, eccentric step-downs¹ Progressive strengthening: - Squats to 90°, lunges (forward/reverse/lateral), single-leg press, 8-inch step-ups/downs - Open-chain knee extension, full arc, progressive resistance - Hamstrings: curls, Romanian deadlifts, Nordics - Hip and core progression; elliptical, swimming Running program (Weeks 16–20, criteria-gated): - Begin only with full symmetric ROM, no effusion, quad ≥ 70% of contralateral, no extensor lag, pain-free normal gait.¹ - Walk-jog intervals → continuous jogging over 2–4 weeks → tempo running → sprinting by Weeks 20–24 Balance:	- Quad strength ≥ 80% of contralateral side - Pain-free continuous running - No effusion with impact activity - Controlled single-leg squat - Minimum 24 weeks for the RTS phase

PHASE	WEIGHT BEARING	BRACE	ROM GOALS	EXERCISES	CRITERIA TO ADVANCE
				Single-leg perturbation, dynamic balance (star excursion)	
PHASE 5 Months 6–12 <i>Return to sport</i>	Full.	None.	Full, symmetric, pain-free ROM.	Agility & sport-specific (from Months 5–6): - Lateral shuffles, carioca, figure-8s, cutting drills - Sport-specific movement patterns Plyometrics: - Bilateral hops → unilateral hops → box jumps → depth jumps Testing & maintenance: - Isokinetic testing at Months 6–9 — target quad LSI ≥ 90% - Continue quad, hamstring, hip, and core strengthening 2–3×/week; strength recovery continues 12–24 months	<i>See Return-to-Sport Criteria section below.</i> Non-contact sport ~6–9 months; contact/collision 9–12 months. Patellar tendon repairs trend longer — mean ~9 months to running and ~17 months to preinjury level.^{1,7}

Procedure-Specific Considerations

Active Extension Is the Protected Motion — Isometrics in Extension Are Not

The distinction that organizes this entire protocol: an isometric quadriceps contraction with the knee in full extension places no tensile load across the repair through an arc, and is the single most important early exercise — it prevents arthrogenic quad inhibition and drives the superior patellar glide that keeps the extensor mechanism mobile. Active extension *through an arc* — the quadriceps pulling the tibia from flexion toward extension — loads the repair directly and is prohibited for 6 weeks, then reintroduced deliberately from the lowest-demand arc (30° → 0°) outward.^{1,2} Prone active flexion is likewise safe: the hamstrings bend the knee against gravity while the quadriceps stays quiet, making it the preferred way to gain flexion without loading the repair.

The Safe Zone Is Set at Surgery

At the time of repair, Dr. Roth flexes the knee under direct visualization to determine the arc of passive flexion the construct tolerates without excessive tension — typically 45°–90° depending on tissue quality and repair robustness. That number governs all early ROM. If it has not reached the therapist, contact the office; the conservative default is 45° for Weeks 0–2, advancing ~15° every 2 weeks toward the 90°-by-Week-6 milestone.¹ Per Dr. Roth's post-operative instructions, patients arrive at the first PT visit having done quad sets, SLR, and ankle pumps only — flexion begins once he initiates it at the first post-op visit.

Stiffness Is the Most Common Complication — Mobilize the Patella from Day One

The patella adheres to the trochlea quickly after extensor mechanism surgery, and prolonged immobilization produces flexion loss, patella baja (after patellar tendon repair) or alta (after quadriceps tendon repair), and persistent anterior knee pain. Aggressive patellar mobilization at every session and steady safe-zone flexion progression are the countermeasures.^{1,2} The escalation gates are explicit: 90° not reached by Week 8 → intensify; 120° not reached by Week 12 → contact Dr. Roth's office. Refractory stiffness occasionally requires manipulation under anesthesia — far better prevented than treated.

Watch for Extensor Lag

A small extensor lag (≤ 10°) occurs in up to a fifth of patients and typically resolves without functional consequence; a persistent lag beyond 10° warrants evaluation.^{1,6} If the patient cannot actively reach

full extension by Week 8, intensify quad sets, NMES, and short-arc quads. A **sudden** loss of active extension is different — see the red-flag callout below.

Quadriceps vs. Patellar Tendon — Same Protocol, Different Patients

Quadriceps tendon ruptures cluster in patients over 40 (mean ~60), often with diabetes, chronic kidney disease, or inflammatory arthritis — conditions that impair tendon healing and raise re-rupture risk (inflammatory arthritis carries a relative risk near 18 for repair failure). Progress these patients more conservatively and coordinate medical optimization.^{8,9,10} Patellar tendon ruptures occur in younger, more athletic patients, carry more residual patellofemoral symptoms, and run a longer timeline to full sport — counsel accordingly, and warn that kneeling may remain uncomfortable long-term (a padded surface helps; this is a consequence of the injury, not failed rehabilitation).^{7,8}

AUGMENTED REPAIRS MAY PROGRESS FASTER — PER DR. ROTH'S WRITTEN INSTRUCTION

When the repair is augmented (suture tape, cerclage wire, or hamstring autograft), the construct shares load with the repair, and a modestly accelerated course is supported: full weight-bearing at 7–10 days and 120° of flexion by Weeks 6–8 produced uniformly good-to-excellent results with no complications in a 50-patient augmented series.⁶ Apply an accelerated progression only when Dr. Roth's written instruction specifies it. Two housekeeping notes: a cerclage wire may require removal at 6–12 months if symptomatic, and when a hamstring autograft was used, defer hamstring strengthening 6–8 weeks for donor-site healing.

RED FLAGS — CONTACT DR. ROTH

- Sudden loss of active extension, a new palpable gap at the repair, or new inability to perform a straight leg raise — concern for re-rupture (3–6% overall; highest risk in the first 6–12 weeks). Immobilize in extension and call the same day.
- Persistent extensor lag > 10° beyond 3 months.
- Flexion stalled — 90° not reached by Week 8 despite intensified work, or 120° not reached by Week 12.
- Increasing pain, warmth, erythema, drainage, or fever — infection rates are meaningfully higher in diabetics; hold PT and refer urgently.
- Loss of previously achieved extension at any point.

Return-to-Sport Criteria

Return is criterion-based, matched to the demands of the target activity. Overall return-to-play is high (~89% for both repairs) but return to preinjury level is lower (~70–81%), and patellar tendon repairs run the longer course — mean ~9 months to running and ~17 months to preinjury competitive level.^{7,8} All criteria for a tier should be met, with final clearance by Dr. Roth.

Domain	Criterion
Range of motion	Full, symmetric flexion and extension; no extensor lag. Mean residual flexion loss across the literature is ~5° — pursue symmetry, counsel realistically.
Joint signs	No pain or effusion at rest or with impact loading.
Quadriceps strength	LSI ≥ 90% on isokinetic testing at 60°/s (typically tested Months 6–9; mean recovery across series ~92%, range 73–105%).
Hop test battery	LSI ≥ 90% on the four-test battery: single hop, triple hop, crossover hop,

Domain	Criterion
	side hop.
Functional progression	Running, agility, and plyometric progressions complete without pain, effusion, or compensation; sport-specific drills at full intensity.
Psychological readiness	Confidence with cutting, landing, and (for patellar tendon repairs) kneeling-adjacent demands.
Time	Non-contact sport ~6–9 months; contact/collision 9–12 months; preinjury competitive level may take 12–18 months, patellar tendon repairs at the long end. Time gates are minimums, not targets. Clearance by Dr. Roth required.

REALISTIC EXPECTATIONS — STRONG FUNCTION, HONEST TIMELINES

Outcomes after extensor mechanism repair are good: ~89% return to play, ~96% return to work, mean Lysholm scores of 92–94 with early-motion protocols, and quadriceps strength recovering to ~92% of the contralateral side.^{6,7} The honest caveats: return to the *same* competitive level is less certain (~70–81%), quadriceps strength keeps improving for 12–24 months and rewards continued training well past formal PT discharge, and patellar tendon repairs carry more residual patellofemoral symptoms and a longer road than quadriceps tendon repairs. Patients who hear these timelines early stay engaged; patients who expect a 3-month recovery read a normal course as failure.

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Glossary

Active extension — The quadriceps pulling the knee from flexion toward extension through an arc — the motion that loads the repair directly; prohibited for 6 weeks.

CKC / OKC — Closed / open kinetic chain; exercises with the foot fixed (squat, leg press) vs. free (seated knee extension).

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Eccentric loading — Loading the muscle-tendon unit as it lengthens (decline squats, eccentric leg press); the key tendon-remodeling stimulus, deferred until Week 12.

Extensor lag — Inability to actively reach the final degrees of extension that are available passively; $\leq 10^\circ$ is common and usually resolves — $> 10^\circ$ persisting warrants evaluation.

Extensor mechanism — The quadriceps–quadriceps tendon–patella–patellar tendon chain that straightens the knee.

LSI — Limb Symmetry Index; the operative limb's value as a percentage of the contralateral limb ($\text{operative} \div \text{contralateral} \times 100$).

MUA — Manipulation under anesthesia; occasionally required for refractory stiffness.

NMES — Neuromuscular electrical stimulation; used to overcome arthrogenic quadriceps inhibition.

Patella alta / baja — Abnormally high / low patellar position. Quadriceps tendon rupture drops the patella (baja); patellar tendon rupture raises it (alta). The repair restores height — rehabilitation should not alter it.

Prone active flexion — Bending the knee against gravity with the hamstrings while lying prone — gains flexion without loading the extensor mechanism; safe and encouraged.

Safe zone — The arc of passive flexion Dr. Roth verified intraoperatively that the repair tolerates; governs all early ROM. Default 45° if not communicated, advancing $\sim 15^\circ$ every 2 weeks.

SAQ — Short-arc quads; active extension through the terminal $30^\circ \rightarrow 0^\circ$ arc — the lowest-demand entry point for the Week-6 active-extension transition.

SLR — Straight leg raise; performed with the brace locked in full extension so the repair is loaded isometrically, not through an arc.



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Dr. Roth completed his orthopaedic surgery residency at Harvard Medical School and his sports medicine fellowship at the Kerlan-Jobe Orthopaedic Clinic in Los Angeles. In practice since 2013, he specializes in advanced arthroscopic techniques and sports medicine procedures, and sees patients at Palo Alto Medical Foundation's Palo Alto and Dublin offices. He welcomes calls from physical therapists about his patients or this protocol.

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