

CLOSING-WEDGE HIGH TIBIAL OSTEOTOMY

Physical Therapy Protocol

PATIENT

SURGEON

Andrew L. Merritt, MD

DATE OF SURGERY

PT START DATE

For the patient

A high tibial osteotomy (HTO) corrected the alignment of your leg at the shin bone. In a closing-wedge operation the bone ends touch each other, so **you can put full weight on your leg right away**, with crutches for support. We also tightened (advanced) the MCL, the ligament on the inner side of the knee. Your crutches are there while your quad muscle wakes up, not because the bone needs protecting.

Getting your quad firing from day 1 is the most important thing you can do. Keep your knee fully straight from day 1: no pillow under your knee.

PROTOCOL AT A GLANCE

WEIGHT BEARING	Full weight from day 1 , with 2 crutches. Most people are off crutches by 4 to 6 weeks
BRACE	Locked straight for walking until good quad control (straight-leg raise without a lag), then unlocked. Worn unlocked for sleep. Hinge 0–90° in week 1, 0–105° in week 2, then fully open. Stops after you are off crutches , around 6 to 8 weeks
MOTION GOALS	Full straightening (0°) from day 1. Bending 90° by week 1, 105° by week 2, 115° by week 3, 125° by week 4
PHYSICAL THERAPY	Starts 5 to 7 days after surgery, 2 times a week at first
KEY PRECAUTIONS	No pillow under the knee. No hamstring exercises in week 1. No anti-inflammatory medicines for 6 weeks. No nicotine for 3 months
RUNNING · SPORT	Running at 5 to 6 months . Cutting and pivoting sports no sooner than 9 months , after testing

Recovery Timeline

Phase	When	PT visits	Focus
1	Weeks 0–4	2× a week	Full weight with crutches, quad activation, full straightening, bending to 125°
2	Weeks 4–8	2× a week	Off crutches, then off the brace; bike, step-ups, hamstring loading
3	Weeks 8–16	1–2× a week	Strength, balance, low-impact activity
4	Months 4–9+	As needed	Running from months 5–6, cutting sports from month 9

For the Therapist

Check the surgeon notes first. They override anything else in this protocol. Questions or setbacks: call (425) 656-5060.

Surgeon notes and special instructions

General principles

- **Weight bearing from day 1.** Bone-to-bone contact gives compressive stability. Crutches are for comfort and quad control, not bone protection.
- **Criterion-based crutch weaning.** Crutches stop when quad control allows safe weight bearing, typically weeks 4–6. The gate is quad strength, not elapsed time.
- **Quad activation is the #1 priority.** Arthrogenic muscle inhibition (AMI) after proximal tibial osteotomy is significant. Quad sets begin day 1. **NMES is provided at each PT visit, starting at the first visit;** no home unit. BFR is approved and strongly encouraged in all phases.
- **Extension first.** Full active extension from day 1. No pillow under the knee at rest.
- **Staged flexion.** 90° by week 1, 105° by week 2, 115° by week 3, 125° by week 4. Brace hinge 0–90° in week 1, 0–105° in week 2, then fully open.
- **Brace.** Locked in extension for walking until the SLR has no lag, then unlocked. On, unlocked, for sleep. Wean after the patient is off crutches, around weeks 6–8. The MCL tightening/advancement done with this surgery is minor; the osteotomy rules apply.
- **Protect early hamstring loading.** The proximal tibial dissection can involve posterior structures: no isolated hamstring work in week 1, co-contractions from week 2, then resisted work.
- **Control effusion.** Ice or cold compression 20 min on, 20 min off, throughout Phase 1.
- **No anti-inflammatory medicines (NSAIDs) for 6 weeks, including topical gels such as Voltaren.** They can slow bone healing; Dr. Merritt decides at the 6-week visit. The 81 mg aspirin is part of the plan and continues.
- **No smoking or nicotine** for at least 3 months after surgery; smoking slows bone healing.

PHASE

1

Early Recovery

Weeks 0–4

For the patient: what to expect

You can put weight on the leg right away; the crutches support you while your quad wakes up. Squeeze your quad every hour, ice 20 minutes on and 20 minutes off, and keep the leg straight when it is up. The brace stays locked for walking until you can lift your leg straight without it sagging. No hamstring exercises this first week.

WEIGHT BEARING	As tolerated from day 1 with 2 crutches; target full weight by weeks 2–3
BRACE	Locked in extension for walking until the SLR has no lag, then unlocked. On, unlocked, for sleep. Hinge 0–90° in week 1, 0–105° in week 2, then open
MOTION	Full extension (0°). Flexion 90° by week 1, 105° by week 2, 115° by week 3, 125° by week 4

Goals

- Active quad contraction (quad sets, NMES)
- Swelling controlled with cold therapy and elevation
- Full extension; flexion to 125° by week 4
- Safe walking on crutches; non-reciprocal stairs

Move on when

- ☐ SLR without a significant lag
- ☐ Extension 0°; flexion at the week's goal
- ☐ Walking as tolerated on crutches, gait improving
- ☐ Swelling and pain controlled; safe on stairs

Exercises

Exercise	How
Quad sets · ankle pumps	Quad sets: 3 × 15 every 1–2 hours while awake (primary day 1 exercise). Ankle pumps: 3 × 20 every hour
NMES	Quadriceps, at each PT visit from the first visit; essential for AMI
Heel slides · patella	Heel slides, supine, gravity-assisted, within the week's flexion goal: 3 × 10. Patellar mobilization once the incision is stable
SLR · hip isometrics	Supine SLR once the quad fires: 3 × 10. Hip abductor, adductor, glute isometrics: 3 × 10
Co-contractions	Isometric quad + hamstring from week 2; no isolated hamstring work in week 1
Gait · stairs	Normalize gait on crutches; non-reciprocal stairs with crutches
BFR	Quad sets and SLR once tolerated

Precautions

- No isolated hamstring contractions in week 1 (posterior soft tissue healing; shear at the osteotomy)
- No pillow under the knee; a flexion contracture now is far harder to fix at week 8 than to prevent
- Cold therapy (20 min on, 20 min off) is required: effusion inhibits the quad through the AMI reflex
- Do not rush crutch weaning: compensatory gait stresses the osteotomy

Why: Bone-to-bone contact allows immediate weight bearing; the early barrier is quad inhibition (AMI), not bone healing.

PHASE

2

Crutch Weaning and Early Strength

Weeks 4–8

For the patient: what to expect

This is when you come off crutches. The gate is quad strength and how smoothly you walk, not the calendar. The brace stops after the crutches. Keep icing after PT and work toward full bending. The stationary bike is great now, and step-ups start to build strength for stairs.

WEIGHT BEARING	Full. 2 crutches → 1 → none as quad control and gait allow; most by weeks 4–6
BRACE	Wean after off crutches, as quad control allows; most stop by weeks 6–8
MOTION	Full: 0° extension, flexion ≥125°

Goals

- Off crutches with a normal gait
- Full motion
- Step-up and step-down training; quad and hip strength
- Progressive hamstring loading

Move on when

- ☐ Off crutches with a normal gait
- ☐ 0° extension, flexion ≥125°
- ☐ 6-inch step with control; sit-to-stand without arms
- ☐ Independent with daily activities; minimal swelling

Exercises

Exercise	How
Quad sets · SLR · BFR	Continue quad sets and NMES (at PT visits) and BFR. SLR all planes with cuff weight
Extension stretching	Prone hang or seated heel prop, daily
Bike · patellar mobilization	Bike: short crank if flexion <90°, full crank once >110°. Patellar glides: continue, add inferior glide
Mini squats · step-ups	Mini squats 0–45°, supported then unsupported; step-up and step-down on a 2–4-inch step
Hamstrings	Week 4: active free curls against gravity. Week 6: resisted curls with band or cuff weight
Hip · gait · ADL	Standing hip abduction and extension with resistance; heel strike and extension at loading response; sit-to-stand, car transfers, stairs

Precautions

- Crutch discontinuation is gated by quad control: a Trendelenburg or quad-avoidance gait needs more time
- Cold therapy after every PT session through week 6
- No aggressive open-chain hamstring resistance before week 6; closed-chain emphasis
- Watch for patella infera; keep up motion and patellar mobilization

Why: The quad is the main dynamic stabilizer in gait. Without it, the knee buckles and compensatory gait adds torsional stress at the osteotomy.

PHASE

3

Strength and Function

Weeks 8–16

For the patient: what to expect

You're off crutches and the bone is healing. Now we build strength. The quad on the surgery side takes a long time to recover, so consistency matters. Leg press, squats, step-ups, and balance work are the focus. Cycling, swimming, and the elliptical are cleared. No running yet.

WEIGHT BEARING	Full, no device, no restrictions. No brace
CONDITIONING	Retro and forward treadmill, elliptical, cycling, swimming cleared

Goals

- Symmetric quad, hamstring, and hip strength
- Advanced closed-chain strength and function
- Balance and single-leg control
- Low-impact recreation

Move on when

- ☐ Strength $\geq 4+/5$; quad LSI approaching 80%
- ☐ Single-leg squat, 5 reps with control
- ☐ Single-leg stance ≥ 45 sec
- ☐ 30-min walk without more swelling

Exercises

Exercise	How
Leg press	Both legs → single leg → eccentric emphasis
Step-up · step-down	Advance to a 6–8-inch step
Squats · lunges	Functional squats 0–90° (wall, ball, body weight). Lunges forward, reverse, lateral from week 12
Single-leg mini squat	0–45°, once quad strength is $\geq 4/5$
Hamstring · glutes	Prone curls, Nordic preparation, band curls; single-leg bridges, monster walks, lateral band walks
Balance	Single-leg stance progression, foam, perturbation
BFR · core	Single-leg leg press with BFR; dead bugs, bird dogs, planks

Precautions

- No running until 5–6 months
- No pivoting, cutting, or jumping until Phase 4
- Persistent swelling after activity: reduce the load

Why: Closing-wedge callus forms faster than opening-wedge, but cortical remodeling still takes 3–4 months. Quad strength commonly lags the bone; BFR and progressive resistance give the fastest gains with the least joint stress.

PHASE

4

Return to Activity and Sport

Months 4–9+

For the patient: what to expect

Running begins at 5 to 6 months with a walk-jog program. Cutting and pivoting sports need passing strength and hop tests and Dr. Merritt's clearance, no sooner than 9 months. Stay consistent: quad weakness after HTO can last beyond 6 months, and the stronger your quad, the better your long-term result.

BRACE	None. Functional brace for sport at Dr. Merritt's discretion
RUNNING	Walk-jog program from months 5–6 with X-ray clearance
CUTTING	Agility drills months 7–9; sport from month 9 with surgeon clearance

Goals

- ≥90% LSI on quad and hamstring strength and hop testing
- Return to running (minimum 5–6 months, surgeon clearance)
- Return to sport (minimum 9 months, surgeon clearance)
- Long-term strength maintenance

Move on when

- ☐ Quad and hamstring ≥90% LSI; single-leg hop ≥90% LSI
- ☐ Solid union on X-ray (surgeon-confirmed)
- ☐ Walk-jog 20 min without swelling
- ☐ Sport drills at game speed without pain

Exercises

Exercise	How
Strength	Advanced leg press, squats, lunges; single-leg deadlifts, Bulgarian split squats, eccentric step-downs
Walk-jog program	From months 5–6 with X-ray clearance
Agility · sport	Cutting, agility, lateral shuffles at months 7–9; sport-specific training at month 9+ with clearance
Plyometrics	Controlled hops → bounding, with surgeon clearance
BFR	Maintenance 2× a week

Precautions

- Pivoting or contact sport before 9 months is not allowed without both X-ray clearance and functional testing (≥90% LSI)

Why: Faster early healing does not shorten return to sport much: cortical remodeling and quad recovery still take 6–12 months. Both the X-ray and functional gates must be passed; meeting only one is the main risk for failure.

Return to Activity and Sport

Both gates, bone healing and function, must be met before clearance.

Measure	Target
Running	At least 5–6 months, with X-ray clearance and surgeon approval
Cutting · pivoting sport	At least 9 months, with X-ray clearance and functional testing
Quad and hamstring strength	≥90% LSI
Single-leg hop	≥90% LSI
Bone healing	Solid union on X-ray, confirmed by Dr. Merritt
Symptoms	No pain or swelling with sport drills at game speed
Clearance	Formal clearance from Dr. Merritt

Functional testing

- Strength: quad and hamstring LSI
- Single-leg hop testing