

Theodore B. Shybut, MD FAANA FAAOS

Southern California Orthopedic Institute
Knee, Shoulder, Elbow Arthroscopy & Reconstructive Surgery
Burbank, Valencia / Santa Clarita, Van Nuys



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Tibial Tubercle Osteotomy (TTO) + Medial Patellofemoral Ligament (MPFL) Reconstruction

Post-Operative Rehabilitation Protocol

Tips for Successful Recovery

- **Surgical precautions:** Do not change bandages unless instructed by physician. Wear compression hose on the operative limb until crutches are discharged. If you suspect a DVT, contact Dr. Shybut's office immediately at 661-290-5473 or refer to ED immediately. If patient has a reactive effusion that does not improve with rest, ice, and compression, contact Dr. Shybut's office. Take DVT prophylaxis as prescribed.
- **Protect the osteotomy and the reconstruction.** The tibial tubercle osteotomy is a bone-healing procedure — weight bearing is deliberately restricted early to protect fixation. The MPFL graft is a soft-tissue restraint — avoid lateralization of the patella and avoid forced or resisted terminal knee extension in the early phases.
- **Weight bearing is limited to 25% for the first 2 weeks** to protect the osteotomy fixation, then advanced per the schedule below. Brace is worn locked in full extension for ambulation until quad control and ROM criteria are met.
- **Address quad activation early** and focus on isolation of quadriceps activation. Use surface EMG, NMES, and cueing to isolate quadriceps. Be aware of co-contraction from hamstrings and ensure proper form. Consider NMES for poor quad sets. Dosing quad sets: 10 minutes of 10 second squeeze / 10 second rest, x5 times a day.
- **Begin extension ROM on day one** and work to full passive extension early. Do not force flexion — respect the flexion limits by phase (0-70° weeks 0-2, 0-90° weeks 2-4, then advance). Restricting flexion protects both the osteotomy and the graft. If extension goals are not met on schedule, notify the physician's office.
- **Straight leg raises:** ensure the quadriceps is activated and maintains contraction throughout the SLR range to eliminate extensor lag. Perform SLR in the brace if a lag is present. Do not progress to standing/loading activities until an isolated quad set and SLR without lag are achieved.
- **Patellar mobility is imperative,** but glide the patella medially and superiorly — avoid lateral glides. Use gentle soft tissue techniques for the anterior interval/fat pad, quadriceps, and hamstrings, and manage scar tissue once healed.
- **Progress closed-chain strengthening within pain-free, protected arcs.** Loaded open-chain (seated) leg extension is prohibited to protect the osteotomy and patellofemoral joint. Squat and leg-press arcs are advanced gradually as ROM and healing allow.
- **Running, plyometrics, and return to sport require MD clearance** and are gated on osteotomy healing (radiographic confirmation), strength symmetry, and demonstrated patellar tracking control — not on time alone.

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PHASE 1 - Protected / Acute (0-6 wks)

GOALS: PROTECT OSTEOTOMY & MPFL GRAFT, CONTROL PAIN/EFFUSION, RESTORE QUAD ACTIVATION WEIGHT BEARING

- 0-2 Weeks — **25% weight bearing** with crutches and brace locked in full extension (protect osteotomy fixation)
- 2-4 Weeks — advance to 50% weight bearing as tolerated, brace locked in extension for ambulation
- 4-6 Weeks — progress toward full weight bearing with symmetrical gait as quad control allows
- Avoid ambulation without the brace for the first 6 weeks

BRACE & CRUTCH USE

- Brace locked in 0° (full extension) for all ambulation, weeks 0-6, unless otherwise directed by MD
- Brace may be removed for hygiene, therapy, and while seated with leg supported / knee in extension
- ROM dial settings: 0-70° (weeks 0-2), 0-90° (weeks 2-4), unlock brace after week 4 with adequate quad control
- D/C crutches once weight bearing is full and gait is non-antalgic (typically ~6 weeks)

RANGE OF MOTION

- Full passive/active-assisted knee extension with leg supported - begin day one (avoid AAROM extension against significant quad atrophy)
- Flexion with no forced motion: 0-70° (weeks 0-2), 0-90° (weeks 2-4), progress as tolerated 4-6 weeks
- Patellar mobilizations — medial and superior glides only; **avoid lateral glides**
- Heel slides out of brace up to ~15° beyond the current brace setting; calf/hamstring stretching, prone hangs

STRENGTHENING

- Ankle pumps, quad sets (NMES for poor recruitment), glute sets
- Straight leg raises (4-way) — in brace if extensor lag present
- Hamstring activation: hamstring sets, heel slides, bridges
- Distal/proximal strengthening within precautions; **no loaded open-chain knee extension**

CRITERIA TO PROGRESS TO PHASE 2

- Full passive knee extension & flexion to ~90°
- SLR without extensor lag
- Minimal effusion; pain controlled
- Isolated quad set with heel lift; adequate quad recruitment
- MD or PT approval

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PHASE 2 - Motion & Gait Normalization (7-12 weeks)

GOALS: RESTORE FULL ROM, NORMALIZE GAIT, PROGRESS QUAD STRENGTH

WEIGHT BEARING / PRECAUTIONS

- Full weight bearing; wean from brace per MD once quad control and gait are adequate
- Continue to **avoid lateralization of the patella**
- Normalize gait with a fully extended knee at loading response to fight quadriceps avoidance
- Respect concomitant-procedure restrictions (osteotomy healing, any cartilage work)

RANGE OF MOTION

- Full PROM/AAROM to full knee extension
- Flexion (seated and supine wall slides): limit 0-110° until 8 weeks; 0-120° by 10 weeks; full flexion 10+ weeks

STRENGTHENING & CONDITIONING

- Progress quadriceps strengthening; advance proximal strength and core
- Initiate balance and proprioceptive training: double-limb on progressively challenging surfaces, advancing to single-limb on level surface with good alignment/control
- Gait training: heel-toe pattern once SLR without lag and terminal extension achieved
- Underwater or anti-gravity treadmill (adequate wound healing); low-grade incline or retro-walking
- Closed-chain, pain-free arc: leg press (bilateral, eccentric) with monitored arc
- Forward step-up progression (6" step) with adequate strength
- Stationary bike: short crank progressing to standard crank as flexion allows (~115°)
- Hip extension with knee flexion, side planks, bridges

CRITERIA TO PROGRESS TO PHASE 3

- Full, pain-free ROM
- Normal gait on level surfaces without brace
- Good patellar mobility and quad contraction
- Radiographic evidence of osteotomy healing per MD
- MD or PT approval

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PHASE 3 - Strength, Balance, Early Impact (13-24 wks)

GOALS: FULL FUNCTIONAL STRENGTH, INITIATE RUNNING & BILATERAL PLYOMETRICS

PRECAUTIONS

- Avoid symptom provocation; correct any gait deviation or patellar tracking fault before advancing
- Maintain full ROM by 12 weeks

STRENGTHENING & CONDITIONING

- Advance proximal and lower-extremity strength through functional activities
- Balance progression: static to dynamic, multiple planes, challenging surfaces; single-limb dynamic control
- Address evaluation-based muscle imbalances
- Cross-training: elliptical, stationary bike, swimming
- Initiate running progression (late phase) with MD clearance and evidence of good eccentric quad control
- Initiate bilateral (double-leg) plyometric program with MD clearance
- Achieve patellar tracking symmetry with squatting and jumping in place

CRITERIA TO PROGRESS TO PHASE 4

- Pain-free ADLs and therapeutic exercise; full maintained ROM
- Good single-limb dynamic balance and patellar tracking
- Symmetrical gait on level surfaces and stairs
- Confirmed osteotomy union; MD clearance for running/plyometrics

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PHASE 4 - Advanced Strengthening, Return to Sport (24-36+ weeks)

GOALS: MAXIMIZE STRENGTH/POWER, RESTORE SPORT-SPECIFIC FUNCTION

PRECAUTIONS

- No pain or apprehension with sport-specific movements
- Adequate strength, ROM, flexibility, and fitness before return to sport
- Maintain full ROM

STRENGTHENING, PLYOMETRICS & AGILITY

- Continue to advance LE strengthening, flexibility, dynamic single-limb stability, and agility
- Advance core stability and strength; continue cross-training
- Advance plyometric program with MD clearance and good eccentric quad control:
 - — Vertical progression: jump-down
 - — Horizontal progression: broad jump, single-leg landings
 - — Progress running program
 - — Cutting, deceleration, and change of direction with MD clearance and dynamic single-limb stability
- Demonstrate patellar tracking symmetry through jumping and single-leg squats

CRITERIA FOR DISCHARGE / RETURN TO SPORT

- Radiographic osteotomy union and MD clearance for return-to-play progression
- Isokinetic testing (if available) at 180°/sec and 300°/sec: $\geq 85\%$ limb symmetry index
- Hop tests $\geq 85\%$ limb symmetry
- Symmetry, quality, and alignment during selected movement and sport-specific patterns
- No apprehension with sport-specific movements