Combined MPFL Reconstruction & Tibial Tubercle Osteotomy (TTO) Protocol

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Critical Precautions: The "Bone & Graft" Rules

- **Osteotomy Protection:** The tibial tubercle is secured with screws. To prevent a non-union or avulsion of the fragment, the knee must remain in extension during weight-bearing.
- **Range of Motion: Strictly no knee flexion** permitted during Phase I (Weeks 0 to 6).
- **Brace Compliance:** Hinged knee brace must be worn 24 hours a day and **locked in full extension (0 degrees)** at all times, including during sleep and ambulation.

Phase I: Bone Healing & Maximum Protection (Weeks 0–6)

Goals: Protect the osteotomy site and MPFL graft, manage edema, and maintain quadriceps tone.

- **Brace Use:** Brace **locked in full extension (0 degrees)** for all activities. Do not unlock the brace.
- **Weight-Bearing: Weight-Bearing As Tolerated (WBAT)** with the brace locked in full extension. Use crutches as needed for balance and to maintain a symmetrical gait.
- **Range of Motion:**
    - **Extension:** Maintain 0 degrees (full extension).
    - **Flexion: No flexion permitted.** * **Exercises:**
    - **Quadriceps Activation:** Quad sets and Straight Leg Raises (SLR) **in the locked brace**. Use of NMES (Electrical Stimulation) is highly recommended to combat quadriceps inhibition.
    - **Patellar Mobilizations:** Gentle superior and inferior glides only. Do not perform lateral glides.
    - **Distal Mobility:** Ankle pumps and circles (100 repetitions daily) to encourage circulation.

- **Upper Body/Core:** General upper body strengthening and core stabilization (seated or supine).

Phase II: Early Mobilization & Initial Flexion (Weeks 6–10)

Goals: Initiate knee flexion, transition to an unlocked brace, and normalize gait.

- **Brace:** Begin weaning the brace to "unlocked" for ambulation at **Week 6**, provided the patient has a strong quadriceps contraction and no extension lag.
- **Motion Progression:**
  - **Flexion Initiation:** Begin gentle passive and active-assisted knee flexion.
  - **Flexion Goal:** Reach **90 degrees** by week 8; progress to 110 to 120 degrees by week 10.
  - **Stationary Bike:** Begin at week 8 once flexion reaches 100 degrees (no resistance).
- **Strengthening:**
  - **Closed-Chain:** Initiate bilateral mini-squats (limit to 0 to 30 degrees) only once flexion is permitted.
  - **Hip/Core:** Advance side-lying hip abduction, clamshells, and glute bridges.

Phase III: Intermediate Strengthening (Weeks 10–14)

Goals: Restore full range of motion and build functional eccentric control.

- **Motion Progression:** Achieve full range of motion (0 to 135+ degrees) by week 14.
- **Strengthening:**
  - **Leg Press:** Progress bilateral loading. Limit depth to 60 degrees initially.
  - **Step-Ups:** Begin with a 2-inch step, focusing on knee alignment (avoiding medial/valgus collapse).
  - **Proprioception:** Double-leg balance on stable surfaces, progressing to foam or balance boards.

Phase IV: Running & Advanced Loading (Weeks 14–20)

Goals: Initiate jogging and advance to single-leg tasks.

- **Running Initiation: Begin running at Week 14 to 16**, provided X-rays show significant bony union of the osteotomy and no localized pain.
- **Strengthening:**
    - **Lateral Movements:** Side-steps and lateral shuffles with resistance bands.
    - **Single-Leg Loading:** Single-leg squats and Bulgarian split squats.
- **Plyometrics:** Initiate bilateral jumping and landing mechanics, emphasizing "soft" landings.

Phase V: Return to Sport (Week 20–26+)

Goals: Full return to high-demand athletics.

- **Return to Sport:** Cleared for full return to sport once the patient passes functional stability testing.
- **Agility:** Figure-eight running, shuttle runs, and sport-specific cutting drills.
- **Discharge Criteria:**
    - Bony union confirmed on X-ray.
    - Quadriceps and Hamstring strength greater than 90 percent of the uninvolved side.
    - Limb Symmetry Index (LSI) greater than 90 percent on hop testing.

Clinical Pearls for the Therapist

1. **Bone Union is Priority:** Because we are advancing weight-bearing immediately, monitor the osteotomy site closely. If the patient develops sharp, localized pain over the tibial tubercle or screws, reduce activity and notify the surgeon.
2. **The "No Flexion" Rationale:** By keeping the knee in 0 degrees of extension for 6 weeks, we ensure the quadriceps force is directed vertically across the osteotomy rather than creating a shear force that could displace the tubercle.
3. **Quadriceps Inhibition:** Long periods of immobilization can lead to significant muscle atrophy. Use of NMES during Phase I is vital to minimize this loss.