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Medial Patellofemoral Ligament Reconstruction with Tibial Tubercle Osteotomy Protocol Revised 2023

The following protocol utilizes a blend of both functional criteria and post-operative timeframes as the determinants for advancement. It is recognized that many patients will be pain free relatively early in their rehabilitation and want to advance to higher level activities as a result. In spite of rapid functional progress, it is important to respect the biological healing component of recovery and limit advancement if the timeframe for a given stage has not been completed. Overall, this protocol targets gradual return to full activity beginning at 9-12 months if all other criteria are also met.

At around 4 months, 7 months and 10 months patient will have scheduled follow-up visits with their surgeon. Strength and functional assessments should be completed prior to these visits at a CHOP sports physical therapy location. Clearance from the surgeon must be obtained to progress to the next phase at these points.

WEEKS 0 to 6 (Initial PT evaluation scheduled within 2 weeks following surgery)

Goals:

- Weight bearing: TTWB with crutches
- Brace use: locked in full extension (-10° on brace) at all times except for PROM exercises
 - Sleep with brace locked in full extension
- Minimize pain and effusion – compression wrap, elevation, ice
- Achieve/Maintain full knee extension
- Increase knee flexion 10° per day (not exceeding 90° of motion)
 - If a CPM is available: begin at 30° and increase 10° daily (not exceeding 90° of motion)
 - **Achieve 90° knee flexion by 4 weeks**
- Restore Quad Activation with knee in **full extension only**

Interventions:

- PROM/Flexibility:
 - Wall slides and/or Heel slides
 - Seated active assistive knee flexion
 - Prone hangs and/or Extension with heel prop
 - Hamstring/Calf stretches (non-weight bearing)
- Manual therapy as needed:
 - Low grade patellar mobilizations: medial, superior, inferior glides (avoid lateral)
- Strength:
 - Promote muscle activation (NMES with quad sets and/or biofeedback) **in full extension**
 - Suggested settings: 20-50 sec OFF, 10 sec ON, 2 sec RAMP, 10-15 mins total, 75 Hz pulse rate, 400 µsec pulse width, symmetrical waveform
 - Achieve an amplitude (in mA) for strong muscle contraction
 - Quad sets
 - SLR's with brace locked in extension (flexion, adduction, abduction, extension)
- Daily home exercise program
 - Include home NMES device 2-3 times per day (**until no quad lag present**)

FOLLOW-UP WITH SURGEON 6-8 WEEKS POST-OPERATIVELY

- Follow STANDARD protocol below, unless otherwise specified by surgeon
- See appendix for ACCELERATED and EXTENDED protocol modifications

WEEKS 6 to 16:

Goals: STANDARD PROTOCOL

- Brace Use/Weight-bearing status:
 - 6 weeks: 50% WB with brace locked in extension. Sleep with brace locked in full extension
 - 8 weeks: Full WB with brace locked in extension. Discontinue brace while sleeping
 - 10 weeks: Full WB with brace unlocked to 45°
 - 12 weeks: Full WB with brace unlocked to 90°
 - 14 weeks: Start weaning from brace **if the following criteria are met:**
 - AROM $\geq 100^\circ$
 - Perform three single leg squats to 30° with proper frontal plane control
- Minimize pain and effusion
- Regain full ROM
- Quadriceps strengthening:
 - 6 weeks: Begin closed chain strengthening from 0-45° of knee ROM, with $\leq 50\%$ body weight
 - 8 weeks: Begin unilateral open chain quad strengthening from 90-45° knee ROM, closed chain strengthening from 0-45° as tolerated
 - 10 weeks: Begin unilateral open chain quad strengthening from 90-0° knee ROM, closed chain strengthening from 0-90° as tolerated
- Normalize patellar mobility (avoid lateral glide)

Interventions (in addition to those listed in previous weeks):

- Gait training per above weight-bearing precautions
- ROM/Flexibility:
 - Initiate stationary bike without resistance for regaining full ROM
- Manual therapy:
 - Low grade patellar mobilizations: medial, superior, inferior glides (avoid lateral)
 - Scar tissue mobilization (once incisions are healed)
- Balance/Proprioception (gradually transition to no brace per criteria above)
- Strength:
 - **Emphasize quadriceps strengthening per above precautions**
 - Continue to improve quad muscle activation as necessary (NMES w/ quad sets and/or biofeedback)
 - Hamstring, hip, calf and core strengthening
 - Initiate bilateral squats and unilateral leg press $\leq 50\%$ body weight until week 8
- Daily home exercise program

CRITERIA TO ADVANCE – 4-month assessment

- Surgeon clearance (testing to be completed at CHOP sports PT location prior to surgeon office visit)
- Isokinetic strength testing - **Quadriceps Peak Torque:** $\leq 25\%$ deficit at 180°/sec
- Lateral step-down test (**Set step height to achieve ~60° knee flexion**): $\leq 3/6$ errors
- Y balance test (**anterior reach only**): ≤ 4 cm difference as compared to uninvolved

WEEKS 16 to 20:

Goals:

- Initiate straight ahead running (if above criteria are met) – begin with walk/jog progression
- May initiate plyometrics (double leg jumping only) once able to advance to run ½ mile on level surface with good limb symmetry and without pain
- Continue improving strength (functional and isolated)

Interventions (in addition to those listed in previous weeks):

- Strength:
 - Functional strengthening/Neuromuscular control:
 - Unilateral functional strengthening and balance with emphasis on control
 - Isolated strengthening/Weight machines:
 - Continue to progress isolated quadriceps/hamstring, and hip abductor/extensor/external rotator strengthening as necessary
- Cardiovascular endurance:
 - Advance resistance, duration, and speed with low impact exercise
 - Gradually advance with straight ahead running progression
- Plyometric training:
 - Begin with basic double leg jumps (50% effort for height/distance)
 - Focus on soft, symmetrical landing of both lower extremities
- Daily home exercise program

MONTHS 5 to 7:**Goals:**

- Plyometrics: Transition to single leg jumps under the guidance of your physical therapist once patient demonstrates proper symmetry and neuromuscular control with all double leg jumps and single leg squats.
- Continue improving strength (functional and isolated)

Interventions (in addition to those listed in previous weeks):

- Plyometrics:
 - Double leg jumps – Progress height/distance, multiple jumps in same direction, varying surfaces, hopping over/onto objects, etc.
 - Initiate single leg jumping focusing on soft landings with good control
 - Start with 50% effort for height/distance
- Strength:
 - Functional strengthening/Neuromuscular control: Unilateral functional strengthening and balance, with multiple components/dual tasking
 - Progress intensity/resistance, speeds, unstable surfaces, cognitive challenges, eyes closed and including upper body movements as appropriate
 - Focus on completing exercise without pain and with appropriate level of difficulty for balance/motor control
- Daily home exercise program

CRITERIA TO ADVANCE – 7-month assessment

- **Surgeon clearance** (assessment to be completed at CHOP sports PT location prior to surgeon office visit)
- **Full knee ROM**
- **No pain or swelling in the involved knee**
- **Isokinetic strength testing - Quadriceps Peak Torque:** $\leq 15\%$ deficit at $180^\circ/\text{sec}$
- **Lateral step-down test (Set step height to achieve $\sim 60^\circ$ knee flexion):** $\leq 1/6$ errors
- **Y balance test (all directions):**
 - Composite score $\geq 90\%$
 - < 4 cm difference for anterior reach, < 6 cm difference for posteromedial and posterolateral reach as compared to uninvolved limb
- **Functional hop testing battery:** $\geq 85\%$ limb symmetry, pain free and good neuromuscular control
 - Single hop for distance
 - Triple hop for distance
 - Crossover triple hop for distance
 - Timed 6 meter hop
 - Unilateral vertical jump for height
- **Drop vertical jump using Landing Error Scoring System (LESS):** < 4 errors

MONTHS 7 to 10:

Goals:

- Initiate sports specific drills and training, including agility training exercises, under supervision of your physical therapist (not with sports team) over the next 3 months if the above criteria are met:
- Overall focus/emphasis for all exercises, including plyometrics and agility training should be:
 - Symmetrical weight-bearing and good neuromuscular control
 - Demonstrating good tolerance for individual non-contact sport specific activities without knee pain/effusion, perceived instability or asymmetrical movement patterns.
- Strength: Continued emphasis on regaining symmetrical quadriceps strength, while also incorporating hip strengthening and core stabilization
 - Focus on completing exercises without pain and with appropriate level of difficulty for balance/motor control

Interventions:

- Plyometrics:
 - Emphasize generating power and force dissipation with landings
 - Single leg - Progress if able to complete with soft landing and good control
 - Fade visual feedback e.g. mirror
 - Consider changing speeds, directions, and landing surfaces as appropriate
 - Incorporate sport or activity specific drills (kicking/catching balls, dribbling, holding sports equipment, etc.)
- Agility:
 - Start with single directional changes at slower speeds (forward sprint/back pedal, lateral shuffle)
 - Emphasize deceleration prior to change in direction, then progress with quicker changes in direction, carioca, resisted running (sport cords) and sport specific activities (incorporating ball or stick) as appropriate

- Strength:
 - Functional strengthening/ Neuromuscular control:
 - Advance to include sport specific demands and equipment (catching/throwing/kicking balls, uneven surfaces, reactive movements)
- Cardiovascular endurance:
 - Progress based on demands of sport, including sprint/distance running, cutting/agility drills (progressing speeds, duration, and changes in direction)
- Final home exercise program/injury prevention program

CRITERIA TO ADVANCE – 10 month assessment/return to sport criteria

- **Surgeon clearance** (assessment to be completed at CHOP sports PT location prior to surgeon office visit)
- **Full knee ROM**
- **No pain or swelling in the involved knee**
- **Isokinetic strength testing - Quadriceps Peak Torque:** $\leq 10\%$ deficit at $180^\circ/\text{sec}$
- **Lateral step-down test (Set step height to achieve $\sim 60^\circ$ knee flexion):** $\leq 1/6$ errors
- **Y balance test (all directions):**
 - Composite score $\geq 90\%$
 - Limb symmetry $\geq 90\%$
 - < 4 cm difference for anterior reach, < 6 cm difference for posteromedial and posterolateral reach as compared to uninvolved limb
- **Functional hop testing battery:** $\geq 90\%$ limb symmetry, pain free and good neuromuscular control
- **Drop vertical jump using Landing Error Scoring System (LESS):** < 2 errors
- **Tuck jump:** < 6 errors (if patient age and skill level appropriate)

Once return to sport criteria are met, the patient will be advised to follow a specific and gradual return to sport progression program which will be provided by surgeon or physical therapist.

Sports Medicine and Performance Center at the Children's Hospital of Philadelphia

Specialty Care Center in King of Prussia
550 South Goddard Blvd
King of Prussia, PA 19046
215-590-6919

Specialty Care Center in Chalfont
500 W Butler Pike
Chalfont, PA 18914
215-590-6930

Buerger Center for Advance Pediatric Care
3500 Civic Center Boulevard
Philadelphia, PA 19104
215-590-5819

Specialty Care at Virtua
200 Bowman Dr. Suite D-260
Voorhees, NJ 08043
215-590-6919

Appendix:

- **ACCELERATED PROTOCOL**
 - **Brace Use/Weight-bearing Status:**
 - 6 weeks: Full WB with brace locked in extension
 - 8 weeks: Full WB with brace unlocked to 45°
 - 10 weeks: Start weaning from brace per following criteria
 - SLR without quadriceps lag
 - AROM $\geq 100^\circ$
 - Perform multiple single leg squats to 30° with proper frontal plane control
 - **Quadriceps strengthening:**
 - 6 weeks: Begin unilateral open chain quad strengthening from 90-45° knee ROM, closed chain strengthening from 0-45° as tolerated
 - 8 weeks: Begin unilateral open chain quad strengthening from 90-0°, closed chain strengthening from 0-90° as tolerated
 - *At 12 weeks return to 16-20 week phase of STANDARD protocol, and continue to subtract 4 weeks from each of the remaining phases going forward*
- **EXTENDED PROTOCOL**
 - **Brace Use/Weight-bearing Status:**
 - 6 weeks: 50% WB with brace locked in extension
 - 8 weeks: Full WB with brace locked in extension
 - 10 weeks: Full WB with brace unlocked to 30°
 - 12 weeks: Full WB with brace unlocked to 60°
 - 14 weeks: Full WB with brace unlocked to 90°
 - 16 weeks: Start weaning from brace per following criteria
 - AROM $\geq 100^\circ$
 - Perform multiple single leg squats to 30° with proper frontal plane control
 - **Quadriceps Strengthening:**
 - 8 weeks: Begin unilateral open chain quad strengthening from 90-60° knee ROM, closed chain strengthening from 0-30° as tolerated
 - 10 weeks: Begin unilateral open chain quad strengthening from 90-30°, closed chain strengthening from 0-60° as tolerated
 - 12 weeks: Begin unilateral open chain quad strengthening from 90-0°, closed chain strengthening from 0-90° as tolerated
 - *At 18 weeks return to 16-20 week phase of STANDARD protocol on page 3*