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**Postoperative Rehabilitation Guidelines**  
**Matrix-Assisted Chondrocyte Implantation (MACI)**  
**Trochlea – with Tibial Tubercle Osteotomy (TTO)**

The following protocol is intended as a general guideline for physical therapist, athletic trainer, and patient after Matrix-assisted chondrocyte implantation (MACI). These guidelines are designed to facilitate the expedited and safe return to athletic or professional activity and is based on a review of the current scientific principles of knee rehabilitation. For the treating health care provider this protocol should not serve as a substitute for individualized clinical decision making during the patient's post-operative course following MACI. It should rather take into consideration the individual's physical findings, progression, and possible post-operative limitations. If the therapist or patient requires assistance or encounters any postoperative complication they should consult with **the surgeon**.

**GUIDELINES**

**PHASE I - PROTECTION PHASE (WEEKS 0-6)**

**Goals:**

- Protect healing tissue from load and shear forces • Restore full passive knee extension
- Regain quadriceps control • Decrease pain and effusion
- Gradually improve knee flexion

**Brace:**

- Locked at 0° during ambulation and weight-bearing activities
- Sleep in locked brace for 4 weeks

**Weight Bearing:**

- Toe touch weight bearing (TTWB) only until 6 week f/u x-ray if concomitant MACI+TTO

**Range of Motion:**

After distal realignment involving an anteromedialization of the tibial tubercle (TTO) the rehabilitation program should avoid excessive strain on the tibial tubercle. Passive ROM should be progressed slowly with the goals of:

- 45° by day 5
- 60° by the end of week 1
- 75° by week 3
- 90° by week 4
- 115° by week 5

- 125° by week 6
- 125°-135° by week 8

**Strengthening Program:****Functional Activities:**

- Gradual return to daily activities
- If symptoms occur, reduce activities to reduce pain and inflammation
- Extended standing should be avoided
- Use caution with stair climbing

**Swelling Control:**

- Ice, elevation, compression, and edema modalities as needed to decrease swelling

**Criteria to Progress To Phase II:**

- Full passive knee extension • Knee flexion to 115°-120°
- Minimal pain and swelling • Voluntary quadriceps activity

**Trochlea Rehabilitation Guidelines<sub>1</sub>** (Intended for small lesions [ $<5\text{cm}^2$ ] with no concomitant procedure)

For concomitant procedures, large lesions ( $\geq 5\text{cm}^2$ ), OCD, uncontained or multiple lesions, please see

additional considerations in the Rehabilitation Guideline Variations below.

- Immediate motion exercise days 1-2
- Full passive knee extension immediately
- Initiate CPM on day 1 for total of 6-8 hours/day (0°-60°; if lesion  $> 6\text{ cm}^2$  0°-40°) for first 2-3 weeks
- Progress CPM ROM as tolerated 5°-10° per day
- May continue use of CPM for total of 6-8 hours per day for 6 weeks
- Patellar mobilization (4-6 times per day)
- Motion exercises throughout the day
- Passive knee flexion ROM 2-3 times daily
- Stretch hamstrings, calf
- Ankle pump using rubber tubing
- Quad setting
- Straight leg raises (4 directions)
- Toe-calf raises by week 2
- Stationary bicycle when ROM allows
- Biofeedback and electrical muscle stimulation, as needed
- Isometric leg press by week 4 (multi-angle)
- Initiate weight shifts by weeks 2-3
- May begin pool therapy for gait training and exercise by week 4

**PHASE II - TRANSITION PHASE (WEEKS 6-12)****Goals:**

- Gradually increase ROM
- Gradually improve quadriceps strength/endurance
- Gradually increase functional activities

**Brace:**

- Discontinue brace by 6 weeks

**Weight-Bearing:**

- Progress weight-bearing as tolerated
- Progress to full weight-bearing by 6-8 weeks
- Discontinue crutches by 6-8 weeks

**Range of Motion:**

- Gradually increase ROM
- Maintain full passive knee extension
- Progress knee flexion to 120°-125° by week 8
- Continue patellar mobilization and soft tissue mobilization, as needed
- Continue stretching program

**Strengthening Exercises:**

- Closed kinetic chain exercises (leg press 0°-60°) by week 8
- Initiate mini-squats 0°-45° by week 8
- Toe-calf raises at week 6
- Open kinetic chain knee extension without resistance
- Begin knee extension 0°-30° then progress to deeper angles
- Stationary bicycle (gradually increase time)
- Stair machine by week 12
- Balance and proprioception drills
- Initiate front and lateral step-ups by weeks 8-10
- Continue use of biofeedback and electrical muscle stimulation, as needed

**Functional Activities:**

- As pain and swelling (symptoms) diminish, the patient may gradually increase functional activities
- Gradually increase standing and walking

**Criteria to Progress To Phase III:**

- Full range of motion
- Acceptable strength level
  - Hamstrings within 20% of contralateral leg
  - Quadriceps within 30% of contralateral leg
- Balance testing within 30% of contralateral leg
- Able to walk 1-2 miles or bike for 30 minutes

**PHASE III: REMODELING PHASE (WEEKS 12-32)****Goals:**

- Improve muscular strength and endurance
- Increase functional activities

**Range of Motion:**

- Patient should exhibit 125°-135° flexion

**Exercise Program:**

- Leg press (0°-60°; progress to 0°-90°)
- Bilateral squats (0°-60°)
- Unilateral step-ups progressing from 2" to 6"
- Forward lunges
- Walking program on treadmill
- Open kinetic chain knee extension (90°-40°) – progress 1 lb every 2 weeks beginning week 20 if no pain or crepitation – must monitor symptoms
- Bicycle
- Stair machine
- Swimming
- Ski machine/Elliptical trainer

**Functional Activities:**

- As patient improves, you may increase walking (distance, cadence, incline, etc.)
- Light running can be initiated toward end of phase based on physician evaluation

**Maintenance Program:**

- Initiate by weeks 16-20
- Bicycle – low resistance, increase time
- Progressive walking program
- Pool exercises for entire lower extremity
- Straight leg raises
- Leg press
- Wall squats
- Hip abduction / adduction
- Front lunges
- Step-ups
- Stretch quadriceps, hamstrings, calf

#### **Criteria to Progress to Phase IV:**

- Full non-painful ROM
  - Strength within 80%-90% of contralateral extremity
  - Balance and/or stability within 75%-80% of contralateral extremity
  - Rehabilitation of functional activities causes no or minimal pain, inflammation or swelling.
- Please see accompanying full Prescribing Information inside back pocket. 13

#### **PHASE IV - MATURATION PHASE (8-15 MONTHS)**

##### **Goals:**

- Gradually return to full unrestricted functional activities

##### **Exercises:**

- Continue maintenance program progression 3-4 times/week
- Progress resistance as tolerated
- Emphasis on entire lower extremity strength & flexibility
- Progress agility and balance drills
- Progress walking program as tolerated
- Impact loading program should be specialized to the patient's demands
- No jumping or plyometric exercise until 12 months
- Progress sport programs depending on patient variables

##### **Functional Activities:**

• Patient may return to various sport activities as progression in rehabilitation and cartilage healing allows. Generally, low-impact sports such as swimming, skating, in-line skating, and cycling are permitted at about 6 months. High impact sports such as jogging, running, and aerobics may be performed at 8-9 months for small lesions or 9-12 months for larger lesions. High impact pivoting sports such as tennis, basketball, football, and baseball may be allowed at 12-18 months. Individual results may vary. Many patients are able to participate in sports with some limitations.

#### **Specific Considerations for concomitant Tibial Tubercle Osteotomy (TTO):**

Scar tissue management and patellar mobilizations are recommended to be performed to minimize the formation of adhesions. Open kinetic chain knee extensions can be initiated without resistance from 60°-0° by weeks 6-8 as tolerated. The use of a bicycle and pool therapy can be initiated by weeks 6-8.