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**Postoperative Rehabilitation Guidelines**  
**Matrix-Assisted Chondrocyte Implantation (MACI)**  
**Femoral condyle – with High Tibial Osteotomy (HTO)**

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
- Decrease pain and effusion • Restore full passive knee extension
- Gradually improve knee flexion • Regain quadriceps control

#### **Brace:**

- Locked at 0° during weight-bearing activities
- Sleep in locked brace for 2-4 weeks

#### **Weight-Bearing:**

- Non-weight-bearing for 1-2 weeks, may begin toe-touch weight bearing immediately per physician instructions
- Toe touch weight-bearing (approx. 20-30 lbs) weeks 2-3
- Partial weight-bearing (approx. 1/4 body weight) at weeks 4-5

#### **Range of Motion:**

High tibial osteotomy to realign the tibiofemoral joint generally requires a slightly accelerated passive ROM progression to avoid motion loss postoperatively with the goals of:

- 90° of knee flexion by week 1
- 105° by week 2
- 115° by week 3
- 125° by week 4
- A gradual progression past 125° beginning by week 6

- Motion exercise 6-8 hours post-operative
- Full passive knee extension immediately
- Initiate Continuous Passive Motion (CPM) day 1 for total of 6-8 hours/day (0°-40°) for 2-3 weeks
- Progress CPM Range of Motion (ROM) as tolerated 5°-10° per day
- May continue CPM for total of 6-8 hours per day for up to 6 weeks
- Patellar mobilization (4-6 times per day)
- Motion exercises throughout the day
- Passive knee flexion ROM 2-3 times daily
- Stretch hamstrings and calf

**Strengthening Program:**

- Ankle pump using rubber tubing
- Quad setting
- Multi-angle isometrics (co-contractions Q/H)
- Active knee extension 90°-40° (no resistance)
- Straight leg raises (4 directions)
- Stationary bicycle when ROM allows
- Biofeedback and electrical muscle stimulation, as needed
- Isometric leg press by week 4 (multi-angle)
- May begin use of pool for gait training and exercises by week 4

**Functional Activities:**

- Gradual return to daily activities
- If symptoms occur, reduce activities to reduce pain and inflammation
- Extended standing should be avoided

**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 120°
- Minimal pain and swelling • Voluntary quadriceps activity

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

**Goals:**

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

**Brace:**

- Discontinue post-operative brace by week 6
- Consider unloading knee brace

**Weight-Bearing:**

- Progress weight-bearing as tolerated
- Progress to full weight-bearing by 8-9 weeks
- Discontinue crutches by 8-9 weeks

**Range of Motion:**

- Gradual increase in ROM
- Maintain full passive knee extension
- Progress knee flexion to 125°-135° by week 8
- Continue patellar mobilization and soft tissue mobilization, as needed
- Continue stretching program

**Strengthening Exercises:**

- Initiate weight shifts week 6
- Initiate mini-squats 0°-45° by week 8

- Closed kinetic chain exercises (leg press)
- Toe-calf raises by week 8
- Open kinetic chain knee extension progress 1 lb/week
- Stationary bicycle, low resistance (gradually increase time)
- Treadmill walking program by weeks 10-12
- Balance and proprioception drills
- Initiate front and lateral step-ups and wall squats by weeks 8-10
- Continue use of biofeedback and electrical muscle stimulation, as needed
- Continue use of pool for gait training and exercise

**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: MATURATION PHASE (WEEKS 12-26)**

**Goals:**

- Improve muscular strength and endurance
- Increase functional activities

**Range of Motion:**

- Patient should exhibit 125°-135° flexion

**Exercise Program:**

- Leg press (0°-90°)
- Bilateral squats (0°-60°)
- Unilateral step-ups progressing from 2" to 8"
- Forward lunges
- Walking program
- Open kinetic chain knee extension (0°-90°)
- Bicycle
- Stair machine
- Swimming
- Ski machine/Elliptical trainer

**Functional Activities:**

- As patient improves, increase walking (distance, cadence, incline, etc.)

**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. 9

**PHASE IV - FUNCTIONAL ACTIVITIES PHASE (WEEKS 26-52)**

**Goals:**

- Gradual 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 and flexibility
- Progress agility and balance drills
- Impact loading program should be specialized to the patient's demands
- 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.

**Variations for High Tibial Osteotomy/Distal Femoral Osteotomy:**

Weight-bearing progression is similar to that of the isolated femoral condyle lesion, although weightbearing may be delayed based on radiographic evidence of bone formation, if bone grafting is used, lesion size or location. Emphasis should be placed on restoring strength and flexibility of the quadriceps for optimal joint function.

Furthermore, the use of external devices to alter the applied load of the tibiofemoral joint may be used such as orthotics, insoles, and heel wedges. The use of an osteoarthritis unloading brace is recommended when the postoperative knee brace is discharged by weeks 6-8.