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Postoperative Rehabilitation Guidelines **Matrix-Assisted Chondrocyte Implantation (MACI)**

Femoral condyle – w/ ACL Reconstruction

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**.

MACI IMPLANTATION

Rehabilitation Guidelines for Femoral Condyle lesions with ACL reconstruction (see Variation section at end)

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:

- Motion exercise 6-8 hours post-operative
- Full passive knee extension immediately

- Initiate Continuous Passive Motion (CPM) day 1 for total of 8-12 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
- Knee flexion ROM goal is 90° by 1-2 weeks
- Knee flexion ROM goal is 105° by 3-4 weeks and 120° by week 5-6
- 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 concomitant Anterior Cruciate Ligament Reconstruction

Reconstruction of the anterior cruciate ligament (ACL) using an ipsilateral patellar tendon graft generally requires an increased rate of passive ROM restoration. Harvesting the ipsilateral patellar tendon may predispose the patient to the development of arthrofibrosis and loss of motion due to excessive scar tissue formation in the anterior aspect of the knee. Emphasis is placed on full passive knee extension and patellar mobilizations immediately following surgery. Passive ROM is slightly accelerated for a femoral condyle implantation during the initial phase of rehabilitation with the goals of:

- 90° of passive knee flexion by week 1
- 100°-105° by week 2
- 115° by week 4
- 125° by week 6
- 135° by week 8.

Weight-bearing precautions and exercise progression are similar to the isolated femoral condyle guideline.

Lesions on the trochlea with a concomitant ACL reconstruction require a more conservative approach than condyle lesions. Passive ROM is progressed slowly at first from:

- 45° by day 3
- 60°-75° by day 7
- 90° by day 10
- 100° by day 14
- 105° by week 3
- 115° by week 4
- 125° by week 6

Partial weight bearing is typically performed immediately in a brace locked in extension similar to an isolated trochlea lesion.

The use of a hamstring autogenous graft for ACL reconstruction involves similar guidelines as the patellar tendon graft. However, caution should be taken with overaggressive hamstring strengthening in the early postoperative phases to minimize graft site morbidity. Aggressive strengthening of the hamstrings should typically be avoided for the first 6-8 weeks.

Allograft tissue may also be used for ACL reconstruction. Rehabilitation does not differ significantly from an autogenous graft although the patient may feel less anterior knee pain due to minimized graft morbidity.