



Knee: Matrix Autologous Chondrocyte Implantation (MACI) Rehab Protocol – Tibiofemoral Joint

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Philosophy: This protocol is designed to serve as a guide for the clinician to rehabilitate a patient following MACI surgery. Time frames allow for optimal healing and should be used as criteria for advancement along with a patient's functional ability. Although timeframes have been established as a guide, it is more important that goals are reached at the end of each phase prior to progression to the next phase. Please do not hesitate to contact Dr. Metzler for any questions regarding this protocol or the patient.

Notes: MACI (autologous cultured chondrocytes on porcine collagen membrane) is an autologous cellularized scaffold product that is indicated for the repair of single or multiple symptomatic, full-thickness cartilage defects of the knee. Particular attention should be paid to whether the repair site is in the patellofemoral or tibiofemoral joint to ensure that rehabilitation exercises do not inflict deleterious forces on the repair site.

Phase I: Immediate Post-op (0-2 weeks following surgery)

Goals:

- Maintain joint mobility and muscle tone while adhering to all post-operative precautions
- Effectively manage pain and swelling with careful introduction of movement

Precautions:

- Touch-down weightbearing with crutches and with brace on and locked in full extension (<20% WB)
- Range of motion: passive and active, progress from 0– 30 degrees flexion
- No active knee extension

Exercises:

- Continuous passive motion (CPM) for a minimum of 1 hour daily up to 4 hours daily
- Active ankle dorsiflexion/plantarflexion exercises
- Passive and active heel slides
- Isometric quadriceps and hamstring exercises
- Modalities as needed for swelling and pain control

Phase II: Restore Mobility (2-4 weeks following surgery)

Goals:

- Pain-free active knee flexion to 90 degrees
- Pain-free full passive knee extension
- Adequate control of post-operative pain and swelling
- Independence with appropriate home exercises as instructed by therapist

Precautions:

- Touch-down weightbearing with crutches and with brace on and locked in full extension (30% WB)
- Range of motion: passive and active, progress from 30 degrees – 90 degrees flexion
- Brace can be unlocked to 45 degrees when seated

Exercises:

- Continuous passive motion (CPM) for 30 minutes daily up to 2 hours daily
- Passive and active heel slides
- Full knee extension
- Careful patellar mobilization in all directions
- Active ankle dorsiflexion/plantarflexion exercises
- Isometric gluteal, quadriceps, hamstring, and calf exercises
- Straight leg raises (hip flexion, abduction, adduction, and extension)
- Modalities as needed for swelling and pain control

Phase III: Strengthen & Straighten (4-6 weeks following surgery)

Goals:

- Pain-free active knee flexion to 125 degrees
- Progress from touch-down weightbearing to 50% weightbearing
- Progression with ROM and strengthening exercises
- Independence with appropriate home exercises as instructed by therapist

Precautions:

- Touch-down weightbearing with crutches and with brace on and locked in full extension
- Range of motion: active, progress from 90 degrees – 125 degrees flexion
- Brace can be unlocked to 90 degrees when seated

Exercises:

- Continuous passive motion (CPM) to maximum comfortable range as required
- Careful patellar mobilization in all directions
- Continue Phase 2 exercises
- Progress straight leg raise activities
- Side-lying gluteal exercises with a flexed knee
- Seated or standing weighted-hip adduction and abduction
- Trunk strengthening exercises (supine sit-ups, weight-supported trunk flexion)
- Recumbent cycling to 90 degrees flexion
- Modalities as needed for swelling and pain control

Phase IV: Independent Movement (6-12 weeks following surgery)

Goals:

- Full pain-free active range of motion
- Progression from 50% weightbearing to full weightbearing at 8-10 weeks post-op
- Progression with ROM and strengthening exercises
- Begin proprioceptive exercises
- Independence in performing home and gym-based exercises for continuation of rehabilitation

Precautions:

- Progress to full weightbearing at 8-10 weeks post-op
- Range of motion: active, progress from 125 degrees flexion – full flexion
- Brace can be fully unlocked when seated and with ambulation
- Full weightbearing indoors, with use of single crutch outside and in uncontrolled environments

Exercises:

- Careful patellar mobilization in all directions
- Continue Phase 2 & 3 stretching & strengthening exercises
- Progress straight leg raise activities
- Side-lying gluteal exercises with a flexed knee
- Standing weighted-hip adduction and abduction
- Introduce weighted knee flexion at Week 8
- Introduce quadriceps stretching at Week 9
- Recumbent cycling to 110 degrees flexion
- Introduce proprioception exercises once full weightbearing
- Slowly progress proprioceptive activities from partial to full weightbearing positions by altering:
 - postural position
 - speed of movement
 - proprioceptive input (eyes open or closed)
 - magnitude of base of support (2-legged to 1-legged, weight transfers)
 - stability of base of support (soft mat, wobble board, dura disc, thera-ball, or mini-trampoline)
- Modalities as needed for swelling and pain control

Phase V: Return to Daily Activity (3-6 months following surgery)

Goals:

- Unimpeded, pain-free active range of motion through everyday environments, including stairs
- Normal gait pattern without walking aids or brace
- Progression with strengthening exercises, including weighted leg press
- Full return to work, depending on the demands of the job
- Independence in performing full weightbearing proprioception activities

Precautions:

- Full weightbearing
- Full and pain-free active range of motion
- No protective knee bracing but knee sleeve as needed for comfort

Exercises:

- Continue Phase 3 & 4 stretching & strengthening exercises
- Introduce bridging exercises
- Introduce standing single-leg calf raises
- Introduce modified open kinetic chain exercises (with appropriate use based on lesion location and knee joint biomechanics)
- Introduce modified closed kinetic chain exercises (inner range quadriceps and leg press activities)
- Full stationary cycling and/or outdoor road cycling
- Introduce rowing ergometry as tolerated

Phase VI: Recreational Activities (6-9 months following surgery)**Goals:**

- Hamstring and calf strength within 80-90% of the contralateral leg
- Ability to tolerate walking distances of > 3 miles (5 km)
- Ability to effectively negotiate uneven ground, including soft sand
- Ability to return to low-impact recreational activities

Precautions:

- Full weightbearing and pain-free active range of motion
- No protective knee bracing but knee sleeve as needed for comfort

Exercises:

- Continue Phase 3 & 4 stretching & strengthening exercises
- Introduce bridging exercises
- Introduce standing single-leg calf raises
- Progression and increased difficulty of open kinetic chain exercises (with appropriate use based on lesion location and knee joint biomechanics)
- Progression and increased difficulty of closed kinetic chain exercises (step-ups/downs, modified squat activities)
- Introduce controlled jogging on treadmill as tolerated

Phase VII: Return to Full Activity (9-12 months following surgery)**Goals:**

- Ability to perform all activities of daily living
- Ability to commence a running program
- Resume dynamic recreational and sports-specific activities
- A full return to the patient's relevant activities

Precautions:

- Full weightbearing and pain-free active range of motion
- No protective knee bracing but knee sleeve as needed for comfort
- Activities that generate high-compression, shear, and rotational loads are to be avoided until 12-18 months after surgery or as directed by the orthopedic surgeon

Exercises:

- Continue Phase 3 - 6 stretching & strengthening exercises
- Progression and increased difficulty of closed kinetic chain exercises
- Introduction of agility exercises relevant to the patient's activities
- Progression of running on treadmill and flat surfaces to uneven terrain relevant to the patient's activities

Note: Individual patient variations must be evaluated when considering a patient's long-term outcome and ability to return to activities. In addition to the commitment and psychological profile of the patient, specific considerations include whether:

- The patient's graft has matured to the point at which it is able to withstand the specific demands of the chosen activity
- The patient has been appropriately rehabilitated to the point at which they are able to physically and psychologically undertake the demands of the chosen activity
- The patient has undergone appropriate clinical assessment by the orthopedic surgeon and has been cleared for increased activity