

Physical Therapy Prescription for:

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KNEE ARTICULAR CARTILAGE MACI PATELLOFEMORAL POST-OPERATIVE GUIDELINES

Diagnosis: Patellar Chondral Defect

Surgical Procedure: MACI to Patella, [] TTO, [] MPFL

Rx: Eval & Treat. 2-3x/week x 12 weeks

Progressions in this guideline are both criteria-based and can be modified for individual patient needs. Phases and time frames are designed to give the clinician a general sense of progression. The rehabilitation program following a MACI procedure emphasizes early, controlled motion to prevent knee stiffness and to avoid disuse atrophy of the musculature. The program should be a balance of managing prior deficits, tissue healing and appropriate interventions to maximize flexibility, strength, and pain-free performance of functional activities. This model should not replace clinical judgment.

These types of patients may have additional alignment issues that may have caused their initial cartilage breakdown. Please be aware if concomitant surgical procedures have been performed. Defer to the surgeon for additional direction.

Monitor swelling throughout the rehabilitation process. If persistent swelling occurs, monitor load volume and consult with the referring physician.

Follow physician modifications and brace guidelines as prescribed.

KNEE ARTICULAR CARTILAGE MACI PATELLOFEMORAL POST-OPERATIVE GUIDELINES

Post-operative Phase 1: Weeks 0-2

PRECAUTIONS

- Range of motion (ROM): progress as tolerated within these limits; do not force ROM
 - Week 1: 0°-20°
 - Week 2: 0°-60°
- Adhere to weight bearing restrictions
 - [] Partial weight bearing 50% [] NWB 6 weeks (TTO)
- Brace Guidelines
 - Ambulation with brace locked and bilateral axillary crutches
 - **Sleep with brace locked in extension for 2 weeks**
- Avoid pillow under knee to prevent knee flexion contracture

ASSESSMENT

- Lower Extremity Functional Scale (LEFS)
- Numeric pain rating scale (NPRS)
- Patellar mobility
- Swelling (girth and description)
- Inspection of incision
- Quality of quadriceps contraction
- Lower extremity (LE) flexibility
- LE active ROM (AROM) and passive ROM (PROM)
- Gait assessment

TREATMENT RECOMMENDATIONS

- Immediate ROM after surgery
 - Continuous passive motion (CPM) 0°-20° week 1; 0°-60° week 2
 - Active assisted ROM pain-free: seated knee flexion off table
 - **Do not force ROM**
- Emphasize full knee extension immediately
 - Heel prop multiple times per day
 - LE stretching (hamstring/gastrocnemius/soleus)
- Patellar mobilization as indicated (all planes)
- Patient education

- Strengthening
 - Quadriceps re-education with neuromuscular electric stimulation (NMES)
 - Straight leg raise (SLR) all planes- emphasize no extensor lag
 - Brace locked in extension if pain/lag
 - Ankle progressive resistive exercises (PRE)
- Consider blood flow restriction (BFR) program with FDA approved device and qualified therapist if patient cleared by MD
- Soft tissue mobilization, if applicable
 - Quadriceps, hamstring, gastrocnemius/soleus
 - Mobilization to superior patellar pouch and infra-patellar soft tissue structures to provide proper patellar mobility
- Edema control (cryotherapy)
- Independent with home exercise program (HEP) that addresses primary impairments

CRITERIA FOR ADVANCEMENT

- Maintain knee ROM: 0°-60°
- Control post-operative pain/swelling
- SLR flexion without extensor lag
- Adherence to post-operative restrictions
- Independent with HEP

EMPHASIZE

- Ambulation with brace locked in extension and 50% PWB
- Improving quadriceps activation
- ROM 0°-60°
- Controlling pain/effusion

KNEE ARTICULAR CARTILAGE MACI PATELLOFEMORAL POST-OPERATIVE GUIDELINES

Post-operative Phase 2 (Weeks 2-6)

PRECAUTIONS

- Progress ROM as tolerated: do not force motion
 - Progress to 0°-110° by week 4
 - Progress to 0°-125° by week 6
- Adhere to weight bearing restrictions
 - Progress to weight bearing as tolerated after 2 weeks with crutches
- Brace guidelines: locked in extension x 6 weeks with ambulation
- Avoid pillow under knee to prevent knee flexion contracture

ASSESSMENT

- LEFS
- NPRS
- Patellar mobility
- Swelling (girth and description)
- Inspection of incision
- Quality of quadriceps contraction
- LE flexibility
- LE AROM and PROM
- Gait assessment

TREATMENT RECOMMENDATIONS

- Range of motion
 - CPM 0°-110° by week 4; 0°-125° by week 6
 - Continue exercises from phase 1
 - Step knee flexion stretch
 - Heel slides against wall
 - Maintain passive knee extension
 - Continue patellar mobilizations as needed
- Continue with LE stretching program

- Strengthening
 - Continue with NMES as needed for quadriceps activation
 - Short crank bike progressing to upright stationary bike (when 110°-115° knee flexion obtained)
 - Multi-angle quadriceps isometrics (avoid lesion)
 - Weight shift exercises with upper extremity support
 - Bilateral leg balance/proprioceptive activities
 - Standing bilateral heel raises
 - Initiate core stabilization/kinetic linking program
 - Progress multiplanar gluteal/core/hip strengthening (continue Phase 1 exercises)
 - Clamshells (with adequate flexion ROM)
 - Bridges with resistance band abduction (with adequate knee flexion ROM)
 - Leg press (light weight bilaterally, monitor arc of motion) – after week 4
 - Hydrotherapy when incisions are healed- week 4-6 for gait, proximal strengthening, functional movements, balance and edema control
- Cryotherapy and elevation of LE to prevent swelling

CRITERIA FOR ADVANCEMENT

- Full weight bearing with crutches
- Progressing toward full ROM
- Normal patella mobility (all planes)
- Proximal strength > 4/5
- Minimal edema
- Well controlled pain

EMPHASIZE

- Do not force ROM/emphasize pain free ROM
- Control edema

KNEE ARTICULAR CARTILAGE MACI PATELLOFEMORAL POST-OPERATIVE GUIDELINES

Post-operative Phase 3 (Weeks 7-12)

PRECAUTIONS

- Progress ROM to full
- Monitor swelling and soreness with weight bearing and therapeutic exercise
- Unlock brace with adequate quadriceps control
- Wean from crutches with non-antalgic gait pattern

ASSESSMENT

- LEFS
- NPRS
- Patellar mobility
- Swelling (girth and description)
- Inspection of incision
- Quality of quadriceps contraction
- LE flexibility
- LE AROM and PROM
- Gait assessment

TREATMENT RECOMMENDATIONS

- Range of motion
 - Gradual increase of ROM to full
 - Continue ROM exercises from Phase 2
 - Prone knee flexion stretch
 - Supine or kneeling hip flexor stretch
 - Flexion stretch on step
 - Maintain full passive knee extension
 - Continue LE stretching program
 - Continue patellar mobilization as needed
 - Initiate foam rolling program
- Brace
 - Unlock brace with adequate quadriceps control.
 - D/C brace per MD direction
- Wean from crutches with non-antalgic gait pattern
- Soft tissue mobilization- continue as needed

- Strengthening
 - Progress stationary bike time
 - Progress to elliptical when able to perform FSU 8"
 - Resisted terminal knee extension
 - Leg press bilateral → eccentric
 - Retro-ambulation for neuromuscular quadriceps control
 - Underwater or anti-gravity treadmill gait training if gait pattern continues to be abnormal
 - Chair/box squats
 - Band around knees to promote gluteal activation
 - Promote movement through hips and proper form
 - Progressively lower seat height as appropriate for strength gains and pain response
 - Suspension system squats
 - Emphasizing same principles as box squat
 - Initiate step up
 - Start with 4" step and progress to 8" with adequate quadriceps strength
 - Emphasize proper movement pattern (no hip drop, no valgus breakdown)
 - Romanian deadlift: double leg → single leg
 - Progressive gluteal/hip strengthening
 - Three-point step
 - Lateral/monster walks
 - Hip abduction isometric at wall
 - Windmills
 - Clamshells in modified side plank
 - Bridge progression
 - Progress balance/proprioception
 - Progress core stabilization/kinetic linking program
 - Initiate step down
 - Start with 4" step and progress to 6" emphasize eccentric control
 - Emphasize proper movement pattern (no hip drop, no valgus breakdown)

CRITERIA FOR ADVANCEMENT

- Full ROM
- Ability to ascend 8" step
- Normal gait pattern
- Squat 0°-90° symmetrically
- Single leg stance > 30 seconds

EMPHASIZE

- Minimal swelling
- Control volume and load with functional activities
- Emphasis on proper movement strategy/quality of movement

KNEE ARTICULAR CARTILAGE MACI PATELLOFEMORAL POST-OPERATIVE GUIDELINES

Post-operative Phase 4 (Weeks 12-18)

PRECAUTIONS

- Avoid pain with therapeutic and functional activities
- Control post-operative edema

ASSESSMENT

- LEFS
- NPRS
- Patellar mobility
- Swelling (girth and description)
- Quality of quadriceps contraction
- LE flexibility
- Strength assessment: isokinetic testing, hand-held dynamometry

TREATMENT RECOMMENDATIONS

- Range of motion: full ROM without limitations
- Strengthening
 - Continue to progress with squat program (PRE)
 - Continue to progress with eccentric leg press
 - Progress with suspension system squats
 - Eccentric double leg squats
 - Single leg squats focusing on control and technique
 - Progress step up and step down progression by increasing height and adding weights (intrinsic load)
 - Advanced proprioception training (perturbations)
 - Continue to progress with aquatic program if available
 - Climbing machine
 - Continue with core/kinetic linking progression

CRITERIA FOR ADVANCEMENT

- 80% quadriceps limb symmetry (dynamometry)
- No pain/inflammation after activity
- Able to descend 8" step with good control, no deviations

EMPHASIZE

- Minimal swelling
- Control volume and load with functional activities
- Emphasis on proper movement strategy/quality of movement

KNEE ARTICULAR CARTILAGE MACI PATELLOFEMORAL POST-OPERATIVE GUIDELINES

Post-operative Phase 5 (Weeks 18+)

Follow physician modifications and brace guidelines as prescribed.

PRECAUTIONS

- Monitor load and volume
- Monitor pain and swelling

ASSESSMENT

- LEFS
- NPRS
- LE flexibility
- Strength assessment: hand-held dynamometry, isokinetic testing
- Return to sport testing, e.g., hop testing
- Apprehension with sports specific movement

TREATMENT RECOMMENDATIONS

- Quality Movement Assessment
- Anti-gravity running progression- week 20+
 - Needs to display good eccentric control with 8" step down to begin
 - Progress interval treadmill running program (be cautious of overloading knee)
 - Monitor for swelling
- Strength maintenance program
 - Bike/elliptical lower resistance
 - Gluteal activation exercises
 - Chair/box squats
 - Leg press
 - Multiplanar hip strengthening
 - Front/side/back lunges
 - Single leg RDL
- LE stretching: foam rolling
- Plyometric program: double leg → single leg
- Progress strength and flexibility through entire kinetic chain (hips, knees, ankles)
- Progress with cardiovascular endurance training while continuing low load methods
- Progress with agility and balance drills
- Progress with sports specific programs

CRITERIA FOR DISCHARGE

- 90% limb symmetry (quadriceps and hamstring) with dynamometry and functional testing
- Independent with gym strengthening and maintenance program

EMPHASIZE

- Monitor volume in sports related activities

KNEE ARTICULAR CARTILAGE MACI PATELLOFEMORAL POST-OPERATIVE GUIDELINES

References

- Brittberg, M., Recker, D., Ilgenfritz, J., and Saris, D.B.F. (2018). Matrix-Applied Characterized Autologous Cultured Chondrocytes Versus Microfracture: Five-Year Follow-up of a Prospective Randomized Trial. *American Journal of Sports Medicine* 46, 1343–1351.
- Ebert, J.R., Robertson, W.B., Lloyd, D.G., Zheng, M.H., Wood, D.J., and Ackland, T. (2008). Traditional vs accelerated approaches to post-operative rehabilitation following matrix-induced autologous chondrocyte implantation (MACI): comparison of clinical, biomechanical and radiographic outcomes. *Osteoarthritis and Cartilage* 16, 1131–1140.
- Ebert, J.R., Edwards, P.K., Fallon, M., Ackland, T.R., Janes, G.C., and Wood, D.J. (2017). Two-year outcomes of a randomized trial investigating a 6-week return to full weightbearing after matrix-induced autologous chondrocyte implantation. *American Journal of Sports Medicine* 45, 838–848.
- Ebert, J.R., Fallon, M., Ackland, T.R., Janes, G.C., and Wood, D.J. (2020). Minimum 10-year clinical and radiological outcomes of a randomized controlled trial evaluating 2 different approaches to full weightbearing after matrix-induced autologous chondrocyte implantation. *American Journal of Sports Medicine* 48, 133–142.
- Ebert, J.R., Fallon, M., Wood, D.J., and Janes, G.C. (2017). A prospective clinical and radiological evaluation at 5 years after arthroscopic matrix-induced autologous chondrocyte implantation. *American Journal of Sports Medicine* 45, 59–69.
- Ebert, J.R., Fallon, M., Zheng, M.H., Wood, D.J., and Ackland, T.R. (2012). A randomized trial comparing accelerated and traditional approaches to postoperative weightbearing rehabilitation after matrix-induced autologous chondrocyte implantation: Findings at 5 years. *American Journal of Sports Medicine* 40, 1527–1537.
- Ebert, J.R., Janes, G.C., and Wood, D.J. (2020). Post-operative sport participation and satisfaction with return to activity after matrix-induced autologous chondrocyte implantation in the knee. *International Journal of Sports Physical Therapy* 15, 1–11.
- Ebert, J.R., Smith, A., Edwards, P.K., and Ackland, T.R. (2014). The progression of isokinetic knee strength after matrix-induced autologous chondrocyte implantation: Implications for rehabilitation and return to activity. *Journal of Sport Rehabilitation* 23, 244–258.
- Edwards, P.K., Ackland, T., and Ebert, J.R. (2014). Clinical rehabilitation guidelines for matrix-induced autologous chondrocyte implantation on the tibiofemoral joint. *Journal of Orthopaedic and Sports Physical Therapy* 44, 102–119.

Gobbi, A., Chaurasia, S., Karnatzikos, G., and Nakamura, N. (2015). Matrix-induced autologous chondrocyte implantation versus multipotent stem cells for the treatment of large patellofemoral chondral lesions: a nonrandomized prospective trial. *Cartilage* 6, 82–97.

J., E., R., C.-S., M., F., H., D., S., G., D.J., W., and G., J. (2010). Arthroscopic matrix-induced autologous chondrocyte implantation (MACI) in combination with accelerated rehabilitation. *Cartilage* 1, 125S.

Kon, E., Filardo, G., Di Martino, A., and Marcacci, M. (2012). ACI and MACI. *The Journal of Knee Surgery* 25, 17–22.

Kraeutler, M.J., Belk, J.W., Carver, T.J., and McCarty, E.C. (2018). Is delayed weightbearing after matrix-associated autologous chondrocyte implantation in the knee associated with better outcomes? A systematic review of randomized controlled trials. *Orthopaedic Journal of Sports Medicine* 6.