

## **Rehabilitation Following Autologous Chondrocyte Implantation or Denovo Chondrocyte Implantation**

### **I. PHASE I – EARLY PROTECTION PHASE (Weeks 0-6)**

#### **Goals:**

- Protect healing tissue from load and shear forces
- Decrease pain and effusion
- Restoration of full passive knee extension
- Gradually improve knee flexion

#### **Brace:**

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

#### **Weight Bearing:**

Weight bearing status varies based on lesion location and size

- For femoral condyle lesions: Non weightbearing for 1-2 weeks, toe touch WB (approx.. 20-30 lbs.) weeks 2-3; progress to partial WB (approx.. ¼ body weight) at week 4-5.
- For patellofemoral lesions: Immediate toe-touch weightbearing of ~25% body weight with brace locked in full extension; progress to 50% WB at week 2 and 75% WB week 3-4 with brace locked in full extension.

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

Immediate motion exercise day 1

- Full passive knee extension immediately
- Initiate CPM day 1 for total of 8-12 hours/day (0-60°; if patellofemoral lesion 6.0 cm<sup>2</sup>, 0-40°)
- Progress CPM 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 at least 2-3 times daily
- Passive knee range of motion as tolerated



- For femoral condyle lesions, knee flexion ROM goal is 90° by 1-2 weeks, 105° week 3, 115° week 4, and 120-125° by week 6.
- For patellofemoral lesions, knee flexion ROM goal is 90° by week 2-3, 105° by 3-4 weeks and 120° by week 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° for femoral condyle lesions (no resistance)
- Straight leg raises (4 directions)
- Stationary bicycle when ROM allows – low resistance
- Electrical muscle stimulation and/or biofeedback during quadriceps exercises
- Isometric leg press at week 4 (multi-angle)
- May begin use of pool for gait training and exercises week 4
- Initiate weight shifting exercises with knee in extension week 2-3 for patellofemoral lesions
- NO active knee extension exercises for patellofemoral lesions

**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

II. **PHASE II – TRANSITION PHASE (Weeks 6-12)**

**Goals:**

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



**Brace:**

- Discontinue brace at week 6
- Consider unloading knee brace for femoral condyle lesions

**Weightbearing:**

- Progress weightbearing as tolerated
- For femoral condyle lesions: ½ body weight with crutches at 6 weeks; progress to full weightbearing at 8-9 weeks, discontinue crutches
- For patellofemoral lesions: Progress to full weightbearing week 6-8, discontinue crutches

**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:**

- Progress closed kinetic chain exercises
- Initiate weight shifts week 6 for femoral condyle lesions
- Leg press week 7-8
- Mini-squats 0-45° week 8
- Toe-calf raises week 6 for patellofemoral lesions, week 8 for femoral condyle lesions
- Progress balance and proprioception drills
- Initiate front lunges, wall squats, affront and lateral step-ups week 8-10
- For femoral condyle lesions, progress open kinetic chain knee extension, 1 lb./week
- For patellofemoral lesion, may begin open kinetic chain knee extension without resistance in a range of motion that does not allow for articulation of the lesion.
- Stationary bicycle, low resistance (gradually increase time)
- Treadmill walking program week 10-12
- Continue use of electrical muscle stimulation and or biofeedback 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

### III. **PHASE III: REMODELING 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
- Progress open kinetic chain extension (0-90°), for patellofemoral lesions perform from 90-40° or avoid angle where lesion articulates
- Progress 1 pound every 2 weeks beginning week 20 if no pain or crepitation – must monitor symptoms
- Continue progressing balance and proprioception
- Bicycle
- Stairmaster
- Swimming
- Nordic-Trak/Elliptical

#### **Functional Activities:**

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

#### **Maintenance Program:**

- Initiate at week 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

IV. **PHASE IV – MATURATION PHASE (Weeks 26-52)**

**Goals:**

- Gradual return to full unrestricted functional activities

**Exercises:**

- Continue maintenance program progression 3-4x/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, rollerblading, and cycling are permitted at about 6 months
- Higher 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 sports such as tennis, basketball, football, and baseball are allowed at 12-18 months.