

## **Autologous Chondrocyte Implantation Procedure Rehabilitation Protocol**

### **Phase 1 – Protection Phase (Weeks 0 – 6)**

#### **Goals for Phase 1**

- Protect healing surfaces from shear forces
- Restore full passive knee extension with gradual increase in flexion
- Control postoperative pain and swelling
- Regain quadriceps control

#### **Precautions**

- Weeks 0-2: PROM only; limited knee flexion 0-40 deg
- No active knee extension from 40-70 deg
- No repetitive closed chain knee flexion from 40-70 deg

#### **Criteria to Progress**

- SLR with no lag (without brace)
- Full passive knee extension
- Knee flexion to 90 deg by week 4, greater than 120 deg by week 6
- Normal patellofemoral mobility
- Controlled swelling

#### **Brace**

- Locked in 0 deg when weight bearing and at night
- Remove for CPM machine and exercises
- Gradually open up brace with WB as quad control improves
- Weeks 4-6: unlock 20-30 deg with ambulation if able to perform SLR without lag
- Can discharge brace at 6 weeks if SLR without lag

#### **Weight Bearing**

- Tibial Tubercle Osteotomy for trochlea patella:
  - TTWB in locked brace
- No osteotomy for trochlea patella:
  - Immediately post op: 25% WB in locked brace
  - Week 2: progress to 50% WB in locked knee brace
  - Weeks 3-4: progress to 75% WB in locked knee brace
  - Weeks 5-6: progress to WBAT in unlocked knee brace
- Femoral Condyle lesions:
  - Sleep in locked brace for 2 weeks
  - NWB (2 weeks)
  - TTWB (week 2-3)
  - Partial 25% WB (week 4-5)
- May change based on the size of the lesion if it involves two opposing surfaces (i.e. patella and trochlea) and stability. Please reach out to physician for clarification.

#### **CPM**

- Weeks 0-2: 0-40 deg
  - Increase CPM range by 5-10 deg per day afterward based on tolerance
- CPM 6-8 hours/day in 2-hour blocks (minimum of one hour daily)
- Can vary based on physician preference. So please reach out to physician for clarification.

#### **Therapeutic Exercise**

- Heel prop with quad set
- Seated knee flexion AAROM (limit 0-40 deg weeks 0-2)
- Heel slides (limit 0-40 deg weeks 0-2) passive and/or active
- Hamstring and glute isometrics
- Four-way SLR sequence
- Stationary bike with elevated seat height (Start at week 4 only if patient has 90 deg knee flexion)

- Blood flow restriction therapy
- NMES for quad strength
- Gentle patellar mobility in all directions
- Pool walking starting at week 4 if incision is fully healed

## Phase 2 – Transition Phase (Week 6 to 12)

### Goals for Phase 2

- Protect healing graft
- Achieve full knee flexion
- Return to full WB with normalized gait pattern
- Progress quad strength and lower extremity control

### Precautions

- No active open chain knee extension from 40-70 deg
- Avoid repetitive closed chain knee flexion from 40-70 deg

### Criteria to Progress

- Full knee ROM
- Minimal/no swelling at baseline
- Normal gait mechanics
- Pain-free sit to stand

### Weight Bearing

- Trochlea Patella
  - At 6 weeks, progress WBAT to full weight bearing by weeks 8-9
- Femoral Condyle lesions:
  - Partial 50% WB (week 6-7)
  - Discharge crutches at week 6-8

### Therapeutic Exercise

- Short arc quad (may begin at week 9)
- Standing heel raise
- Bridging
- Terminal knee extension
- Mini squats
- Wall slides
- Step ups
- Lateral step down
- Resisted side stepping (band at thighs)
- Weighted knee flexion (week 8)
- Stretching quadriceps musculature (weeks 9-10)

### Balance/Proprioception Exercise

- Double leg balance from 6-8 weeks
- Single leg balance begin at week 8
  - Static or dynamic challenges on and off compliant surfaces as tolerated
  - With upper extremity reach (begin week 10)

### Aerobic Exercise

- Stationary bike (no/minimal resistance with emphasis on ROM)
- Treadmill walking
- Aquatic flutter or straight leg kicks with kickboard

## Phase 3 – Late Post-Op Phase (Weeks 12 to 24)

### Goals for Phase 3

- Protect healing graft
- Progress single leg strength, control and load tolerance
- Progress balance work in all 3 planes of motion

### Precautions

- Significant pain during activity
- Significant swelling after activity
- Post activity soreness > 24 hours
- No active knee extension from 40-70 deg
- Avoid repetitive closed chain knee flexion from 40-70 deg

### Criteria to Progress

- Bilateral squat to 40 deg knee flexion with good mechanics without pain
- Single leg squat depth to at least 40 deg knee flexion with good control without pain
- All ADLs performed without pain or swelling

### Therapeutic Exercise

- Single leg dead lift
- Single leg calf raises
- Initiate bridging exercises
- Leg press < 40 deg flexion
- Single leg squat < 40 deg flexion
- Seated hamstring curl machine
- Standing resisted knee flexion
- Double leg mini squat
- SLR with weight
- Small step up with weight if appropriate

### Balance/Proprioception Exercise

- Progress single leg balance with lower extremity reaching and perturbations

### Aerobic Exercise

- Treadmill forward and retro walking
- Aquatics: flutter kicking (no whip kicks) and aqua jogging

## Phase 4 – Advanced Strengthening (Weeks 24+)

### Goals for Phase 4

- Progress active knee flexion in full ROM
- Hamstring and calf strength within 80% of the contralateral limb
- Ability to ambulate long distance (5-10 km) without pain
- Ability to effectively negotiate uneven terrain
- Return to pre-operative low-impact recreational activities

### Criteria to Progress

- No effusion/pain after exercise
- Return to low-level impact recreational activities without pain or swelling
- Ability to perform bilateral and single leg squat in increased ROM with good control without pain

### Additional Interventions

- Progression of phase 2-3 exercises incorporating increased knee flexion (now permitted to perform knee flexion 40-70 deg)

## Phase 5 – Early Return to Sport (9-12 Months)

### Goals for Phase 5

- Quadriceps strength within 90% of contralateral limb
- Ability to perform all activities of daily living pain free
- Initiate return to running program

### Additional Interventions

- Begin sub-max sport-specific training in the sagittal plane
- Interval running program
- Progress to plyometric and agility program

### Criteria to Progress

- Clearance from MD and ALL milestone criteria have been met
- Completion of jog/run program without pain/effusion/swelling
- Functional assessment:
  - Quads/hamstring/glute index > 90% HHD mean or isokinetic testing at 60 deg/sec
  - Hamstring/quad ratio >66%
  - Hop testing > 90% compared to contralateral side, demonstrating good landing mechanics

## Phase 6 – Unrestricted Return to Sport (12 months+)

### Goals for Phase 4

- Continue strengthening and proprioceptive exercises
- Symmetrical performance with sport-specific drills
- Safely progress to full sport

### Additional Interventions

- Multi-plane sport-specific plyometrics program
- Multi-plane sport-specific agility program
- Include hard cutting and pivoting depending on the individuals' goals
- Non-contact practice -> full practice -> full play

### Criteria to Progress

- Functional assessment:
  - Quadricep/hamstring/glute index >90% HHD mean or isokinetic testing at 60 deg/second
  - Hamstring/quad ratio >66%
  - Hop testing >90% compared to contralateral side, demonstrating good landing mechanics
- KOOS-sport questionnaire >90%
- International Knee Committee Subjective Knee Evaluation > 93

This protocol was updated and reviewed by Dr Kurcz, Stephanie Jensen, and Jaclyn Karbon of Orthopedics & Sports Medicine BayCare Clinic Manitowoc on 5/23/2024.

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