

**DR. CARL DIRAIMONDO / DR. BRIAN KURCZ / DR. CRAIG OLSON
AUTOLOGOUS CHONDROCYTE IMPLANTATION POST-OP THERAPY PROTOCOL**

**Phase 1 – Protection Phase (0-6 weeks)
(continued on next page)**

Goals for Phase 1	Precautions for Phase 1	Criteria to Progress to Phase 2
<ul style="list-style-type: none"> • Protect healing surfaces from shear forces • Restore full passive knee extension with gradual increase in flexion • Control postoperative pain and swelling • Regain quadriceps control 	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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
- **4-6 weeks:** 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
 - **2 weeks:** progress to 50% WB in locked knee brace
 - **3-4 weeks:** progress to 75% WB in locked knee brace
 - **5-6 weeks:** progress to WBAT in unlocked knee brace
- Femoral condyle lesions:
 - Sleep in locked brace for 2 weeks
 - **2 weeks:** NWB
 - **2-3 weeks:** TTWB
 - **4-5 weeks:** Partial 25% WB
- 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. Please reach out to physician for clarification.

Phase 1 – Protection Phase (0-6 weeks)

Therapeutic Exercise

- Heel prop with quad set
- **0-2 weeks:** (limit 0-40 deg) seated knee flexion AAROM
- **0-2 weeks:** (limit 0-40 deg) heel slides, 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

**DR. CARL DIRAIMONDO / DR. BRIAN KURCZ / DR. CRAIG OLSON
AUTOLOGOUS CHONDROCYTE IMPLANTATION POST-OP THERAPY PROTOCOL**

Phase 2 – Transition Phase (6-12 weeks)

Goals for Phase 2	Precautions for Phase 2	Criteria to Progress to Phase 3
<ul style="list-style-type: none"> • Protect healing graft • Achieve full knee flexion • Return to full WB with normalized gait pattern • Progress quad strength and lower extremity control 	<ul style="list-style-type: none"> • No active open chain knee extension from 40-70 deg • Avoid repetitive closed chain knee flexion from 40-70 deg 	<ul style="list-style-type: none"> • Full knee ROM • Minimal/no swelling at baseline • Normal gait mechanics • Pain-free sit to stand

Weight Bearing

- Trochlea patella:
 - **6 weeks**: progress WBAT to full weight bearing by weeks 8-9
- Femoral condyle lesions:
 - **6-7 weeks**: partial 50% WB
 - **6-8 weeks**: discharge crutches

Therapeutic Exercise

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

Balance/Proprioception Exercise

- **6-8 weeks**: double leg balance
- **8 weeks**: single leg balance begin
 - Static or dynamic challenges on and off compliant surfaces as tolerated
 - **10 weeks**: begin with upper extremity reach

Aerobic Exercise

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

**DR. CARL DIRAIMONDO / DR. BRIAN KURCZ / DR. CRAIG OLSON
AUTOLOGOUS CHONDROCYTE IMPLANTATION POST-OP THERAPY PROTOCOL**

Phase 3 – Late Post-Op Phase (12-24 weeks)

Goals for Phase 3	Precautions for Phase 3	Criteria to Progress to Phase 4
<ul style="list-style-type: none"> • Protect healing graft • Progress single leg strength, control and load tolerance • Progress balance work in all 3 planes of motion 	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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

**DR. CARL DIRAIMONDO / DR. BRIAN KURCZ / DR. CRAIG OLSON
AUTOLOGOUS CHONDROCYTE IMPLANTATION POST-OP THERAPY PROTOCOL**

Phase 4 – Advanced Strengthening (24+ weeks)

<p>Goals for Phase 4</p> <ul style="list-style-type: none"> • 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 	<p>Criteria to Progress to Phase 5</p> <ul style="list-style-type: none"> • 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)

**DR. CARL DIRAIMONDO / DR. BRIAN KURCZ / DR. CRAIG OLSON
AUTOLOGOUS CHONDROCYTE IMPLANTATION POST-OP THERAPY PROTOCOL**

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

<p>Goals for Phase 5</p> <ul style="list-style-type: none"> • Quadriceps strength within 90% of contralateral limb • Ability to perform all activities of daily living pain free • Initiate return to running program 	<p>Criteria to Progress to Phase 6</p> <ul style="list-style-type: none"> • Clearance from physician and ALL milestone criteria have been met • Completion of jog/run program without pain/effusion/swelling • Functional assessment: <ul style="list-style-type: none"> ○ Quads/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
---	--

Additional Interventions

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

**DR. CARL DIRAIMONDO / DR. BRIAN KURCZ / DR. CRAIG OLSON
AUTOLOGOUS CHONDROCYTE IMPLANTATION POST-OP THERAPY PROTOCOL**

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

Goals for Phase 6	Criteria to Return to Unrestricted Sport
<ul style="list-style-type: none"> • Continue strengthening and proprioceptive exercises • Symmetrical performance with sport-specific drills • Safely progress to full sport 	<ul style="list-style-type: none"> • Functional assessment: <ul style="list-style-type: none"> ○ 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

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