

DR. CARL DIRAIMONDO
AUTOLOGOUS CHONDROCYTE IMPLANTATION POST-OP THERAPY PROTOCOL

Phase 1 – Protection Phase (0-6 weeks)
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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
- 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.

Phase 1 – Protection Phase (0-6 weeks)

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

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Phase 2 – Transition Phase (6-12 weeks)

Goals for Phase 2	Precautions for Phase 2	Criteria to Progress to Phase 3
<p>Goals for Phase 2</p> <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 	<p>Precautions for Phase 2</p> <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 	<p>Criteria to Progress to Phase 3</p> <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
 - 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

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

Goals for Phase 3	Precautions for Phase 3	Criteria to Progress to Phase 4
<p>Goals for Phase 3</p> <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 	<p>Precautions for Phase 3</p> <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 	<p>Criteria to Progress to Phase 4</p> <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

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Phase 4 – Advanced Strengthening (24+ weeks)

Goals for Phase 4	Criteria to Progress to Phase 5
<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	<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)

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

Goals for Phase 5	Criteria to Progress to Phase 6
<ul style="list-style-type: none">Quadriceps strength within 90% of contralateral limbAbility to perform all activities of daily living pain freeInitiate return to running program	<ul style="list-style-type: none">Clearance from MD and ALL milestone criteria have been metCompletion of jog/run program without pain/effusion/swellingFunctional assessment:<ul style="list-style-type: none">Quads/hamstring/glute index > 90% HHD mean or isokinetic testing at 60 deg/secHamstring/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

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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/glut 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