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OSTEOCHONDRAL AUTO OR ALLO-GRAFT TRANSPLANTATION (OATS) **PHYSICAL THERAPY AND REHABILITATION GUIDELINES**

Phase 1 (Weeks 0 to 2 after surgery)

PRECAUTIONS

- Range of motion (ROM): progress as tolerated (DO NOT FORCE ROM)
 - 0-90° over first 2 weeks
- Adhere to weight bearing restrictions
 - 25% foot flat weight bearing (FFWB) with bilateral axillary crutches for 3 weeks
- Brace Guidelines
 - Ambulation with brace locked in extension and bilateral axillary crutches for 2 weeks
 - Sleep with brace locked in extension for 2 week
- Avoid pillow under knee to prevent knee flexion contracture
- Control post- operative swelling

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

- ROM/Soft Tissue
 - Immediate ROM after surgery
 - 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
 - Quad sets, straight leg raises (SLR) with neuromuscular electrical stimulation (NMES)
 - SLRs (all planes)
 - Emphasize no extension lag during exercise
 - Initiate primary core stabilization/Kinetic linking program
 - Abdominal sets
 - Pelvic bracing
 - BKFO
 - Clam shells
 - Ankle progressive resistive exercises (PRE)
 - Consider blood flow restriction (BFR) program with FDA approved device and qualified therapist if patient cleared by MD
- Independent with home exercise program (HEP) that addresses primary impairments

CRITERIA FOR ADVANCEMENT

- Maintain knee ROM: 0°-90°
- 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 20% FFWB
- Improving quadriceps activation
- Full knee extension
- Controlling pain/effusion
- Improving patellar mobility

Phase 2 (Weeks 2-6)

PRECAUTIONS

- Progress ROM as tolerated: **do not force motion**

- Adhere to weight bearing restrictions
 - Weeks 3-5: partial weight bearing up to 50% with crutches
 - Weeks 5-6: weight bearing as tolerated
- Brace guidelines
 - Weeks 2-3: Locked in extension for ambulation
 - Weeks 3-5: Unlock brace when proper quad control is established
 - Discharge brace after week 5 (may use knee sleeve or unloader brace at this point if needed)
- Avoid pillow under knee to prevent knee flexion contracture
- Control post-operative swelling

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

- ROM/Soft Tissue
 - ROM goals (USE AS A GUIDELINE)
 - Week 3- 0-105°
 - Week 4- 0-115/120°
 - Week 6- 0-130° (progressing to full ROM)
 - Continue exercises from phase 1
 - Heel slides against wall should there be difficulty gaining ROM
 - Step knee flexion stretch
 - Supine hip flexor stretch when tolerated
 - Maintain passive knee extension
 - Maintain patellar mobility
 - Continue LE soft tissue treatment as needed
 - Continue LE stretching per phase 1
- Strengthening
 - Continue Quadriceps re-education with NMES as needed
 - Continue blood flow restriction (BFR) program if patient cleared by MD
 - Bilateral Leg Press
 - 60° → 0° arc (week 2-4)
 - 90° → 0° arc (week 4-6) *depending on ROM gains*
 - Initiate core stabilization/Kinetic linking program
 - Standing bilateral heel raises-Week 2-3
 - Short crank bicycle progressing to upright bike with adequate ROM (110-115° of ROM)

- Multiplanar gluteal/core/hip strengthening
 - Bridges with elastic band
 - Side lying clamshells
 - Standing clamshells
- Weight shift exercises with upper extremity (UE) support
 - Bilateral weight bearing proprioception exercises
 - Single leg (SL) balance/proprioceptive activities after proper quad control obtained
- Hydrotherapy when incisions are healed for gait, proximal strengthening, functional movements, balance and edema control- week 4-6
- Underwater treadmill/anti-gravity treadmill gait training if gait pattern continues to be abnormal

CRITERIA FOR ADVANCEMENT

- ☐ Full weight bearing with crutches, discharge brace
- ☐ Demonstrate a normal gait pattern without deviations
- ☐ Progressing toward full ROM
- ☐ Normal patellar mobility (all planes)
- ☐ Proximal strength > 4/5
- ☐ Minimal edema
- ☐ Well controlled pain
- ☐ Independent with HEP

EMPHASIZE

- Proper gait pattern
- Continued full knee extension
- Controlling pain and effusion

Phase 3 (Weeks 6-12)

PRECAUTIONS

- Progress to full ROM
- Avoid pain with therapeutic exercises and functional activities
- Continue to control post-operative swelling

ASSESSMENT

- ☐ LEFS
- ☐ NPRS
- ☐ Patellar mobility
- ☐ Swelling (girth and description)
- ☐ Inspection of incision
- ☐ Quality of quadriceps contraction
- ☐ LE flexibility

- ☐ LE AROM and PROM
- ☐ Gait assessment
- ☐ Movement assessment

TREATMENT RECOMMENDATIONS

- ROM/Soft Tissue
 - Gradual increase of ROM to full
 - Continue ROM exercises from Phase 2
 - Prone knee flexion stretch
 - Maintain full passive knee extension
 - Continue patellar mobilization as needed
 - Continue with LE soft tissue program as needed
 - Continue with LE stretching program (hip, hamstring, gastrocnemius/soleus)
 - Add hip flexor and quad stretching
 - Initiate foam rolling program
- Strengthening
 - Progress stationary bicycle time
 - Initiate interval bicycle program between weeks 10-12 to help with fitness training
 - Progress to elliptical
 - Single leg pawing → retrograde treadmill
 - Multiplanar gluteal/core/hip strengthening
 - Continue exercises from phase II
 - Three point step/hip clocks
 - Lateral/monster walks
 - Romanian Dead Lift (RDL): double leg → single leg
 - Initiate open kinetic chain (OKC) knee extension (multiple angle isometrics, avoid lesion)
 - Progressing to isotonics (PRE)
 - Progress to eccentric leg press (2 up/1 down)
 - Emphasis on SLOW ECCENTRIC LOWERING and good alignment
 - Suspension training squats
 - Chair/Box Squats
 - Band around knees to promote gluteal activation and avoid valgus breakdown
 - Promote movement through hips and proper form.
 - Progressively lower seat height per strength gains
 - Progress to adding weights as appropriate (PREs)
 - Introduce step-up progression (week 6-8)
 - Start with 4" step → 6" step → 8" step
 - Emphasize proper movement pattern (no hip drop, no valgus breakdown)
 - Progress to adding weights as appropriate (PREs)
 - Emphasize good control
 - Front lunges → traveling lunges (DON'T PUSH ROM)

- Progressive gluteal/hip strengthening
 - Continue phase 2 exercises
 - SL wall push
 - Windmills
 - Clamshells in modified side plank
 - Bridge progression
- Progress balance/proprioception
 - Rockerboard
 - SL rebounder (Progress to foam pad/ ½ foam roller)
 - Sports specific balance
- Core/kinetic linking progression
- Progress BFR program to more weight bearing activities (i.e. squats, leg press)
- Introduce eccentric step down program (week 8-12)
 - Start with 4” step → 6” step → 8” step (assisted with railing if necessary)
 - Emphasize proper movement pattern (no hip drop, no valgus breakdown)
 - Emphasize good control
 - Progress to adding weights as appropriate (PREs)

MINIMUM CRITERIA FOR ADVANCEMENT

- ☐ Full pain-free ROM
- ☐ Chair/box squats with proper form and without complaints of pain
- ☐ SL stance > 30 sec with proper form and control
- ☐ Demonstrate ability to ascend 8” step with proper form, no pain
- ☐ Descend 6” step with good eccentric control, no pain
- ☐ Independent with HEP

EMPHASIZE

1. Minimal swelling
2. Control volume and load with functional activities
3. Emphasis on proper movement strategy/quality of movement

Phase 4 (Weeks 12-20)

PRECAUTIONS

- Avoid pain with therapeutic exercises and functional activities
- Control post-operative edema
- Monitor overall load and volume

ASSESSMENT

- ☐ LEFS
- ☐ NPRS
- ☐ Patellar mobility
- ☐ Swelling (girth and description)

- ☐ Quality of quadriceps contraction
- ☐ LE flexibility
- ☐ Strength assessment: isokinetic testing, hand-held dynamometry
- ☐ Movement assessment

TREATMENT RECOMMENDATIONS

- ROM/Soft Tissue
 - Patient should demonstrate full ROM without limitations
 - Continue LE soft tissue treatment as needed
- Strengthening ****EMPHASIZE ECCENTRIC STRENGTH AND CONTROL****
 - Continue to progress with squat program (PREs)
 - 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-ups/downs by increasing height and adding weights (intrinsic load)
 - Advanced proprioception training (perturbations)
 - Continue to progress with aquatic program if available
 - Stair machine/stair climber
 - Continue with core/kinetic linking progression
 - Continue with LE stretching
 - Progress isotonic knee extension OKC – progress to isokinetics at high to moderate speeds
 - Initiate running progression with anti-gravity treadmill or pool running - weeks 16-18
 - Must have good eccentric control with 8” step down
 - Monitor for swelling

CRITERIA FOR ADVANCEMENT

- ☐ 80% limb symmetry (quadriceps and hamstring) with hand-held dynamometry and functional testing
- ☐ No pain/inflammation after activity
- ☐ Movement without asymmetrical deviations and a hip dominant strategy
- ☐ Independent with HEP

EMPHASIZE

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

Phase 5 (Weeks 20+)

PRECAUTIONS

- Avoid pain with advanced strengthening, and plyometric activity

- Avoid pain with progression of return to running program
- Be cautious of patellofemoral overload with increased activity level
- Continue to control post-operative swelling
- Monitor overall load and volume

ASSESSMENT

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

TREATMENT RECOMMENDATIONS

- Advanced strength program 3-4 times/week
 - Cardiovascular endurance training with continued low load methods
 - Bicycle/elliptical/stair machine/rower
 - Gluteal activation exercises
 - Chair/box squats
 - Leg press (DL/SL)
 - Multiplanar hip strengthening
 - Front/side/back lunges
 - RDL (DL/SL)
 - Advanced kinetic linking progression
 - Chops/lifts
 - LE stretching/foam rolling program
- Plyometric program (DL → SL)
 - Individualized per sport and patient need
- Progress strength and flexibility through entire kinetic chain (hips, knees, ankle)
- Agility and balance drills
 - Progress with sport specific programs
 - Return to running program at month 6
 - MUST HAVE GOOD ECCENTRIC CONTROL WITH 8" STEP DOWN
 - Progress with interval treadmill program (be cautious of overloading the knee)
- Strength maintenance program
 - Bicycle/elliptical lower resistance
 - Gluteal activation exercises
 - Chair/box squats
 - Leg press
 - Multiplanar hip strengthening
 - Front/side/back lunges
 - SL RDL

- LE stretching: foam rolling
- Plyometric program: DL → SL
- Progress strength and flexibility through entire kinetic chain (hips, knees, ankle)
- Progress with cardiovascular endurance training with continue low load methods
- Progress with agility and balance drills
- Progress with sports specific programs

CRITERIA FOR DISCHARGE

- ☐ 90% limb symmetry (quadriceps and hamstring) with **hand-held** dynamometry and functional testing
- ☐ Isokinetic test $\geq$ 90% limb symmetry (IF AVAILABLE)
- ☐ Independent with gym strengthening and maintenance program
- ☐ Movement without asymmetrical deviations and a hip dominant strategy
- ☐ Lack of apprehension with sports specific movement (e.g. acceleration/deceleration, cutting)

EMPHASIZE

- Monitor volume in sports related activities

Physician's Signature: _____

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