Rehabilitation Protocol for Osteochondral Autograft/Allograft Transfer System (OATS) Procedure

This protocol is intended to guide clinicians through the post-operative course for OATS procedure, a method for autogenous/allograft hyaline cartilage resurfacing of full thickness chondral defects of the weightbearing areas of the femoral condyle. This protocol is time based (dependent on tissue healing) as well as criterion based. Additionally, the location of the surgery is critical to safeguard against potentially harmful forces early in the rehabilitation process. Specific intervention should be based on the needs of the individual and should consider exam findings and clinical decision making. The timeframes for expected outcomes contained within this guideline may vary based on surgeon's preference, additional procedures performed, and/or complications. If a clinician requires assistance in the progression of a post-operative patient, they should consult with the referring surgeon.

The interventions included within this protocol are not intended to be an inclusive list of exercises. Therapeutic interventions should be included and modified based on the progress of the patient and under the discretion of the clinician.

Considerations for the Post-operative Rehabilitation of the OATS Procedure
Many different factors influence post-operative rehabilitation outcomes, including location, size, depth, and containment of the lesion(s), as well as presence of concomitant injury. This protocol distinguishes between condylar and patellofemoral lesions as there are considerations unique to each. However, it is recommended that clinicians utilize their clinical judgment and collaborate closely with the referring physician throughout the rehabilitation process.

PHASE I: IMMEDIATE POST-OP (0-6 WEEKS AFTER SURGERY)

Rehabilitation Goals	• Maintain strength and flexibility of uninvolved leg • Control post-operative swelling and pain • Respect weightbearing restrictions to protect surgical leg
Weightbearing	• Crutches and hinged knee orthosis locked in extension with ambulation for all lesions • Non-weightbearing for 2 weeks for all lesions • Initiation of partial weightbearing is dependent on the location, size, and condition of the recipient site. When the site is a posterior condylar lesion or a patellofemoral lesion, partial weightbearing is allowed at 2 weeks. When the recipient site is located antero-central, partial weightbearing is allowed at 2 weeks for a small defect, 3 weeks for a medium-sized defect, and at 4 weeks for a large defect. • Full weightbearing is allowed by 6-10 weeks depending on condition

Interventions	*Swelling Management:*
	• Ankle pumps
	• Ice, compression, elevation (check with MD re: cold therapy)
	• Retrograde massage
	
	Range of Motion/Mobility:
	• Continuous Passive Motion (CPM): Immediately post-operative, perform 6-8 hours/day.
	  ○ Start at 0-60 degrees for condylar lesions and patellofemoral lesions <6 cm^2. Start at 0-40 degrees for patellofemoral lesions >6 cm^2. Progress 5-10 degrees/day.
	  ○ If no CPM, perform wall slides ~500 repetitions, 3x/day
	• Passive range of motion (PROM) and active-assisted range of motion (AAROM) facilitating knee flexion and extension in protected ranges of motion
	  ○ Condylar lesions:
	  ▪ Week 2: 0-90 degrees

	▪ Week 3: 0-105 degrees ▪ Week 4: 0-115 degrees ▪ Week 5-6: 0-125 degrees ○ Patellofemoral lesions: ▪ Week 2-3: 0-90 degrees ▪ Week 4: 0-105 degrees ▪ Week 5-6: 120 degrees • Hamstring and calf stretching with knee extended • Patellar mobilization *Strengthening:* • Quad sets ○ Functional electrical stimulation (as needed for trace to poor quadriceps control) NMES high intensity (2500 Hz, 75 bursts) supine knee extended 10 sec/50 sec, 10 contractions, 2x/wk during sessions—use of clinical stimulator during session, consider home units distributed immediate post op • 4-way straight leg raise (SLR) • Active knee extensions 90-40 degrees for condylar lesions only • Resisted plantarflexion in long sitting *Additional Therapeutic Exercise:* • Upper body ergometer (UBE)
Criteria to Progress	• Minimal pain and swelling • Compliance with weightbearing restriction • Achievement of range of motion goals (see above) • Quad contraction with superior patella glide and full active extension • Able to perform SLR without extension lag

PHASE II: INTERMEDIATE POST-OP (6-12 WEEKS AFTER SURGERY)

Rehabilitation Goals	• Protect surgical leg with appropriate weightbearing • Restore range of motion • Control swelling • Normalize gait
Weightbearing	• Crutches and hinged knee orthosis unlocked with ambulation • Progress to full weightbearing by Weeks 6-10 depending on condition
Additional Interventions **Continue with Phase I interventions*	*Range of Motion:* • Discontinue CPM at 8 weeks • Continue with PROM and AAROM from 0-120 degrees • Active range of motion (AROM) in protected range of motion: ○ Condylar lesions: active knee extensions 0-90 degrees beginning at Week 8 ○ Patellofemoral lesions: active knee extensions 0-30 degrees beginning at Week 12 *Strengthening*: • Condylar lesions: ○ Mini squats 0-60 degrees at Week 8 ○ Leg press 0-90 degrees at Week 10 • Patellofemoral lesions: ○ Mini squats 0-45 degrees at Week 8 ○ Leg press 0-60 degrees at Week 10 • Glute bridges in protected range of motion depending on lesion location • Standing resisted knee flexion in protected range of motion as indicated • Clamshells • Standing calf raises

	Gait Training: • Weight shifting • Ambulation over level ground • Treadmill training *Conditioning:* • Stationary cycling • Water activities (upon wound closure and clearance from MD), with gradually increasing knee flexion, with gradual progression from freestyle to breast stroke or side kick
Criteria to Progress	• Full, pain-free active and passive range of motion • Typical gait pattern over level ground

PHASE III: LATE POST-OP (3-5 MONTHS AFTER SURGERY)

Rehabilitation Goals	• Continue to protect surgical leg • Maintain full ROM • Safely progress strengthening • Promote proper movement patterns • Avoid post exercise pain/swelling • Avoid activities that produce pain
Weight Bearing	• Full weightbearing without hinged orthosis
Additional Intervention **Continue with Phase I-II Interventions as indicated*	*Strengthening*: • Squat to chair • Lumbopelvic strengthening: bridge & unilateral bridge, sidelying hip external rotation-clamshell, bridges on physioball, bridge on physioball with roll-in, bridge on physioball alternating, hip hike *The following exercises to focus on proper control with emphasis on good proximal stability • Lateral lunges • Romanian deadlift • Single leg progression: partial weight bearing single leg press, slide board lunges: retro and lateral, step ups and step ups with march, lateral step-ups, step downs, single leg squats, single leg wall slides *Balance/Proprioception*: • Single leg standing balance (knee slightly flexed) static progressed to dynamic and level progressed to unsteady surface • Lateral step-overs • Joint position re-training • Perturbation training *Conditioning:* • Stationary cycling • Elliptical • Treadmill training (incline, decline, intervals) • Stair climber • Interval running program ○ Return to Running Program •
Criteria to Progress	• No effusion/swelling/pain after exercise • Normal gait • ROM equal to contralateral side • Joint position sense symmetrical (<5-degree margin of error)

PHASE IV: TRANSITIONAL (5-6 MONTHS AFTER SURGERY)

Rehabilitation Goals	• Maintain full ROM • Safely progress strengthening • Promote proper movement patterns • Avoid post exercise pain/swelling • Avoid activities that produce pain at graft donor site
Additional Intervention **Continue with Phase I-III interventions as indicated*	• Begin sub-max sport specific training in the sagittal plane • Bilateral partial weightbearing (PWB) plyometrics progressed to full weightbearing (FWB) plyometrics

Criteria to Progress	• No episodes of instability
	• Maintain quad strength
	• 10 repetitions single leg squat proper form through at least 60 deg knee flexion
	• Drop vertical jump with good control
	• KOOS-sports questionnaire >70%
	• Functional Assessment
	  ○ Quadriceps index >80%; HHD or isokinetic testing 60d/s
	  ○ Hamstrings ≥80%; HHD or isokinetic testing 60 d/s
	  ○ Glut med, glut max index ≥80% HHD

PHASE V: EARLY RETURN TO SPORT (6+MONTHS AFTER SURGERY)

Rehabilitation Goals	• Safely progress strengthening • Safely initiate sport specific training program • Promote proper movement patterns • Avoid post exercise pain/swelling • Avoid activities that produce pain
Additional Intervention **Continue with Phase II-IV interventions as indicated*	• Progress to plyometric and agility program (with functional brace if prescribed) ○ Agility and Plyometric Program

Criteria to Progress	• Clearance from MD and ALL milestone criteria below have been met
	• Completion jog/run program without pain/effusion / swelling
	• Functional Assessment
	  ○ Quad/HS/glut index ≥90%; HHD mean or isokinetic testing @ 60d/s
	  ○ Hamstring/Quad ratio ≥66%
	  ○ Hop Testing ≥90% compared to contra lateral side, demonstrating good landing mechanics
	• KOOS-sports questionnaire >90%
	• International Knee Committee Subjective Knee Evaluation >93
	• Psych Readiness to Return to Sport (PRRS)

PHASE VI: UNRESTRICTED RETURN TO SPORT (8-12 MONTHS AFTER SURGERY)

Rehabilitation Goals	• 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

**Continue with Phase II-V interventions as indicated*	• Non-contact practice→ Full practice→ Full play
Criteria to Progress	• Last stage, no additional criteria

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Contact	Please email MGHSportsPhysicalTherapy@partners.org with questions specific to this protocol

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