

Orthobiological Repair of Osteochondral Defect

This rehabilitation program is designed to return the individual to their activities as quickly and safely as possible. It is designed for rehabilitation following orthobiological repair of an osteochondral defect including Microfracture, OATS and ACI procedures. Modifications to the protocol may be necessary dependent on size and location of defect being repaired, concomitant injuries or procedures performed, and patient specific goals of therapy. This rehabilitation protocol is criterion-based and time frames in each phase will vary depending on many factors including patient demographics, goals, and individual progress. This protocol is designed to progress the individual through rehabilitation to full activities. The therapist must modify the program appropriately depending on the individual's goals for activity following reconstruction.

This protocol is intended to provide the treating clinician with a guideline for rehabilitation. It is not intended to substitute for making sound clinical decisions regarding the patient's post-operative care based on exam/treatment findings, individual progress, and/or the presence of post-operative complications. If the clinician should have questions regarding post-operative progression, they should contact the referring physician.

General Guidelines/Expectations

- Therapist will monitor pain and swelling and adjust program appropriately
- Weight-bearing will be per surgeon's post-operative order depending on repair location & size. Please consider that controlled weight-bearing with axillary crutches will facilitate healing by nourishing articular cartilage. It will also provide the necessary signals to the repair to produce a matrix to match environmental forces. Please see appendix for guidelines on weight-bearing.
- Bracing will be per surgeon's post-operative order. Please see appendix for guidelines on bracing.
- Early emphasis placed on providing sufficient controlled motion to prevent development of adhesions within the joint and to stimulate healing without placing the repair site at risk from load & shear forces. Knowledge of the location defect and repair is essential in allowing the repair to heal.
- Restoration of full passive motion is anticipated between 10-12 weeks post-operative unless otherwise dictated by size and location of repair and directed by physician
- No impact activities until adequate maturation of chondral tissue has occurred and patient demonstrates full ROM, no swelling, adequate strength, and proper biomechanics are demonstrated through appropriate functional progression (minimum of 24 weeks unless otherwise cleared by physician)
- Progression to running program at 24-28 weeks (based on physician clearance), when able to demonstrate sufficient symmetry and shock absorption with running mechanics and level 1 testing activities
- Level 1 Return to Play testing (see appendix) considered at 24 weeks post-op with physician clearance
- Return to full activities when able to complete Level 2 Return to Play testing (see appendix) at game speed with sufficient biomechanics (45/50 score), confidence in limb, and/or release by physician.

Approximately 6.5 -7 months with OATS, 8-17 months with Microfracture, 18-25 months with ACI

Weightbearing & Bracing: Appendix 1

PHASE	INTERVENTION	GOALS/CRITERIA FOR PROGRESSION
<p>Phase I - Maximum Protection Phase (Weeks 0-2)</p> <p>Expected visits: 0-2</p>	<p>Gait and stair training with assistive device on day of surgery if ordered, per WB restrictions</p> <p>Weight bearing: per physician order and/or guidelines in appendix Bracing per physician order and/or guidelines in appendix Education on care of incision sites</p> <p>Ankle pumps Heelcord stretching HEP Hamstring stretching HEP Quad Activation: Quad sets HEP Patellar mobilizations, all directions, but take care with patellofemoral repairs AAROM heel slides, ROM limitations per orthopedic surgeon. Patellar/trochlear deficits have slower progression in ROM than femoral defects.</p> <p>Edema controlling measures Elevation Cryotherapy Compression therapy/garment use</p>	<p>Goals of Phase:</p> <ol style="list-style-type: none"> 1. Provide environment of proper healing of chondral tissue/matrix 2. Prevention of post-operative complications <p>Criteria to Advance to Next Phase:</p> <ol style="list-style-type: none"> 1. Control of post-operative pain (0-1/10 with ADL's in brace) 2. Resolution of post-operative effusion (trace to 1+)
<p>Phase II - Early Protection Phase (Weeks 2-6)</p> <p>Expected visits: 4-9</p>	<p>Specific Instructions: Continue previous exercises as HEP. Weight bearing: per physician order and/or guidelines in appendix Bracing per physician order and/or guidelines in appendix</p> <p>Suggested Treatments: Modalities Indicated: Edema controlling treatments. NMES as indicated for quad re-education Vasopneumatic compression therapy and retrograde massage ROM: Passive and AAROM specific limitations as directed by orthopedic surgeon. Progress to AROM during this phase. May do stationary cycle once 100 degrees of knee flexion is achieved Restore any residual knee extension stiffness Patellar mobilizations in superior, inferior, medial directions (caution with PFJ repairs) Ankle strengthening exercise with resistance band Hip Activation-Glut retraining: Glut sets Hip abduction side-lying Clamshells side-lying Progress quad sets to multi-angle isometrics SLR Weight-shifting within WB restrictions</p>	<p>Goals of Phase:</p> <ol style="list-style-type: none"> 1. Prevention of complication through gentle protected motion 2. Reduction of post-operative effusion (no to trace effusion) 3. Re-education of quad control with active SLR without extensor lag 4. Protection of tissue matrix against load and shear forces <p>Criteria to Advance to Next Phase:</p> <ol style="list-style-type: none"> 1. Restoration of full passive knee ROM (0-90 degrees) 2. Minimal or absent pain at rest 3. Minimal or no effusion (no to trace)

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<p>Phase III - Early-Intermediate (Motion and Activation) Phase</p> <p>(Weeks 6-10)</p> <p>Expected visits: 9-16</p>	<p>Specific Instructions: Continue previous exercises Weight bearing: per physician order and/or guidelines in appendix Bracing per physician order and/or guidelines in appendix</p> <p>Suggested Treatments: Modalities: NMES as necessary for quad re-education ROM: Progression to full AROM if not already there</p> <p>Exercise Examples: Progress gluteal activation exercises such as fire hydrants & seated hip IR/ER Progress knee exercises to light resistance within safe ranges, with no resistance over repaired zone Gait training with brace opened to available ROM as proper quad control is demonstrated Proprioception exercises: stable to unstable surfaces, uniplanar to multiplanar, double leg to single leg exercises as proper control is demonstrated Aquatic exercise to assist in training normalized gait mechanics, if available Open and closed chain gastroc-soleus strengthening with progression to single leg as appropriate</p>	<p>Goals of Phase:</p> <ol style="list-style-type: none"> 1. Progression of full pain-free ROM 2. Resolution of post-operative effusion (trace to no effusion on stroke test) 3. Improve muscular strength and endurance 4. Normalized level ground ambulation with appropriate bracing <p>Criteria to Advance to Next Phase:</p> <ol style="list-style-type: none"> 1. Full pain-free AROM 2. Normalized gait with brace open (0-90 degrees) 3. No or minimal pain 4. No or minimal effusion
<p>Phase IV - Intermediate (Strength progression and normalized ADL) Phase</p> <p>(Weeks 10-16)</p> <p>Expected visits: 16-22</p>	<p>Specific Instructions: Continue previous exercises Suggested Treatments: Initiation of limited range and resistance open and closed chain strengthening</p> <p>Exercise Examples: Shallow depth double limb closed chain exercises (0-60 degrees unless otherwise directed) Forward step-ups Partial squats Low weight leg press Wall sits Front lunges Limited range open chain quad and hamstring strengthening Aquatic based exercise progression (non-impact)</p>	<p>Goals of Phase:</p> <ol style="list-style-type: none"> 1. Normal pain-free ADL's without incidents of patella instability 2. Improve quad and hamstring strength and control with closed chain activities 3. Improved gluteal strength <p>Criteria to Advance to Next Phase:</p> <ol style="list-style-type: none"> 1. Quad and Hamstring strength 4/5 2. Gluteal strength >80% of contralateral limb 3. Proper biomechanics and control with stair ambulation 4. Normalized single leg static balance with proper proximal control (no valgus or hip medial rotation)

PHASE	INTERVENTION	GOALS/CRITERIA FOR PROGRESSION
<p>Phase V - Advanced strengthening and eccentric control phase</p> <p>Months 4-6</p> <p>Expected visits 22-24</p>	<p>Specific Instructions:</p> <p>Progression of closed and open chain quad strengthening (0-90 degrees)</p> <ul style="list-style-type: none"> Squat progressions Lateral dips Forward step downs Multi-plane lunges <p>Progression to single leg strength training as strength and control allows Non-impact cardiovascular training</p> <ul style="list-style-type: none"> Elliptical Stairmaster Treadmill walking <p>Aquatic running/agilities</p> <p>Continue hip and core strength</p>	<p>Goals of Phase:</p> <ol style="list-style-type: none"> 1. Improve quad, hamstring and gluteal strength 2. Improve proprioception with static and dynamic activities <p>Criteria to Advance to Next Phase:</p> <ol style="list-style-type: none"> 1. <20% strength deficit in quads 2. Normalized hamstring and gluteal strength 3. Proper biomechanics and control with forward step down 4. Improved single leg proprioception (80% or greater on anterior and posterior lateral reach of Y Balance test)
<p>Phase VI - Advanced Movement and Impact Phase</p> <p>Months 6-8</p> <p>Expected Visits</p>	<p>Specific Instructions:</p> <p>Progression to running program (with appropriate bracing) with training to improve/normalize form and shock absorption</p> <p>Progression of open and closed chain strengthening for the entire LE chain with emphasis on single limb strengthening.</p> <p>Progression of strengthening program to include multiple plane movements as control allows</p> <p>Progression of sport specific functional skills as control and pain allow including:</p> <ul style="list-style-type: none"> Lateral shuffling Drop jumping Deceleration Hopping Cutting 	<p>Goals of Phase:</p> <ol style="list-style-type: none"> 1. <10% strength deficit in quads 2. Limb similarity index of 90% or greater on functional hop tests and Y balance tests 3. 45/50 on Biomechanical functional assessment tests 4. No pain or complaints of instability with functional progression of sport specific skills

NOTE: Progression of functional activities should be performed only as pain and proper biomechanics allow. Emphasis should be on proper shock absorption and control of dynamic valgus stress at knee (hip medial rotation with knee valgus) with each task performed. Progression to single limb based tasks (deceleration, hopping, cutting) should not be performed until double limb activities have been mastered. Activities requiring dynamic control of rotational stress at the knee (cutting, multiple plane lunges/jumps/hops) should not be performed until sagittal and frontal plane control has been mastered (in that order).

Appendix 1: Guidelines for weightbearing & bracing per site & procedure.
These guidelines do not supersede a specific physician order which may be different.

SURGERY	SITE	BRACING	WEIGHTBEARING
Microfracture	Femoral condyle or tibial plateau	Not indicated	TTWB 6-8 weeks then progress to WBAT
Microfracture	Patellar femoral/trochlear	Hinged brace 0-30 degrees x 8 weeks, may be removed for additional range of motion in PT	PWB 2-4 weeks then progress to WBAT
OATS	All lesions	Hinged brace, locked in extension x 2 weeks, may be removed for range of motion in PT. Weeks 2-6 open the brace in 20 degree increments	NWB 0-2weeks PWB 2-4weeks Progress to WBAT at 4-6 weeks
ACI	Femoral condyle or tibial plateau	Hinged brace locked in extension, may be removed for range of motion in PT	TTWB 0-6 weeks Progress to WBAT at 6 weeks
ACI	Patellar femoral/trochlear	Hinged brace locked in extension, may be removed for range of motion in PT	TTWB 0-2 weeks PWB 50% 3-4 weeks PWB 75% 4-5 weeks Progress to FWB by 10 weeks

Appendix 2 – Return to play testing

Comprehensive testing performed at the Sanford POWER Center that evaluates an athlete’s ROM, strength, proprioception, and functional movement patterns. There are 2 levels of testing performed based on stage of rehabilitation.

Level 1

- Completed 24 week postoperatively
- Determine an athlete’s level of progress at the mid-point of their rehabilitation, identify impairments that may need further attention, and used to determine athlete’s readiness for the Return to Performance program
- Patient must meet all criteria prior to level 1 testing
 - Physician approval
 - Full ROM
 - No pain and swelling
 - Weight bearing symmetry
 - Restoration of balance and postural stability
 - Normal gait
 - Hip and pelvic stability
 - >10 step downs on 8” step with good form

Level 2

- Completed 8-9 months postoperatively
- Determine an athlete’s level of readiness to return to full participation based on performance with functional tests, agility, strength, and proprioception.
- Components of Level 2 testing includes
 - Physician approval
 - Biomechanical assessment of
 1. Forward step down
 2. Lateral shuffle
 3. Drop jump
 4. Deceleration
 5. Triple hop
 6. Side step cut (90 degree)
 - Assessment of running mechanics
 - Static and Dynamic Balance
 - Strength and endurance
 1. Goal: Less than 10% deficit in quads and gluteals (compared to contralateral limb or normative data) and 1:1 quad to gluteal ratio
- A score of 45/50 total points on biomechanical assessment is recommended prior to return to sport.

Appendix 3 – Considerations for rehabilitation

CONSIDERATION/SPECIFIC FACTORS	IMPLICATION
Individual	
Athlete’s age	Slower cartilage repair with increased age
Body mass index	More gradual rehabilitation progression with body mass index greater than 30 kg/m ²
Type of sport	Higher demand on repair tissue in impact sports
Competitive level	Competitive athletes have better outcomes
Psychological	Less fear of reinjury and higher self-efficacy are associated with better outcomes
Lesion/defect	
Defect size	Smaller defects frequently improve faster with rehabilitation
Repair technique	More rapid rehabilitation progression with restorative techniques
Defect location	Immediate weight bearing for patellofemoral defect (knee brace locked in full extension)
Duration of symptoms	Longer recovery if symptoms persist longer than 12 months (deconditioning)
Cartilage quality	Slower rehabilitation progression with generalized joint chondropenia
Lesion/defect	
Concomitant procedures	Modified protocols for anterior cruciate ligament reconstruction, meniscal repair, osteotomy, etc
Meniscus status	Slower rehabilitation progression after meniscectomy (especially lateral meniscus)

References:

Edwards, Peter, Ackland, Timothy & Jay Ebert. Clinical Rehabilitation Guidelines for Matrix-Induced Autologous Chondrocyte Implantation on the Tibiofemoral Joint Journal of Orthopedic & Sports Physical Therapy 2014; 44(2): 102-119

Hurst, Jason M, Steadman, Richard, O'Brien, Luke & William Rodkey. Rehabilitation Following Microfracture for Chondral Injury in the Knee

Clin Sports Med. 2010 Apr;29(2):257-65

Mehmet Erdil, Bilsel, Kerem, Faruk Taser Omer, Sen Cenqiz and Mehmet Asik. Osteochondral autologous graft transfer system in the knee; mid-term results. The Knee 2013 January 20(1): 2-8

Mithoefer, Kai, Hambly, Karen, Logerstedt, David, Ricci, Margherita, Silvers, Holly & Della Villa Stefano. Current Concepts for Rehabilitation and Return to Sport After Knee Articular Cartilage Repair in the Athlete, Journal of Orthopedics & Sports Physical Therapy 2012; 42(3): 254-273

Murray, Iain, Benke Michael and Mandelbaum, Bert. Management of knee articular cartilage injuries in athletes: chondroprotection, chondrofacilitation & resurfacing Knee Surgery, Sports Traumatology, Arthroscopy 2016 May; 24(5): 1617-1626

Ness, Brandon, PT, DPT Acute Articular Cartilage Injuries: Osteochondral lesions presentation to the University of South Dakota Physical Therapy students Wilk, Kevin E., Macrina Leonard C and Michael Reinold Rehabilitation following Microfracture of the Knee, Cartilage. 2010 Apr; 1(2): 96-107