Pediatric Rehabilitation Protocol for Fixation of Osteochondritis Dissecans (OCD) of The Knee Complex

This protocol is intended to guide clinicians through the post-operative course for fixation of osteochondritis dissecans lesion at the knee complex. This protocol is time based (dependent on tissue healing) as well as criterion based. 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 Pediatric/Adolescent Patient:

Children are not small adults! Children have different psychological and physiological needs than adults. These needs should be considered when designing any rehabilitation program. Rehabilitation timeframes may be protracted by these factors and often will require modification/adaptation to the individual patient.

- **Biological Age:** Rates of growth and development are highly variable, making it important to consider that the patient in front of you may be very different than another patient of the same chronological age. Alterations in center of mass, muscle imbalances, and the relative tightening of the muscle–tendon units due to rapidly growing bones may cause difficulty with coordinated athletic movements or motor learning.
- **Training Age:** The length of time, if at all, a child has followed a structured and supervised resistance training or conditioning program. It is important to consider that some young athletes have never been trained in common functional or joint specific movements found in post operative rehabilitative programs. Extensive motor learning may need to take place prior to multi-joint or compound exercise progression.
- **Development of Strength:**
    - Prepubescent children gain strength primarily through neural adaptation, as they lack the necessary hormones for muscle hypertrophy. Once children reach puberty, strength development becomes primarily hormonal which stimulates hypertrophic changes in muscle.
    - Myelination of nerve fibers (motor neurons) is absent or incomplete in children, making fast reactions and skilled movements difficult to perform. Thus, high levels of strength and power will not be achieved as in an adult patient.
- **Epiphyseal Plates:** Prepubescent children's epiphyseal plates have yet to close, so high impact activities such as depth jumps should be progressed with caution. Also, weight bearing, and plyometric activities should be varied to avoid repetitive stress to growth plates.
- **Psychological State:** For many pediatric patients, this may be their first serious injury or surgery. High levels of anxiety both pre and post operatively from patient and parent can affect pain, and thus limit weight bearing/ROM progressions, home exercise performance, and motivation. Different than adults, successful rehab will depend on collaboration with caregivers to assure proper carryover of home exercises. Positive factors found in recovery include being provided with detailed knowledge of the recovery process, developing trusting relationships with providers, having individualized goals, and including sport specific activities as much as possible.

- **Self-reported Outcome Measures:** It is strongly suggested to use pediatric-specific outcome measures. There is strong evidence supporting the use of the Pediatric International Knee Documentation Committee: Subjective Knee Evaluation Form (Pedi-IKDC) as it shown to have good properties over the Knee Injury and Osteoarthritis Outcome Score - Child (KOOS Child).

PHASE I: IMMEDIATE POST-OP (0-2 WEEKS AFTER SURGERY)

Rehabilitation Goals	• Ambulate TDWB gait with crutches, and brace locked in extension • Demonstrate proper brace use • Knee extension 0 degrees • Manage swelling • Assure proper wound healing
Brace/Precautions	• TDWB with bilateral axillary crutches • Brace always locked in extension • No knee flexion
Interventions	*Pain/Effusion Management* • Ice, compression, elevation • Retrograde effleurage • Ankle pumps *Range of Motion/Mobility* • Grade III superior and inferior patellofemoral joint (PFJ) mobilization, only with condylar lesion fixation. Patellar lesion with clearance from surgeon • Low intensity, long duration extension stretches: prone hang, heel prop • Gastroc stretch with strap: long sitting or seated • Supine passive hamstring stretch with strap *Therapeutic Exercise* • Pain free quad sets • Ankle AROM all directions • Hip abduction, adduction, and extension against gravity • SLR if able to maintain full terminal knee extension
Criteria to Progress	• Proper TDWB gait with use of crutches and brace

PHASE II: EARLY POST-OP (2-4 WEEKS AFTER SURGERY)

Rehabilitation Goals	• Knee flexion ROM of up to 60 degrees • Improved quadriceps muscle activation evidenced by superior patella glide with quad set • Full terminal extension with x1 SLR
Brace/Precautions	• TDWB with bilateral axillary crutches • Brace locked in extension for ambulation, removed for ROM exercises only • Knee flexion only < 60 deg
Additional Interventions **Continue with Phase I interventions*	*Range of Motion/Mobility* • Grade III superior and inferior patellofemoral joint (PFJ) mobilization. Add if patellar lesion fixation and cleared by surgeon • Heel slides: 0 – 60 knee flexion *Therapeutic Exercise* • Quad sets • Multi- angle quad isometrics < 60 • Prone knee flexion to 60 • AAROM SAQ < 60 • 4 Way SLR (hip flex/ext/ab/adduction) • Do not perform SLR if knee extension lag is present

	• Ankle plantarflexion against resistance band
Criteria to Progress	• Knee ROM 0 – 60 flexion • Improving Quad activation evidenced by superior patella glide with quad set • Maintain terminal extension with SLR

PHASE III: INTERMEDIATE POST-OP (4-6 WEEKS AFTER SURGERY)

Rehabilitation Goals	• Ambulate PWB (up to 25% body weight) with crutches and brace locked in extension • Demonstrate knee flexion ROM of up to 90 degrees • Demonstrate improved quad function/endurance with x10 SLR and no lag
Brace/ precautions	• PWB (25%) with bilateral axillary crutches • Brace locked in extension for ambulation, removed for ROM exercises only • Knee flexion only < 90 deg
Additional Interventions **Continue with Phase I-II Interventions as indicated*	*Pain/Effusion Management (As needed)* *Range of Motion/Mobility* • Grade III-IV superior and inferior patellofemoral joint (PFJ) mobilization • Tibiofemoral joint mobilization as indicated • Stationary bike: semi revolutions if needed to avoid flex >90 deg • Heel slides: 0 – 90 knee flexion (can be replaced with bike if patient has access at home) • Rectus Femoris stretch: pain-free, < 90 deg knee flex *Therapeutic Exercise* • Quad sets • 4 Way SLR with resistance as appropriate (hip flex/ext/ab/adduction) • AROM knee extension LAQ: 0 – 90, add light resistance as tolerated • AROM knee flexion to 90: add light resistance as tolerated
Criteria to Progress	• Cleared by surgeon to advance WB after the 6-week follow up visit • Knee flexion ROM 90 degrees • No lag with repeated SLR

PHASE IV: LATE POST-OP (6-8 WEEKS AFTER SURGERY)

Rehabilitation Goals	• Ambulate in FWB with normalized gait pattern • Demonstrate full knee flexion ROM • Perform baseline strength measures of glut max/med, quads, and hamstrings with HHD
Brace/Precautions	• Gradually wean crutches and brace • No impact loading
Additional Intervention **Continue with Phase II-III interventions as indicated*	*Pain/Effusion Management (As needed)* *Range of Motion/Mobility* • Patellofemoral and tibiofemoral mobilization until full knee ROM is attained • Gentle stretching all muscle groups: prone quad stretch, standing quad stretch, kneeling hip flexor stretch *Therapeutic Exercise* • Walking program: Progression from 15 to 30 min over 4 weeks • Stationary bike: light to moderate resistance for cardiovascular training • Hamstring curl with band, bilateral hamstring curl machine • Heel raises: bilateral to unilateral • Resisted long arc quad, bilateral knee extension machine • Wall slides, squats, leg press machine **If resistance machines are to be used, the patient must be sized appropriately to the machine. Adolescent patients may be too small for machines or not be able to independently decide on appropriate weight/progression. In this case, body weight exercises or smaller loads applied in the*

	clinic under close supervision are encouraged. Parents may be included in the process to assure carryover for home program *Balance & motor control* • Tandem stance • Single leg stance once attained FWB • Gradual progress from stable to unstable surface
Criteria to Progress	• No unexpected increase in pain & swelling with new HEP or w/ FWB • Good tolerance of walking program with normal gait and without pain/swelling

PHASE V: TRANSITIONAL (9-12 WEEKS AFTER SURGERY)

Rehabilitation Goals	• Progress endurance with proper gait • Increase strength of glut max/med, quads, and hamstrings to demonstrate LSI score >75% of non-surgical side • Promote proper movement patterns
Additional Interventions **Continue with Phase II-IV interventions*	*Range of Motion/Mobility* • Patellofemoral and tibiofemoral mobilization until full knee ROM is attained *Cardio* • Continue with progressing Walking Program to 45 min • Stationary bike, full revolutions with moderate to heavy resistance for cardiovascular training. ○ Can add elliptical and/or cross trainer *Therapeutic Exercise* • Hip strengthening: band walks, monster walks, hip ab/adductor machine • Open chain quadriceps strength, single leg knee extension machine • Bilateral squats • 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 • Unilateral hamstring curl machine • Seated calf machine, weighted calf raises *Balance & motor control* • Progress to complex conditions (multi/dual task) *Plyometrics* • Begin with double leg and straight plane, progressing to single leg and multi-directional ***Please review special consideration for epiphysial plate in the intro*
Criteria to Progress	• Met > 75% LSI • No pain or swelling during or after training

PHASE VI: EARLY RETURN TO SPORT (3-6 MONTHS AFTER SURGERY)

Rehabilitation Goals	• Glut max/med, quads, and hamstrings LSI score >90% • Hop testing to achieve LSI >90% • Appropriate landing mechanics with plyometrics/impact activity
Additional Interventions	*Range of Motion/Mobility* • Establish a routine dynamic & static stretching program addressing sport-specific musculature.

**Continue with Phase III-V interventions*	*Therapeutic Exercise* • Initiate Running Program- Phase I (Appendix 1) ○ Normal running mechanics ○ LSI > 75% in glut max/med, quads, and hamstrings ○ Good control with bilateral and unilateral plyometrics and no pain/swelling ○ 10 reps single leg squats with good control through 60 degrees knee flexion *Balance & motor control* • Reactive and perturbation training on stable and unstable surfaces *Plyometric and Agility* • Begin formal agility and plyometric program *(Appendix 2)* • Movement quality should be emphasized
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

PHASE VI: UNRESTRICTED RETURN TO SPORT (6+ MONTHS AFTER SURGERY)

Rehabilitation Goals	• Participate in regular practice & games routine at pre-injury capacity.
	** Further interventions and exercise prescription should be well coordinated with coaches/trainers to provide a gradual transition from rehabilitation to practice avoiding overuse and redundancy.* • Sport-specific problem-based therapeutic activities • Include hard cutting and pivoting depending on the individuals' goals (~7 mo)

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

References:

1. Matsuzaki Y, Chipman DE, Perea SH, Green DW. Unique considerations for the pediatric athlete during rehabilitation and return to sport after anterior cruciate ligament reconstruction. *Arthroscopy, Sports Medicine, and Rehabilitation*. 2022 Jan 1;4(1):e221-30.

2. Baechle TR, Earle RW, editors. Essentials of strength training and conditioning. Human kinetics; 2008.

3. Kramer DE, Yen YM, Simoni MK, Miller PE, Micheli LJ, Kocher MS, Heyworth BE. Surgical management of osteochondritis dissecans lesions of the patella and trochlea in the pediatric and adolescent population. *The American Journal of Sports Medicine*. 2015 Mar;43(3):654-62.

4. Van Der Velden, C.A., Van Der Steen, M.C., Leenders, J., Van Douveren, F.Q., Janssen, R.P. and Reijman, M., 2019. Pedi-IKDC or KOOS-child: which questionnaire should be used in children with knee disorders?. BMC musculoskeletal disorders, 20, pp.1-8.

Appendix 1: Return to Running Program

This program is designed as a guide for clinicians and patients through a progressive return-to-run program. Patients should demonstrate > 80% on the Functional Assessment prior to initiating this program (after a knee ligament or meniscus repair). Specific recommendations should be based on the needs of the individual and should consider clinical decision making. If you have questions, contact the referring physician.

PHASE I: WARM UP WALK 15 MINUTES, COOL DOWN WALK 10 MINUTES

Day	1	2	3	4	5	6	7
Week 1	W5/J1x5		W5/J1x5		W4/J2x5		W4/J2x5
Week 2		W3/J3x5		W3/J3x5		W2/J4x5	
Week 3	W2/J4x5		W1/J5x5		W1/J5x5		**Return to Run**

Key: W=walk, J=jog

***Only progress if there is no pain or swelling during or after the run*

PHASE II: WARM UP WALK 15 MINUTES, COOL DOWN WALK 10 MINUTES

Week	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	20 min		20 min		20 min		25 min
2		25 min		25 min		30 min	
3	30 min		30 min		35 min		35 min
4		35 min		40 min		40 min	
5	40 min		45 min		45 min		45 min
6		50 min		50 min		50 min	
7	55 min		55 min		55 min		60 min
8		60 min		60 min			

Recommendations

- Runs should occur on softer surfaces during Phase I
- Non-impact activity on off days
- Goal is to increase mileage and then increase pace; avoid increasing two variables at once
- 10% rule: no more than 10% increase in mileage per week

Appendix 2: Agility and Plyometric Program

This program is designed as a guide for clinicians and patients through a progressive series of agility and plyometric exercises to promote successful return to sport and reduce injury risk. Patients should demonstrate > 80% on the Functional Assessment prior to initiating this program. Specific intervention should be based on the needs of the individual and should consider clinical decision making. If you have questions, contact the referring physician.

PHASE I: ANTERIOR PROGRESSION

Rehabilitation Goals	• Safely recondition the knee • Provide a logical sequence of progressive drills for pre-sports conditioning
Agility	• Forward run • Backward run • Forward lean in to a run • Forward run with 3-step deceleration • Figure 8 run • Circle run • Ladder
Plyometrics	• Shuttle press: Double leg→alternating leg→single leg jumps • Double leg: ○ Jumps on to a box→ jump off of a box→ jumps on/off box ○ Forward jumps, forward jump to broad jump ○ Tuck jumps ○ Backward/forward hops over line/cone • Single leg (these exercises are challenging and should be considered for more advanced athletes): ○ Progressive single leg jump tasks ○ Bounding run ○ Scissor jumps ○ Backward/forward hops over line/cone
Criteria to Progress	• No increase in pain or swelling • Pain-free during loading activities • Demonstrates proper movement patterns

PHASE II: LATERAL PROGRESSION

Rehabilitation Goals	• Safely recondition the knee • Provide a logical sequence of progressive drills for the Level 1 sport athlete
Agility **Continue with Phase I interventions*	• Side shuffle • Carioca • Crossover steps • Shuttle run • Zig-zag run • Ladder
Plyometrics **Continue with Phase I interventions*	• Double leg: ○ Lateral jumps over line/cone ○ Lateral tuck jumps over cone • Single leg (these exercises are challenging and should be considered for more advanced athletes): ○ Lateral jumps over line/cone ○ Lateral jumps with sport cord
Criteria to Progress	• No increase in pain or swelling • Pain-free during loading activities • Demonstrates proper movement patterns

PHASE III: MULTI-PLANAR PROGRESSION

Rehabilitation Goals	• Challenge the Level 1 sport athlete in preparation for final clearance for return to sport
Agility **Continue with Phase I-II interventions*	• Box drill • Star drill • Side shuffle with hurdles
Plyometrics **Continue with Phase I-II interventions*	• Box jumps with quick change of direction • 90 and 180 degree jumps
Criteria to Progress	• Clearance from MD • <u>Functional Assessment</u> ○ Quad/HS/glut index ≥90% contra lateral side (isokinetic testing if available) ○ Hamstring/Quad ratio ≥70% ○ Hop Testing ≥90% contralateral side • Patient Outcome Measures: ○ KOOS-sports questionnaire >90% ○ International Knee Committee Subjective Knee Evaluation >93 ○ ACL-RSI