Kai Mithoefer, MD
840 Winter Street, Waltham, MA 02451, (781) 890-2133
125 Parker Hill Avenue, Boston, MA 02120, (617) 264-1100
40 Allied Drive. Dedham, MA 02026 (617) 264-1100

Postoperative Rehabilitation Instructions
Bridge-Enhanced ACL Repair (BEAR)

This patient received the BEAR Implant as treatment for a torn ACL. This is not an ACL Reconstruction (ACLR), and the Rehabilitation Protocol is different. Please follow this specialized BEAR Implant Rehabilitation Protocol in the pages that follow. For any questions please contact Dr. Mithoefer's office.

Pre-Surgical Preparation for Surgical Team

- The patient should begin their home exercises within the first week after surgery. Please teach these exercises to the patient at the last pre-operative visit
  - These exercises will be reviewed again at their first PT visit to ensure proper form and frequency
- Notify the patient at their last pre-op visit that they should schedule their first Physical Therapy visit to take place within first week post-op

Weight Bearing Status

- Weight bearing as tolerated after nerve block has worn off

Bracing Instructions

ACL hinged knee brace (TROM or equivalent) for weight bearing activities

- Locked for ambulation at 0° for the first 4 weeks post-op
- Locked for sleep at 0° for first 6 weeks post-op
- Unlock for range of motion (ROM) to specified degrees when seated or at physical therapy for gait training after 2 weeks
- Advance to unlocked brace for ambulation at week 4 if the patient is comfortable doing so and if they demonstrate appropriate quadriceps control (should not flex past 90° until week 4)

Brace Range

Timeframe	Degree Range
First 24 hours only	Brace locked at 0° or until 1st post-op surgeon visit for adolescents
0 to 2 Weeks	0 - 45°
2 to 4 Weeks	0 - 90°
4 to 6 Weeks	Progress to full ROM as tolerated
	Change to functional brace (if requested by surgeon) when Active Range of Motion (AROM) is 0 to ≥110°

Recommendations

- No scar massage until phase 3
- No manual PROM during any point in phase 1-3 of the protocol/rehabilitation
- **No CPM**
- Driving: No driving until patient is off all narcotics; for patient with RIGHT leg procedure, no driving until the patient is full weight bearing without crutches and has at least 60° of flexion
- Jobs with physical labor: Restrictions per operating surgeon and in the following PT protocol
- The only modalities for muscular strengthening to be used are NMES (NeuroMuscular Electrical Stimulation) and optional low intensity Blood Flow Restriction (BFR) strength training for patients limited by pain or poor load tolerance
- If stiffness is observed at any phase, please contact the operating surgeon and:
  - Ensure proper post-op management of pain and swelling
  - Ensure patient is following the recommended BEAR Implant rehab protocol
    - If operating surgeon has specifically recommended a protocol deviation, please consult with the operating surgeon before action is taken

Additional Instructions:

Phase 0: Preoperative PT and Immediately After Surgery

Preoperative Recommendations

Phase Goals: Begin as soon as possible following initial injury to re-establish the following goals prior to surgery

- Full active (AROM) and passive (PROM) knee extension
- Knee flexion ROM within 10° of uninvolved limb
- Trace to zero knee effusion
- No knee extension lag with straight leg raise (SLR)
- Quadriceps Strength Index (QI) ≥80% of uninvolved limb - Retain values for post-operative comparison to minimize overestimation of strength
- Teach the Home Exercises to patient/guardian(s) at the last pre-operative visit (see After Surgery Instructions document). Also highlight the importance of rehabilitation compliance
- Educate on brace, crutch use and PWB

Patient Education

- Importance of prehab for optimal post-operative outcomes
- What to do immediately after surgery (0-48 hours)
- Anticipated return to sport timeline: 9-12 months
- Expected outcomes: Return to prior level of competition is often difficult, but possible
- Osteoarthritis risk

Phase 1: Weeks 0 to 4

Home Program with PT Supervision

Important Instructions for Phase 1

- **Facilitated by PT:** The After Surgery Instructions and Home Exercises should be reviewed and taught again at the first post-op clinic visit with surgeon and again with PT at their week 1 and 2 post-op visits

Recommendations

Area	Instructions
Crutch Use	• Weightbearing as tolerated without crutches but with leg locked in full extension in TROM brace starting postoperative day 1 after nerve block is fully worn off.
Bracing	• Brace locked at 0° for the first 24 hours after surgery • Hinged Knee Brace instructions after the first 24 hours post-op – While seated (at rest) and for ROM exercises, brace range should be set to 0 - 45° for weeks 0 to 2 and then 0 - 90° for weeks 2 to 4. Do not flex the knee past the specified degrees – For ambulation and weightbearing, brace should be locked at 0° for 2 weeks and then unlocked for ambulation gait training and ADLs – For sleep, brace should be locked at 0° for 4 weeks
Muscle Performance Exercises	Patient should begin these within the first week after surgery. Do not flex past specified degrees • Extension and Flexion exercises that are allowed in this phase are wall slides – Extension ~4-5min, 2x per day – Flexion ~1 or 2 sets x10 reps with a 5 – 10 sec hold, at least 2x per day • Quad set/quad with superior patellar glide based on visual inspection and palpation isometric contraction 3 sets x10 reps, 2 or 3x per day • **Patellar mobilizations: medial/lateral mobilization, superior/inferior direction (5 sets, 3x per day)**
NMES	• With knee in full extension on a treatment table, increase stimulation amplitude so that at a minimum it would result in a full tetanic contraction of the quadriceps (no fasciculations observed on visual inspection) with evidence of superior patellar glide, based on visual inspection and palpation • Continue to increase the stimulus amplitude to the patient's maximum tolerance level • 10-15 10s contractions with a 50s rest between contractions  Electrodes Distal are center/medial and proximal center/lateral and are large
Cryotherapy	• Cold with compression/elevation (e.g., Cryo-cuff, Don Joy Iceman, GameReady device or equivalent) • First 24 hours or until acute inflammation is controlled: every waking hour for 15 minutes • After acute inflammation is controlled: 3 times a day for 15-20 minutes • Do not sleep with automated device running while on the knee • Keep a layer of fabric or ace wrap between skin and icing device at all times

Criteria for progression to Phase 2

☐ 4 weeks out of surgery

Phase 2: Weeks 4 to 7

Early Post-Operative Physical Therapy

Goals

1. Full knee extension
2. Flexion ROM >90°
3. Good quadriceps isometric contraction
4. Minimize pain and swelling

Recommendations

Area	Instructions
Crutch Use	• Continue weight bearing as tolerated. Walking practice in the clinic should occur to normalize gait during this phase to facilitate normal walking pattern beginning 2 weeks after surgery.
Bracing	• Hinged Knee Brace: Brace range set to 0 - 90° for weeks 2 to 4; once 90° ROM is met, patient may advance brace range to allow for full ROM • Unlocked for weight bearing and ambulation if good quad control has returned At 6 weeks brace is no longer required for sleeping
Range of Motion	• Extension: Low load, long duration stretching (~5 minutes) such as heel prop. The patient can now add bag hang minimizing co-contraction and nociceptor response as indicated • Patellar mobilization: medial/lateral mobilization initially followed by superior/inferior direction while monitoring reaction to effusion and ROM • No manual Passive Range of Motion into flexion
Muscle Activation & Strengthening	• Quadriceps sets emphasizing whole muscle activation • Long arc quad exercises 90 to 0 • Straight Leg Raise (SLR) emphasizing no lag • Start reciprocal stair training at 4 to 6 weeks
NMES	• Continue until quad limb symmetry index is 80%

Stiffness has been observed in this phase and is most associated with “fear avoidance,” rehab non-compliance, and in patients with concomitant procedures such as meniscal repair. In the case of stiffness, the following should be implemented:

- Ensure proper post-op management of pain and swelling
- Ensure patient is compliant with the recommended protocol (please consult with the surgeon before any action is taken in the case where the patient’s protocol has been altered for any reason)
- Additional modalities/exercises are recommended:
  - Continue recommended exercises
  - Patella mobilizations: high grade more often, 30 second stretches
  - Supine bag hangs (weighted)

Criteria for progression to Phase 3

- ☐ 7 weeks out from surgery
- ☐ ROM full extension to >90°

Phase 3: Weeks 7 to 12

Post-Operative Physical Therapy

Goals

1. Minimize pain and swelling
2. Full knee extension ROM; flexion to within 15° of the contralateral
3. Good quadriceps control (≥20 no lag SLR)
4. Normal gait pattern

Recommendations

Area	Instructions
Crutch Use	• WBAT • Establish normal gait pattern; ability to safely ascend/descend stairs without noteworthy pain or instability (reciprocal stair climbing)
Hinged Knee Brace: T-ROM or ACL Brace	• Okay to change to functional ACL brace when AROM in flexion is 110° or more • Can be in functional ACL brace for walking and any other weight bearing and closed chain activity (bike, elliptical, leg press, wall slides, mini squats, etc.)
Range of Motion	• Extension: Low load, long duration (~5 minutes) stretching (e.g., heel prop, bag hang minimizing co-contraction and nociceptor response) • Flexion: AROM/AAROM exercises (e.g., wall slides, heel slides, seated active-assisted knee flexion (no manual passive ROM) • Bike: Rocking-for-range
Muscle Activation & Strengthening	• Quadriceps sets emphasizing vastus lateralis and vastus medialis activation • SLR emphasizing no lag • Electric Stimulation: Continue until quadriceps QI is ≥80% • Double-leg wall slides or mini-squats without knee over foot • Hamstring sets: For hamstring curls, do not flex knee more than is comfortable for patient. • Proximal Hip Strengthening: e.g., side-lying hip adduction/abduction, Prone Hip Extension • Quadriceps/hamstring co-contraction supine • Open chain knee extension progressive resistance • Reciprocal stair training • Aqua jogging in pool okay starting at 8 weeks post op
NMES	• Continue until QI is ≥80%
Neuromuscular Control	• Weight shift • Joint angle repositioning

Criteria for progression to Phase 4

- ☐ Minimum of 12 weeks from surgery
- ☐ 20 reps no lag SLR
- ☐ Normal gait
- ☐ Crutch/Immobilizer D/C
- ☐ ROM: No greater that 5° active extension lag and 90° active flexion
- ☐ QI = 60-80%

Phase 4: Weeks 12 to 20

Early Strengthening & Rehabilitation

Goals

1. Full extension ROM, flexion ROM with 10° of uninvolved knee
2. Improve muscle strength
3. Progress neuromuscular retraining

Recommendations

Area	Instructions
Range of Motion	• Low load, long duration (assisted prn) • Heel slides/wall slides • Heel prop/bag hang (minimize co-contraction/nociceptor response) • Bike (rocking-for-range -> riding with high seat height until comfortable and then bringing seat height down as ROM improves) • Flexibility stretching of all major muscle groups
Strengthening Quadriceps	• Quad sets (Mini squats/wall squats) • Step-ups • Leg press; shuttle press without jumping action • PREs knee extension of dynamometer, knee extension machine, bag weights
Strengthening Hamstring	• Hamstring curls • Resistive back SLR with sports cord for hamstring
Strengthening Other Musculature (if needed)	• Hip adduction/abduction: side lying SLR or with equipment • Standing heel raises progress from double to single leg support • Seated calf press against resistance • Multi-hip machine in all directions with proximal pad placement • Swimming with flutter kicks only
Neuromuscular	• Wobble board, rocker board, single-leg stance with or without equipment (e.g., instrumented balance system), slide board
Cardiopulmonary	• Bike, elliptical trainer, Stairmaster, flutter kicking in pool starting at week 12 • Transition to straight line running on treadmill (zero gravity or standard treadmill) or in a protected environment after clearance by operating surgeon and quad QI ≥80%, zero effusion and full ROM, otherwise, hold off on straight line running until Phase 5

Criteria for progression to Phase 5

- ☐ Full ROM
- ☐ Minimal effusion and pain
- ☐ Functional strength and control in daily activities (QI ≥80% LSI)
- ☐ Minimum 20 weeks out from date of surgery

Phase 5: Weeks 20 to 30

Strengthening & Control

Goals

1. Maintain full ROM
2. Running without pain or swelling
3. Hopping without pain, swelling or giving way

Recommendations

Area	Instructions
Strengthening	• OKC knee extension • Squats • Leg press • Hamstring curl • Step-ups/down • Shuttle • Sports cord • Wall squats • Progress to single leg squats
Agility Drills	• Double leg jumping progressing to hopping as tolerated
Neuromuscular	• Wobble board/rocker board/roller board • Perturbation training, instrumented testing systems, varied surfaces
Cardiopulmonary	• Begin or continue running progression on treadmill or in protected environment after clearance by operating surgeon and QI = 80%, to trace effusion and full ROM • NO cutting or pivoting • All other cardiopulmonary equipment

Criteria for progression to Phase 6

- ☐ Running without increase in pain or swelling
- ☐ Neuromuscular and strength training exercises without difficulty
- ☐ Able to hold single leg balance for 60 seconds
- ☐ 50% hop height on operated leg (hop test in brace)
- ☐ Completion of functional hop testing and clearance by operating surgeon
- ☐ Minimum of 30 weeks out from date of surgery
- ☐ QI ≥80%

Phase 6: Weeks 30 to 36

Advanced Training

Goals

1. Running patterns (figure-8, pivot drills, etc.) at 75% speed without difficulty
2. Jumping without difficulty
3. Hop tests at 85% contralateral values (Cincinnati hop tests: single-leg hop for distance, triple-hop for distance, crossover hop for distance, 6-meter timed hop)

Recommendations

Area	Instructions
Strengthening	• Squats • Lunges • Plyometrics
Agility Drills	• Shuffling • Hopping • Cariocas • Vertical jumps • Running patterns at 50 to 75% speed • Initial sports specific drill patterns at 50 to 75% effort
Neuromuscular Training	• Wobble board/rocker board/roller board • Perturbation training, instrumented testing systems, varied surfaces
Cardiopulmonary	• Running • Other cardiopulmonary exercises

Criteria for progression to Phase 7

- ☐ Maximum vertical jump without pain or instability
- ☐ 85% of contralateral on hop tests
- ☐ Run at 85% speed without difficulty
- ☐ IKDC Question #10 (Global Rating of Knee Function) score of ≥8
  (suggested criteria; see page 11)
- ☐ Completion of functional hop testing showing 85% function and clearance by operating surgeon
- ☐ 85% QI

Phase 7: Weeks 36 to 52

Return-to-Sport

Goals

1. 90% contralateral quad strength
2. 90% contralateral on hop tests
3. Sport-specific training without pain, swelling or difficulty

Recommendations

Area	Instructions
Strengthening	• Squats • Lunges • Plyometrics
Sports Specific Activities	• Interval training programs • Running patterns in football • Sprinting • Change of direction • Pivot and drive-in basketball • Kicking in soccer • Spiking in volleyball • Skill/biomechanical analysis with coaches and sports medicine team
Return-To-Sports	• Balance test: Single leg balance for 60 seconds without touchdown for each leg • Single leg squat: Get to 60° of flexion, able to do without IR at the hip or valgus at the knee • Hop tests (single leg hop for distance) to be 95% of contralateral side • QI ≥90%

Return-to-Team Training Criteria

- ☐ No functional complaints
- ☐ Confidence when running, cutting, jumping at full speed
- ☐ 90% contralateral values on hop tests
- ☐ 90% QI
- ☐ IKDC Question #10 (Global Rating of Knee Function) of ≥9
  (suggested criteria; see page 11)
- ☐ Clearance by operating surgeon

Current Function Of Your Knee: Daily Activities

IKDC QUESTION #10

How would you rate the function of your knee on a scale of 0 to 10, with 10 being excellent function and 0 being the inability to perform any of your usual daily activities which may include sports?

1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Tests include:*

1. Dynamometer strength testing of hamstring and quadriceps
2. KT testing for AP laxity
3. Single, triple, crossover, and timed hop tests

**Patient should bring ACL functional brace (if required by surgeon) for this testing.*