ORTHOPEDICS & SPORTS MEDICINE
BAYCARE CLINIC

DR. JONATHON HENRY
ACL RECONSTRUCTION REHABILITATION THERAPY PROTOCOL

The following document is an evidence-based rehabilitation protocol for knee arthroscopy with ACL reconstruction. The protocol is both chronologically and criterion based for advancement through four post-operative phases:

- Phase 1 : Maximum protection
- Phase 2 : Progressive stretching and early strengthening
- Phase 3 : Advanced strengthening and plyometrics
- Phase 4 : Return to sports functional program

If a meniscus repair is performed in conjunction with ACL reconstruction, **follow meniscus repair protocol.**

Graft choice:

- Allograft:
  - Fastest rate of progression
  - Graft of choice in low demand/older patients
- Hamstring Autograft:
  - Graft of choice for high impact and agility sports
  - Preferred over BTB if open growth plates present
- Bone-Patellar Tendon-Bone Autograft (BTB):
  - Risk of anterior knee pain during early phases of rehabilitation
  - Graft of choice in high impact and contact sports

	Weight Bearing* **	**Crutches or Assistive Device**	**Brace**	**ROM Limitations/Goals**
Allograft	WBAT	Wean over 1-2 weeks with progression to FWB	• 0-90º seated • 0-30º when ambulating • Gradually unlocked 10º as quad function improves	• 0-90º knee flexion at 2 weeks • 120º at 4 weeks • Full at 6 weeks
Hamstring Autograft	WBAT	Wean over 1-2 weeks with progression to FWB	• 0-30º • gradually open 10-20º as quad function improves	• 0-90º knee flexion at 2 weeks • 120º at 4 weeks • Full at 6 weeks
BTB Autograft	WBAT	Wean over 1-2 weeks with progression to FWB	• Unlocked 0-30º • Gradually open 10-20º as quad function improves	• 0-90º knee flexion at 2 weeks • 0-120º at 4 weeks • Full at 6 weeks

If meniscus repair performed, weight bearing limited to toe touch weight bearing (max 20-25 lbs.) for the first 4 weeks post-operatively and follow meniscus repair protocol

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Pre-Operative Physical Therapy Visits

Pre-Operative Physical Therapy Visits
- Emphasis on reducing swelling and inflammation
- Restore terminal extension
- Emphasis on full active and passive range of motion (0°-120°)
- Educate on quadriceps function – quad sets, straight leg raises, prone terminal knee extension
- Normalize gait mechanics
- Priority becomes protection if concurrent meniscus tear or articular cartilage defect
- Prepare patient for initial post-operative phase
- Consider pre-operative strength testing on uninvolved LE for baseline numbers
- Force plate vs. isokinetic testing vs. dynamometer – pick appropriate for patient

Post-Operative Precautions
- Educate on any post-operative precautions
    - Dependent on procedure planned (i.e. meniscus repair)

Weight Bearing Restrictions
- Instruct on post-operative WB restriction (dependent on procedure performed)
    - **Weight bearing as tolerated**
    - **Toe touch weight bearing** for meniscus repair 4-6 weeks to limit stress on repaired meniscus

Crutches/Assistive Devices
- Instruct on proper use of crutches/assistive device
    - Weaning to occur as tolerated within 1-2 weeks of surgery
        - Consider pain, swelling, and gait quality
    - If meniscus repair, weaning to occur after 4-6 weeks post-operative, increasing weight bearing 26% every 3-4 days until full weight bearing and normalized gait pattern

ROM Limitations
- Instruct on post-operative ROM limitations

Initial Post-Operative Exercises
- Instruct on initial post-operative exercises to be performed 3 times per day
    - Include ankle pumps, quad set, straight leg raise, assisted heel slides and heel prop

Modalities
- Instruct on cryotherapy post-operative with Game Ready (worker's comp) or IceMan unit
- Instruct on elevation above heart to reduce post-operative swelling

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Phase 1 – Maximum Protection (0-6 weeks)
(continued on next page)

Goals for Phase 1	Criteria for Progression to Phase 2
• Minimize pain and inflammation • Swelling within 1.0 cm of contralateral • Protect ACL graft • Emphasis on quad function • Restore terminal extension (0°) • Scar tissue mobility • Prevent quadriceps inhibition • Initiate knee PROM and AROM within limitations • Restore normalized gait pattern	• Minimal pain with Phase 1 exercises • Full knee extension • Knee ROM ≥ 90° • Perform straight leg raise without lag sign • Normal neuromuscular firing patterns of knee musculature • Normalized gait pattern with proper lower extremity biomechanics OR ability to unilateral WB without pain

Post-Operative Physical Therapy
- First visit to occur within 3 days of surgery
    - Review initial post-operative exercises
    - Perform first dressing change

Weight Bearing
- Weight bearing as tolerated

Brace (0-6 weeks post-operatively)
- Hamstring allograft : 0-90°, gradually unlocked as quad function improves (10° each week)
- Hamstring autograft : 0-30°, gradually unlocked as quad function improves (ex: 10-20° each week)
- BTB autograft : 0-30°, gradually unlocked as quad function improves (ex: 10-20° each week)

ROM
- **0-2 weeks** : 0-90°, emphasis on extension
- **2-6 weeks** : 0-120°, emphasis on extension
- **6+ weeks** : full ROM

Stretching
- Emphasis on terminal knee extension (avoid hyperextension)
    - Heel prop for extension, calf stretch, prone hang
    - Avoid hamstring stretching if hamstring autograft used

Manual Therapy
- Patellar mobilizations – all directions
- Tibiofemoral mobilizations to promote knee flexion
    - Avoid anterior tibiofemoral glides to reduce stress on graft
- Scar mobilization, soft tissue mobilization, lymph edema massage as needed

NMES
- Quadriceps re-education
    - Consider home unit if insurance allows

Phase 1 – Maximum Protection (0-6 weeks)

AAROM

- Stationary bike
  - Relatively high seat height, low resistance level
  - Rocking for range of motion
- Heel slides, seated slides on floor, supine slides at wall

AROM

- Knee AROM to tolerance within limitations
  - If hamstring autograft, no active knee flexion for 6 weeks

Strengthening

- Ankle pumps, calf sets
- Quadriceps sets, prone terminal knee extension
- Open kinetic chain hip strength including straight leg raises – all planes with goal of no lag sign
  - Avoid adduction if grade 2-3 MCL sprain present
  - Brace to be worn if lag sign present
- Progress to closed kinetic chain as able (demonstrates strong quadriceps contraction, minimal swelling, able to bear at least 50% weight)
  - Standing TKE, leg press, mini squats/weight shifts, forward step up program (8” stair goal), double leg bridging
- Hamstring isometrics with progression to AAROM and AROM as able
  - Avoid AAROM and AROM if hamstring autograft used
- Blood flow restriction training
  - May initiate once incisions are completely healed and edema is less than 1.0 cm
  - Ideally performed 2-3 times per week utilizing 3-5 exercises
- Core stabilization exercises

Proprioception

- Bilateral leg on stable surface, advancing difficulty as tolerated

Gait Re-Training

- Normalize gait pattern
  - Utilize Alter-G treadmill or underwater treadmill if available

Cardiovascular

- Upper body ergometer

Aquatics

- Initiate aquatic therapy when surgical incisions have healed
  - Focus on normalizing weight bearing and gait
  - Consider alternating between land and water-based sessions if available

Modalities

- Instruct on cryotherapy use – at least three times per day for 20-30 minutes with leg elevated above heart
- NMES unit at home if significant quadriceps lag present
- Compression to be worn during all waking hours
  - May remove to sleep

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Phase 2 – Progressive Stretching & Early Strengthening (6-12 weeks)
(continued on next page)

Goals for Phase 2	Precautions	Criteria for Progression to Phase 3
• Minimize pain and inflammation • Restore full knee ROM • Progress muscle strength and endurance • Initiate neuromuscular control exercises • Perform ADLs with minimal pain or compensation • Able to descend 8” stair with proper knee control and without pain • Forward step down or SL squat to specific ROM	• No kicking in the pool for 12 weeks • Avoid twisting and pivoting • Avoid impact until able to pass functional testing (Y balance & 3PQ / dynamometry)	• Minimal pain with Phase 2 exercises • Forward step down or SL squat to specific ROM • Full pain-free knee ROM • Descend 8” stair with proper knee control/alignment • Less than a 20% quadriceps strength deficit on 3PQ

Brace
- Wear for at risk activity

Stretching
- Continue stretching of all lower musculature as needed

Manual Therapy
- Patellar mobilizations – all directions
- Motion dominant tibiofemoral mobilizations to restore full ROM
- Scar mobilization, soft tissue mobilization, lymphedema massage as needed

ROM
- Restore full ROM by week 8

Strengthening
- Continue phase 1 strengthening exercises
- Continue focus on closed kinetic chain quadriceps strength with progression from bilateral to unilateral
  - Leg press, squats, step-up/downs, lateral stepping, multi- directional lunges, etc.
  - Focus on avoidance of knee valgus
- Progress closed kinetic strength hamstring to open kinetic chain as able
- Blood flow restriction training
  - Continue 2-3 times per week utilizing 3-5 exercises
  - Introduce endurance protocol as necessary
- Core stabilization

Proprioception
- SL balance
  - Progress stable to unstable surfaces
  - Add perturbation and dual tasking as able

Phase 2 – Progressive Stretching & Early Strengthening (6-12 weeks)

Cardiovascular
- Stationary bike, elliptical trainer, stair climber
- Retrograde treadmill walking

Aquatics
- Continue phase 1 aquatics, as needed

Modalities
- Utilize cryotherapy and other modalities, as needed

Testing
- Y balance test within 6 cm of uninvolved side
- 3PQ isometric or hand-held dynamometry quadriceps testing (<20% difference)

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Phase 3 – Advanced Strengthening, Proprioception, and Plyometric (12-24 weeks)
(continued on next page)

Goals for Phase 3	Criteria for Progression to Phase 4
• Minimize pain and inflammation • Maintain full knee ROM • Improve muscle strength and endurance • Quad girth within 1-2 cm of contralateral • Improve neuromuscular control • Initiate return-to-running progression • Initiate plyometrics and agility training • Isokinetic test ≥ to 85% limb symmetry (or force plate/dynamometer)	• Minimal pain with Phase 3 exercises • Isokinetic test ≥ 85% limb symmetry • No apprehension with basic plyometric and agility activity • Initiated return-to-running progression with proper lower extremity biomechanics and without pain • Reports confidence in lower extremity with sport specific activities

Stretching
- Continue stretching of all lower extremity musculature as needed

Manual Therapy
- As needed to maintain range of motion and flexibility

Strengthening
- Continue phase 2 strengthening exercises
- Introduce isokinetic knee extension (full arc, pain and crepitus free)
- Single leg exercise progressions (step-ups/downs, lunges, squats & RDLs)
  - Progress to multi-directional stepping patterns
  - Progress stable to unstable surfaces
  - Add perturbations
- Progressive hip and hamstring strengthening
  - Multi-directional band walks and stability training
  - Introduce eccentric hamstring strength training
- Core Stabilization
  - Focus on rotational patterns

Neuromuscular Control
- Incorporate unstable surfaces and dynamic movement patterns with functional strengthening progression
- Incorporate dual tasking and sport-specific progressions

Advanced Gait Re-Training & Agility
- Initiate return-to-running progression (12-14 weeks)
  - Utilize Alter-G treadmill or underwater treadmill if available
  - **14+ weeks**: sagittal plane jogging, sub-maximal ladder drills
  - **16+ weeks**: advance to multi-directional running, sub- maximal pivoting and cutting

Plyometrics
- Initiate and gradually progress return hoping activities
  - Sagittal → Frontal → Rotational
  - Double leg → Single leg
  - Ascending → Descending → Repetitive box jumps/hops

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Phase 3 – Advanced Strengthening, Proprioception, and Plyometric (12-24 weeks)

Aquatics

Advanced gait re-training

- Plyometric drills

Athletic Republic

- Consider ACL Bridge as early as 12 weeks post-operatively

Work Conditioning

- Consider at 12 weeks if physically demanding occupation

Modalities

- Utilize cryotherapy, thermotherapy, and electrical modalities as needed

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Phase 4 – Return to Sports Functional Program (24+ weeks)

Goals for Phase 4	Criteria to Return to Sport and Activity
• Minimize pain and inflammation • Restore muscle strength and endurance • Restore neuromuscular control • Safe and effective return to previous level of function for sport or activity • Forward step down or SL squat to 60°	• Full, pain free knee ROM • Normal lateral step-down test without compensation • Successful completion of return-to-sport testing • Lower Extremity Functional Scale score ≥ • 80/80 (athletes) and 75/80 (sedentary) • Reports confidence in lower extremity with sport specific activities (ACL-RSI)

Independent Gym Based Program (HEP)
- Stretching as needed
- Single leg strength stabilization, and power development with emphasis on dynamic knee control
- Continue incorporation of core integrated exercises with functional strengthening progression

Agility & Plyometrics
- Advanced agility and plyometric drills
    - Progress towards full speed with sudden changes in direction
    - Incorporate dual tasking and sport-specific progressions
    - Continue focus on proper lower extremity biomechanics

Sport-Specific Training
- Initiate sport-specific training programs
    - Interval sport programs for running, cycling, swimming, skating, throwing, golfing, etc.
    - Olympic/power weight-lifting exercises
- Transition to Athletic Republic program if competitive or recreational athlete with specific goals for return-to-sport
- Progress return-to-running program
    - Progress distances, speed intervals, surfaces, hill training, and sprint work if appropriate

Activity-Specific Training
- Transition to work re-conditioning program if physical laborer or if specific occupational demands

Modalities
- Utilize cryotherapy and other modalities as needed

Brace
- Custom fit functional brace to be utilized for contact or potential contact sports or activities for ~1 year post-op

Return to Sport Testing (6-12 months post-op per physician)
- Balance: Y-balance testing within 4 cm of uninvolved side
- Strength: Knee isokinetic testing ≥ 90-95% of the uninvolved side, lateral step-down test without compensation
- Hop Testing: ≥ 90-95% limb symmetry
- Agility: Full speed sport-specific drills without pain or compensation
- ACL-RSI to determine readiness to return-to-play