

# **Bone–Patellar Tendon–Bone (BTB) ACL Reconstruction Postoperative Rehabilitation Protocol**

**Procedure:** Primary ACL reconstruction with BTB autograft

**Therapy:** Begin within 3–7 days after surgery. Progress by clinical criteria, not time alone.

**Key goals:** Restore full extension early, control effusion, normalize gait, regain quadriceps control and strength, restore neuromuscular control, and safely return to sport/activity.

## **General Precautions**

- Avoid twisting, pivoting, cutting, running, jumping, and open-chain resisted knee extension from 45° to 0° until cleared.
- Prioritize full passive knee extension from the first postoperative visit.
- Monitor for increasing pain, effusion, warmth, loss of motion, extensor lag, or patellar tendon donor-site irritability; reduce activity if present.
- Patellar mobilization is encouraged, especially inferior/superior mobility, as tolerated.
- Brace use and duration are surgeon-directed. If used, lock in extension for ambulation until adequate quadriceps control and normalized gait are present.
- Avoid kneeling or direct anterior-knee pressure until the BTB harvest site is comfortable.

## **Phase I: Immediate Postoperative Phase — Weeks 0–2**

### **Goals**

- Protect reconstruction and incision.
- Control pain and swelling.
- Achieve full passive extension and flexion to at least 90°.
- Independent straight-leg raise without extensor lag.
- Ambulate safely with appropriate assistive device.

### **Weight Bearing / Brace**

- Weight bear as tolerated with crutches unless otherwise specified.
- Brace locked in extension for ambulation and sleep if prescribed.
- Unlock brace for exercises and seated range of motion.

## **Exercises**

- Ankle pumps.
- Quad sets; consider NMES for quadriceps activation.
- Straight-leg raise in brace until no extensor lag.
- Heel slides and wall slides.
- Prone hangs and heel-prop extension stretching.
- Patellar mobilizations.
- Hip abduction/adduction/extension strengthening.
- Gentle calf and hamstring stretching.
- Stationary bicycle without resistance once ROM permits a full revolution.

## **Criteria to Progress**

- Minimal effusion and controlled pain.
- Full passive extension equal to contralateral side.
- Flexion at least 90°.
- Straight-leg raise without extensor lag.
- Safe ambulation with appropriate gait pattern.

## **Phase II: Early Strengthening and Motion — Weeks 2–6**

### **Goals**

- Maintain full extension.
- Progress flexion toward full ROM.
- Normalize gait and wean crutches/brace as appropriate.
- Improve quadriceps activation and begin closed-chain strengthening.
- Minimize patellofemoral and donor-site symptoms.

### **Weight Bearing / Brace**

- Weight bear as tolerated.
- Discontinue crutches when gait is non-antalgic and quadriceps control is adequate.
- Discontinue brace per surgeon preference once straight-leg raise is without lag and gait is normalized.

### **Exercises**

- Continue ROM work, emphasizing terminal extension.
- Stationary bike; progress resistance gradually.
- Closed-chain strengthening in protected ranges:

- Mini-squats, typically 0–45° progressing toward 0–60°.
- Leg press, typically 0–60°.
- Step-ups, lateral step-ups, and controlled step-downs.
- Weight shifts and balance/proprioceptive drills.
- Bridges, hip/core strengthening.
- Calf raises.
- Open-chain knee extension may begin at week 4 in a protected arc of 90–45°, progressing gradually as tolerated.
- Avoid heavy open-chain knee extension from 45° to 0°.

### **Criteria to Progress**

- Full, pain-free ROM or near-symmetric ROM.
- Trace or no effusion.
- Normal gait without assistive device.
- Good quadriceps control with functional closed-chain activity.
- No increased swelling or pain after therapy progression.

## **Phase III: Progressive Strengthening and Neuromuscular Control — Weeks 6–12**

### **Goals**

- Full, symmetric ROM.
- Restore progressive lower-extremity strength.
- Improve single-leg control, balance, and movement quality.
- Prepare for running progression.

### **Exercises**

- Progressive leg press, squats, split squats, step-downs, lunges, and hip strengthening.
- Single-leg balance and perturbation training.
- Core strengthening.
- Elliptical, bike, pool running if incisions healed.
- Advance open-chain knee extension range and resistance as tolerated; avoid provoking anterior knee pain.
- Controlled lateral movement and low-level agility drills once adequate strength/control are demonstrated.

### **Criteria to Begin Running Program**

- Full ROM.

- No effusion or pain with daily activity.
- Normal walking gait.
- Good single-leg squat/step-down mechanics without valgus collapse.
- Quadriceps strength at least 70% of contralateral limb, if objective testing available.
- Surgeon and therapist clearance.

## **Phase IV: Running, Plyometrics, and Advanced Strengthening — Months 3–6**

### **Goals**

- Restore muscular strength and endurance.
- Initiate graded running and plyometric program.
- Improve landing mechanics, deceleration, and dynamic knee control.
- Address sport- or work-specific requirements.

### **Exercises**

- Graduated walk-jog/running program.
- Progressive single-leg strengthening and eccentric quadriceps training.
- Plyometric progression: double-leg landing, then single-leg landing, hopping, bounding, and multidirectional drills.
- Agility, deceleration, cutting preparation, and sport-specific drills.
- Continue hip, trunk, quadriceps, hamstring, and calf strengthening.

### **Criteria to Begin Cutting/Pivoting**

- No pain, instability, or effusion.
- Full ROM.
- Demonstrates good landing and deceleration mechanics.
- Quadriceps and hamstring strength at least 80–90% of contralateral limb.
- Functional hop testing at least 80–90% limb symmetry, depending on activity demands.

## **Phase V: Return to Sport / High-Demand Work — Months 6–9+**

### **Goals**

- Restore symmetric strength, power, and neuromuscular control.
- Complete sport-specific progression without symptoms.
- Safely return to unrestricted activity.

## **Return-to-Sport Criteria**

- No pain, effusion, instability, or giving-way episodes.
- Full, symmetric ROM.
- Quadriceps and hamstring strength at least 90% of contralateral limb; consider 95% or greater for high-risk pivoting sports.
- Hop and functional testing at least 90% limb symmetry with appropriate movement quality.
- Demonstrates controlled single-leg landing, cutting, and deceleration without dynamic valgus or compensatory movement.
- Psychological readiness and surgeon clearance.
- Return to unrestricted pivoting/cutting sports is generally not before 9 months postoperatively and should be criteria-based.

## **Modification: Concomitant Meniscus Repair**

The meniscus repair restrictions supersede the standard ACL protocol. Restrictions should be individualized to tear pattern, location, repair technique, and surgeon preference.

## **Standard Meniscus Repair Precautions**

### **Weeks 0–4**

- Brace locked in full extension for ambulation.
- Partial weight bearing with crutches; typically 25–50% weight bearing unless otherwise directed.
- ROM limited to 0–90°.
- No loaded flexion beyond 45°.
- No squatting, lunging, leg press, hamstring curls, pivoting, or twisting.
- Emphasize quad sets, straight-leg raises, patellar mobility, and protected ROM.

### **Weeks 4–6**

- Progress weight bearing toward full weight bearing as gait and swelling allow.
- Continue brace per surgeon preference; may unlock gradually for ambulation when quadriceps control is adequate.
- Maintain flexion limit of 90° until 6 weeks.
- Begin protected closed-chain strengthening from 0–45°, progressing cautiously toward 0–60°.
- Continue to avoid loaded knee flexion greater than 90°.

### **Weeks 6–8**

- Advance to full ROM as tolerated.
- Progress closed-chain strengthening and functional activities.
- Avoid deep squats, loaded flexion greater than 90°, pivoting, or impact activity until at least 8 weeks and cleared.
- Follow standard ACL strengthening progression thereafter, provided no joint-line pain, recurrent effusion, or mechanical symptoms.

### **After Week 8**

- Resume standard ACL reconstruction progression, including running and impact progression based on ACL criteria.
- Continue to avoid deep loaded flexion until strength, motion, and symptoms permit; use surgeon-specific restrictions for complex, radial, root, or ramp repairs.

## **Additional Meniscus Repair Considerations**

- **Partial meniscectomy:** Usually follows the standard ACL protocol without additional weight-bearing or ROM restrictions unless otherwise specified.
- **Root repair, radial repair, complex repair, or meniscal transplantation:** Follow the more protective procedure-specific protocol; these cases often require longer non-weight-bearing/partial-weight-bearing and ROM restrictions.
- Do not advance activity in the presence of joint-line pain, catching/locking, recurrent effusion, or loss of ROM.

**Surgeon-directed restrictions take precedence over this protocol.**