**ACL Recon Rehab Protocol**

*This protocol encompasses the spectrum of ACL reconstruction techniques and may be modified to account for additional procedures and/or special circumstances outlined by the surgeon. Each therapist is encouraged to use evidence-based clinical reasoning when choosing an exercise or therapeutic procedure.*

Key Considerations for Each Graft:

Quad Tendon: Slower to progress with quad activation and strength, blood flow restriction therapy may accelerate rehab

BPTB: Closely monitor complaints of anterior knee pain during the rehab process (tendonitis, anterior interval scarring).

Hamstring Tendon: Avoid isolated resisted isotonic hamstring exercises for ~6 weeks to allow scarring of the semitendinosus and gracilis to occur. Patients ready for resisted hamstring exercises will be non-tender to palpation and able to actively straight leg raise (SLR) to 70° without pain. Submax isometric hamstring exercises can begin as early as 3 weeks.

Allograft: Avoid overstressing the graft between weeks 6 and 10 as revascularization takes longer with an allograft.

**PHASE 1 (Week 0 – Week 6) – Graft Protection/Mobility**

**Goals:**

Minimize pain and swelling

Restore patellar complex mobility with emphasis on patellar tendon mobility

Restore voluntary quadriceps activation

Normalize motion and gait pattern

**Brace:**

Worn at all times while not exercising in PT for 5-6 weeks. Locked at 0 for 5-7 days, then unlocked 0-90 for ~4 wks

Sleep in brace locked in extension ~2 weeks or until symmetrical active extension is achieved

**Weight-bearing:**

WBAT with 2 crutches

Crutch progression: 2 crutches > 1 crutch > no crutch when gait is symmetrical with appropriate quad activation in stance phase (weeks 2-4)

**ROM:**

Patellar tendon and patellar complex mobilization emphasized for at least the first 6-8 weeks

Restore ROM with goal of full range by 6 weeks. Emphasize symmetrical active extension.

**Key Exercises:**

Quad sets and SLR (with NMES, biofeedback, and BFR for quad activation)

 *(if quad lag, continue to use brace during SLR)*

Gastrocnemius stretch for extension ROM

Wall/heel slides

Bike for motion starting at 1-2 weeks

Open- and closed-chain terminal knee extension (TKE)

Anterior/posterior weight shifting in brace

Double-leg shuttle leg press *(ie Total Gym)* for muscle activation no earlier than 4 weeks (0-60°)

\*\*\*Patient must demonstrate appropriate voluntary quad activation, co-contraction and endurance to allow for controlled motion on the shuttle

**Exercises to AVOID:**

Squats with acutely inflamed knee

Progressing CKC strength before full active extension has been achieved

**Criteria for Progression to Phase 2:**

• Symmetrical active extension and >120\* flexion

• Normal patellar mobility

• Minimal swelling (<1cm difference in mid-patellar girth)

• Minimal pain (<2/10 with activity)

• 3x30 straight leg raise with NO extension lag

• Static single leg balance x 1 minute (stable surface)

• Symmetrical gait

**Phase I Clinical Pearls:**

1. Control inflammation with frequent icing and elevation. Partial weight-bearing PWB for the first two weeks limits swelling. It is important for the patient avoid extensive periods with their leg in a dependent position, especially during the first week. Limit time at work and school during week 1.
2. Retrograde effleurage with leg elevation is beneficial for edema reduction and corresponding increases in ROM and quad control.
3. Obtaining full extension early is essential for a successful outcome. Use sound clinical judgment when determining how aggressive one needs to be. A female with hyper-laxity (10° hyperextension) can work at neutral for 1-2 weeks then gradually work toward full hyperextension, while a fairly tight 35 year old male may need to work hyper-extension with heel props beginning post-op day 1.
4. Patients may have difficulty generating an adequate VMO contraction secondary to both disuse atrophy and reflex inhibition related to swelling. Use NMES for neuromuscular re-education as needed but work aggressively for a controlled volitional contraction. Have the patient work to achieve a “heel up” position when quad setting. Placing a small 1” towel roll under the heel while executing a quad set will help the quadriceps contract at end range. Remove the towel after 10-15 reps with a 10 second contraction, the patient should then be able to demonstrate full or near full active extension. Encourage the patient to perform an additional 10-15 repetitions to reinforce this movement pattern.
5. Perform PROM exercises 3x/day to maximize ROM return. Instruct patient on the importance of restoring ROM before concentrating on strength.
6. Begin soft tissue mobilization to the hamstrings and gastrocnemius to reduce muscle tightness, myofascial restriction, and trigger points, which will subsequently improve knee extension. Integrate soft tissue mobilization and myofascial release of the quadriceps, IT band, and adductor groups as appropriate.
7. Restoring normal patellofemoral (PF) arthrokinematics is essential for restoration of normal PF tracking and ultimately a successful outcome. Manual mobilization of the patella with medial/lateral/superior/inferior glides, medial/lateral tilts. These mobilizations can be performed with the knee in full extension (loose-packed position for the patellofemoral joint) and slight knee flexion (approximately 30°).
8. Begin stationary bicycle after week 1 to increase knee flexion. Initially, patients may not be able to pedal through a full revolution, instruct the patient to perform partial forward and backward revolutions until there is adequate knee flexion to allow a full cycle. Note: Most patients are able to achieve a full cycle revolution backwards first, followed by forward.
9. Educate the patient on the importance of core control using level 1 core exercises. Reinforce that the patient is using and integrating “neutral spine” mechanics throughout the phase 1 program.

**PHASE 2 (Week 7 – Week 12) – Endurance**

**Goals**

Improve closed-chain single leg strength, endurance, and neuromuscular control

Develop strength and stability in the sagittal plane under various proprioceptive conditions with

gradual initiation of frontal plane activities

Maximize cardiovascular fitness and muscular endurance

**Brace**

Optional hinged knee brace per surgeon, unlocked (no brace in controlled PT environment)

**ROM**

Ensure full extension is maintained as CKC activities progress

**Key Exercises**

*Increase repetitions/weight of Phase 1 exercises, plus:*

1. Double/Single leg bridges

2. Shuttle progression; add bilateral shuttle jumps in late phase II

3. Squat progression, including double and single leg squats with sport cord

4. Step-up progression

5. Lunge progression

6. Balance progression

*Exercise progression:*

Double leg to Single leg

Stable surface to Unstable surface

Sagittal plane to Frontal plane

**Criteria for Progression to Phase 3:**

• Minimal pain, no swelling

• No incidence of giving way

• Full AROM

• Y-balance Test anterior reach within 10cm

• Single leg squat with sport cord for 1 minute

**PHASE 3 (Week 13 – Week 20) – Strength**

**Goals**

Increase intensity and build on foundation of strength and cardiovascular fitness/endurance

Introduce transverse plane motions in late phase 3

Transition to movements geared towards speed, power, and function

Incorporate functional balance activities utilizing muscle strength, proprioception, and external perturbation

Emphasize safe deceleration, eccentric control, and proper biomechanical alignment/control

\*\*Pass sport cord test between 5-6 months to allow return to **participation progression** to begin.

**Expected full clearance for returning to sport is 6 months or beyond.**

**Brace**

Optional hinged knee brace per surgeon, unlocked (no brace in controlled PT environment)

**Key Exercises**

Focus on increasing sets/duration of four sport cord test components to prepare for test

Increase intensity of cardiovascular interval training

Initiate squat jump progression from shuttle to gravity dependent position

Advance plyometrics from bilateral to unilateral as pt demonstrates quad control

**Running**

Timeline: Between 3-4 months

Criteria:

1. Single leg squat with sport cord for 90 seconds

2. Forward & Backward sport cord jog for 1 minute each

**Exercise Progression**

Weighted squat progression – gradually increase depth and resistance

Leg press, hamstring curls, RDL’s, single leg calf raises

Single leg squat/step-up/lunge progression (dips, retro, walk and split), focus on eccentric control

and alignment. Slow and gradual progression with increasing depth

Monster walks

**Core Program**

Front plank – full, may advance to alternating leg lift

Bridge – marching or single leg
Side plank – full
Dead bug progression

Quadruped alternating arm-leg

**Cardio Exercise**

Stationary Biking
Treadmill/outdoor walking with focus on proper gait mechanics

Arc trainer or elliptical
Stadium stair walking

**Sport Specific Activity Progression**

Outdoor biking: week 8-10
Pool running: week 8-10
Swimming free style: week 8-10
Higher intensity interval work with CV program – week 10-12

**Criteria for Progression to Phase 4:**

• Sport Cord Test > 46/54 (black sport cord: >150 lbs; blue sport cord: female or <150lbs)

• Symmetric running gait: audibly rhythmic foot strike without gross asymmetries in visual kinematics when running between 6-10mph

• Y-Balance Test anterior reach within 4 cm

**Phase III Clinical Pearls:**

1. Manual work in this phase will begin to decline relative to treatment time spent performing therapeutic exercises for specific stretching, advanced strengthening, and higher-level functional task training. Keep in mind it is important to maintain proper PF tracking by using patella mobilization as needed.
2. Emphasize the importance of proper alignment with all bilateral and unilateral impact and non- impact closed chain loading. In the frontal plane, the hip, knee and foot should maintain a straight alignment without the knee falling into a valgus position. With proper sagittal plane alignment, the knees do not cross beyond the end of the toes, the hips drop posterior while the torso inclines forward, this allows the patient/athlete to maintain their center of gravity while dampening vertical load with take off and landing.
3. Proper dynamic warm-up, muscle activation series and self directed soft tissue mobilization using a foam roller are important preparatory exercise prior to weight room and cardiovascular activity. Patients commonly develop PF pain when they reduce their intrinsic hip stability and soft tissue mobility exercises in the later stages of their rehab program.
4. Swelling and pain will indicate when introduction to low amplitude impact loading is appropriate beyond the 12 week mark.
5. Educate patients on proper frequency and intensity for performance of their HEP; LE strengthening should be performed a maximum of 3x/week to allow for adequate muscle recovery between sessions. Higher intensity/interval cardiovascular days should be following by lighter recovery work. Follow the LE workout design outlined in phase 2 with increasing resistance. Error on the side of caution when prescribing both load and recovery!
6. Building muscular endurance is critical during phase III. Interval training offers a higher intensity non-impact loading that will build muscular strength, endurance and girth without overstressing articular cartilage and remodeling connective tissue.
7. Increase eccentric load with all closed chain work. Retrograde elevated treadmill walking at 10-12% elevation is an excellent way to add quality eccentric work. A typical program will consist of 4 sets, 20 minutes total; 3 minutes forward at 10-15% @ 3.0-4.0 MPH and 2 minutes backward 10-12% @ 2.8-3.5 MPH, 2x/week. Reverse sled pulls and stadium stair walks may be used as an alternate exercise selection
8. Ideal take-off and landing mechanics include hip flexion, knee flexion and ankle dorsiflexion; teaching “foot flat” mechanics optimally transfers proper squatting alignment into ballistic impact activity offering the safest transition to impact loading.

**PHASE 4 (Week 20+) – Return to Sport Spectrum**

**Goals**

Plyometric Power

Dynamic Balance

Multi-Planar Movement

Athletic Agility

Cardiovascular fitness

**Brace**

Fit for sport brace (per surgeon preference)

**Exercises**

Sport specific movement patterns practiced in supervised and controlled environment

**Return to Participation**

Graded re-integration into sport activities

Controlled, predictable environment to Unpredictable drills and environment

Individual drills to Team drills

Non-contact to Contact

Supervised rehabilitation ~1x/wk for 4-6 weeks with controlled practice and game participation

Coordination with ATC

**Exercise Progression**

Increasing loads from phase III

**Core Program**

Increasing loads from phase III

**Non-impact cardiovascular exercise**

Stationary Biking
Arc trainer or elliptical

Swimming

**Running Progression**

Pool Running (if available) – 8-10 weeks

Basic ladder series – 12 weeks
Skipping – 12 weeks
Walk/jog interval – 12 weeks
Linear acceleration/deceleration – 16 weeks

Sprinting – 20 weeks

Change of direction and lateral agility – 20 weeks

**Jumping Progression (Gradual Progression)**

Low amplitude bilateral single response jumps – 12-14 weeks

Bilateral multiple response jumps – 20 weeks

Unilateral single response jumps – 20 weeks

**Sport Specific Activity Progression**

Non-contact and non-reactive field/court progression – 20 weeks

Interval golf program – 20 weeks

**Criteria for Progression to Return to Play:**

• LESS of 5 or less

• Single hop & Triple hop test for distance within 90% of uninvolved

• Y-Balance Test (94% composite) when fatigued

• Hand-held dynamometry within 90% of uninvolved quad/hamstring/hip abductors

**Return to Play**

Clearance by surgeon, PT, and ATC for full, unrestricted return to sport at 6 months or beyond.

Typical timeframe will be anywhere between **6-12 months.**

**Phase IV Clinical Pearls:**

1. Ensure proper warm-up before performance of all plyometric and functional training. Continued soft tissue maintenance with foam roller and massage stick.
2. Skilled supervision by a coach, therapist or trainer is needed to evaluate the athlete during field/court progressions to ensure they are using proper acceleration, deceleration and cutting mechanics. Compensatory patterns can easily develop if left unaddressed leading to inefficiency and possible injury.
3. Proper recovery with ice, rest and pool work is essential to combat swelling with gradually increasing loads. Use sound clinical judgment by resting an athlete an additional 24 hours to allow full recovery from intense bouts when necessary.
4. Create variety in the weight room program design as outlined. In phase 4 cardiovascular and functional days should be more specific to the patients sport. Remember, that each day can’t be a high intensity day, otherwise a significant setback is inevitable. Heavy loading days should comprise 3 out of the 5-6 workouts in a given week. More load can be implemented when an athlete is able to break up the weight room and functional work in two separate times during the day. Many working adults don’t have that luxury so it is important to structure a program that can be complete in about 90 minutes to ensure quality work.
5. Training at these higher levels calls attention to the importance of proper hydration and nutrition before, during and after the workout. Make sure the patient/athlete understands the importance of these two variables and their impact on the quality of exercise, the response to loading and the recovery afterward.