

## ACL Reconstruction Physical Therapy Protocol

This protocol encompasses the spectrum of ACL reconstruction techniques, but has some portions of the rehabilitation that are to be modified to account for additional procedures (e.g. meniscus or cartilage repairs) and/or individual circumstances (i.e. graft choice), as outlined by the treating orthopedic surgeon. Exercises should be gradually progressed based upon protocol recommendations, physician discretion, and the patient's ability to perform the exercises correctly and without an increase in pain. This protocol has many notes relating to our philosophy and rationale behind the rehabilitation after ACL reconstruction, and we ask that you read them as you come across them as they may differ from your standard rehabilitation experience. We have avoided making many notes for specific time points in our protocol, as progression should be largely based on achievement of milestones rather than the passage of time. Some patients recover more slowly than others, and that is fine as long as steady forward progress is happening. This protocol is not designed to replace the judgment, communication, and experience of a skilled physical therapist. If at any point in the rehabilitation process there are concerns or questions that arise, please do not hesitate to contact us so that we can answer it to the best of our ability.

Thank you for your dedicated effort!

Andrew Parker, MD

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### Key Considerations

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#### Patient Education

It is important to take the time during initial evals, and then regularly throughout the course of rehabilitation, with patients to discuss and review important considerations related to their injury. Remember that each patient will present with different post-surgical considerations, pain levels, goals etc. Reviewing this information with the patient and what to expect throughout the rehabilitation is of paramount importance.

#### Surgical Technique and Procedures

##### *BTB Graft:*

Pay attention to complaints of anterior knee pain during the rehabilitation process. (tendinopathy, anterior interval scarring)

##### *Quad Graft:*

Early scar mobilization is needed to prevent the incision from scarring to the quadriceps tendon, which can inhibit flexion

##### *Hamstring Tendon Graft:*

Hamstring exercises should be closely monitored. Remember that hamstring tendon grafts can take up to 8-12 weeks to fully incorporate into tunnels and the semi-tendinosis and gracilis muscles both need to scar down to surrounding soft tissue.

##### *Allograft:*

Patients often experience less postoperative pain in the first week or two and therefore may be able to progress faster with rehabilitation. However, be careful that the graft is not stressed too much/too soon since revascularization takes longer with an allograft.

##### *Meniscus repairs, cartilage repairs, or collateral knee ligament injuries:*

Concurrent ligamentous or meniscal involvement will likely alter post-surgical timelines, the patient's initial restrictions, and weight bearing status. Make sure you pay close attention to those specific portions of the protocol to ensure all these restrictions are considered prior to initiating rehabilitation.

### Milestones and Required Clinical Visits in MD's Office

- 2 weeks – Incision check
- 6 weeks – Motion check
- 12 weeks – Muscle control and motion check
- 5-6 months – Strength check
- 9 months – Performance check

For the Physical Therapist

*Arthrogenic Muscle Inhibition (AMI):*

Arthrogenic muscle inhibition (AMI) is a common occurrence following knee surgery and limits the quadriceps ability to activate effectively. Clinicians should consider the use of neuromuscular electrical stimulation (NMES), cryotherapy, etc. to limit the effects of AMI and promote quadriceps activation.

*Exercise Progressions/Loading:*

All exercises should be performed with progression of loading variables as tolerated (increased repetitions, sets, weight, speed, etc.)

*Patellar/Supra/Infrapatellar Fat Pad Mobility*

Patellar mobility should be addressed early and often. Superior/inferior and medial/lateral gliding can be used initially which will concurrently address fat pad restrictions within the first two weeks. Patellar mobilizations and applied pressure to the superior or inferior fat pad (depending on quad or BTB graft, respectively) can be progressed as tolerated two weeks after surgery.

*Maintenance of Strength in Uninvolved Limb*

Start bilateral strength work (single leg exercises should be performed on the operative side AND uninjured side) by week 3-4 – it is critical to keep the uninvolved limb from becoming the involved limb

*Movement Quality*

It is important to evaluate the entire kinetic chain. The knee is controlled from above and below - poor hip/ankle mobility can force the knee joint to become extra mobile, which is unnecessary stress on the ACL graft (or native, uninjured ACL), and poor hip adduction/IR strength or hyperpronation of the foot can result in lack of control of the knee.

- **If at any time there are signs of infection (increased swelling, redness, drainage from the incisions, warmth, fever, chills or severe pain that is uncontrolled with the pain medication), please contact us at the office: 214-383-9356.**

Phase I: Early Motion/Healing – Protection Phase	
Goals	<ul style="list-style-type: none"> <li>- Gain control of pain and diminish joint swelling</li> <li>- Restoration of patellar mobility (suprapatellar/infrapatellar fat pad)</li> <li>- Emphasis on regaining full passive extension as early as possible as well as gradual improvement of knee flexion</li> <li>- Increased quadriceps activation and reestablishing quad control (emphasize gaining double leg eccentric control)</li> <li>- Normalized gait/Weight Shifting – restore independent ambulation</li> </ul>
Brace/crutches	<p><b>Weightbearing</b> is <u>expected to be weightbearing as tolerated from day one</u> unless complex meniscus repair is performed</p> <p><b>Brace</b> is to be worn at all times except for showering/bathing, working with PT, or doing home exercises/stretchers. The brace is to be locked out in full extension during ambulation until:</p> <ul style="list-style-type: none"> <li>- Unlocked brace with crutches = 5 straight leg raises without extension lag</li> <li>- Unlocked brace without crutches = 20 straight leg raises without extension lag</li> <li>- Brace can be unlocked when sitting or non-weightbearing starting post-op day 3</li> <li>- Brace to be worn at night unless released by MD</li> </ul>
Precautions for individual circumstances	<ul style="list-style-type: none"> <li>- <b>BTB/QUAD GRAFT</b> – begin frequent infra/suprapatellar pouch mobilizations immediately, with direct scar mobilizations ok to begin at week 3, this is critical to reduce sensitivity and prevent adhesions</li> <li>- <b>ALLOGRAFT</b> – may have less pain early on but must diligently follow precautions, allograft ACLs cannot enter phase 2 until 6 weeks postop even if they meet progression criteria earlier as this graft has a slower healing/uptake process and needs to be protected</li> <li>- <b>MENISCUS REPAIR</b> – must maintain <u>brace locked in extension for ambulation for 6 weeks</u> postoperatively regardless of quad control, avoid any active resisted hamstrings (ok for bike, heel slides) or active open chain knee flexion beyond 90 degrees for 8 weeks</li> <li>- <b>COMPLEX MENISCUS REPAIR</b> – <u>non-weightbearing with crutches until 1 month postop</u>, then progress with same restrictions as above standard meniscus repair</li> </ul>

Suggested Exercises	<p><b>ROM</b></p> <p>Patellar Mobilizations</p> <ul style="list-style-type: none"> <li>- All 4 directions; anterior interval, suprapatellar pouch</li> </ul> <p>Extension ROM</p> <ul style="list-style-type: none"> <li>- Hamstring/gastroc stretching, etc.</li> <li>- Low load long duration stretching (heel prop/prone hang) equal to uninjured <ul style="list-style-type: none"> <li>• Patient should be doing multiple times daily starting as early as day of surgery</li> </ul> </li> </ul> <p>Flexion ROM</p> <ul style="list-style-type: none"> <li>- Heel/wall slides, etc.</li> <li>- Don't worry if flexion is tough to obtain in the earliest phase <ul style="list-style-type: none"> <li>• We have to go slow early to go fast later in a painful/swollen ("reactive") knee</li> </ul> </li> </ul> <p><b>Strength</b></p> <p>Quadriceps strength/control</p> <ul style="list-style-type: none"> <li>- NMES <ul style="list-style-type: none"> <li>• To be used with all quadriceps exercises</li> <li>• Utilize until able to perform 20 full range active terminal extensions</li> </ul> </li> <li>- Short arc quad progression <ul style="list-style-type: none"> <li>• Towel roll at heel → mid-gastroc → knee → decrease towel height to table</li> </ul> </li> <li>- Straight leg raise</li> <li>- Long arc quad <ul style="list-style-type: none"> <li>• Unresisted full ROM is allowed when non-painful</li> <li>• Use isometrics at varying angles to build tolerance</li> <li>• Resistance applied only from 90° to 40° until 12 weeks</li> </ul> </li> <li>- Standing terminal knee extensions</li> </ul> <p>Bilateral lower extremity strength</p> <ul style="list-style-type: none"> <li>- Hamstring (standing curls, etc.)</li> <li>- Gastroc/soleus (heel raises, seated heel raises, etc.)</li> <li>- Hip (clamshells, double leg deadlifts, bridges, etc.)</li> <li>- Core (deadbugs, crunches, planks, etc.)</li> </ul> <p><u>Note on blood flow restriction:</u> BFR has excellent results in preventing atrophy and producing muscle hypertrophy but only once there is good voluntary contraction. BFR to be used once unlocked ambulation is achieved.</p> <p><b>Balance/proprioception:</b></p> <p>Weight shifts (body weight) sagittal/frontal planes</p> <ul style="list-style-type: none"> <li>- Progress to single leg balance, add visual restriction etc.</li> </ul> <p>Gait training drills</p> <ul style="list-style-type: none"> <li>- Retro walking, cone step overs, etc.</li> </ul>
Frequency & Duration	2-3x weekly formal PT, 2-3x daily home exercises/ROM work
Progression Criteria	<p>Must meet <b>ALL</b> criteria prior to progressing into phase 2:</p> <ol style="list-style-type: none"> <li>1. Full knee <u>active</u> range of motion: &gt; 0-120 with side to side knee extension difference ≤ 5°</li> <li>2. Minimal complaints of pain and swelling in the surgical knee</li> <li>3. Complete 3 sets of 20 repetitions of a straight leg raise with no extension lag</li> <li>4. Perform single leg balance of the surgical limb on a solid surface for 1 minute (0-20 degrees of knee flexion)</li> <li>5. Perform sit to stand task (at least 5 times) with bilateral loading symmetry and control: w/o obvious weight shift or offloading through trunk lean, dynamic valgus, or unequal foot position</li> <li>6. Perform single limb heel raise (at least 15 times) with minimal upper extremity assistance.</li> </ol>

## Phase II: Motion and Strengthening

Goals	<ul style="list-style-type: none"> <li>- Improve single limb strength (emphasis on eccentric strengthening and neuromuscular control).</li> <li>- Develop strength and stability in all planes of motion (sagittal, frontal, transverse planes) and under various proprioceptive conditions while focusing on achieving proper trunk, knee, and ankle alignment.</li> <li>- Increase external focus of control with feedback and instructions</li> <li>- Improve cardiovascular fitness and muscle endurance</li> </ul>
Precautions	Meniscal repair precautions remain in effect even if patient has progressed into phase 2 until time points are reached
Suggested Exercises	<p><i>Increase repetitions, weight, and visual manipulation of phase 1 exercises, plus:</i></p> <p><b>ROM</b> Continue to progress flexion with goal of symmetry to contralateral side, often BTB/quad autografts are slow to regain terminal knee flexion</p> <p><b>Strength</b> Squat movement pattern</p> <ul style="list-style-type: none"> <li>- Lunge → lateral step down → single leg squat → resisted single leg squats</li> <li>- Use shuttle/leg press to help bridge gap between stages</li> </ul> <p>Hip hinge movement pattern</p> <ul style="list-style-type: none"> <li>- Double leg deadlift → single leg deadlift</li> </ul> <p>Bilateral lower extremity strength</p> <ul style="list-style-type: none"> <li>- Continue progression of all phase 1 exercises</li> </ul> <p><b>Balance/proprioception</b> Use of unstable surfaces and visual manipulation create positive outcomes in regard to restoring neuromuscular pathways in the body</p>
Frequency & Duration	2-3x weekly formal PT, daily home exercises/stretching
Progression Criteria	<p>Must meet <b>ALL</b> criteria prior to progressing into Phase 3:</p> <ol style="list-style-type: none"> <li>1. Full knee active range of motion: no side to side active knee extension difference</li> <li>2. Minimal complaints of pain and swelling in the surgical knee</li> <li>3. Normalized gait</li> <li>4. Single limb squat for 1 minute without resistance using Vail Sport Cord criteria (testing protocol online)</li> <li>5. Quadriceps strength (Biodex @ 180°/sec) limb symmetry index (LSI) to 50% of non-surgical limb</li> </ol>

## Neuromuscular Based Training

We believe that heavy emphasis on proprioceptive exercises to include perturbation and reactive training beginning around 2 months postoperatively creates positive outcomes in regard to restoring neuromuscular pathways in the body. It may sound trite, but we are not treating a knee, we are treating a person who has a knee injury. The knee is a complex joint of bone, cartilage, ligaments, etc, but the neuroreceptors within these structures and their connections to their controlling muscle, as well as the processing centers and programming for knee joint movement in the brain are underappreciated and often under-rehabbed.

## Phase III: Introduction to Landing

Goals	<ul style="list-style-type: none"> <li>- Increase the intensity of training</li> <li>- Improve the strength foundation</li> <li>- Incorporate functional balance activities utilizing muscle strength, proprioception, and UE manipulation</li> </ul>
Precautions	<p><b>MENISCAL REPAIR OR COMPLEX MENISCAL REPAIR:</b> No twisting/cutting/pivoting motions for 4 months postoperatively regardless of meeting other criteria for progression</p>
Suggested Exercises	<p><i>Increase repetitions, resistance, and speed of movement of earlier phases, plus:</i></p> <p><b>Landing Progression</b> Proper eccentric control must be taught before jumping/running can begin</p> <ul style="list-style-type: none"> <li>- 2-leg to 2-leg with hold → 2-leg to 1-leg with hold → 1-leg to 1-leg with hold</li> <li>- 2-leg to 2-leg repeated → 2-leg to 1-leg repeated → 1-leg to 1-leg repeated</li> </ul> <p><b>Bodyweight Assisted Running</b> Alter-G and pool running can be a great adjunct in preparation to run, as it allows for introduction to impact without need for full resistance of gravity as the patient continues to become stronger. Patients will become more comfortable with running technique as well.</p> <p><b>Reactive Exercises</b> Cognitive challenges applied during exercise/activity allow for attentional focus to be directed away from task at hand, similar to in sport. This is important for patients as they progress from a period of internal to external focus during activity.</p> <ul style="list-style-type: none"> <li>- Visual (stroboscopic glasses, etc.)</li> <li>- Cognitive (completing math problems, etc.)</li> <li>- Coordination (catching different colored items, touching different items, etc.)</li> </ul>
Frequency & Duration	2x weekly formal PT with 4x weekly home exercises
Progression Criteria	<p>Must meet <b>ALL</b> criteria prior to progressing into Phase 4:</p> <ol style="list-style-type: none"> <li>1. Perform a single limb squat (knee flexion 90-30) with heavy resistance cord for one minute with good neuromuscular control, forward and backward jog as per Vail Sport Cord criteria (testing protocol online)             <ol style="list-style-type: none"> <li>a. Patient weighs less than 160 pounds → use 15 pounds of resistance</li> <li>b. Patient weighs more than 160 pounds → use 20 pounds of resistance</li> </ol> </li> <li>2. Display IKDC score of <math>\geq 55</math></li> <li>3. Be able to perform 30 single leg calf jumps with minimal assistance for balance</li> <li>4. Complete jump landing progression with good neuromuscular control</li> <li>5. Quadriceps strength LSI to 60% of non-surgical limb or 40% peak torque to bodyweight ratio of surgical limb</li> </ol>

## Return to Running

Our protocol for return to running is slow compared to the standard for our area as we believe that running prior to excellent strength and motor control can allow for maladaptive gait patterns and neuromuscular programming that can be very difficult to overcome once set in the brain. By pushing the return to full body weight running further back, we have found improved results with being able to run with a normal gait and no increase in anterior knee pain, which translates to a sense of enjoyment and success with running to the athlete, rather than apprehension or dread. This allows for more rapid progression of sport specific activities rather than languishing in the running phase for too long due to abnormal gait or increased knee pain.

Phase IV: Return to Running	
Goals	<ul style="list-style-type: none"> <li>- Start progression of running program</li> <li>- Transition to movements geared more towards speed, power, and function</li> </ul>
Precautions	<p><b>MENISCAL REPAIR OR COMPLEX MENISCAL REPAIR:</b> No twisting/cutting/pivoting motions for 4 months postoperatively regardless of meeting other criteria for progression</p>
Suggested Exercises	<p><i>Increase repetitions, resistance, and speed of movement of earlier phases, plus:</i></p> <p><b>Continued Strengthening Program</b> Ensure that patient is continuing to progress in overall weight and intensity of resistance training during this phase</p> <p><b>Interval Running Program</b> Utilize a program focused on progression of running volume while utilizing walking rest</p> <ul style="list-style-type: none"> <li>- Program can be downloaded from surgeon's website</li> </ul> <p><b>Multi-planar Movements</b> Introduction of horizontal and transverse plane movements, starting with static and progressing to dynamic in preparation of jumping in other planes</p> <ul style="list-style-type: none"> <li>- Static (lateral lunges in place, etc.)</li> <li>- Dynamic (lateral lunges, curtsy lunges, single leg balance with rotation, etc.)</li> <li>- Jumping (2-leg → 1-leg lateral/rotational bounding → hopping, etc.)</li> </ul>
Frequency & Duration	2x weekly formal PT with 3-4x weekly home/gym based program
Progression Criteria	<p>Must meet <b>ALL</b> criteria prior to progressing into Phase 5:</p> <ol style="list-style-type: none"> <li>1. Able to run 30 minutes at comfortable pace without rest</li> <li>2. Quadriceps strength LSI to 70% of non-surgical limb or 55% peak torque to bodyweight ratio of surgical limb</li> <li>3. Pass Vail Sport Cord Test: 40/54 (testing protocol online)</li> <li>4. Able to achieve 70% LSI during hop testing (single leg hop, single leg triple hop)</li> <li>5. Double leg broad jump &gt; height</li> </ol>

## Note for Non-Competitive Athletes

For patients who have undergone ACL reconstruction but do not desire a return to competitive sport, their progression through this protocol will likely end here. Though they may be through with formal physical therapy at 4-5 months postoperatively, they must be counseled that their recovery will continue for many, many months, often beyond one year after surgery, and they must remain diligent and accountable with continuing their strengthening program or they will not achieve their full potential and best possible outcome.

## Phase V: Return to cutting/pivoting/jumping

Goals	<ul style="list-style-type: none"> <li>- Continue to increase the intensity of training.</li> <li>- Increase specificity of training – sport-specific.</li> <li>- Progress movements geared toward speed, power, and function based upon sport and position requirements.</li> <li>- Incorporate reactive functional balance activities that require athlete to react to changing environment of their particular sport.</li> </ul>
Suggested Exercises	<p><i>Increase repetitions, resistance, and speed of movement of earlier phases and in multi-planar movements as athlete now reacts to changing demands of the environment, plus:</i></p> <p><b>Cutting/Pivoting</b> Movements should be in a graded manner, starting with activities that have lower cognitive load at lower speeds and progressing to more anticipatory activities at higher speeds</p> <ul style="list-style-type: none"> <li>- Introductory (planned 30° cut, planned forward to backward running, etc.)</li> <li>- Intermediate (planned 45° cut, reactive forward to backward running, etc.)</li> <li>- Advanced (reactive 90° cut, mirror drills with partner, etc.)</li> </ul> <p><b>Power/Rate of Force Development (RFD)</b> Important to focus on increasing speed of exercises at this stage, as athlete is normalizing overall strength but will likely be lacking proper RFD for sport activities</p> <p><b>Bridge Program</b> Connect athlete with qualified sports performance personnel 2 to 3 days per week to work on speed, agility, and functional performance within their respective sport</p> <p><b>Sprinting Progression</b> Utilize a program focused on progression of sprinting volume and intensity</p> <ul style="list-style-type: none"> <li>- Find example program <a href="#">attached/online</a></li> </ul>
Frequency & Duration	1-2x weekly formal PT, 2-4x weekly exercises with athletic trainer/coach/home
Progression Criteria	<p>Must meet <b>ALL</b> criteria prior to progressing into Phase 6:</p> <ol style="list-style-type: none"> <li>1. Pass Vail Sport Cord Test: 46/54</li> <li>2. Achieve an IKDC <math>\geq 70</math></li> <li>3. Y-Balance Test: anterior reach within 4 cm and composite score <math>&gt; 95\%</math></li> <li>4. Quadriceps/hamstring strength LSI to 90% of non-surgical limb <b>AND</b> quadriceps strength <math>&gt; 70\%</math> peak torque to bodyweight ratio of surgical limb</li> <li>5. Single leg hop: within 10% of uninvolved limb and <math>&gt; 70\%</math> of patient height</li> <li>6. Single leg triple hop: within 10% of uninvolved limb</li> <li>7. Double leg broad jump: <math>&gt; 100\%</math> of patient height</li> </ol>

## Phase VI: Return to Sport

Goals	<ul style="list-style-type: none"> <li>- Return to sport progression</li> <li>- Athlete to demonstrate improved functional and reactive strength during sport-specific demands</li> <li>- Athlete to begin re-integration to team and team activities</li> </ul>
Suggested Exercises	<ul style="list-style-type: none"> <li>- Continue to address remaining deficits, focusing on power/RFD and quadriceps strength</li> <li>- Initiation of Interval Sport Program</li> <li>- Sport Specific skills to prepare for participation in practice</li> </ul>
Frequency & Duration	As determined between physical therapist, athletic trainer, performance coaches/bridge program, and patient preference
Progression Criteria	<ul style="list-style-type: none"> <li>- Must see MD for full clearance to return to competitive sports. Return to sport testing including strength and motion analysis will be performed prior to this visit.</li> </ul>

## Surgeon's note to patient and physical therapist

Our primary goal of return to sport testing is to prevent reinjury to the surgical knee AND injury to the other knee. In young athletes, the risk of another injury (not necessarily another ACL tear) to their knees can be as high as 30-40%. However, that injury rate after they have been documented as **PASSING** all return to sport criteria can drop as low as 5%. Also, every month returning to sport before 9 months increases the risk of reinjury by 51%, **so there are VERY few cases where someone will be released to competitive play prior to 9 months postoperatively, and some will not be ready until 12-15 months.** Half of all new injuries or reinjuries occur within the first ~70 practices and games because people just aren't ready.

When returning to sports, there are three distinct milestones or phases that define recovery from ACL reconstruction surgery. They are as follows:

- Return to sport (partial practice → full practice)
- Return to competitive play
- Return to prior performance (playing as well as before the injury)

Each of these phases requires several months of continued hard work following achievement of the preceding step. Many athletes, when asked to look at their recovery years after they have returned to performance at a high level, will acknowledge that it was often 1.5-2 years after surgery before they really felt they were the same athlete as they were before their injury. Only a small part of this stage of recovery is physical, often the neuromuscular pathways and psychological effects of an injury like an ACL tear take far longer to overcome than quad strength.