



# ***ACL Reconstruction***

## *Rehabilitation Guideline*

This rehabilitation program is designed to return the individual to their activities as quickly and safely as possible. It has been developed for rehabilitation following ACL reconstruction performed with an arthroscopic approach. Modifications to the protocol may be necessary dependent on type of graft used, primary reconstruction versus ACL revision, or concomitant injuries or procedures performed. This evidence-based ACL rehabilitation protocol is criterion-based and timeframes in each phase will vary depending on many factors including patient demographics, goals, and individual progress. This guideline is designed to progress the individual through rehabilitation to full sport participation. The therapist must modify the program appropriately depending on the individual's goals for activity following reconstruction.

This guideline is intended to provide the treating clinician with a guideline for rehabilitation. Clinicians should continue to make sound clinical decisions regarding the patient's post-operative care based on exam/treatment findings, individual progress, and/or the presence of post-operative complications. If the clinician should have questions regarding post-operative progression, they should contact the referring physician

# General Guidelines/Precautions:

- Therapist will monitor pain and swelling and adjust program appropriately.
- Full hyperextension with heel propped equal to the other side at 2 weeks.
- Full flexion equal to other side in 6-8 weeks.
- Post-operative drop lock knee brace used for the first 6 weeks, unlocked for walking when patient can complete a SLR with no extension lag.
- Weight bearing will begin immediately unless restricted by concomitant procedure.
- If available and per physician approval, Blood Flow Restriction (BFR) training can begin after suture removal and progress along with recommendations.
- Progression into functional activities and resisted knee extension will be slower with an Allograft.
- Level 1 Return to Play testing (see appendix) at or near 4 months post op.
  - PNo impact activities until full ROM, no swelling, adequate strength and biomechanics are demonstrated.
  - Progression to running program at 4 months based on Level 1 Return to Play testing, physician preference, and demonstrating adequate symmetry and shock absorption with running mechanics and plyometrics
- Level 2 Return to Play testing (see appendix) at 7+ months post-op.
  - Return to full sport activities when able to complete Level 2 Return to Play testing with sufficient biomechanics, strength, balance and confidence. (See guideline and appendix for more specific information).
- May initiate open kinetic chain knee extension strengthening exercises at 4 weeks post-op from 90 degrees-45 degrees progressing knee extension ROM 10 degrees/week until performing full ROM. Caution against excessive resistance for first 12 weeks post-op to prevent graft elongation.

# ACL Rehabilitation Guideline (6-12 months)

PHASE	SUGGESTED INTERVENTIONS	GOALS/MILESTONES FOR PROGRESSION
<p><b>Phase 0</b> Patient Education Phase</p> <p>Pre-operative Phase</p>	<p><b>Discuss:</b> Anatomy, existing pathology, post-op rehab schedule, bracing, and expected progressions</p> <p><b>Pre-operative testing:</b> Test contralateral isokinetics at 60/180/300o per sec introduction to blood flow restriction training</p> <p><b>Instruct on Pre-op exercises:</b></p> <ul style="list-style-type: none"> <li>• Quad setting</li> <li>• Straight leg raises</li> <li>• Heel stretching</li> <li>• Towel calf stretching</li> </ul> <p><b>Immediate Post-Operative Instructions:</b></p> <ul style="list-style-type: none"> <li>• Use ice and medication as instructed</li> <li>• Quad setting every hour</li> <li>• Heel propped to tolerance every 3 hours</li> </ul>	<p><b>Goals of Phase:</b></p> <ol style="list-style-type: none"> <li>1. Regain near normal joint and gait mechanics</li> <li>2. Reduce fear or anxiety prior to surgery.</li> </ol> <p><b>Criteria to Advance to Next Phase:</b></p> <ol style="list-style-type: none"> <li>1. No pain or swelling</li> <li>2. Normal gait and ROM</li> <li>3. Excellent quad activation</li> </ol>
<p><b>Phase I</b> Maximum Protection Phase</p> <p>Weeks 0-3</p> <p>Expected visits: 6-9</p>	<p><b>Specific Instructions:</b></p> <ul style="list-style-type: none"> <li>• Weight bearing in locked brace (full extension), unlocked with excellent quad control</li> <li>• Crutches for the first 7-14 days as needed</li> </ul> <p><b>Suggested Treatments:</b></p> <p><b>Modalities as indicated</b></p> <ul style="list-style-type: none"> <li>• Edema controlling treatments</li> <li>• NMES for quad activation</li> </ul> <p><b>ROM:</b></p> <ul style="list-style-type: none"> <li>• Full extension with heel propped equal to the other side at 2 weeks</li> <li>• Flexion ROM to 90° by 10 days, 110o by 3 weeks</li> </ul> <p><b>Manual Therapy:</b> Patellar mobilizations, focused on superior glide</p> <p><b>Exercise Examples:</b></p> <ul style="list-style-type: none"> <li>• Quad set, straight leg raise, isometric quad set at 60o with strap</li> <li>• Towel calf stretch, static knee extension stretch</li> <li>• Seated PROM knee flexion, wall slide, towel heel slide</li> <li>• Prone and standing hamstring curls in available ROM (BTB graft)</li> <li>• Clamshells, SL hip abduction, calf raises</li> <li>• Initiation of blood flow restriction training if applicable</li> </ul> <p><b>Other Activities:</b></p> <ul style="list-style-type: none"> <li>• Recumbent bike, upright bike when ROM allows, no resistance, using strobe glasses, or other vision challenges with balance exercises</li> </ul>	<p><b>Goals of Phase:</b></p> <ol style="list-style-type: none"> <li>1. Prevention of post-operative complications</li> <li>2. Reducing fear with regaining ROM</li> </ol> <p><b>Criteria to Advance to Next Phase:</b></p> <ol style="list-style-type: none"> <li>1. Control of post-operative pain (0-2/10 with ADL's in brace)</li> <li>2. Restoration of full extension (compared to contralateral side)</li> <li>3. PROM 0-110°</li> <li>4. Independent SLR without brace with no extension lag</li> <li>5. Normal walking with brace unlocked</li> </ol>

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# ACL Rehabilitation Guideline (6-12 months)

<p><b>Phase II</b>  <i>Early Rehabilitation Phase</i></p> <p>Weeks 3-6</p> <p>Expected visits: 5-10</p>	<p><b>Specific Instructions:</b></p> <ul style="list-style-type: none"> <li>• Continue with previous exercise program</li> <li>• Progress to light CKC program with good knee control</li> <li>• Continue with drop lock brace use at all times</li> </ul> <p><b>Suggested Treatments:</b></p> <p><b>Modalities Indicated:</b></p> <ul style="list-style-type: none"> <li>• Edema controlling treatments</li> <li>• NMES for quad activation</li> </ul> <p><b>ROM:</b></p> <ul style="list-style-type: none"> <li>• Continue to reinforce full extension</li> <li>• Progressive flexion as tolerated</li> </ul> <p><b>Manual therapy:</b> continue with patellar mobilizations as indicated</p> <p><b>Exercise Examples:</b></p> <ul style="list-style-type: none"> <li>• HS stretching</li> <li>• Leg extensions 90-45 (see general guidelines)</li> <li>• 4-8 inch eccentric step ups</li> <li>• Mini squats to table, wall sits, band walks</li> <li>• HS isometrics, AROM hamstring at 4 weeks</li> <li>• DL or SL leg press to tolerance, eccentrics</li> </ul>	<p><b>Goals of Phase:</b></p> <ol style="list-style-type: none"> <li>1. Prevention of arthrofibrosis through ROM program</li> <li>2. Reduction of post-operative swelling and inflammation (no to trace effusion)</li> <li>3. Re-education and initiation of quad control with east CKC program</li> <li>4. Protect the graft</li> </ol> <p><b>Criteria to Advance to Next Phase:</b></p> <ol style="list-style-type: none"> <li>1. Symmetrical hyperextension to 130°+ flexion</li> <li>2. Normal walking with brace unlocked</li> <li>3. Good knee control and symmetry with CKC exercises</li> </ol>
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# ACL Rehabilitation Guideline (6-12 months)

<p><b>Phase III</b>  <i>Controlled Abulation and Strengthening Phase</i></p> <p>Weeks 6-16</p> <p>Expected visits: 10-20</p>	<p><b>Specific Instructions:</b></p> <ul style="list-style-type: none"> <li>• Reorganize home program to address current deficiencies</li> <li>• Weight training program on their own 1-2 times per week</li> </ul> <p><b>Suggested Treatments:</b></p> <p><b>ROM:</b> Progression of full flexion ROM (kneeling), progress strength training</p> <p><b>Exercise Examples:</b></p> <p><b>Week 6</b></p> <ul style="list-style-type: none"> <li>• Initiation of resisted hamstring curls, progressing as tolerated</li> <li>• Single leg calf raises</li> <li>• Leg extensions 90-45 with slow increase in ROM (see general guidelines)</li> <li>• Plank progressions</li> <li>• Leg press progressions</li> <li>• Eccentric focused program</li> <li>• Goblet squat</li> <li>• Offset squats (biased for surgical side)</li> <li>• DB eccentric step ups (forward and lateral)</li> <li>• Lateral step downs</li> <li>• Standing fire hydrant holds</li> <li>• Single leg squats</li> <li>• Higher level proprioceptive progressions</li> </ul> <p><b>Week 10-12</b></p> <ul style="list-style-type: none"> <li>• Reorganize home program to address current deficiencies</li> <li>• Front/back squat</li> <li>• Lunge progressions (all directions)</li> <li>• Progress weight with previous exercises</li> <li>• Leg extensions 90-0 (see general guidelines)</li> </ul> <p><b>Week 15</b></p> <ul style="list-style-type: none"> <li>• To prepare for Level 1 testing:</li> <li>• Initiate jumping progressions (see appendix)</li> <li>• Initiate functional movement progressions (see appendix)</li> </ul> <p><b>Week 16+</b></p> <ul style="list-style-type: none"> <li>• Level 1 Return to Play testing (see appendix)</li> </ul> <p><b>Other Activities:</b></p> <ul style="list-style-type: none"> <li>• Aquatic program, resisted bike/elliptical intervals</li> </ul>	<p><b>Goals of Phase:</b></p> <ol style="list-style-type: none"> <li>1. Improve muscular strength and endurance</li> <li>2. Improve cardiovascular endurance and conditioning</li> <li>3. Reduce fear and improve confidence in the limb</li> </ol> <p><b>Criteria to Advance to Next Phase:</b></p> <ol style="list-style-type: none"> <li>1. Full pain free active and passive ROM</li> <li>2. Quad and HS deficit &lt;25% 60°/sec</li> <li>3. Single leg step down with good form with no compensatory movements</li> <li>4. Back squat 70% body weight with no compensatory movements</li> </ol>
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# ACL Rehabilitation Guideline (6-12 months)

<p><b>Phase IV</b> Advanced Strengthening and Power Phase</p> <p>Weeks 16-24+</p> <p>Expected visits: 8-16</p>	<p><b>Specific Instructions:</b></p> <ul style="list-style-type: none"> <li>Reorganize home program to address current deficiencies</li> </ul> <p><b>Suggested Treatments:</b></p> <p><b>ROM:</b> Progression of closed and open chain quad strengthening (0-90°)</p> <p><b>Exercise Examples:</b></p> <ul style="list-style-type: none"> <li>Depending on specific demands of the patient's goal for an activity level: <ul style="list-style-type: none"> <li>Continued single leg strengthening as needed</li> <li>More advanced strength and power lifts</li> <li>3-4 sets of 2-8 reps for strength (heavy weight, 2-3 min. rest)</li> <li>3-4 sets of 8-15 reps for hypertrophy (moderate weight, 45-60 sec. rest)</li> <li>3-4 sets of 1-5 reps for power (lighter weight, 5-10 min. rest)</li> </ul> </li> </ul>	<p><b>Goals of Phase:</b></p> <ol style="list-style-type: none"> <li>Improve muscular strength, power and endurance</li> <li>Improve cardiovascular endurance and conditioning</li> <li>Reduce fear and improve confidence in the limb</li> </ol>
<p><b>Phase V</b> Advanced Movement Phase</p> <p>Months 16+</p> <p>Expected Visits: 8-24</p>	<p><b>Specific Instructions:</b></p> <ul style="list-style-type: none"> <li>Reorganize home program to address current deficiencies</li> </ul> <p><b>Suggested Treatments:</b></p> <ul style="list-style-type: none"> <li>Depending on specific demands of the patient's goal for an activity level: <ul style="list-style-type: none"> <li>Interval Distance Running Program (appendix); Interval Intensity Running Program (appendix), Plyometric Progressions (appendix), Movement Retraining Progressions (appendix)</li> </ul> </li> </ul> <p><b>Exercise Examples:</b></p> <ul style="list-style-type: none"> <li>Sport specific <ul style="list-style-type: none"> <li>Interval Distance Running Program (appendix); Interval Intensity Running Program (appendix), Plyometric Progressions (appendix), Movement Retraining Progressions (appendix)</li> </ul> </li> <li>Level 2 Return to Play Test (7+ month)—see appendix</li> </ul>	<p><b>Criteria for Beginning Phase V Activities:</b></p> <ol style="list-style-type: none"> <li>&lt;25% strength deficit in quad, HS, gluteals</li> </ol> <p><b>Criteria for Discharge:</b></p> <ol style="list-style-type: none"> <li>&lt;10% strength deficit in quads and gluteals</li> <li>Limb similarity index of 90% or greater on functional hop and Y balance tests</li> <li>45/50 on Biomechanical functional assessment tests (if performed)</li> <li>No pain or complaints of instability with functional progression of sport specific skills</li> <li>&gt;90% on outcome measures</li> </ol>

**\*\*NOTE:** Progression of functional activities performed only as pain and proper biomechanics allow. Emphasis should be on proper shock absorption and control of dynamic valgus stress at knee (hip medial rotation with knee valgus) with each task performed. Progression to single limb based tasks (deceleration, hopping, and cutting) should not be performed until double limb activities have been mastered. Activities that require dynamic control of rotational stress at the knee (cutting, multiple plane lunges/jumps/hops) are performed only after sagittal and frontal plane control is achieved. Return to sport may occur at any time during this stage per physician clearance and goal achievement.

# Appendix

This is a list of objective measures that will be tested during the Level One and Level Two Return to Play tests at their respective times post-operatively. Please use this information to prepare your patient for formal testing. Portions of the test may need to be re-assessed prior to clearance by the physician if there are significant deficits.

## Level 1 Return to Play Test (4 months) Components:

ACL-RSI Outcome Measure

Mid-range isometric hip abduction strength testing bilaterally three reps each: 05 holds

Mid-range isometric hip extension strength testing bilaterally 3 reps each: 05 holds

Functional Movements with Video Analysis (all performed on both limbs)

- 8" forward step down
- 18" drop jump
- Lateral shuffle 2x5 yards

Single leg squat to near parallel with goal of 25 repetitions each side (or comparable to uninvolved side)

Single leg calf raise with goal of 25 repetitions each side (or comparable to uninvolved side)

Isokinetics (use clinical judgement on preferred speeds)

- 60/180/300o/sec

OR

- 120/180/240o/sec

## Level 2 Return to Play Test (7+ month) Components:

**All** Level 1 Components plus:

Functional Movements with Video Analysis (all performed on both limbs)

- Decelerations
- 90° cut
- Triple hop (90% of average triple hop distance)

Triple hop for distance 3 repetitions each side

Single leg hop for distance 3 repetitions each side

Crossover triple hop for distance 3 repetitions each side

Lateral hop testing - tape lines 40 cm apart, number of successful side-to-side hops on single leg in 30 seconds

Isokinetics each side

- 60/180/300%/sec

Compare isokinetic results to pre-surgery values on uninvolved side to insure return to normal strength.

# Return to Running Program

## Guidelines

- Running program is completed in addition to rehab program and other cardiovascular exercise.
- A dynamic warmup and 3-5 minute walk should precede each run
- Run only every other day (increase rest days as needed)
- If pain is not sharp, is present during warmup but improves with running, or does not increase as you run, you may continue run and stay at that level until pain free.
- Each level should be completed 3x without pain prior to moving on to next level; repeat sequence as needed
- If pain increases as you run, creates soreness that disrupts sleep or rest after run, causes swelling, or alters mechanics, stop running and take next day off.
- Consult with your physical therapist throughout return to running process for individualized recommendations.

	DATE COMPLETED	RUN	WALK	REPS
Level 1	1 _____ 2 _____ 3 _____	3 minutes	5 minutes	3
Level 2	1 _____ 2 _____ 3 _____	3 minutes	3 minutes	4
Level 3	1 _____ 2 _____ 3 _____	4 minutes	3 minutes	3
Level 4	1 _____ 2 _____ 3 _____	5 minutes	3 minutes	3
Level 5	1 _____ 2 _____ 3 _____	7 minutes	3 minutes	2
Level 6	1 _____ 2 _____ 3 _____	1 mile	2 minutes	1
Level 7	1 _____ 2 _____ 3 _____	1 mile › walk › ½ mile	2 minutes	1
Level 8	1 _____ 2 _____ 3 _____	1 ½ mile	---	1



# Interval Sprinting/Running Program

## Guidelines

- Increase total distance by 10% per workout
- To be complete with no pain and or swelling
- Repeat 3 times at same distance with no swelling or pain prior to 10% increase

**Stage I:** Purpose: build up work capacity and improve technique (1:5 work:rest ratio)

1. 5 x 20 yds or 5 x  $\frac{3}{4}$  court
2. 4 x 50 yds or 4 x 2 full court
3. 5 x 40 yds or 5 x 1  $\frac{1}{2}$  court
4. 2 x 50 yds or 2 x full court
5. 1 x 100 yds or 1 x 3 courts

**Stage II:** Purpose: work on increased speed and build intensity (1:3 work:rest ratio)

1. 5 x 20 yds or 5 x  $\frac{3}{4}$  court (63 feet)
2. 4 x 50 yds or 4 x 2 full court (168 feet)
3. 5 x 40 yds or 5 x  $\frac{3}{4}$  court (63 feet)
4. 2 x 50 yds or 2 x full court (168 feet)
5. 1 x 100 yds or 1 x 3 courts (252 feet)

**Stage III:** Purpose is to build into max speed with bias towards sports specific speed/distance and metabolic demands

(these sprint intervals should be developed based on the needs of the individual patient and the demands of the sport they are planning to return to, the program does not need to be 5 different levels, but intensity should be high)

- 1.
- 2.
- 3.
- 4.
- 5.

*Work:Rest Ratio or based on sports specific demands: \_\_\_\_\_:\_\_\_\_\_*  
*INTENSITY 90-100%*

# Plyometric Progressions

## Guidelines

- Must be able to perform full, free-weight squat 1.5-2.5 times body weight or squat 60% of body weight five times in five seconds.
- Add to sessions 1-2x/wk – 3 days between sessions.
- Begin with 30-40 foot contacts per session and increase as able.
- No more than 80-120 foot contacts per session.

## Step 1

- Jumping TO box (decreased landing forces)
- 2 legs to 2 legs
- 2 legs to 1 leg
- 1 leg to opposite leg
- 1 leg to same leg

## Step 2

- Jumping FROM box
- Landing on 2

## Step 3

- Squat jumps
- 1 leg jump -> 2 leg land
- 2 leg jump -> 1 leg land
- Split squat jumps -> scissor jumps
- 1 leg jump -> opposite leg land
- 1 leg jump -> same leg land

## Step 4

- Progress to various planes of movement as able.  
ie: Double leg broad jumps, single leg lateral hops, skater lateral jumps, bounding, drop jumps to jumps over hurdles forward or lateral, etc.

# Movement Retraining Progressions

## Guidelines

- Single skill blocked practice
- Single skill variable practice
- Combination of multiple skills in blocked practice
- Combination of multiple skills in variable practice
- Combination of multiple skills with reactive cueing
- Use sport specific work:rest ratios

Excellent lateral lunge at multiple speeds -> lateral shuffle cone drills

- Progressing to reactive drills

Excellent forward and reverse lunge at multiple speeds -> decelerations

- 3 step walking deceleration cone drill
- Jogging deceleration drills, increasing speed as able
- Reactive deceleration drills

Excellent lateral shuffle and deceleration at multiple speeds -> cutting

- Shallow cuts jogging (45 degrees)
- Deceleration to lateral shuffle cone drills, increasing speed as able
- Deceleration to 90 degrees cuts, increasing speed as able
- Reactive cutting drills

Excellent lateral shuffle, deceleration, cutting, and jumping

- Reactive, variable, combined drills
  - Utilize strobe glasses, resistance cords, cones, sport specifics, varied surfaces, perturbations

## REFERENCES:

1. Adams D, et al. Current concepts for anterior cruciate ligament reconstruction: a criterion-based rehabilitation progression. JOSPT. 2012;(42):601-614.
2. Wilk, KE, Macrina LC, Cain EL, Dugas JR, Andrews JR. Recent advances in the rehabilitation of anterior cruciate ligament injuries. JOSPT. 2012 (42)3:153-171.
3. Lewek M, Rudolph K, Axe M, Snyder-Mackler L. The effect of insufficient quadriceps strength on gait after anterior cruciate ligament reconstruction. Clin Biomech (Bristol Avon). 2002;17:56-63.
4. Paterno MV, et al. Biomechanical measures during landing and postural stability predict second anterior cruciate ligament injury after anterior cruciate ligament reconstruction and return to sport. Am J Sports Med. 2010;(38):1968-1978.
5. Lynch AD, Logerstedt DS, Grindem H, et al. Consensus criteria for defining 'successful outcome' after ACL injury and reconstruction: a Delaware-Oslo ACL cohort investigation. BR J Sports Med 2015;49:335-342.
6. Bedoya AA, Milltenberger MR, Lopez RM. Plyometric training effects on athletic performance in youth soccer athletes: a systematic review. JSCR 2015.
7. Performance Enhancement in Rehabilitation: "Bridging the Gap", Dan Lorenz DPT,PT,LAT,CSCS,USAW: March 5-6, 2016.
8. Davies G, Riemann BL, Manske R. Current concepts of plyometric exercise. Int J Sports Phys Ther. 2015;10(6):760-86.
9. Chmielewski TL, George SZ, Tillman SM, et al. Low- Versus High-Intensity Plyometric Exercise During Rehabilitation After Anterior Cruciate Ligament Reconstruction. Am J Sports Med. 2016;44(3):609-17.

