ANTERIOR CRUCIATE LIGAMENT REHABILITATION PROTOCOL

Return to participation  ➔  Sport or activity  ➔  Performance

Glen Sather Sports Medicine Clinic Interdisciplinary Knee Team

1st Edition - Revised January 09, 2017 *

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ACL REHAB
A CRITERION AND GOAL BASED APPROACH TO KNEE REHAB

PHASE 1: POST SURGERY
0-6 weeks

PHASE 2: STRENGTH TRAINING
6 wks - 2 yr

PHASE 3: DYNAMIC TRAINING
> 3-4 months

PHASE 4: SPORT SPECIFIC TRAINING
> 6 months

PHASE 5: RETURN TO ACTIVITY OR SPORT
> 9 months

PHASE 6: INJURY PREVENTION
> 1 year

GSSMC ACL PROTOCOL 1
UNIVERSITY OF ALBERTA
GLEN SATHER SPORTS MEDICINE CLINIC
Background

The Glen Sather Sports Medicine Clinic (GSSMC) is an interdisciplinary clinic located in Edmonton, Alberta, Canada. The primary clinic objectives are to educate and provide excellent patient care based on current evidence and clinical expertise.

To optimize patient care following anterior cruciate ligament (ACL) injury, the GSSMC has developed an evidence-based protocol to guide patients and physical therapists during the rehabilitation process. This protocol is suited for patients who have undergone ACL reconstruction (ACLR) as well as patients who have opted for non-operative management. Furthermore, these guidelines may also be applied after other traumatic knee injuries if approved by an orthopaedic knee surgeon or sports medicine physician or physical therapist.

The protocol emphasizes criterion-based progression versus time-based progression.

The ultimate goal of ACL rehabilitation is successful return to sport (RTS) or return to activity (RTA) while minimizing the risk of a re-injury. To ensure success and safety, patients must complete specific goals to advance from one stage of rehabilitation to the next. This shift away from time-based progression places responsibility on patients and physical therapists to achieve certain physical and psychological qualities before introducing more difficult tasks. For those undergoing surgery, meeting these criteria will also ensure the ACL graft is not excessively stressed during the healing phases. A criterion-based progression allows physical therapists to understand each patient’s abilities and subsequently create individualized treatments in every stage of rehabilitation.

Did you know?

- Failure to complete a rehabilitation program before return to sport increases risk of ACL graft rupture by 4 times\(^1\)

- 65% of athletes return to pre-injury level of sport or activity after ACLR\(^2\)

- 55% of athletes return to competitive level of sport or activity after ACLR\(^2\)
ACL Protocol

STAGE 1
Post-operative ACL reconstruction or acute ACL injury

- Goals: reduce inflammation, control pain and restore full range of motion
- Restore quadriceps activation, normal gait and terminal knee extension
- Introduce low impact cardio - e.g. stationary biking, rowing, straight-line swimming using pull buoy
- Encourage symmetrical weight bearing with exercises

- Weight bearing and early range of motion is not detrimental and should be encouraged immediately following surgery or injury\(^3\)\(^4\)
ACL Protocol

STAGE 2
Strength and neuromuscular training

• **Goals:** increase strength and introduce neuromuscular training
• Introduce body weight strengthening and progress to weight lifting as tolerated
• Encourage hypertrophy and development of quadriceps
• Caution heavy loading of hamstring exercises with ACLR using hamstring autograft in the first 6-8 weeks
• Use limb symmetry index (LSI) as a measure of unilateral strength - be aware that the contralateral leg will also have strength deficits following surgery or injury
• **Longest phase and most imperative to complete to ensure appropriate development of strength**

• Must achieve adequate strength prior to return to sport or activity
• Patients with quadriceps deficits pre-operatively had worse knee function following ACLR and displayed strength deficits up to 2 years after surgery
ACL Protocol

STAGE 3
Dynamic neuromuscular training

3 to 4 months

- Goals: progress to basic agility (e.g. ladder), running and jumping
- Demonstrate sufficient strength and control required to run and jump
- Provide a gradual return to jogging program that minimizes possibility of knee soreness and worsening of effusion
- Teach proper movement patterns and strategies to reduce risk of re-injury
- Continue strength training and addressing areas of weakness in lower extremity

- Do not commence dynamic training prior to 12 weeks post-ACLR to allow the ACL graft sufficient time to heal ⁸
ACL Protocol

STAGE 4
Sport specific training

6 months or greater

- **Goals:** introduce ‘sport specific movements’ in controlled environment
  - Sport specific movements include accelerating, decelerating, changing direction and pivoting
  - Progress by increasing speed and combining multiple skills in a single exercise
  - Add reactionary or decision-making drills to mimic sport or activity scenarios when running skills are performed with proper technique even if fatigued
  - Introduce and maintain cardiovascular fitness (aerobic or anaerobic) for the desired sport or activity

- Objective strength and functional tests should be nearly symmetrical and within 10% difference compared to the un-injured leg prior to progressing to the next phase.
ACL Protocol

**STAGE 5**
Gradual return to sport or activity

9 months or greater

- **Goals: gradual return to sport or activity**
- Add specific skill of the desired sport or activity to sport specific movements learned in prior stage
- Introduce contact drills when sport specific skills are performed with proper movement control
- Discuss and address any psychological barriers that may arise from questionnaires
- LSI should be \( \geq 90\% \) for all strength and functional tests - ideally aim for 100\% symmetry
- Return to sport before 9 months may not be realistic due to both biological healing and knee function

- All patients that returned to their sport within 6 months of surgery suffered an ACL graft rupture
- Between 6- and 9-months post-operative, each month of delayed return to sport decreased the risk of re-injury by 51\%
- Symmetrical quadriceps strength substantially reduced re-injury
- On average, NFL players require 11 months of rehabilitation before return to sport after ACLR
- Complete ligamentization of the ACL graft takes up to at least 1 year following surgery
ACL Protocol

STAGE 6
Injury prevention

- **Goals: educate about various injury prevention strategies**
- FIFA 11+ - 68% reduction in lower extremity injuries with high compliance to program
- Prevent Injury and Enhance Performance (PEP) Program from Santa Monica - 41% reduction in ACL injury rate
- Emphasize maintenance of strength and neuromuscular training

- 30% of athletes with ACLR sustain a re-injury in the same or opposite knee within the first 20 athletic exposures and 50% sustain a re-injury within the first 72 exposures
- Up to 30% of patients with ACLR will suffer a re-injury to the same or contralateral leg if returning to high risk pivoting sport (ex. soccer, football, basketball)
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<th>STAGES</th>
<th>EARLY POST-OPERATIVE or POST-INJURY</th>
<th>STRENGTH</th>
<th>DYNAMIC NEUROMUSCULAR TRAINING</th>
<th>SPORT-SPECIFIC TRAINING</th>
<th>RETURN TO SPORT/ACTIVITY</th>
<th>INJURY PREVENTION</th>
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<td>EST. TIME POST OP</td>
<td>Day 1 to 6 weeks</td>
<td>6 weeks and ongoing</td>
<td>3-4 months</td>
<td>6 months or greater</td>
<td>9 months or greater</td>
<td>On-going after RTS/RTA</td>
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<td>RESTRICTION OR PRECAUTION</td>
<td>Monitor for DVT and infection ACL graft is weakest from 4-12 weeks</td>
<td>No running before 12 weeks due to ACL graft healing</td>
<td>Regardless of time, appropriate strength and control is needed with all exercises prior to entering this stage</td>
<td>Complete several full practices prior to return to game</td>
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<td>GOALS &amp; EXPECTATIONS</td>
<td>• Restore full and symmetrical range of motion (including hyperextension) • Reduce effusion and pain • Restore symmetrical quadriceps activation • Restore normal gait</td>
<td>• Restore strength to the lower extremity Primary: glutes, quadriceps, hamstrings Secondary: core, hip flexor, calf • Encourage proper vertical alignment of hip, knee, ankle • Encourage symmetrical weight bearing • Encourage body weight squat to 90° (unless restrictions) • Gradual introduction to strength training (higher loads and lower reps) • Maintain upper body strength and cardiovascular fitness</td>
<td>• Progress towards jogging program • Introduce plyometrics starting with 2 leg jumps and progressing towards 1 leg jumps • Start agility training • Continue to encourage proper movement mechanics • Ensure no reactive effusion after exercises • Continue strength training and address specific strength deficits</td>
<td>• Introduce sport-specific movements under supervision: acceleration, deceleration, plant and cut and pivot • Progress running and agility drills to higher intensity • Integrate reaction and decision-making exercises • Integrate perturbations exercises • Begin individual technical work for sport or activity • Continue to work on appropriate cardiovascular fitness systems</td>
<td>• Return to controlled practices: progression from technical skills to game-like, unpredictable drills • Begin with larger field of play and progress to smaller field • Progress to contact drills • Lastly, progress to full scrimmage with equipment</td>
<td>• Return to or above pre-injury level • Introduce injury prevention program (see appendix)</td>
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<td>CRITERIA FOR PROGRESSION TO NEXT PHASE</td>
<td>• Pain under control&lt;br&gt;• Normal gait&lt;br&gt;• No to moderate effusion; effusion should not increase with ADLs&lt;br&gt;• Near full range of motion (including full and symmetrical hyperextension)&lt;br&gt;• Full terminal knee extension in supine and standing&lt;br&gt;• Able to demonstrate quadriceps activation with a straight leg raise (SLR)</td>
<td>• Able to squat to 90° with weight&lt;br&gt;• Quadriceps and hip flexor strength relatively symmetrical with manual muscle testing&lt;br&gt;• Limb symmetry index (LSI) ≥ 80% for single leg 1 RM on leg press&lt;br&gt;• Complete 10-15 single leg squats to 70° of knee flexion with adequate control and quality</td>
<td>• Able to jump in all directions on 2 legs&lt;br&gt;• Able to hop on 1 leg with good control and technique&lt;br&gt;• Able to run forward, backward and side shuffle&lt;br&gt;• Adequate cardiovascular endurance&lt;br&gt;• No to minimal effusion with dynamic program&lt;br&gt;• LSI ≥ 90% for quadriceps strength (1RM on leg press and 30-second single leg squat test)</td>
<td>• Able to demonstrate the above movements with proper mechanics bilaterally&lt;br&gt;• No effusion post exercises&lt;br&gt;• LSI ≥ 90% for quadriceps strength of contralateral leg&lt;br&gt;• Symmetrical strength of lower extremity&lt;br&gt;• No secondary injuries&lt;br&gt;• Objective clinical tests passed</td>
<td>• Able to fully participate in practice with no knee restrictions or secondary injuries&lt;br&gt;• Symmetrical measures for objective clinical tests&lt;br&gt;• Confident mentally and physically for RTS/RTA</td>
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<td>CLINICAL OUTCOMES</td>
<td>• Range of motion&lt;br&gt;• Swipe effusion test&lt;br&gt;• Quadriceps activation in supine, standing, and SLR&lt;br&gt;• Proper lower extremity (LE) alignment with exercises&lt;br&gt;• Pain (VAS)&lt;br&gt;• KOOS questionnaire</td>
<td>• Observation of squat to 90°&lt;br&gt;• 1 RM leg press&lt;br&gt;• 30-second single leg squat test&lt;br&gt;• Proper LE alignment with exercises&lt;br&gt;• Pain (VAS)&lt;br&gt;• KOOS questionnaire</td>
<td>• 1 RM leg press&lt;br&gt;• 30-second single leg squat test&lt;br&gt;• Y Balance Test&lt;br&gt;• Vertical jump test&lt;br&gt;• Standing long jump tests (2 to 2 leg, 1 to 2 leg, 1 to 1 leg)&lt;br&gt;• KOOS questionnaire</td>
<td>• Same outcomes as previous stage&lt;br&gt;• Triple single leg hop test&lt;br&gt;• Single leg cross over hop test&lt;br&gt;• KOOS questionnaire</td>
<td>• Same outcomes as previous stage with goal to be symmetrical&lt;br&gt;• Psychosocial measures (e.g. KOOS, ACL-RSI, Sport Rehabilitation Locus of Control scale, etc.)</td>
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<td>FUNCTIONAL GOALS</td>
<td>• LSI ≥ 80% for 1 RM leg press&lt;br&gt;• 30-second single leg squat test: ≥ 10 (non-athletic population) or ≥ 15 (athletic population) with goal being ≥ 15 throughout rehab</td>
<td>• LSI ≥ 90% for 1 RM leg press&lt;br&gt;• Y Balance Test: symmetry&lt;br&gt;• LSI ≥ 80% for 1 to 2 leg and 1 to 1 leg standing long jump distance</td>
<td>• LSI ≥ 90% for 1 RM leg press&lt;br&gt;• Y Balance Test: symmetry&lt;br&gt;• 2 to 2 leg standing long jump: distance equal to or greater than patient’s height&lt;br&gt;• LSI ≥ 90% for 1 to 2 leg and 1 to 1 leg standing long jump</td>
<td>• Y Balance Test: symmetry&lt;br&gt;• 2 to 2 leg standing long jump: distance equal to or greater than patient’s height&lt;br&gt;• LSI ≥ 90% for 1 to 2 leg and 1 to 1 leg standing long jump</td>
<td>• Sport performance&lt;br&gt;• Coach feedback&lt;br&gt;• Psychosocial measures</td>
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Clinical outcomes should be used in conjunction with a patient’s clinical exam to determine if a patient is ready to progress to the next phase. All tests are to be completed on both legs.

**Functional tests:**

1. **30-second single leg squat test (see figure 1)**  
   Goal: quantify strength and neuromuscular control  
   • How: perform as many single leg squats to 70° as possible in 30 seconds  
   • Record quantity but also note quality in both sagittal and coronal planes  
   • Limit upper extremity help by placing hands on hips

2. **Single leg on leg press 1 repetition max (1RM)**  
   Goal: quantify quadriceps strength  
   • How: measure maximum amount of weight a patient can push on a leg press with a single leg

3. **Standing long jump**  
   Goal: quantify power, neuromuscular control and confidence during a dynamic activity  
   • How: jump as far as possible from standing - must stick the landing for 3 seconds in order for the trial to count  
   • Measure the distance from the standing position to the back of the heel where the patient landed  
   • Record distance but also note quality of jump (e.g. landing with knee valgus, lack of absorption when landing)  
   • Perform 2 foot to 2 foot jump (see figure 2), 1 foot to 2 foot jump (see figure 3), and 1 foot to 1 foot jump (see figure 4)
4. Triple single leg hop test
   Goal: quantify power, neuromuscular control and confidence during a dynamic activity
   • How: jump as far as possible three times consecutively on a single leg - must stick each landing with the last jump to be held for 3 seconds in order for the trial to count
   • Measure the distance from the standing position to the back of the heel where the patient landed
   • Record distance but also note quality of jump
   • Crossover hop test is performed the same way with the addition of alternately crossing over a line

Psycosocial and quality of life questionnaires:

2. Anterior Cruciate Ligament Return to Sport after Injury (ACL- RSI) - can be downloaded in the Apple Store
3. Sport Rehabilitation Locus of Control (SRLC) scale (see figure 5)

Injury prevention programs:

1. FIFA 11+: http://f-marc.com/11plus/home
2. Santa Monica PEP: http://smsmf.org/smsf-programs/pep-program

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<tr>
<th>STATEMENT</th>
<th>1 = STRONGLY DISAGREE (SD)</th>
<th>2 = MODERATELY DISAGREE (MD)</th>
<th>3 = SLIGHTLY DISAGREE (D)</th>
<th>4 = SLIGHTLY AGREE (A)</th>
<th>5 = MODERATELY AGREE (MA)</th>
<th>6 = STRONGLY AGREE (SA)</th>
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<tbody>
<tr>
<td>1. The main thing, which affects whether I get back to match fitness or not is what I do myself.</td>
<td>1 2 3 4 5 6</td>
<td></td>
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<td>2. It is my own behaviour which will determine when or if I will get back to match fitness.</td>
<td>1 2 3 4 5 6</td>
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<td>3. I'm in control of my rehabilitation and return to match fitness.</td>
<td>1 2 3 4 5 6</td>
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<td>4. My teammates have a lot to do with whether or not I will get back to match fitness.</td>
<td>1 2 3 4 5 6</td>
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<tr>
<td>5. Medically trained professional (physician, physiotherapist) control my rehabilitation and return to match fitness.</td>
<td>1 2 3 4 5 6</td>
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<td>6. Whenever I regain match fitness it will be because other people have been taking good care of me.</td>
<td>1 2 3 4 5 6</td>
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<td>7. If it is meant to be, I'll get back to match fitness.</td>
<td>1 2 3 4 5 6</td>
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<td>8. Luck plays a big part in how soon I will be able to regain match fitness.</td>
<td>1 2 3 4 5 6</td>
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<tr>
<td>9. No matter what I do I'm not likely to regain match fitness.</td>
<td>1 2 3 4 5 6</td>
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Figure 4: 1 foot to 1 foot standing long jump

Figure 5: Sport Rehabilitation Locus of Control scale
References


*This protocol has been compiled by the following GSSMC knee interdisciplinary team. Orthopaedic surgeons: Dr. Catherine Hui, Dr. David Otto and Dr. Mark Sommerfeit. Physical therapists: Ian Hallworth, Christina Le and Linda Truong. Sports medicine physicians: Dr. Jennifer Obst and Dr. Terry Defreitas.

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