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## **ACL Reconstruction Protocol**

**DISCLAIMER:** The following physical therapy protocol is intended to be utilized by the clinician as a guideline in the treatment of this disorder. It is based on current research and has been formulated as a collaborative effort between Physicians and Physical Therapists. It is not intended to serve as a substitute for sound clinical decision making. Every patient is a unique case, and it should be anticipated that not all patients will fit into the timelines set forth in this protocol. If the physical therapist has any questions regarding the course of treatment, the referring physician should be contacted for further guidance.

### **Pre-op Protocol<sup>1</sup>**

#### **Phase: 2 to 4 Weeks**

##### **Goals:**

- Diminish pain and swelling
- Restore normal ROM particularly extension
- Restore voluntary muscle activation
- Protect the knee from further injury
- Educate patient in preparation for surgery

##### **Education:**

- Proper use of NMES for quad facilitation to be used post surgery
- Gait training with crutches post surgery
- Proper technique for don/doffing brace, locking and unlocking brace

##### **Therapeutic Intervention:**

##### **Modalities:**

- **NMES to quad during voluntary quad exercises (four to six hours per day) if approved by insurance. Otherwise in PT sessions.**
- Ice/elevation: apply ice 20 min every hour with leg elevated above heart in full extension

**Gait:**

- WBAT with or w/o crutches
- Eliminate quad avoidance gait

**ROM/Strengthening:**

- Brace: elastic or knee sleeve to reduce swelling
- WBAT with or w/o crutches:
- Stationary bike
- Ankle pumps
- Passive knee extension to 0 deg
- Passive knee flexion to tolerance
- SLR (4 way)
- Quad retraining
- Retro stepping drills
- Closed kinetic chain exercises: mini-squats, lunges, step ups, leg press
- Balance training drills

## Post-Op Protocol<sup>2</sup>

**Phase I: Weeks 0-2 post-op****Goals:**

- Protect graft
- Reduce swelling
- Minimize pain
- Restore patellar mobility
- Restore full extension ROM, gradual improve knee flexion ROM
- Re-establish quad control

**Education:**

- Brace is to be worn at all times **LOCKED** into full extension including ambulation and sleeping: may be unlocked in the sitting position 2-3 days post op at therapist discretion. Brace may be removed during therapeutic exercises (as indicated by therapist), while bathing (seated with knee extended) and when in the CPM.
- Do not rest with a towel under knee
- Do not kick you knee out straight
- Do not pivot on surgical side

**Gait training:**

- Initially, WBAT with crutches and brace locked. May D/C crutches when the patient can ambulate safely, confidently and with no pain.
- May unlock brace with ambulation when the patient is able to perform a SLR with no extension lag.
- Stair negotiation: step to pattern leading with non-surgical side when ascending stairs and leading with surgical side plus crutches when descending stairs.

**Therapeutic Intervention:****Modalities:**

- CPM: 2 hours twice per day; increase ROM 5 degrees per day using 4 hours per day separated in varying intervals ie: 30-60 min at a time. Progress until 0-90 deg knee flexion is achieved then discharge unit.
- Ice and elevation: 15-20 min per hour
- NMES: high intensity: supine with knee extended 10 sec on/50 sec rest, 10 contractions (will be issued for home use).

**ROM: Goal- 0 to 110 degrees knee motion with stress on full extension**

- Stationary bike
- Ankle pumps
- Seated assisted knee flexion and extension
- Heel slides with towel supine and on wall
- Low load, long duration prone hang, heel prop
- Standing gastroc and soleus stretch
- Hamstring/IT band/hip flexor stretch stretch

**Strengthening:**

- Seated hamstring, prone hamstring curls, banded knee flexion
- Quad set: full knee extension and 65 deg knee flexion: may complement with NMES as needed
- SLR x 4 directions with brace (progress to without brace if able to perform without extension lag) progress to resistance above the knee
- Calf raises
- Bilateral mini-squats: 0-40 degrees
- Multi-angle isometric 90 and 60 deg knee extension
- Upper body and core strengthening

**Manual:**

- Retrograde massage to reduce swelling
- Patellar mobilizations: inferior/superior and medial/lateral

**Cardio:**

- UBE or upper body only

**Criteria to progress:**

- Knee extension ROM equals 0 deg
- Quad contraction with superior patellar glide and full extension
- Able to perform SLR without a lag

**Phase II: Weeks 3 to 5:****Goals:**

- Continue to protect graft
- Maintain full extension, restore full flexion
- Normalize gait

**Education:**

- Continue with locked brace for sleeping if loss of extension occurs
- Unlock brace for sitting, PT to monitor knee extension ROM to avoid loss of motion

**Gait training:**

- Discontinue brace when indicated by physician

**Therapeutic Intervention:** (continue with Phase I interventions)**Modalities:**

- Ice to reduce swelling
- NMES until patient is able to perform SLR without an extension lag

**ROM:**

- Stationary bike
- Stretching all muscle groups: except prone quad stretch (to be initiated at week 6)

**Strengthening:**

- Prone hamstring curls
- Step ups, step up with march
- Partial squat: 0- 80 degrees: add resistance as tolerated
- Bilateral heel raises
- Ball squats, wall squats
- Lateral step-overs
- Terminal knee extension in standing with band: 0-15
- Bilateral leg press from 0-40 deg progressing to 80 deg progressing to unilateral if bilateral is performed without pain and with good control
- Stairmaster
- Core strengthening: bridge, unilateral bridge, clamshells, bridge on ball, bridge on ball with hamstring curl, hip hike

**Balance/Proprioception:**

- Bilateral leg standing balance static
  - progressed to dynamic and steady surface, add perturbations
  - progressed to unsteady surface, add perturbations
  - progressing to single leg balance
- Joint position retraining

**Criteria to Progress:**

- No swelling ( Modified Stroke Test)
- Flexion ROM within 10 deg of contralateral side
- Extension ROM equal to contralateral side

**Phase III: Weeks 6 to 8****Goals:**

- Continue to protect graft site
- Maintain full ROM
- Safely progress strengthening
- Promote proper movement patterns
- Avoid post exercise pain and swelling
- Avoid activities that promote pain at the donor site

**Gait training:**

- Normalize gait

**Therapeutic Intervention:** (continue with Phase I, II interventions)**Strengthening:**

- Gym: Leg press machine, seated hamstring machine, hip add/abd machine, hip extension machine, roman chair, seated calf machine
- Squat to chair
- Lateral lunges
- Romanian deadlift
- Single leg progression: partial weight bearing single leg press, slide board lunges: retro and lateral, step ups: fwd, fwd with march, lateral, step downs, single leg squats, single leg wall slides
- Eccentric "star" taps
- Eccentric step downs
- Introduce Isokinetic program if available

**Manual:**

- Rotational tibial mobilizations if ROM is limited

**Balance/Proprioception:**

- Perturbation progression:
  - steady surface to unsteady surface
  - progressing from double leg to single leg activities
- Stability step ups ie: Bosu

**Plyometrics:**

- Single limb hopping on leg press

**Cardio:**

- Elliptical, stair climber, pool jogging

**Criteria to Progress:**

- No swelling/pain after exercise
- Normal gait
- ROM equal to contralateral side
- Joint position sense symmetrical (< 5 deg margin of error)
- Quadriceps index > or = to 80%

**Phase IV: Weeks 9 to 12**

**Goals:**

- Maintain full ROM
- Safely progress strengthening
- Promote proper movement patterns
- Avoid post exercise pain and swelling
- Avoid activities that produce pain at donor site

**Therapeutic Intervention:** (continue with Phase I-III interventions)

**Plyometrics:**

- Bilateral PWB plyometrics progressed to FWB plyometrics
  - Progress leg press to ground
  - Progress double leg to single leg

**Other:**

- Begin with sub max sport specific training in the sagittal plane

**Criteria to Progress:**

- No episodes of instability
- Maintain quad strength
- 10 repetitions single leg squat proper form through at least 60 deg knee flexion
- KOOS-sports questionnaire > 70%
- Functional assessment/ Return to Sport testing
  - Single leg hop testing (if applicable)
- isometric/isokinetic dynamometer testing (quads, hip abd, hamstrings, hip add, glutes):
  - Quad index > 80%; HHD mean preferred

- Hamstring, glut med, glut max index > or = 80%

### **Phase V: 3- 5 months after surgery (Early Return to Sport Training)**

#### **Goals:**

- Safely progress strengthening
- Safely initiate sport specific training program
- Promote proper movement patterns
- Avoid post exercise pain and swelling
- Avoid activities that produce pain at graft donor site

#### **Interventions:** (continue with Phase II-IV interventions)

- Drop vertical jump with good control
- Interval running program (no sooner than 3 months post-op)
  - See attached sheet
- Progress to plyometric and agility program (with functional brace if issued by physician)
  - See attached sheet
- Transition to Sports Performance training ~ 5 months

#### **Criteria to Progress:**

- Clearance from MD and ALL milestone criteria below have been met
- Completion of jog/run program without pain and swelling
- Functional assessment:
  - Baseline isometric/isokinetic dynamometer testing (quads, hip abd, hamstrings, hip add, glutes)
    - Quad/HS/Glut index > or = 90%
    - Hamstring/Quad ratio > or = 70%
  - Single Hop, 6 meter timed hop, Crossover Hop, Triple Hop testing > or = 90% compared to contralateral side
  - Star Excursion Balance Test (Anterior, posteromedial, posterolateral)
  - KOOS-sports questionnaire > 90%
  - International Knee committee Subjective Knee Evaluation > 93
  - Psych Readiness to Return to Sport

### **Phase VI: 6 months to 9 months (Restricted return to sport)**

#### **Goals:**

- Continue strengthening and proprioceptive exercises
- Symmetrical performance with sport specific drills
- Safely progress to full sport

#### **Interventions:** (continue with Phase II-V interventions)

- Multi-plane sport specific plyometrics program

- Multi-plane sport specific agility program
- Include hard cutting and pivoting depending on the individuals' goals (~ 7 mo)
- Non-contact practice → Full practice→ Full play once cleared by Sports performance

**Criteria to progress to full return to sport:**

- No clearance for sports prior to 9 months
- Will need clearance from sports performance to demonstrate strength symmetry right compared to left < 15% difference

1. Accelerated Rehabilitation Following ACL-PTG Reconstruction. Advanced Continuing Education Institute, LLC. accessed March 2020; 1-7.
2. Rehabilitation Protocol for ACL Reconstruction. Massachusetts General Hospital Sports Medicine. Boston, MA: accessed March 2020; 1-15.

Included guidelines:

Return to Running program

Agility and Plyometric Program

KOOS- sports questionnaire

International Knee committee Subjective Knee Evaluation

Psych Readiness to Return to Sport





## Return to Running Program

This program is designed as a guide for clinicians and patients through a progressive return-to-run program. Patients should demonstrate > 80% on the Functional Assessment prior to initiating this program (after a knee ligament or meniscus repair). Specific recommendations should be based on the needs of the individual and should consider clinical decision making. If you have questions, contact the referring physician.

### PHASE I: WARM UP WALK 15 MINUTES, COOL DOWN WALK 10 MINUTES

Day	1	2	3	4	5	6	7
Week 1	W5/J1x5		W5/J1x5		W4/J2x5		W4/J2x5
Week 2		W3/J3x5		W3/J3x5		W2/J4x5	
Week 3	W2/J4x5		W1/J5x5		W1/J5x5		<b>Return to Run</b>

Key: W=walk, J=jog

*\*\*Only progress if there is no pain or swelling during or after the run*

### PHASE II: WARM UP WALK 15 MINUTES, COOL DOWN WALK 10 MINUTES

Week	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	20 min		20 min		20 min		25 min
2		25 min		25 min		30 min	
3	30 min		30 min		35 min		35 min
4		35 min		40 min		40 min	
5	40 min		45 min		45 min		45 min
6		50 min		50 min		50 min	
7	55 min		55 min		55 min		60 min
8		60 min		60 min			

#### Recommendations

- Runs should occur on softer surfaces during Phase I
- Non-impact activity on off days
- Goal is to increase mileage and then increase pace; avoid increasing two variables at once
- 10% rule: no more than 10% increase in mileage per week

## Agility and Plyometric Program

This program is designed as a guide for clinicians and patients through a progressive series of agility and plyometric exercises to promote successful return to sport and reduce injury risk. Patients should demonstrate > 80% on the Functional Assessment prior to initiating this program. Specific intervention should be based on the needs of the individual and should consider clinical decision making. If you have questions, contact the referring physician.

### PHASE I: ANTERIOR PROGRESSION

<b>Rehabilitation Goals</b>	<ul style="list-style-type: none"> <li>• Safely recondition the knee</li> <li>• Provide a logical sequence of progressive drills for pre-sports conditioning</li> </ul>
<b>Agility</b>	<ul style="list-style-type: none"> <li>• Forward run</li> <li>• Backward run</li> <li>• Forward lean in to a run</li> <li>• Forward run with 3-step deceleration</li> <li>• Figure 8 run</li> <li>• Circle run</li> <li>• Ladder</li> </ul>
<b>Plyometrics</b>	<ul style="list-style-type: none"> <li>• Shuttle press: Double leg → alternating leg → single leg jumps</li> <li>• Double leg:             <ul style="list-style-type: none"> <li>○ Jumps on to a box → jump off of a box → jumps on/off box</li> <li>○ Forward jumps, forward jump to broad jump</li> <li>○ Tuck jumps</li> <li>○ Backward/forward hops over line/cone</li> </ul> </li> <li>• Single leg (these exercises are challenging and should be considered for more advanced athletes):             <ul style="list-style-type: none"> <li>○ Progressive single leg jump tasks</li> <li>○ Bounding run</li> <li>○ Scissor jumps</li> <li>○ Backward/forward hops over line/cone</li> </ul> </li> </ul>
<b>Criteria to Progress</b>	<ul style="list-style-type: none"> <li>• No increase in pain or swelling</li> <li>• Pain-free during loading activities</li> <li>• Demonstrates proper movement patterns</li> </ul>

### PHASE II: LATERAL PROGRESSION

<b>Rehabilitation Goals</b>	<ul style="list-style-type: none"> <li>• Safely recondition the knee</li> <li>• Provide a logical sequence of progressive drills for the Level 1 sport athlete</li> </ul>
<b>Agility</b> <i>*Continue with Phase I interventions</i>	<ul style="list-style-type: none"> <li>• Side shuffle</li> <li>• Carioca</li> <li>• Crossover steps</li> <li>• Shuttle run</li> <li>• Zig-zag run</li> <li>• Ladder</li> </ul>
<b>Plyometrics</b> <i>*Continue with Phase I interventions</i>	<ul style="list-style-type: none"> <li>• Double leg:             <ul style="list-style-type: none"> <li>○ Lateral jumps over line/cone</li> <li>○ Lateral tuck jumps over cone</li> </ul> </li> <li>• Single leg (these exercises are challenging and should be considered for more advanced athletes):             <ul style="list-style-type: none"> <li>○ Lateral jumps over line/cone</li> <li>○ Lateral jumps with sport cord</li> </ul> </li> </ul>
<b>Criteria to Progress</b>	<ul style="list-style-type: none"> <li>• No increase in pain or swelling</li> <li>• Pain-free during loading activities</li> <li>• Demonstrates proper movement patterns</li> </ul>

***PHASE III: MULTI-PLANAR PROGRESSION***

<b>Rehabilitation Goals</b>	<ul style="list-style-type: none"> <li>• Challenge the Level 1 sport athlete in preparation for final clearance for return to sport</li> </ul>
<b>Agility</b> <i>*Continue with Phase I-II interventions</i>	<ul style="list-style-type: none"> <li>• Box drill</li> <li>• Star drill</li> <li>• Side shuffle with hurdles</li> </ul>
<b>Plyometrics</b> <i>*Continue with Phase I-II interventions</i>	<ul style="list-style-type: none"> <li>• Box jumps with quick change of direction</li> <li>• 90 and 180 degree jumps</li> </ul>
<b>Criteria to Progress</b>	<ul style="list-style-type: none"> <li>• Clearance from MD</li> <li>• <u>Functional Assessment</u> <ul style="list-style-type: none"> <li>○ Quad/HS/glut index <math>\geq 90\%</math> contra lateral side (isokinetic testing if available)</li> <li>○ Hamstring/Quad ratio <math>\geq 70\%</math></li> <li>○ Hop Testing <math>\geq 90\%</math> contralateral side</li> </ul> </li> <li>• KOOS-sports questionnaire <math>&gt;90\%</math></li> <li>• International Knee Committee Subjective Knee Evaluation <math>&gt;93</math></li> <li>• <u>Psych Readiness to Return to Sport (PRRS)</u></li> </ul>

# KOOS KNEE SURVEY

Today's date: \_\_\_\_/\_\_\_\_/\_\_\_\_ Date of birth: \_\_\_\_/\_\_\_\_/\_\_\_\_

Name: \_\_\_\_\_

**INSTRUCTIONS:** This survey asks for your view about your knee. This information will help us keep track of how you feel about your knee and how well you are able to perform your usual activities. Answer every question by ticking the appropriate box, only one box for each question. If you are unsure about how to answer a question, please give the best answer you can.

**Symptoms**

These questions should be answered thinking of your knee symptoms during the **last week**.

- S1. Do you have swelling in your knee?  
 Never  Rarely  Sometimes  Often  Always
- S2. Do you feel grinding, hear clicking or any other type of noise when your knee moves?  
 Never  Rarely  Sometimes  Often  Always
- S3. Does your knee catch or hang up when moving?  
 Never  Rarely  Sometimes  Often  Always
- S4. Can you straighten your knee fully?  
 Always  Often  Sometimes  Rarely  Never
- S5. Can you bend your knee fully?  
 Always  Often  Sometimes  Rarely  Never

**Stiffness**

The following questions concern the amount of joint stiffness you have experienced during the **last week** in your knee. Stiffness is a sensation of restriction or slowness in the ease with which you move your knee joint.

- S6. How severe is your knee joint stiffness after first wakening in the morning?  
 None  Mild  Moderate  Severe  Extreme
- S7. How severe is your knee stiffness after sitting, lying or resting **later in the day**?  
 None  Mild  Moderate  Severe  Extreme

**Pain**

P1. How often do you experience knee pain?

- Never  Monthly  Weekly  Daily  Always

What amount of knee pain have you experienced the **last week** during the following activities?

P2. Twisting/pivoting on your knee

- None  Mild  Moderate  Severe  Extreme

P3. Straightening knee fully

- None  Mild  Moderate  Severe  Extreme

P4. Bending knee fully

- None  Mild  Moderate  Severe  Extreme

P5. Walking on flat surface

- None  Mild  Moderate  Severe  Extreme

P6. Going up or down stairs

- None  Mild  Moderate  Severe  Extreme

P7. At night while in bed

- None  Mild  Moderate  Severe  Extreme

P8. Sitting or lying

- None  Mild  Moderate  Severe  Extreme

P9. Standing upright

- None  Mild  Moderate  Severe  Extreme

**Function, daily living**

The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

A1. Descending stairs

- None  Mild  Moderate  Severe  Extreme

A2. Ascending stairs

- None  Mild  Moderate  Severe  Extreme

For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

A3. Rising from sitting	None <input type="checkbox"/>	Mild <input type="checkbox"/>	Moderate <input type="checkbox"/>	Severe <input type="checkbox"/>	Extreme <input type="checkbox"/>
A4. Standing	None <input type="checkbox"/>	Mild <input type="checkbox"/>	Moderate <input type="checkbox"/>	Severe <input type="checkbox"/>	Extreme <input type="checkbox"/>
A5. Bending to floor/pick up an object	None <input type="checkbox"/>	Mild <input type="checkbox"/>	Moderate <input type="checkbox"/>	Severe <input type="checkbox"/>	Extreme <input type="checkbox"/>
A6. Walking on flat surface	None <input type="checkbox"/>	Mild <input type="checkbox"/>	Moderate <input type="checkbox"/>	Severe <input type="checkbox"/>	Extreme <input type="checkbox"/>
A7. Getting in/out of car	None <input type="checkbox"/>	Mild <input type="checkbox"/>	Moderate <input type="checkbox"/>	Severe <input type="checkbox"/>	Extreme <input type="checkbox"/>
A8. Going shopping	None <input type="checkbox"/>	Mild <input type="checkbox"/>	Moderate <input type="checkbox"/>	Severe <input type="checkbox"/>	Extreme <input type="checkbox"/>
A9. Putting on socks/stockings	None <input type="checkbox"/>	Mild <input type="checkbox"/>	Moderate <input type="checkbox"/>	Severe <input type="checkbox"/>	Extreme <input type="checkbox"/>
A10. Rising from bed	None <input type="checkbox"/>	Mild <input type="checkbox"/>	Moderate <input type="checkbox"/>	Severe <input type="checkbox"/>	Extreme <input type="checkbox"/>
A11. Taking off socks/stockings	None <input type="checkbox"/>	Mild <input type="checkbox"/>	Moderate <input type="checkbox"/>	Severe <input type="checkbox"/>	Extreme <input type="checkbox"/>
A12. Lying in bed (turning over, maintaining knee position)	None <input type="checkbox"/>	Mild <input type="checkbox"/>	Moderate <input type="checkbox"/>	Severe <input type="checkbox"/>	Extreme <input type="checkbox"/>
A13. Getting in/out of bath	None <input type="checkbox"/>	Mild <input type="checkbox"/>	Moderate <input type="checkbox"/>	Severe <input type="checkbox"/>	Extreme <input type="checkbox"/>
A14. Sitting	None <input type="checkbox"/>	Mild <input type="checkbox"/>	Moderate <input type="checkbox"/>	Severe <input type="checkbox"/>	Extreme <input type="checkbox"/>
A15. Getting on/off toilet	None <input type="checkbox"/>	Mild <input type="checkbox"/>	Moderate <input type="checkbox"/>	Severe <input type="checkbox"/>	Extreme <input type="checkbox"/>

For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

A16. Heavy domestic duties (moving heavy boxes, scrubbing floors, etc)  
None  Mild  Moderate  Severe  Extreme

A17. Light domestic duties (cooking, dusting, etc)  
None  Mild  Moderate  Severe  Extreme

**Function, sports and recreational activities**

The following questions concern your physical function when being active on a higher level. The questions should be answered thinking of what degree of difficulty you have experienced during the **last week** due to your knee.

SP1. Squatting  
None  Mild  Moderate  Severe  Extreme

SP2. Running  
None  Mild  Moderate  Severe  Extreme

SP3. Jumping  
None  Mild  Moderate  Severe  Extreme

SP4. Twisting/pivoting on your injured knee  
None  Mild  Moderate  Severe  Extreme

SP5. Kneeling  
None  Mild  Moderate  Severe  Extreme

**Quality of Life**

Q1. How often are you aware of your knee problem?  
Never  Monthly  Weekly  Daily  Constantly

Q2. Have you modified your life style to avoid potentially damaging activities to your knee?  
Not at all  Mildly  Moderately  Severely  Totally

Q3. How much are you troubled with lack of confidence in your knee?  
Not at all  Mildly  Moderately  Severely  Extremely

Q4. In general, how much difficulty do you have with your knee?  
None  Mild  Moderate  Severe  Extreme

***Thank you very much for completing all the questions in this questionnaire.***