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Atlantic Medical Group

ACL Reconstruction Rehabilitation Protocol Nick Avallone, M.D.

MD visit at 7 days post-op
Physical therapy begins at 1-2 days post-op

Phase 0: Pre-op protocol (2-4 weeks pre-op)

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 ROWStrengthening:
- Brace: elastic or knee sleeve to reduce swelling
- WBAT with or w/o crutches:
- Stationary bike
- Ankle pumps
- Passive knee extension to 0 degrees
- 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

Phase I: Initial post-op (weeks 0-2)

Goals

- Protect graft
- Reduce swelling
- Minimize pain

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- 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

Precautions – If a meniscal repair has been performed

- WBAT with brace locked in full extension with crutches. D/C crutches when patient is FWB in locked knee brace and ambulating safely and confidently
- Knee brace is worn at all times locked in full extension including during ambulation, sitting and sleeping. The only times that the brace may be removed are during for therapeutic exercises (except as noted in the exercise section) and while bathing (seating with knee extended)
- No hamstring strengthening for the first 6 weeks following a posterior horn repair
- Range of motion (ROM) is limited to 0-90º for 4 weeks
- If a radial tear or a meniscal root tear has been repaired, then NWB for 4 weeks
- No hyperflexion exercises at any time during rehabilitation

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.

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).

Therapeutic Intervention

- ROM: Goal 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 to phase II
- 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
    - progressing to dynamic and steady surface, add perturbations
    - progressing 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 6-8

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: find, fivd 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 i.e., 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
- Begin with sub max sport specific training in the sagittal plane

Criteria to progress to phase V

- 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 months)
- Non-contact practice —Full practice— Full play once cleared by Sports performance

Criteria to progress to full return to sport

- Typical clearance to return to sport is approximately 9 months
- Will need clearance from sports performance to demonstrate strength symmetry right compared to left < 15% difference

Accelerated Rehabilitation Following ACL-PTG Reconstruction. Advanced Continuing Education Institute, LLC. accessed March 2020; 1-7.

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Rehabilitation Protocol for ACL Reconstruction. Massachusetts General Hospital Sports Medicine. Boston, MA: accessed March 2020; 1-15.

Return to Running program
Agility and Plyometric Program
KOOS- sports questionnaire
International Knee committee Subjective Knee Evaluation
Psych Readiness to Return to Sport

The above 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.

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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		**Return to Run**

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

Rehabilitation Goals	• Safely recondition the knee • Provide a logical sequence of progressive drills for pre-sports conditioning
Agility	• Forward run • Backward run • Forward lean in to a run • Forward run with 3-step deceleration • Figure 8 run • Circle run • Ladder

Plyometrics	• Shuttle press: Double leg→alternating leg→single leg jumps
	• Double leg:
	  ○ Jumps on to a box→ jump off of a box→ jumps on/off box
	  ○ Forward jumps, forward jump to broad jump
	  ○ Tuck jumps
	  ○ Backward/forward hops over line/cone
	• Single leg (these exercises are challenging and should be considered for more advanced athletes):
	  ○ Progressive single leg jump tasks
	  ○ Bounding run
	  ○ Scissor jumps
	  ○ Backward/forward hops over line/cone

Criteria to Progress	• No increase in pain or swelling • Pain-free during loading activities • Demonstrates proper movement patterns

PHASE II: LATERAL PROGRESSION

Rehabilitation Goals	• Safely recondition the knee • Provide a logical sequence of progressive drills for the Level 1 sport athlete
Agility **Continue with Phase I interventions*	• Side shuffle • Carioca • Crossover steps • Shuttle run • Zig-zag run • Ladder

Plyometrics
**Continue with Phase I interventions*
	• Double leg:
	  ○ Lateral jumps over line/cone
	  ○ Lateral tuck jumps over cone
	• Single leg (these exercises are challenging and should be considered for more advanced athletes):
	  ○ Lateral jumps over line/cone
	  ○ Lateral jumps with sport cord

Criteria to Progress	• No increase in pain or swelling • Pain-free during loading activities • Demonstrates proper movement patterns

PHASE III: MULTI-PLANAR PROGRESSION

Rehabilitation Goals	• Challenge the Level 1 sport athlete in preparation for final clearance for return to sport
Agility **Continue with Phase I-II interventions*	• Box drill • Star drill • Side shuffle with hurdles
Plyometrics **Continue with Phase I-II interventions*	• Box jumps with quick change of direction • 90 and 180 degree jumps

Criteria to Progress	• Clearance from MD
	• Functional Assessment
	  ○ Quad/HS/glut index ≥90% contra lateral side (isokinetic testing if available)
	  ○ Hamstring/Quad ratio ≥70%
	  ○ Hop Testing ≥90% contralateral side
	• KOOS-sports questionnaire >90%
	• International Knee Committee Subjective Knee Evaluation >93
	• Psych Readiness to Return to Sport (PRRS)

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	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A4. Standing

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A5. Bending to floor/pick up an object

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A6. Walking on flat surface

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A7. Getting in/out of car

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A8. Going shopping

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A9. Putting on socks/stockings

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A10. Rising from bed

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A11. Taking off socks/stockings

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A12. Lying in bed (turning over, maintaining knee position)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A13. Getting in/out of bath

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A14. Sitting

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A15. Getting on/off toilet

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.

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.