

Sports Medicine Rehabilitation- ACL Repair

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Special Thank You to...

- Mark Levensen, PT, MA, OCS, COMT, FAAOMPT
- Kevin Farrell, PT, PhD, OCS, FAAOMPT

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Objectives

- Description of injury, and common mechanism of injury.
- General time-line for rehabilitation.
- Understand criteria based progression
- Precautions with rehabilitation.
- Demonstrations of ROM techniques.
- Demonstrations of strength and proprioception progression.
- Functional testing measures.

ACL Injury Partial vs. Complete Rupture

- What defines the need for surgery?
 - Meniscal involvement
 - Presence of pivot shift
 - Age
- What are the pre-surgical rehabilitation goals?
- What influences the graft choice?
 - Allograft vs. autograft, HS, BPTB

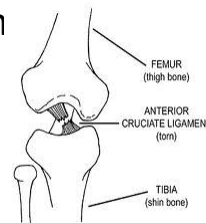


Mechanism of Injury

- Contact: a blow to the knee with the foot planted. A valgus collapse of the knee, with poor hamstring control due to weakness or above average flexibility.
- Noncontact: Typically a sudden deceleration prior to change of direction/landing. This tear occurs with the knee close to full extension.

Pre-Surgical Goals

- Reduce knee swelling, protect the knee
- Restore extensor mechanism
- Talk to athlete and parent about return to play timelines
- Spencer et al found as little as 20 m joint effusion caused an active exte



Timeline for Phase I 0-6 weeks

- Educate the athlete on surgical procedure. 6-8 weeks for tissue to heal.
 - Graft failure in first 6 weeks is usually at fixation site. Site should heal in 5-6 weeks.
 - The graft undergoes revascularization @ 4-6 weeks.
 - The graft is @ its weakest at 6-8 weeks.
 - Following 6 weeks, failure occurs midsubstance.

Phase I Goals





- Protect the surgical site
- Decrease knee edema; control knee effusion to decrease reflexive inhibition of the quadriceps; ice, compression, elevation, and E-stim.
- Restore passive knee extension. This will decrease the chance of arthrofibrosis. Examples of knee extension are...

Phase I Goals Continued

- Normalize WB and gait. Watch for rear-foot pronation, as this will place the tibia in internal rotation.
 - When is it appropriate for patient to walk independently?
- Start muscle contractions, to slow muscle atrophy.
- 0 – 90° AROM in first week. Prone heel height less than 5cm difference.

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Ball rolling for ROM

<ol style="list-style-type: none">1. Position on floor or bed with foot on gymnic ball2. Roll ball out slowly (4-count) and back (avoid knee pain) <p>Perform ball rolls for ____ seconds/minutes or repetitions; perform ____ times/day</p>	
	
<ol style="list-style-type: none">3. Pull toes toward nose to create stretch in hamstring or calf4. Point toes down <p>Add pulling toes up ____</p>	

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Functional exercise for knee control and ROM

- Involved knee is stationary leg (back leg)

Goal: straighten back knee, stretch hip flexors of back leg and weight accept on front leg

- Step different distances with the heel of the back leg remaining on the ground → this causes the knee of the back leg to extend



- Vary stride length go short and then long and then short
- Maintain heel of back foot on ground



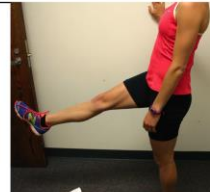
- By placing a towel roll under the forefoot of the back leg → this causes DF of back foot and emphasizes stretch of calf and knee extension



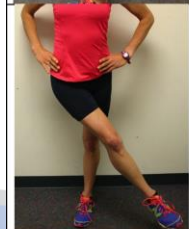
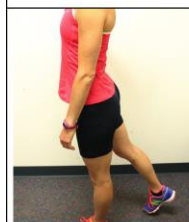
Perform for _____ seconds
repetitions _____ X day _____ use
towel under toes

Functional exercise for knee and hip ROM

- Involved leg can be swing leg for ROM purposes or stationary leg for stability purposes
- In a group of normal PT students two-30 second bouts of forward leg swings improved SLR by an average of 15 degrees



Perform _____ repetitions; perform _____ sets;
perform _____ times/day



- Top left, top right & middle left: swing leg forward at different distances and speeds → **avoid pain → you should loosen up as you swing your leg**
- Middle right and bottom left: perform side-to-side swings → vary distance and speed.
- Use involved leg both as swing leg and as weight bearing leg.
- Perform with weight bearing leg on an uneven surface

Phase I Continues

- Prepare for functional activities when extensor lag is gone.
- Encourage early WB to improve cartilage nutrition, increase quad recovery, decrease osteopenia, and peripatellar fibrosis.
- Knee extension and Cyclopes lesions.

Phase I Continues

- Start eccentric quad strengthening @ week 3-4.
- Increase endurance through reps and cardio.
- Advance proprioception from standing to movement-based (e.g. agility ladders, Bosu ball, and Air-ex).
- Concepts of PL & AM bundles.
- Goal is to have 0 – 120° with no anterior knee pain.

Knee Extension

- Passive vs. Active limitations.
 - Joint limitation.
 - Muscle guarding.
- Hyper-extension.



Phase I Strengthening





- Distefano et al found side-lying hip abduction/clam shells to be best exercise for gluteal strengthening.
- Single leg squats followed by single leg dead lift- best way of strengthening gluteus maximus.
- Plank stabilization: watch for knee pain reproduction
- Quad strength progression from isometric to eccentric

Phase I Rehabilitation Exercise

- Isometrics, boring but necessary!
- Weight shifts, heel lifts, proprioception, plyo-
sled.
- Hip extension, standing 45's, clam shells, HS
curls on theraball, and single leg RDLs.
- Gastroc- anterior/posterior tibial strength in
closed chain.
- Hamstring strength in closed chain unless HS
graft was used.

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Soft tissue mobilization for ROM

<ul style="list-style-type: none">• Patient has knee over bolster• Therapist extends knee with non-mobilizing hand• Therapist creates glide of quadriceps towards waist (5 second rule)		
<ul style="list-style-type: none">• While maintaining glide the therapist lowers the lower leg towards the table → increasing force of mobilization		
<ul style="list-style-type: none">• Same technique can be performed on medial or lateral thigh		

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Patellar Mobilization & Self-Mobilization

1. Knee is lightly flexed over a towel roll as shown
2. In picture @ right a glide medial/lateral (to inside/outside) is shown



3. A glide up and down is shown
- Mobilize patella for ___ minutes; perform ___ times/day*
- Use of a small plunger may be used to help mobilize**



Phase I

Rehabilitation Exercise Continued

- Closed chain TE 0-35° of knee flexion. This position will enhance neural feedback through joint compression. Decreased patellofemoral strain.
- Open chain TE 90-40° of knee extension to decrease tibial shear. Reilly et al found peak PF force occurs @ 36°. Shear force on ACL @ 30°.
- Proprioceptive drills. Start slow with 2 LE WB.

Phase I Rehabilitation Exercise Continued

- Gerber et al found eccentric resistance started @ 3 weeks post-op and continued for 12 weeks has...
 - Greater quadriceps, gluteus maximus strength
 - Hopping ability @ 15 weeks and 1 year following surgery

Criteria for Progression to Phase II

- No extensor lag
- Graft is weak at 8-12 weeks. Failure occurs mid-substance.
- AROM 0-90°.
- Prone heel height < 5cm difference.
- WB independently with minimal gait deviations.
- No knee effusion anterior/posterior.
- Revascularization occurs @ 6 weeks




Phase II Goals

- Normalize gait
- AROM 0-135°
- Establish single limb hip and knee control
- Single leg BW squat to 60° of knee flexion with 5 second hold
- Start single leg proprioception activity
- Core strengthening
- For HS graft, prone curls may begin
- Eccentric quad strengthening

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Eccentric quad control exercise

- Follow Alfredson protocol concept for Achilles
- Emphasis on quadriceps control

<p>1. Stand with heels on towel roll (the higher the roll the more intense the exercise)</p>	
<p>1. Perform a partial squat to facilitate quadriceps control on decline</p> <p><i>Perform ___ repetitions; perform ___ sets; perform ___ times/day</i></p> <p>Avoid anterior knee pain</p>	
<p>2. Perform single limb (an alternative would be to place toe of non-squat leg on floor behind towel roll)</p> <p><i>Perform ___ repetitions; perform ___ sets; perform ___ times/day</i></p> <p>Avoid anterior knee pain</p>	

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Standing on involved leg with slight bend in knee and hip

- Stand on involved leg and move thigh slowly between therapist's hands
- Progression: have therapist move hands further apart
- Progression: change distance between hands that is unanticipated
- Progression: change angles of plane of movement
- Progression: increase speed of movement
- **Caution:** avoid excessive IR of tibia relative to femur → follow time-based criterion for when to progress



Phase II Rehabilitation 6 – 12 weeks

- Symmetrical AROM to uninvolved knee
- Progress ADLs to independent
- Agility ladders
- Jump training progression
 - Jump rope, line jumps, jump up, & eccentric catch
 - Running progressions to be controlled by physician
- Quad strength should be 60-80% of the contralateral
- Solid mechanical control with double and single leg activity

Phase III Goals

- Sport Specific Training
 - Identify individual demands
 - Hip & core strength
 - Single limb hip-to-knee angles
 - Advanced proprioception

Core strengthening

Fire hydrant

1. Position on all-4's on floor or table
2. With pelvis stable (abdominal draw-in) → lift leg to be exercised out to side and back as shown at right → lower to 4-count

Desired response is fatigue with sensation in buttock

Perform ___ repetitions; perform ___ sets;
perform ___ times/day



Fire hydrant with theraband

1. Position on all 4's with appropriate theraband just above knees
2. With pelvis stable (abdominal draw-in) → lift leg to be exercised out to side and back as shown at right → lower to 4-count.

Desired response is fatigue with sensation in buttock

Perform ___ repetitions; perform ___ sets;
Perform ___ times/day



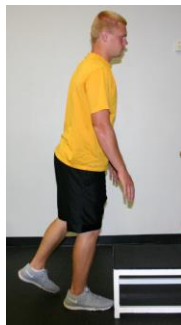
Sport-specific training: planks and side planks



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Sport-specific training: RDL's

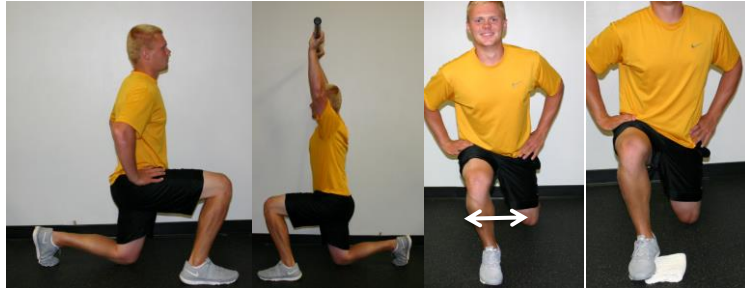
RDL's- improves single limb control,
emphasizing hip control



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Sport-specific training: lunges and side-lunges

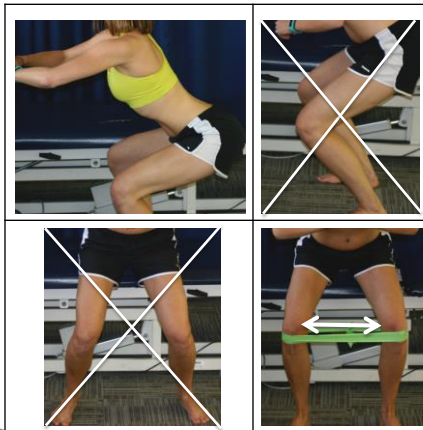
- **Backward lunge or forward lunge:**
 - Bar overhead increases demand of lunge
 - If frontal plane control problems → check lateral hip strength and foot alignment → if you suspect foot alignment problems (large varus component) → place towel roll under forefoot and reassess



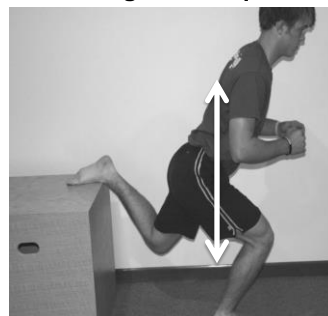
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Sport-specific training: squatting

Squat with external focus for frontal plane control (check foot for alignment problems)



Single-limb squat



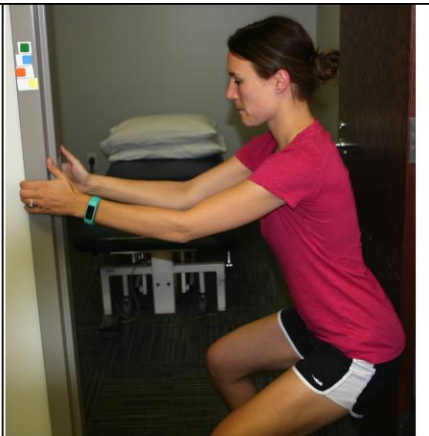
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Assisted squats

Assisted squat: For the patient who cannot control squat

1. Grasp a door sill or door handles
2. Perform squat with assist from hands keeping chest and head up
3. Slowly work your way down the door sill and back up

Perform ___ repetitions; perform ___ sets; perform ___ times/day



Lateral and Diagonal steps



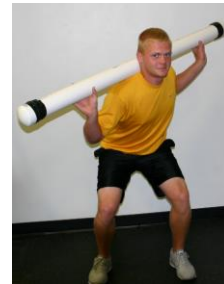
- Use of theraband above knee can enhance functional frontal/sagittal plane control.
- Diagonal steps is functional for sports such as wrestling or football
- Diagonal steps can be performed forwards and backwards

Slosh tubes: increase a dynamic component to exercises

Squats

Overhead squats (good for sports such as basketball)

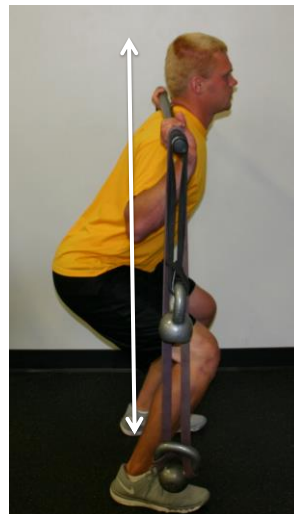
Rotation (good for any sport that requires torso or LQ rotation)



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Squats with kettle bells

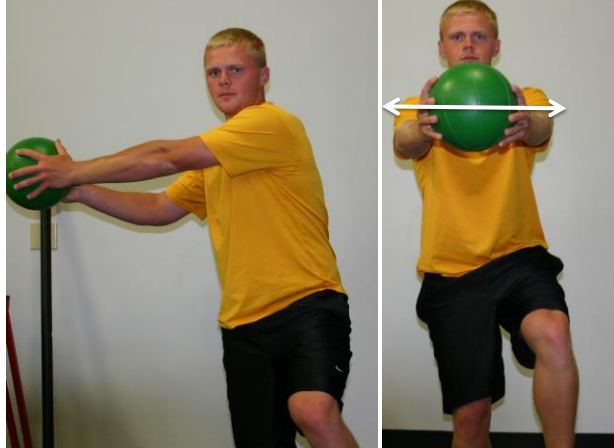
- Using kettle bells suspended by elastic bands was found to increase quad EMG by 20%, calf EMG by 75%, core musculature EMG by 80%
- Total weight should approximate 60% of 1 rep max



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Single limb medicine ball rotation:

Single limb stance with slight flexion in hip and knee
Designed to improve proprioception and rotational control



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Manual resistance in weight bearing:

- Initial is two hand isometric → therapist can vary direction
- Single limb progression
- Have patient follow and resist → therapist can move arm faster then cue patient to not allow motion → vary direction in unanticipated manner



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Hand fighting:

- Therapist initially provides slow and anticipated resistance
- Progression: change direction of force & increase speed of change in unanticipated directions
- Progression for football offensive and defensive linemen → place bags to step over
- Progression for wrestlers: follow therapist

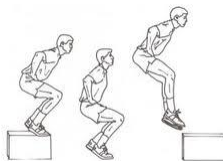


Phase III Goals

- Video Analysis
 - Feedback to improve muscle memory and motor patterns
 - Running mechanics
 - Single limb mechanics, core control

Phase III Goals

- Jump Progressions
 - 2 leg sagittal plane, frontal and transverse plane
 - Single leg progressions
 - Jump rope to improve WB and timing
 - Eccentric control with catch drills
 - Depth jumps



Phase III Goals

- Change of Direction Running
 - Speed cuts
 - Power cuts
 - Figure 8
 - Proagility

Phase III Goals

- Functional Testing
 - Static and Dynamic $\frac{1}{4}$ squat
 - Single leg hop test
 - Single leg triple hop test
 - Single leg crossover test

ACL Prevention Programs

- Improve neuromuscular control of “dynamic valgus” (knock kneed)
- Improve hamstring strength and utilization during jumping and pivoting
- Improve hip and core strength to control lower chain movements
- Improve lower chain flexibility

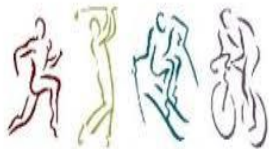
Multiple ACL Prevention Program

- Sportsmetrics Program
- Santa Monica Sports Medicine Program
- OSU ACL Program
- Roseville ACL Program

- PV Girls Soccer Problem

Why the PEP Program?

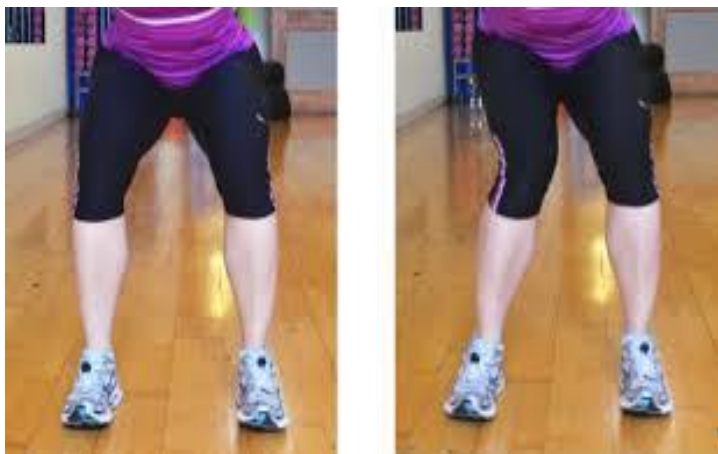
- Santa Monica Sports Medicine (SMSM) Prevent Injury and Enhance Performance (PEP)
- Research Supported
- Low Equipment Cost
- Low Time Cost
- Coach/Athlete Driven
 - User friendly monitoring of athletes



SANTA MONICA ORTHOPAEDIC
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Monitoring of Athletes

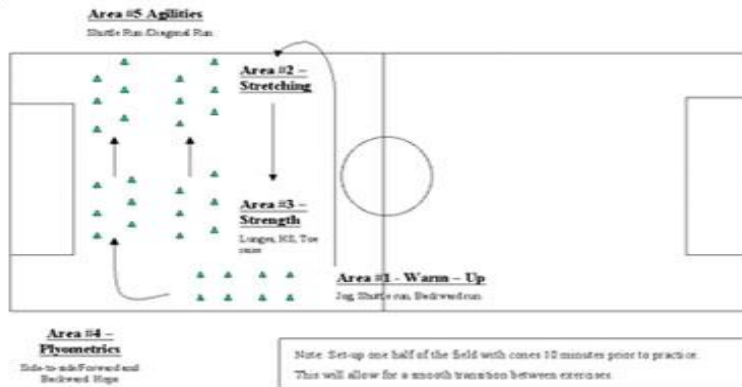


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PEP Program Set Up



PEP Program Prevent injury and Enhance Performance
Field Set-Up



Warm Up

- Jogging for 3 minutes
- Lateral Shuttle Run
- Backward Running



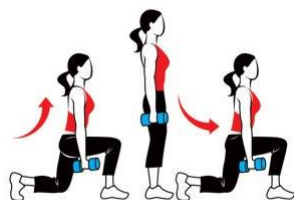
Extra Warm Up (non-PEP)

- Dynamic Warm Up
 - Knee to Chest Pulls
 - Foot Pull Back
 - Walking Toe Touches
 - Standing Leg Swings
 - Forward/Back
 - Side/Side



Strengthening

Walking Lunges



Single Toe Raises



Strengthening

Russian Hamstring



Non PEP extras

- Lateral Squat Walks (with bands)
- Standing Squats
- Single Leg Balance with Ball Toss
- Side Straight Leg Raise
- Single Leg Bridges

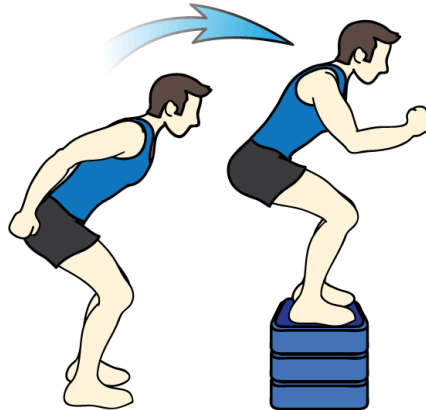
Plyometrics

- Lateral Hops Over Ball
- Forward/Back Hops Over Ball
- Single Leg Side Hops Over Ball
- Squat Jumps
- Lunge Scissor Jumps



Plyometrics (non PEP)

- Form Running Drills
 - A Skips
 - B Skips
 - Fast Leg
- Box Hops
 - 2 feet down to 2 feet
 - 2 feet up to 2 feet
 - 2 feet down to 1 foot



Agilities

- Forward Run With 3 Step Deceleration
 - 15 m, brake into offset squat, 15 m, brake again
- Lateral Diagonal Run with Controlled Pivot
- Bounding Runs
- Non PEP Agilities
 - Pro Agility Drill
 - Ladder Drills



Stretching

- Calf Wall Stretch
- Standing Quad Stretch
- Seated Figure 4 Stretch
- V-sit Adductor Stretch
- Hip Flexor Lunge Stretch

- Leg Crossover Stretch
(non-PEP)



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Take Home

- Non-Contact ACL injuries can occur with any pivoting or jumping sport
- The risk of ACL tears decrease with proper strength and balance training
- An effective prevention program is easy to implement and can protect your athletes

- PV Girls Soccer Success

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