Sports Medicine Rehabilitation- ACL Repair

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Special Thank You to...

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- Kevin Farrell, PT, PhD, OCS, FAAOMPT
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 mL 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.

Ball rolling for ROM

1. Position on floor or bed with foot on gymnic ball
2. Roll ball out slowly (4-count) and back (avoid knee pain)
   Perform ball rolls for ______ seconds/minutes or repetitions; perform ______ times/day

3. Pull toes toward nose to create stretch in hamstring or calf
4. Point toes down
   Add pulling toes up ______
**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.

  1. Step different distances with the heel of the back leg remaining on the ground; this causes the knee of the back leg to extend.
  2. Vary stride length going short and then long and then short.
  3. Maintain heel of back foot on ground.
  4. 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.**

  1. 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.
  2. Middle right and bottom left: perform side-to-side swings; vary distance and speed.
  3. Use involved leg both as swing leg and as weight bearing leg.
  4. 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.

Soft tissue mobilization for ROM

• Patient is knee over table
• Therapist exerts force with non- limiting hand
• Therapist’s center glide of quadrapes towards acetabulum (5 second held)

• While maintaining glide the therapist moves the knee and calf towards the table increasing force of distraction

• Some technique can be performed on medial or lateral thigh
**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

Use of a small plunger may be used to help mobilize

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**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

Eccentric quad control exercise

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

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<thead>
<tr>
<th>Exercise</th>
<th>Instructions</th>
<th>Notes</th>
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<tr>
<td>1.</td>
<td>Stand with heels on towel roll (the higher the roll the more intense the exercise)</td>
<td>Avoid anterior knee pain</td>
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<td>2.</td>
<td>Perform single limb (an alternative would be to place toe of non-squat leg on floor behind towel roll)</td>
<td>Avoid anterior knee pain</td>
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<td>Perform ___ repetitions; perform ___ sets; perform ___ times/day</td>
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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

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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 contra-lateral
- 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 buttck
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 buttck
Perform ___ repetitions; perform ___ sets; Perform ___ times/day
Sport-specific training: planks and side planks

Sport-specific training: RDL’s

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

Sport-specific training: squatting

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

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**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)

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

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
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 ¼ 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

- Sportsmectics 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

Monitoring of Athletes
PEP Program 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

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

Non PEP extras

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

Plyometrics
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)

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