ACL Injury Prevention
Through Proprioceptive & Neuromuscular Training

Arlington Soccer Club
April 1, 2010

Matthew R. McManus, PT
Co-Owner & Regional Clinical Director - Massachusetts
ProEx Physical Therapy

www.PROexPT.com
Anatomy and Biomechanics

• ACL is 2nd weakest ligament in knee (LCL is weakest but less commonly injured due to location)
• Prevents tibial anterior translation
• Acts as a secondary restraint in tibial rotation
• ACL is made of two bands and remains tight throughout knee ROM → can be torn at any knee angle
Mechanism of Injury

• CONTACT
  – Forceful impact to front or outside of knee or lower leg

• NON-CONTACT
  – Landing a jump on a hyper-extended knee or with excessive ankle, knee, and/or hip rotation
  – Pivoting on a fixed foot
Recovery

• Surgery is necessary for most athletes (any sports that involve lateral motion, jumping, pivoting, or cutting)
• Most cases require 6-9 months of post-op rehabilitation before returning to sport
Injury Rates

• ACL injuries in general population: est. 1 in 3500
• Soccer players injure knees at rate of 1-3 injuries per 100 hours (~ 1 every 5-6 weeks)
• Females are 2.4-9.7x more likely than males to injure ACL in comparable sports (bball and soccer)
• Females have 25% chance of re-injuring ACL
Theories for Increased Injury Rate

- Anatomical/Biomechanical
- Functional
- Environmental
Anatomical/Biomechanical

- Femoral condyle/notch size relative to ACL size
- Lower extremity alignment
  - (valgus angle, Q angle, femoral/tibial rotation – *may change during skeletal growth)
- Quad:Hamstring strength ratio
  - (quad-dominance is seen more often in females)
- Muscle activation/firing pattern of quads/hamstrings
- Decreased strength:weight ratio
- Increased joint/ligamentous laxity
Functional

- Jumping & landing mechanics
  - Knees extended/hyperextended, hips internally rotated and/or adducted
  - Joint loading versus muscle loading (increased force of impact)
- Sport experience/skill level
  - Lower kinematic/body awareness
  - Sensory overload
- Fatigue
Environmental

• Cleats
  – Increased friction with planting, cutting, and push-off
• Training surface (remember Astroturf)
  – Change in friction, speed of play, and impact forces
Recent Research

• Ligamentous laxity due to hormones
  – Estrogen and progesterone have no effect on ACL injury rate (study evaluated effect of BCP on injury rates)

• Strength:weight ratio & skill level/sport experience
  – No change in injury rate from high school to college

  • (implies ACL injuries are independent of strength and skill)
Recent Research

• Quad:hamstring strength ratio
  – Hamstring activation decreases with fatigue
  – No change in quad activation with fatigue

• Jumping/landing
  – Knee joint angle during landing decreases with fatigue (more likely to hyperextend)

• Proprioceptive & Neuromuscular Training
  – Decreased ACL injury rate by 88% in female soccer players (14-18y.o.) within one year
    • (implies anatomical factors’ influence is less than previously thought)
The PEP Program

• “**Prevent Injury and Enhance Performance (PEP)**”

• A neuromuscular training program designed by the Santa Monica ACL Prevention Project

• Goal is to decrease ACL injuries in female athletes
The PEP Program

• 20 minutes at the start of practice, 2-3x per week (pieces of the program are already performed by most teams)
• Focuses on muscle strength and power, balance, coordination, agility, endurance, and flexibility
• Increases athletes’ performance while decreasing risk of injury
  – (plyometrics are most important based on studies of individual components of program)
Warm-up

- Jog line to line
- Shuttle Run
- Backward Running
Stretches

• Calf muscle
• Quadriceps muscle
• Hamstrings (Figure 4)
• Adductors
• Hip Flexors
Exercise Demo

• Ensure that the stretch is felt in the correct muscle
• Keep lower back in neutral alignment
• Hold stretch in static position, DO NOT BOUNCE
Strengthening

- Walking Lunges
- Russian Hamstrings
- Single Toe Raises
Exercise Demo

• Check ankle/knee/hip alignment during lunges
  – 90 degree angle at each joint
• Motion should be slow and controlled throughout exercise
Plyometrics

- Lateral Hop
- Forward/Backward Hop
- Single Leg Hop
- Vertical Jump
- Scissors Jump
Landing from a Jump

Less knee flexion = More impact force (risk of injury)

More knee flexion = Lower risk of injury
Exercise Demo

- Perform hops over cone
- Cue athlete to land softly with hips and knees bent
- Check alignment of hips/knees/ankles
- Add headers to jumping drills ONLY when athletes’ form is correct
Agilities

- Shuttle Run Forward & Backward
- Diagonal Run
- Bounding Run
Exercise Demo

- Check alignment of hips/knees/ankles during acceleration & deceleration
- Easiest to observe from front or back
Alternative Exercises

• Bridging with Alternating Hip Flexion
• Abdominal Crunches
• Single & Double Knee to Chest
• Piriformis Stretch (Figure 4)
• Butterfly Stretch
Exercise Demo

• Motion should be slow and controlled for strengthening exercises
• Keep lower back in neutral alignment for stretches
Implementation

PEP Program: Prevent injury and Enhance Performance
Field Set-Up

**Area #1 - Warm-Up**
- Jog, Shuttle run, Backward run

**Area #2 - Stretching**
- Length, HS, Toe raise

**Area #3 - Strength**
- Lunges, HS, Toe raise

**Area #4 - Plyometrics**
- Side-to-side, Forward and Backward Hops

**Area #5 Agilities**
- Shuttle Run, Diagonal Run

Note: Set-up one half of the field with cones 10 minutes prior to practice. This will allow for a smooth transition between exercises.

www.PROexPT.com
References

Thank You

• Jess Barsotti, DPT, ATC
  ProEx Boston/ProEx Woburn
• Kate Doherty, ATC
  ProEx Woburn/Head ATC Wilmington High School
• Kelly Hardy
  ProEx Woburn
Questions?

Contact Info:
Matt McManus, PT
300 TradeCenter, Suite 1650
Woburn, MA 01801
P  (781) 935-2655
F  (781) 935-9097
mmcmmanus@PROexPT.com