

ACL Injury Prevention Through Proprioceptive & Neuromuscular Training

Arlington Soccer Club

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ProEx Physical Therapy

Anterior Cruciate Ligament (ACL)

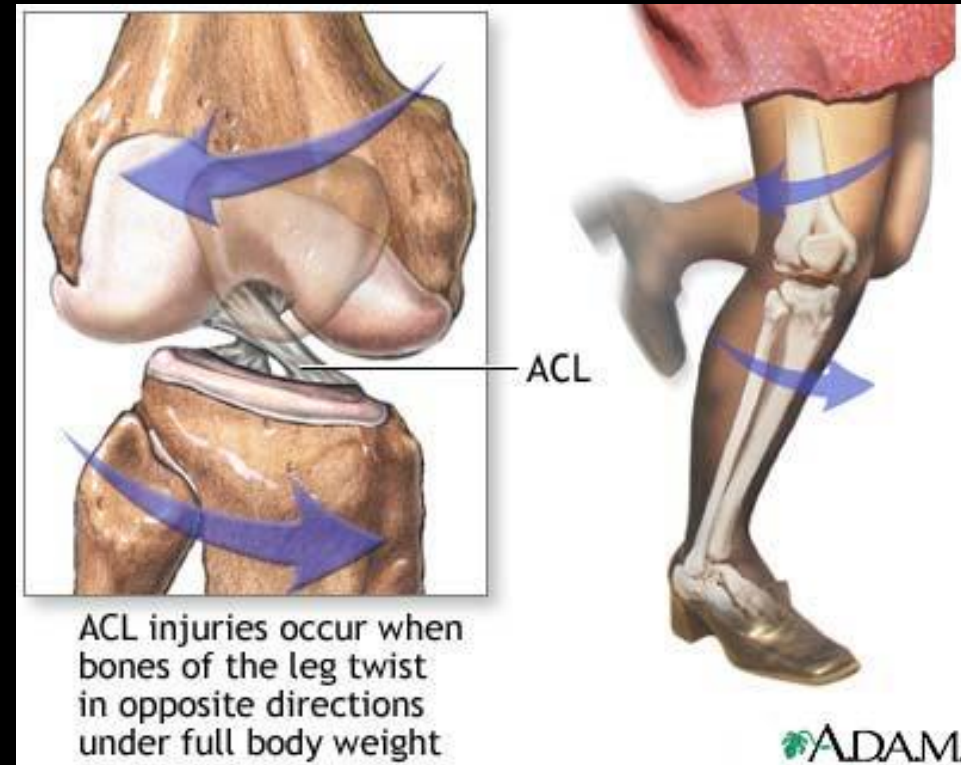


Anatomy and Biomechanics

- 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

A soccer player in a white and blue jersey with the number 10 on the back is captured in a dynamic pose, leaning forward and to the side, suggesting a lateral movement or a pivot. The player is wearing white socks and white cleats. The background is a blurred soccer field with a goal visible in the distance.

- 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

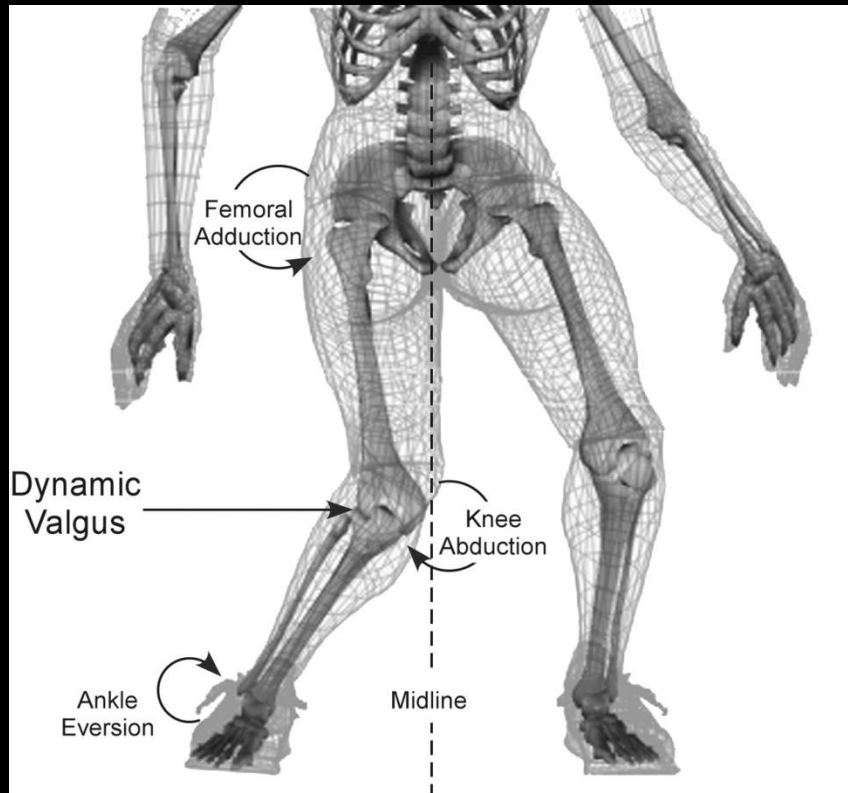
- Anatomical/Biomechanical
- Functional
- Environmental



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

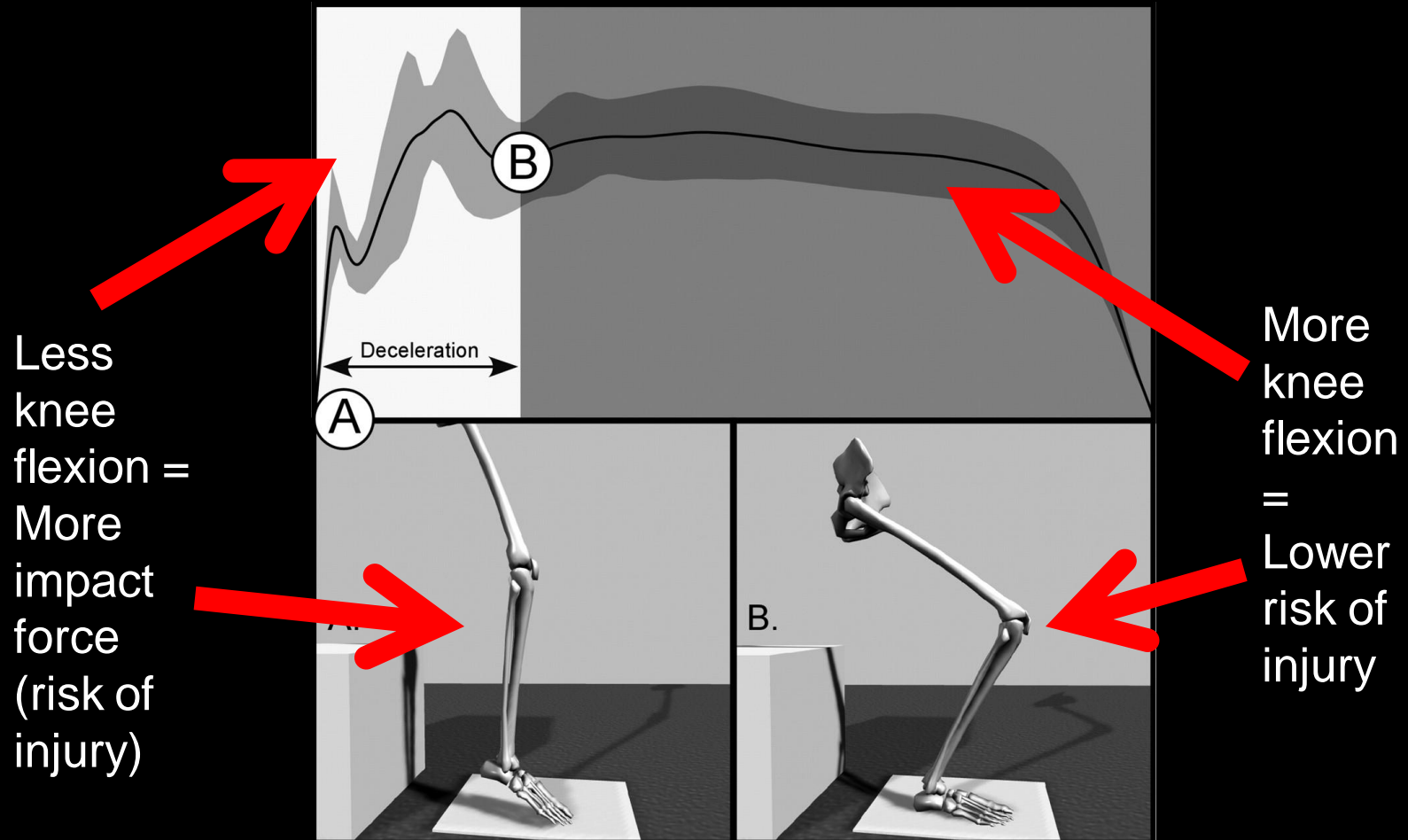
- Check ankle/knee/hip alignment during lunges
 - 90 degree angle at each joint
- Motion should be slow and controlled throughout exercise

Plyometrics

- Lateral Hop
- Forward/Backward Hop
- Single Leg Hop
- Vertical Jump
- Scissors Jump

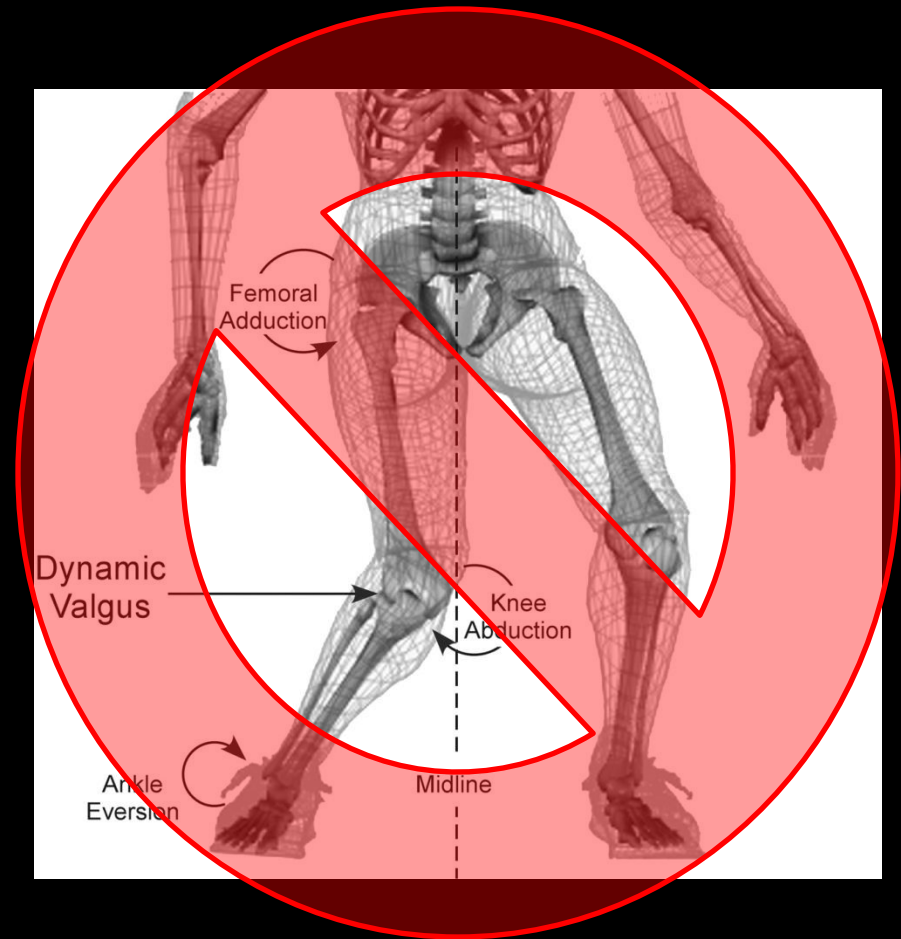


Landing from a Jump



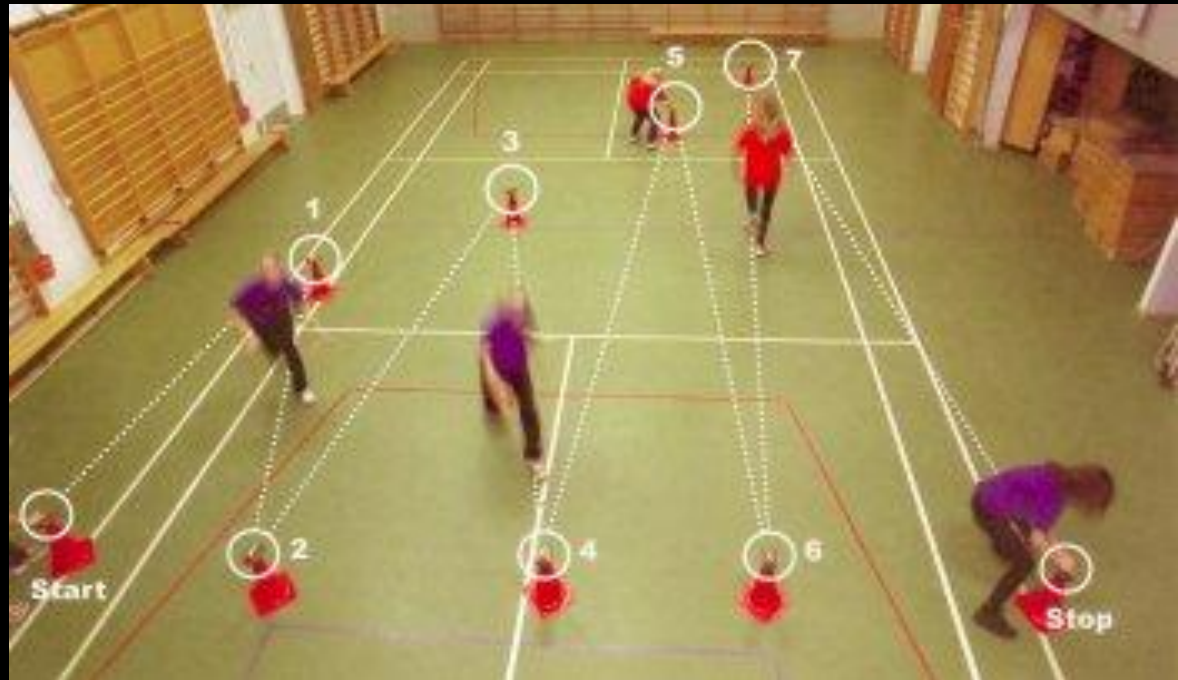
Exercise Demo

- 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

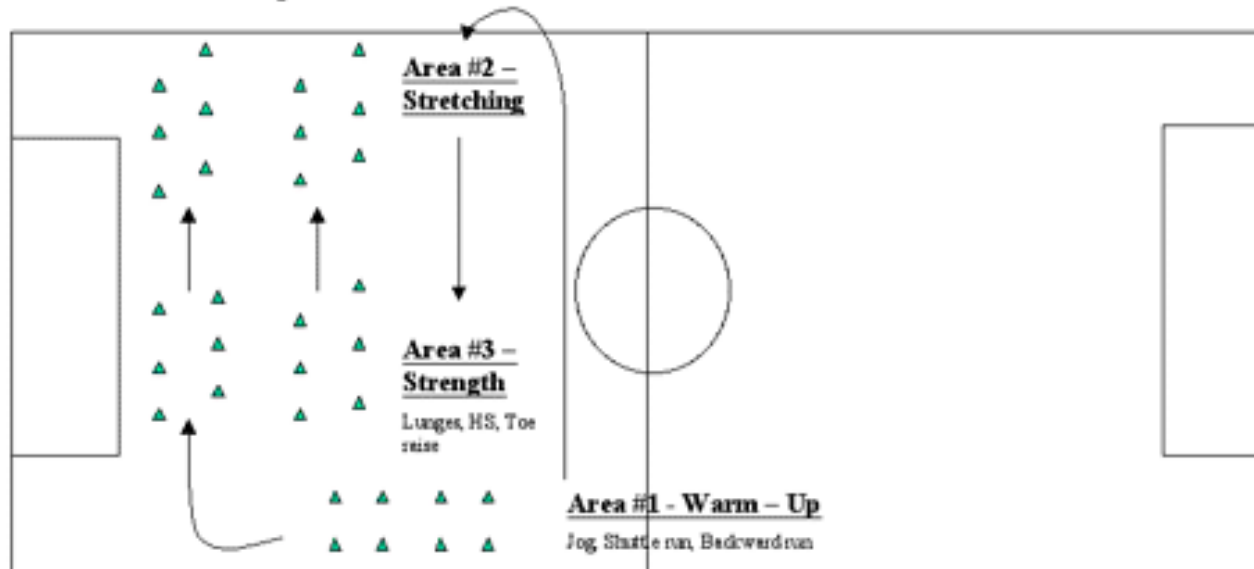
Implementation



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

Area #5 Agilities

Shuffle Run / Diagonal Run



Area #2 – Stretching

Area #3 – Strength

Lunges, HS, Toe
raise

Area #1 - Warm - Up

Jog, Shuffle run, Backward run

Area #4 – Plyometrics

Side-to-side/Forward and
Backward Hops

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

References

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Thank You

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ProEx Boston/ProEx Woburn

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