



MASSACHUSETTS  
GENERAL HOSPITAL

---

**Sports Physical Therapy**



## **Sports Conditioning for the Female Knee: An Injury Prevention Program**



MASSACHUSETTS  
GENERAL HOSPITAL

Sports Physical Therapy

## **Sports Conditioning for the Female Knee: An Injury Prevention Program**

### **Program Background**

Knee injuries have become a significant problem in women's sports. Studies have shown that females sustain injuries to the anterior cruciate ligament (ACL) at a far greater rate than their male counterparts. These injuries most frequently occur in sports such as soccer, basketball and gymnastics. All of these sports require athletes to perform sudden cuts, jumps and stops. Nearly three-fourths of these injuries occur with little or no physical contact.

Females are two to eight times more likely than males to sustain an ACL injury. Researchers have attempted to explain this gender-based discrepancy by citing factors such as anatomical differences; hormonal influences; biomechanical factors such as altered mechanics with jumping and cutting tasks; and muscle strength imbalances.

Current research focuses on neuromuscular training programs as one strategy to minimize the risk of ACL injuries. Several programs have had success in reducing these injury rates. We have adapted our training program from the ACL Prevention Project, created by the Santa Monica Orthopaedic and Sports Medicine Foundation ([www.aclprevent.com](http://www.aclprevent.com)).

### **Purpose of the Program**

- To decrease the incidence of lower extremity injuries in female athletes

### **Goals**

- Increase athletes' strength and flexibility
- Improve athletes' awareness of proper mechanics and technique with athletic tasks
- Enhance team training regimens with plyometric and agility drills

### **Consultation**

The MGH Sports Physical Therapy Service would be very happy to assist any group in the design, implementation and supervision of this program. We believe that our staff of physical therapists and athletic trainers would be integral in assisting the coach and athletes in fully understanding the program and obtaining maximum benefit from it.

If you would like to discuss this opportunity with us further please call MGH Sports Physical Therapy at 617-643-9999 and ask to speak with Anne Viser, PT, ATC or Jim Zachazewski, PT, DPT, SCS, ATC.

The detailed program can also be accessed at [www.massgeneral.org/sports/therapy.html](http://www.massgeneral.org/sports/therapy.html)

### **Program Format**

The program consists of 6 progressive training sessions. Each training session will include 5 main components: (1) active warm-up; (2) stretching exercises; (3) strengthening exercises; (4) plyometric drills; (5) agility drills. Each session's exercises will build upon those performed during the previous session. As the athlete's skill improves, we will increase the challenge and level of intensity. By the end of the program, athletes will be able to perform a complete training regimen (15-20 minutes) which can be implemented into the regular sports season.

## **SESSION 1**

**Warm-up:** A warm-up is performed to help prepare your muscles for exercise.

1. Jog line to line  
Complete a slow jog from near to far sideline of the field.
2. Shuttle Run (side to side)  
Start in an athletic stance with a slight bend at the hips and knees. Leading with the right foot, sidestep pushing off with the left foot. When you drive off the back leg, be sure the hip, knee and ankle are in a straight line. Switch sides at half field.
3. Backward Running  
Run backwards from sideline to sideline. Stay on your toes and remember to keep the knees slightly bent at all times.

**Stretching:** After a short warm-up, it is helpful to stretch your muscles. These exercises help to improve your flexibility and reduce stiffness in your joints. This helps to reduce the risk of injury and improve your overall mobility and performance.

1. Quadriceps stretch (30 second hold x 2 reps each side)  
Place your left hand on your partner's left shoulder. Reach back with your right hand and grab the front of your right ankle. Bring your heel to your buttock. Make sure to keep the knee pointed down toward the ground and your knees together. Do not allow the knee to wing out to the side and do not bend at the waist.
2. Figure Four Hamstring Stretch (30 second hold x 2 reps each side)  
Sit on the ground with your right leg extended out in front of you. Bend your left knee and rest the bottom of your foot on your right inner thigh. With a straight back, try to bring your chest toward your knee. Do not round out your back. If you can, reach down toward your toes and pull them up toward your head. Remember not to bounce.

## Sports Conditioning for the Female Knee: An Injury Prevention Program

3. Calf & Hip Flexor Stretch (30 second hold x 2 reps each side)  
Stand in a forward lunge position, with your back leg straight and your front knee bent. Shift your weight forward onto your front leg, while keeping your back straight. Tighten your abdominal muscles. You should feel a stretch in the calf and in the front hip of the back leg.
4. Inner Thigh/Butterfly stretch (30 second hold x 2 reps)  
Sit on the ground and bring your feet in together allowing the soles of your shoes to touch. With both hands, grab onto your shoes pushing down your knees with your elbows.

**Strengthening:** These exercises strengthen the muscles of the leg, helping to provide support to the knee joint. Technique is very important during each of these exercises in order to avoid injury.

1. Forward Walking Lunges (10 reps x 3 sets)  
Lunge forward, leading with your right leg. Push off with your right leg and lunge forward with your left leg. Drop the back knee straight down. Make sure that you keep the tip of your toes, kneecap and hip all in line. Control the motion and try to avoid your front knee from caving inward. If you can't see your toes on your leading leg, you are doing the exercise incorrectly.
2. Bridge (10 reps x 3 sets)  
Lie on your back with your knees bent and feet flat. Tighten your abdominals. Lift your hips in the air and squeeze your buttocks. Make sure your back does not arch. Slowly lower back down to the start position. Repeat.
3. Crunch (10 reps x 3 sets)  
Lie on your back with your knees bent and feet flat. Place your hands behind your head. Squeeze your abdominals, lifting your shoulders slightly off of the floor, keeping your neck straight and your elbows out to the side. Breathe out as you come up and hold at the top for a five seconds. Slowly lower back down to start position.

**Plyometrics:** These exercises are explosive and help to build power, strength and speed. Proper landing technique is very important. When you land from a jump, you want to softly accept your weight on the balls of your feet, slowly rolling back to the heel. It is important to land with a bend in your knees and hips.

1. Lateral Hops over cone (20 reps)  
Stand with a 6-inch cone to your left. Hop to the left over the cone softly landing on the balls of your feet. Land with your knees bent. Repeat this exercise hopping to the right.



## Sports Conditioning for the Female Knee: An Injury Prevention Program

### 2. Forward/Backward Hops over cone (20 reps)

Hop over the cone softly landing on the balls of your feet and bending at the knee. Now, hop backwards over the cone using the same landing technique as before.

**Agility:** These drills incorporate balance, coordination, speed and strength to help improve the body's ability to quickly react and change direction during sport activity. Agility drills should be performed explosively, but in a controlled manner.

#### 1. Shuttle run with forward/backward running

Start drill by running forward. When you come to the first marker, pivot to transition into backwards running. Continue running backwards then pivoting on the opposite foot at the next marker to transition to forward again. Continue this sequence for the length of the field.

#### 2. Diagonal runs (3 passes)

Face forward and run to the first cone on the left. Pivot off the left foot and run to the second cone. Now pivot off the right leg and continue onto the third cone. Make sure that the outside leg does not cave in. Keep a slight bend to the knee throughout.

## SESSION 2

### Warm-up

1. Jog line to line
2. Shuttle Run (side to side)
3. Backward Running

### Stretching

1. Quadriceps stretch (30 second hold x 2 reps each side)
2. Figure Four Hamstring Stretch (30 second hold x 2 reps each side)
3. Calf & Hip Flexor Stretch (30 second hold x 2 reps each side)
4. Inner Thigh/Butterfly stretch (30 second hold x 2 reps)

### Strengthening

1. Forward Walking Lunges (10 reps x 3 sets):
2. Bridge Progression with Knee Extensions (10 reps x 3 sets)  
Lie on your back and bend your knees. Tightening your buttocks and abdominals, lift your hips off the ground. Your hips should stay level, keeping your body in good alignment. Lift one leg up and straighten the knee. Slowly lower the leg back down. Now, repeat with the opposite leg. Repeat.
3. Crunches (10 reps x 3 sets)
4. Oblique Crunches (10 reps x 2 sets)  
Lie on your back, and bend your knees. Take one leg and cross it over the other allowing the foot to rest on the opposite knee. Now, bend the opposite arm and place it behind your head. Contract your abdominals, lifting in a diagonal pattern toward the opposite knee.

### Plyometrics

1. Lateral Hops over cone (20 reps)
2. Forward/Backward Hops over cone (20 reps)
3. Diagonal Hops over cone (20 reps)  
With both feet together, jump at a forward diagonal angle over the cone. When you land make sure to land on the balls of your feet and keep the knees soft and slightly flexed. Now, jump backwards in a diagonal fashion to where you started. Repeat.

### Agility

1. Shuttle run with forward/backward running
2. Diagonal Runs (3 passes)
3. Bounding Run  
Start on the near sideline. Run to the far side with knees up toward chest. Bring your knees up high. Jump forward, landing on the ball of your foot, keeping your knees slightly bent. Increase the distance of the jump as this exercise gets easier.

## SESSION 3

### Warm-up

1. Jog line to line
2. Shuttle Run (side to side)
3. Backward Running

### Stretching

1. Quadriceps stretch (30 second hold x 2 reps each side)
2. Figure Four Hamstring Stretch (30 second hold x 2 reps each side)
3. Calf & Hip Flexor Stretch (30 second hold x 2 reps each side)
4. Inner Thigh/Butterfly stretch (30 second hold x 2 reps)

### Strengthening

1. Forward Walking Lunges (10 reps x 3 sets)
2. Bridge Progression with Knee Extension (10 reps x 3 sets)
3. Crunches
4. Oblique Crunches (10 reps x 2 sets)
5. Lower Abdominal Exercise (10 reps x 2 sets)

Lie on your back with your knees up and feet flat. Start by pulling in your abdominal muscles. Think of sucking your belly up and in under your ribcage. Keep your back flat. Continue to hold your abdominals in as you slowly lift your foot off the floor bringing your knee towards your chest. Now bring your second knee up, keeping your abdominals tight and your back flat. Slowly lower one leg down at a time to the start position. Repeat.

### Plyometrics

1. Lateral Hops over cone (20 reps)
2. Forward/Backward Hops over cone (20 reps)
3. Diagonal Hops over cone (20 reps)
4. Lateral Single Leg hops over cone (20 reps)  
Hop sideways over the cone landing on the ball of your foot remaining in a slightly flexed position at the knee. Now, hop back to the opposite side over the cone using the same landing technique. Be careful not to snap your knee back to straighten it. Repeat for 20 reps. Repeat exercise with the left leg.

### Agility

1. Shuttle run with forward/backward running
2. Diagonal runs (3 passes)
3. Bounding run

## SESSION 4

### Warm-up

1. Jog line to line
2. Shuttle Run (side to side)
3. Backward Running

### Stretching

1. Quadriceps stretch (30 second hold x 2 reps each side)
2. Figure Four Hamstring Stretch (30 second hold x 2 reps each side)
3. Calf & Hip Flexor Stretch (30 second hold x 2 reps each side)
4. Inner Thigh/Butterfly stretch (30 second hold x 2 reps)

### Strengthening

1. Forward Walking Lunges (10 reps x 3 sets)
2. Bridge Progression with Marching (10 reps x 3 sets)  
Lie on your back and bend your knees. Tightening your buttocks and abdominals, lift your hips off the ground. Your hips should stay level, keeping your body in good alignment. Now, lift one knee up at a time, alternating legs like you are marching.
3. Crunches (10 reps x 2 sets)
4. Oblique Crunches (10 reps x 2 sets)
5. Lower Abdominal Exercise (10 reps x 2 sets)

### Plyometrics

1. Lateral Hops over cone (20 reps)
2. Forward/Backward Hops over cone (20 reps)
3. Diagonal Hops over cone (20 reps)
4. Single Leg Lateral hops over cone (20 reps)
5. Single Leg Forward/Backward hops over cone (20 reps)  
Hop over the cone landing on the ball of your foot, remaining in a slightly flexed position at the knee. Now, hop backwards over the cone using the same landing technique. Be careful not to snap your knee back to straighten it. Repeat for 20 reps. Repeat exercise with the opposite leg.
6. Scissor Jumps (20 reps)  
Lunge forward onto your right leg. Keep your knee over your ankle. Now, push off with your right foot and propel your left leg forward into a lunge position. Be sure your knee does not cave in or out. It should be stable and directly over the ankle. Remember the proper landing technique; accept the weight on the ball of your foot with a slight bend to the knee.

### Agility

1. Shuttle run with forward/backward running
2. Diagonal runs (3 passes)
3. Bounding Run



## SESSIONS 5 & 6

*These sessions are designed to run through the entire program to practice perfecting your technique.*

### Warm-up

1. Jog line to line
2. Shuttle Run (side to side)
3. Backward Running

### Stretching

1. Quadriceps stretch (30 second hold x 2 reps each side)
2. Figure Four Hamstring Stretch (30 second hold x 2 reps each side)
3. Calf & Hip Flexor Stretch (30 second hold x 2 reps each side)
4. Inner Thigh/Butterfly stretch (30 second hold x 2 reps)

### Strengthening

1. Forward Walking Lunges (10 reps x 3 sets)
2. Bridge Progression (10 reps x 3 sets)
3. Lower Abdominal Progression (10 reps x 2 sets)
4. Crunches (10 reps x 2 sets)
5. Oblique Crunches (10 reps x 2 sets)

### Plyometrics

1. Lateral Hops over cone (20 reps)
2. Forward/Backward Hops over cone (20 reps)
3. Diagonal Hops over cone (20 reps)
4. Lateral Single Leg hops over cone (20 reps)
5. Forward/Backward Single Leg hops over cone (20 reps)
6. Scissor Jumps (20 reps)

### Agility

1. Shuttle run with forward/backward running
2. Diagonal runs (3 passes)
3. Bounding run

## Additional Exercises

Below is a list of additional or alternate exercises to the basic training program.

### Warm-up

- Carioca (Run sideways by alternately crossing leg in front and then behind)
- High Knees Running

### Stretching

- Single and Double Knee to Chest
- Figure Four Piriformis Stretch
- Half-Kneeling Hip Flexor Stretch
- Trunk Rotation

### Strengthening

- Forward Lunges with Medicine Ball
  - Overhead Reaches with ball
  - Trunk Rotation with ball
- Monster Walks (with Elastic Band)
  - Forward/Backward/Side-to-Side
- Bridge Progression
  - Single Leg Bridge
- Abdominal Progression
  - Lower Abdominals with Leg Extensions
  - Crunch with Partner Ball Toss (with partner)
- Single Leg Standing with 3-cone triangle reach and pick-up

### Plyometric

- Rotational Jumps
- Jump Tucks
- Successive Jumps over Hurdles Down Field (10 jumps)

### Agility

- Ladder Drills

Contact Anne Viser, PT, ATC ([aviser@partners.org](mailto:aviser@partners.org)) or Lisa Woodbury, ATC ([lwoodbury@partners.org](mailto:lwoodbury@partners.org)) if you have questions regarding this program at 617-643-9999.

**References:**

Agel J, Arendt E, Bershadsky B. [Anterior Cruciate Ligament Injury In National Collegiate Athletic Association Basketball and Soccer: A 13-Year Review.](#) Am J Sports Med.2005; 33:524-531.

Mandelbaum, B.R., Silvers, H.J et al. [Effectiveness of a neuromuscular and proprioceptive training program in preventing anterior cruciate ligament injuries in female athletes.](#) Am J Sports Med. 2005;33:1003-1010.

Hewett TE, Lindenfeld TN, Ricoobene JV, Noyes FR. [The effect of neuromuscular training on the incidence of knee injury in female athletes. A prospective study.](#) Am J Sports Med. 1999;27:699-706.

**Online Resources:**

MGH Sports Physical Therapy: [www.massgeneral.org/sports/therapy.html](http://www.massgeneral.org/sports/therapy.html)

Santa Monica ACL Prevention Project: [www.aclprevent.com](http://www.aclprevent.com)

Web-based lesson on PEP Program: [http://www.la84foundation.org/3ce/acl\\_frmst.htm](http://www.la84foundation.org/3ce/acl_frmst.htm)