

CHESAPEAKE ORTHOPAEDIC & SPORTS MEDICINE CENTER

Comprehensive Orthopedic Care for Your Family

ORTHOPAEDIC SURGEONS

Leo A. Courtney, M.D., F.A.C.S.
James J. York, M.D.
John C. Barry, M.D.
Terrence M. O'Donovan, M.D., F.A.C.S.
Bryan R. Klepper, M.D.
Hugh O. House, M.D.
Amir R. Moinfar, M.D.



NURSE PRACTITIONERS

Pamela Lentz Williams, MS., C.R.N.P.
Karen M. Pipkin, MS., C.R.N.P.

PHYSICIAN'S ASSISTANTS

Lisa P. Knisley, PA-C
Daniel E. Stenger, PA-C

How to reduce the risk of Anterior Cruciate Ligament Injuries of the Knee

Tens of thousands of serious knee injuries occur in female collegiate and high school athletics each year. The **majority of these injuries (80%) are non-contact injuries**. These injuries often occur while landing from a jump or pivoting when running.

A number of studies have unequivocally demonstrated that **female athletes who participate in jumping and cutting sports are about five times more likely** to sustain serious knee injuries than males. The anterior cruciate ligament, posterior cruciate ligament, and medial collateral ligament all connect the femur and tibia together and keep the knee stable. The lateral collateral ligament connects the femur and fibula. The anterior cruciate ligament (ACL) controls pivoting and "sliding" motion of the knee and, along with the quadriceps and hamstrings muscles, helps stabilize the joint. Patients who tear this ligament often have an unstable knee that can collapse, causing falls and further damage to the knee. ACL tears usually require surgical reconstruction in order to resume the ability to play at a high level.

The cost of serious knee injuries in female athletes may reach \$100 million at both high school and collegiate levels in the United States, where over two million females participate in high school sports. Therefore, even though high school female knee injury rates are only about one-tenth as high as for collegiate females (approximately one knee injury per 100 participants), athletic participation at the high school level is expected to account for twice as many injury occurrences yearly (over 20,000 knee injuries) as are found at the collegiate level.

WHY THE HIGHER INJURY RATES? Three theories: anatomy, hormones, training.

Some reports attribute injury rate differences to physiological differences, such as increased joint laxity among women, while others refute this claim. Several reports suggest that the hormone estrogen is directly involved in increased female injury rates. It has also been argued that anatomical differences in pelvic structure and lower extremity alignment (i.e. Q-angle) may account for differences in male and female injury rates. These have not been shown to be statistically significant factors.

The training theory: here is where we can make a difference!

A consensus group of members from the American Orthopaedic Society for Sports Medicine, Orthopaedic Research and Education Foundation, National Athletic Trainers Association Research and Education Foundation and the National Collegiate Athletic Association, concurred that while there is not presently a "clear understanding of the cause of noncontact ACL injuries...prevention programs designed to increase neuromuscular control, improve balance and teach avoidance strategies for at-risk situations appear to be effective in decreasing injury rates." Jump training programs incorporating stretching, plyometric exercises and weight lifting have been advocated to increase performance and decrease injury risk in competitive athletes in jumping sports.

Biomechanical studies have shown that decreased neuromuscular strength and coordination in the musculature that stabilizes the knee joint may be responsible for this increase in injuries. A biomechanical study showed that males activate their knee flexors at three times the level of females during landing from a jump. It also showed that the female hamstrings were significantly weaker than males prior to training. With a "jump training" program, females showed increased hamstrings strength and improved ability to control dangerous forces at the knee.

The hamstrings and calf muscles are the key to decreasing dangerous torques and impact forces. Another biomechanical study demonstrated a marked imbalance between hamstrings and quadriceps strength in female athletes prior to training. A plyometric, stretching and strength training program was demonstrated to decrease peak landing forces by decreasing varus (tendency to bow outward) and valgus (tendency to bow inward) forces at the knee. The program also significantly increased hamstrings power and strength, increased hamstrings to quadriceps peak torque ratios, and decreased hamstrings side-to-side strength imbalances. Such training, if effectively used on a widespread basis, might help to significantly decrease the number of athletes injured each year. For further information, please contact us about a neuromuscular training program that is particularly effective in youth and High School athletics.

CHESAPEAKE ORTHOPAEDIC & SPORTS MEDICINE CENTER

Comprehensive Orthopedic Care for Your Family

ORTHOPAEDIC SURGEONS

Leo A. Courtney, M.D., F.A.C.S.
James J. York, M.D.
John C. Barry, M.D.
Terrence M. O'Donovan, M.D., F.A.C.S.
Bryan R. Klepper, M.D.
Hugh House, M.D.
Amir R. Moinfar, M.D.



NURSE PRACTITIONER

Pamela Lentz, MS., C.R.N.P.
Karen M. Pipkin, MS., C.R.N.P.

PHYSICIAN'S ASSISTANTS

Daniel E. Stenger, PA-C

Dear Coach:

I am pleased to introduce the **Santa Monica Prevent Injury / Enhance Performance (PEP)** program. I am working with the Santa Monica Orthopedic Group to bring this important Anterior Cruciate Ligament (ACL) Knee injury prevention program to Maryland. Over the last two years, this has been used and evaluated at over eighty Division One college soccer programs. The Southern California and Maryland Soccer Olympic Development Program has begun to use it as well. This Warm-up / Training program has been shown to help reduce the risk of ACL injuries and has the added benefit of improving athletic performance.

As a coach of girls, and father of two soccer players, I am personally as well as professionally aware of the need to reduce injury risk as much as possible.

Over the last several years, it has become increasingly known that in soccer, basketball and other competitive sports, the incidence of ACL injuries in girls / women is two to eight times greater than that seen in men. Extensive research has been done to evaluate the reasons for this and to look for solutions.

Neuromuscular training programs that incorporate agility, plyometrics, avoidance of riskier knee / leg positions combined with overall strengthening have been shown to reduce the incidence of ACL injuries in women. This Santa Monica program is particularly well suited to youth and high school athletics. It is specific, well documented and easy to set up as a warm-up / strengthening program for practices.

For further details about ACL injury prevention and other sports medicine topics, please see the public information web site for our practice: www.orthopedicdoc.net.

Please let me know if I can be of any other assistance to you.

Best wishes for a safe and successful season.

Sincerely yours,

Jim York

The Santa Monica PEP Program: Prevent injury and Enhance Performance

This prevention program consists of a warm-up, stretching, strengthening, plyometrics, and sport specific agilities to address potential deficits in the strength and coordination of the stabilizing muscles around the knee joint. It is important to use proper technique during all of the exercises. The coaches and trainers need to emphasize correct posture, straight up and down jumps without excessive side-to-side movement, and reinforce soft landings. This program should be completed 2 to 3 times a week at a minimum.

The field should be set up 10 minutes prior to the warm-up. This will allow for a smooth and quick transition between all of the activities. A sample field set-up has been included in your packet.

This program should take approximately 15 minutes to complete. Along side each exercise you will notice a box with the approximate amount of time that should be spent on each activity. This will serve as a guideline to you in order to conduct your warm-up in a time efficient manner.

1. Warm-up: Warming up and cooling down are a crucial part of a training program. The purpose of the warm-up section is to allow the athlete to prepare for activity. By warming up your muscles first, you *greatly reduce* the risk of injury.

A. **Jog line to line** (cone to cone):

Elapsed Time: 0 - 0.5 min.

Purpose: Allows the athletes to slowly prepare themselves for the training session while minimizing the risk for injury. Educate athletes on good running technique; keep the hip/knee/ankle in straight alignment without the knee caving in or the feet whipping out to the side.

Instruction: Complete a slow jog from near to far sideline

B. **Shuttle Run** (side to side)

Elapsed Time: 0.5 to 1 min.

Purpose: engage hip muscles (inner and outer thigh). This exercise will promote increased speed. Discourage inward caving of the knee joint.

Instruction: Start in an athletic stance with a slight bend at the knee.

Leading with the right foot, sidestep pushing off with the left foot (back leg). When you drive off with the back leg, be sure the hip/knee/ankle are in a straight line. Switch sides at half field.

C. **Backward Running**

Elapsed Time: 1 -1.5 min.

Purpose: continued warm-up; engage hip extensors/hamstrings. Make sure the athlete lands on her toes. Be sure to watch for locking of the knee joint. As the athlete brings her foot back, make sure she maintains a slight bend to the knee.

Instruction: Run backwards from sideline to sideline. Land on your toes without snapping the knee back. Stay on your toes and keep the knees slightly bent at all times.

2. Stretching: It is important to incorporate a short warm-up prior to stretching. Never stretch a "cold muscle". By doing the exercises outlined here, you can improve and maintain your range of motion, reduce stiffness in your joints, reduce post exercise soreness, reduce the risk of injury and improve your overall mobility and performance.

- Do a large muscle warm-up such as brisk walking for five to 10 minutes before stretching.
- Don't bounce or jerk when you stretch. Gently stretch to a point of tension and hold.
- Hold the stretch for 30 seconds. Concentrate on lengthening the muscles when you're stretching.
- Breathe normally. Don't hold your breath.

A. **Calf stretch** (30 seconds x 2 reps)

Elapsed Time: 1.5 to 2.5 min.

Purpose: stretch the calf muscle of the lower leg

Instruction: Stand leading with your right leg. Bend forward at the waist and place your hands on the ground (V formation). Keep your right knee slightly bent and your left leg straight. Make sure your left foot is flat on the ground. Do not bounce during the stretch. Hold for 30 seconds. Switch sides and repeat.

B. Quadricep stretch (30 seconds x 2 reps)

Elapsed Time: 2.5 to 3.5 min.

Purpose: stretch the quadricep muscle of the front of the thigh

Instruction: 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 buttock. Make sure your knee is pointed down toward the ground. Keep your right leg close to your left. Don't allow knee to wing out to the side and do not bend at the waist. Hold for 30 seconds and switch sides.

C. Figure Four Hamstring stretch (30 sec x 2 reps)

Elapsed Time: 3.5 - 4.5 min

Purpose: To stretch the hamstring muscles of the back of the thigh.

Instruction: 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 your back. If you can, reach down toward your toes and pull them up toward your head. Do not bounce. Hold for 30 seconds and repeat with the other leg.

D. Inner Thigh Stretch (20 sec x 3 reps)

Elapsed Time: 4.5 - 5.5 min

Purpose: Elongate the muscles of the inner thigh (adductor group)

Instruction: Remain seated on the ground. Spread you legs evenly apart. Slowly lower yourself to the center with a straight back. You want to feel a stretch in the inner thigh. Now reach toward the right with the right arm. Bring your left arm overhead the stretch over to the right. Hold the stretch and repeat on the opposite side.

E. Hip Flexor Stretch - (30 sec x 2 reps)

Elapsed Time: 5.5- 6.5 Min

Purpose: Elongate the hip flexors of the front of the thigh.

Instruction: Lunge forward leading with your right leg. Drop your left knee down to the ground. Placing your hands on top of your right thigh, lean forward with your hips. The hips should be square with your shoulders. If possible, maintain your balance and lift back for the left ankle and pull your heel to your buttocks. Hold for 30 seconds and repeat on the other side.

3. **Strengthening:** This portion of the program focuses on increasing leg strength. This will lead to increased leg strength and a more stable knee joint. *Technique is everything;* close attention must be paid to the performance of these exercises in order to avoid injury.

A. Walking Lunges (3 sets x 10 reps)

Elapsed Time: 6.5 -- 7.5 min

Purpose: Strengthen the thigh (quadriceps) muscle.

Instruction. 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 your front knee over your ankle. Control the motion and try to avoid you front knee from caving inward. If you *can't see your toes on your leading leg, you are doing the exercise incorrectly.*

B. Russian Hamstring (3 sets x 10 reps)

Elapsed Time: 7.5--8.5 min

Purpose: Strengthen hamstrings muscles

Instruction: Kneel on the ground with hands at your side. Have a partner hold firmly at your ankles. With a straight back, lead forward leading with your hips. Your knee, hip and shoulder should be in a straight line as you lean toward the ground. Do not bend at the waist. You should feel the hamstrings in the back of your thigh working. Repeat the exercise for 3 sets of 10, or a total of 30 reps.

C. Single Toe Raises (30 reps x 2 reps)

Elapsed Time: 8.5 - 9.5 min

Purpose: This exercise strengthens the calf muscle and increases balance.

Instruction: Stand up with your arms at your side. Bend the left knee up and maintain your balance. *Slowly* rise up on your right toes with good balance. You may hold your arms out ahead of you in order to help.

Slowly repeat 30 times and switch to the other side. As you get stronger, you may need to add additional repetitions to this exercise to continue the strengthening effect of the exercise.

4. Plyometrics - These exercises are explosive and help to build, power, strength and speed. The most important element when considering performance technique is the landing. *It must be soft!* 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 with a bent knee and a straight hip. These exercises are basic, however, it is critical to perform them correctly. Please take the time to ensure safe and correct completion of these exercises.

A. Lateral Hops over Cone (20 reps)

Elapsed Time: 9.5 - 10min.

Purpose: Increase power/strength emphasizing neuromuscular control

Instruction: Stand with a 6" cone to your *left*. Hop to the *left* over the cone *softly* landing on the balls of your feet land bending at the knee. Repeat this exercise hopping to the right.

B. Forward/Backward Hops over cone (20 reps) Elapsed Time: 10 - 10.5 min

Purpose: Increase power/strength emphasizing neuromuscular control

Instruction: Hop over the cone/ball softly landing on the balls of your feet and bending at the knee. Now, hop backwards over the ball using the same landing technique. Be careful not to snap your knee back to straighten it You want to maintain a slight bend to the knee. Repeat for 20 reps.

C. Single Leg hops over cone (20 reps)

Elapsed Time: 10.5 -11 min.

Purpose: Increase power/strength emphasizing neuromuscular control.

Instruction: Hop over the cone/ball landing on the ball of your foot bending at the knee. Now, hop backwards over the ball using the same landing technique. Be careful not to snap your knee back to straighten it. You want to maintain a slight bend to the knee. Repeat for 20 reps. Now, stand on the left leg and repeat the exercise. Increase the number of repetitions as needed.

D. Vertical Jumps with headers (20 reps)

Elapsed Time: 11 -11.5 min.

Purpose: Increase height of vertical jump.

Instruction: Stand forward with hands at your side. Slightly bend the knees and push off jumping straight up. Remember the proper landing technique; accept the weight on the ball of your foot with a slight bend to the knee. Repeat 20 times and switch sides.

E. Scissors Jump (20 reps)

Elapsed Time: 11.5 -12 min.

Purpose: Increase power and strength of vertical jump.

Instruction: Lunge forward leading with 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. Repeat 20 times.

5. Agilities

A. Shuttle run with forward/backward running

Elapsed Time 12-13 min.

Purpose: Increase dynamic stability of the ankle/knee/hip complex

Instruction: Starting at the first cone, sprint forward to the second cone, run backward to the third cone, sprint forward to the fourth cone (etc...).

B. Diagonal runs (3 passes)

Elapsed Time 13-14 min.

Purpose: To encourage proper technique/stabilization of the outside planted foot to deter the position from occurring.

Instruction: 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 and make sure the knee stays over the ankle joint.

C. **Bounding run** (44 yds.)

Elapsed Time 14 -15 min.

Purpose: To increase hip flexion strength/increase power/speed

Instruction: Starting on the near sideline, run to the far side with knees up toward chest. Bring your knees up high. Land on the ball of your foot with a slight bend at the knee and a straight hip. Increase the distance as this exercise gets easier.

6. **Alternative Exercises- Warm Down and Cool Down**

We all know how imperative a cool down is. Please don't skip it. It allows the muscles that have been working hard throughout the training session to elongate and deters the onset of muscle soreness. Please emphasize the importance of adequate fluid intake (optimally water). Athletes should have a water bottle by their side during the cool down. The cool down should take approximately 10 minutes. It should begin with a slow jog to allow the heart rate to come down before stretching. This should be followed by some light strength training exercises. We are recommending two strengthening exercises (see below). Finally, stretch the hamstrings, calves, inner thigh, quadriceps, and low back (all of these are explained in the protocol). In addition to those basic stretches, we are offering some additional stretches to target 3 muscle groups that are often forgotten.

A. **Bridging with Alternating Hip Flexion** (30 reps)

Purpose: Strengthen outer hip muscles (Hip abductors, flexors) and buttocks

Instruction: Lie on the ground with your knees bent with feet on the ground. Raise your buttocks up off the ground and squeeze. Now, lift your right foot off the ground and make sure that your right hip does not dip down. Lower your right foot and now lift your left foot making sure your left hip does not dip down. Repeat 30 times on each side. As you get stronger, you will place your feet on top of a ball and repeat the exercise.

B. **Abdominal Crunches** (30 reps x 2 reps)

Purpose: Strengthen the abdominals (rectus abdominus, obliques)

Instruction: Lie on the ground with you knees bent. Place your hands behind your head with your elbows out wide. Support your neck lightly with your fingers. Take a deep breath in and slowly contract your abdominal muscles as you exhale. Repeat 30 times. Drop your legs off to the right side. Slowly crunch up with your elbows out wide. You should feel your oblique muscles working on the side of your waist. Repeat 30 times and switch to the other side.

C. **Single and Double Knee to Chest** (supine) (30 sec x 2 reps)

Purpose: Elongate the low back muscles

Instruction: Lie on your back. Bring your right knee toward your chest and hug firmly. Keep your left leg out straight in front of you. You should feel a stretch along your low back and into your buttocks. Hold the stretch for 30 seconds and switch sides. Now bring both knees to chest. If you feel any pain in the low back, discontinue the stretch and inform your coach/trainer.

D. **Figure Four Piriformis stretch-** supine (30 sec x 2 reps)

Purpose: Elongate the rotators of the hip.

Instruction: Lie on your back and bend both of your knees. Fold your left ankle over your right knee. Place your hands behind your right thigh and pull your right knee to chest. You should feel a good stretch in the left gluteals region and the side of the thigh. Hold for 30 seconds and repeat on the other side. If you experience and low back pain with this stretch, slowly lower your legs down and let your coach/trainer know.

E. **Seated Butterfly stretch** - seated (30 sec x 2 reps)

Purpose: Elongate the inner thigh muscles (adductors).

Instruction: Sit up bringing your feet in so that the soles of your feet are touching. Gently place your elbows on your knees and slowly push down. You should feel a good stretch of the inner thigh. Hold this for 30 seconds and repeat 2 to 3 times.

If you have any questions or concerns regarding this program, please contact James J. York, M.D. at jjyork@ix.netcom.com or 410-768-5555.

Copyright: Santa Monica Orthopedic Group

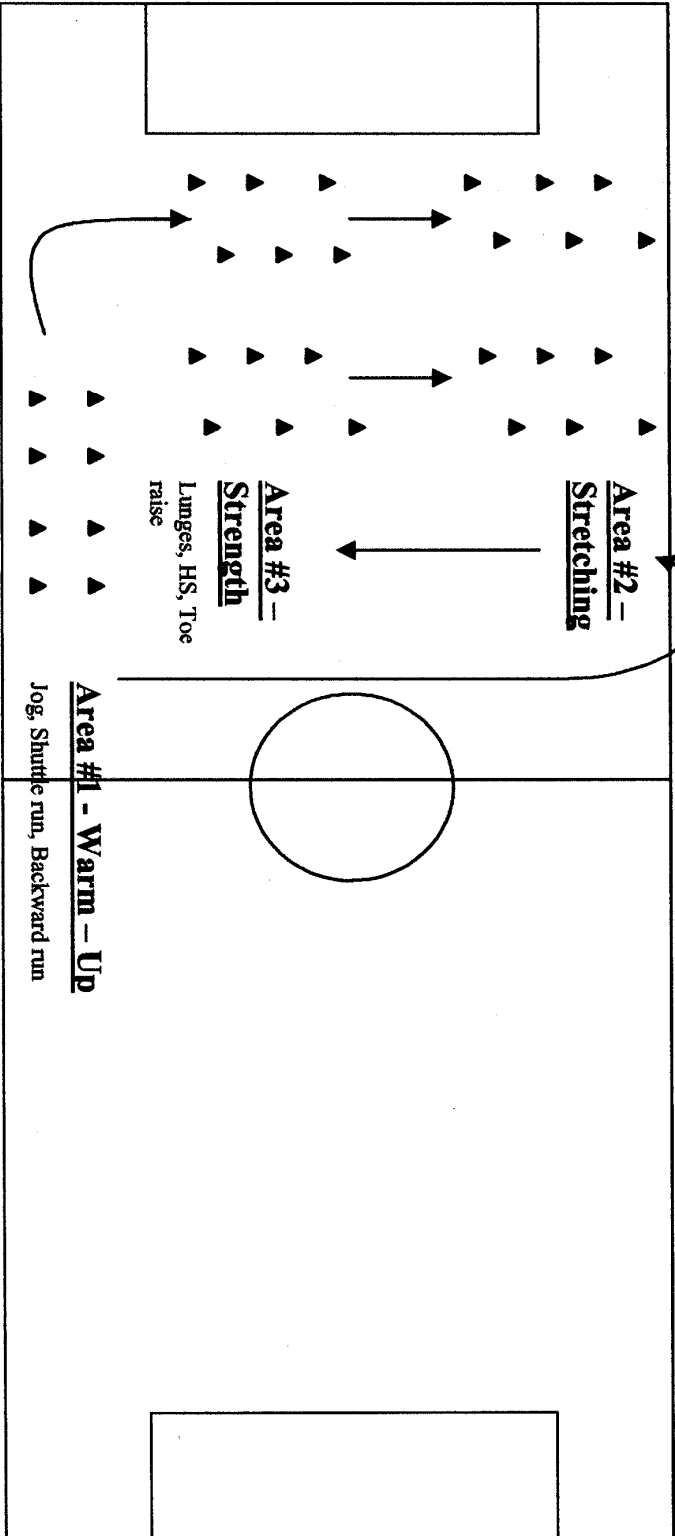


PEP Program: Prevent injury and Enhance Performance

Field Set-Up

Area #5 Agilities

Shuttle Run / Diagonal 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.

