With this understanding comes a training approach with the potential to lower the female athlete’s risk of significant knee injury.

**The Female Athlete’s Guide to Lower Extremity Stability**

As described above, many female athletes seem to have problems controlling their trunk, pelvis, hip and knee posture while landing on one foot. There is a high probability that this is tied to the female athlete having an increased risk of serious knee injury. Logically then, female athletes should train specifically to improve their functional core stability and their pelvis-hip-knee mechanics. Every female athlete should structure their conditioning program around the following: core stability training, lower body integrative training and lower limb mechanics.

The preceding sections detailed a comprehensive series of exercises which may be used to improve the athlete’s functional core stability and lower body strength. The following section will detail a specific set of exercises used to improve the **lower limb mechanics** of the female athlete. These exercises rely more on technical precision and the quality of movement rather than lifting significant amounts of weight. In the final section of *The Athlete’s Ball*, a comprehensive sample program for female athletes is presented (page 131).

Just as the spinal joints are supported and controlled by stabilizing muscles, the pelvis and hip joints are also controlled by specific stabilizing muscles. In many people with poor lower limb mechanics an important stabilizer of the pelvis and hip - the gluteus medius muscle - needs specific training attention.

Clinically we note that the gluteus medius (GM) muscle is often poorly activated in women with a variety of low back, hip and knee problems. This is an important finding since the function of the GM is to keep the pelvis level whenever we are supported on one foot (while walking, running or landing). If the GM does not contract correctly, the pelvis will drop towards the unsupported side and the hip and knee will collapse inwards. In other words, motor control problems affecting the GM can result in the faulty biomechanics demonstrated in figure 4.1.

Often, as if to compensate for this deficit, the tensor fasciae latae (TFL) muscle becomes excessively active. To correct this problem, the athlete must re-teach her nervous system to correctly activate the GM without relying too heavily on the TFL.

![Gluteus Medius, Tensor Fascia Latae](image)

*Figure 4.2 - In many female athletes a poorly controlled GM may be the primary culprit leading to knee pain and injury*
Specific Exercises for the Female Athlete

Sections 3.2 through 3.4 and section 3.6 described in detail a wide range of core and lower body Integrative Training exercises. All athletes, regardless of gender, should include a selection of these as the foundation of their conditioning programs. This section focuses specifically on the exercises used to improve or correct the lower limb mechanics of female athletes.

The section begins with a progressive series of exercises designed to improve the performance of the gluteus medius muscle from a motor control perspective. Once this is established, you will move on to performing low load squats, hamstring exercises, then more advanced squats. Finally, the series moves into more advanced dynamic exercises such as lunges and ‘jump-downs’ to improve landing mechanics. Do the exercises in order, and develop excellent technique and endurance before trying the next exercise.

Gluteus Medius 1

This ‘clamshell’ exercise is intended to improve the nervous system’s ability to activate the gluteus medius (GM) muscle. It is especially useful in those athletes whose GM is poorly active while their TFL is overly active.

From a sidelying position, align your legs as shown. Place your upper hand on your top hip as Kathleen demonstrates. Firmly push your thumb into the GM muscle and lay your fingers over the TFL muscle in front (see figure 4.2). You will use your thumb and fingers to ‘monitor’ the relative amount of contraction in each muscle.

Prior to actually lifting the top knee, try to develop a little tension in the GM muscle. Once you feel this initial contraction in the GM, continue with a small lift of the top knee. Try to keep the GM more active than the TFL throughout the motion.

Do not allow the pelvis to roll backward as the knee is lifted.

When you can complete 12 - 15 ‘small-lift’ repetitions with the GM firmly contracted, move on to the next exercise.
Gluteus Medius 2

Set up as Kathleen demonstrates - it is the same initial posture as the 'clamshell'. Note that with this exercise, the entire lower extremity is lifted just a little.

Keep the pelvis stacked vertically being sure to prevent the top half of the pelvis from rolling backwards. Use your thumb and fingers to monitor the relative activation of the GM and TFL muscles. Perform slow, easy repetitions keeping a firm contraction in the GM muscle. Once the GM begins to fatigue and the TFL becomes more dominant, stop the exercise.

Complete up to 20 repetitions but be sure to stop sooner if the TFL feels too active and the gluteus medius too quiet.
Once the athlete has re-established good activation of the GM, they are ready to strengthen the GM muscle. By this point in the gluteus medius exercise progression, the exercises begin to look a little more familiar to people. Variations on this exercise are used in Pilates and in general fitness classes.

However, it is still critical that the athlete monitor their TFL and GM and that they activate the GM at least as much as, if not more than, their TFL.

Again, if the TFL is noticeably more active than the GM as the top leg is lifted, you will end up strengthening the wrong muscle. Do not perform this exercise if you cannot keep the TFL relatively quiet.
Ideal Lower Limb Alignment

In this figure, Cathy is demonstrating good lower limb alignment. Her pelvis is level, her knee is directly underneath her hip and her kneecap is lined up directly over the space between her first and second toes. As much as possible, this is the lower limb alignment one would want to maintain when landing a jump or with each running stride.

This is also the lower limb alignment one should maintain when performing any type of squat exercise.

Stability Ball Squat 1

Facing a mirror, stand with your shoulder holding a stability ball against the wall and your outside foot directly under your knee and hip; lift your inside foot off the floor.

Squat to a maximum of 45 degrees keeping your pelvis level and your shoulders square. Your knee is directly under your hip and your kneecap lines up over the space between your first and second toes.

Perform up to 30 repetitions, but stop at the point of technical fatigue.

NOTE: ‘Eagle-eyed’ readers may note that Kathleen’s torso seems a little off in terms of its vertical alignment. Kathleen has a moderate lumbar scoliosis which results in a slight shift of her spinal posture.
Hamstring Curl 1

The hamstrings are extremely important in maintaining knee stability. The hamstrings act as the primary decelerating force at the knee. When they work correctly, they assist the ACL, lessening the load on this crucial ligament.

There is some evidence that, on average, hamstring function is somewhat impaired in female athletes relative to male athletes.

Put special emphasis on the negative phase of this exercise, being sure to control the ball as it slowly returns to the start position.

Hamstring Curl 2

Sarah demonstrates a more advanced version, the single leg hamstring curl. As you progress with these hamstring exercises, you may also try the even harder versions on page 47.

Again, always emphasize the negative phase of this exercise - control the ball so that it slowly returns to the start position.
Stability Ball Squat 2

Facing a mirror, organize your alignment before your begin the exercise. Set up with your knee below your hip and your kneecap over the space between your first and second toes.

Squat to a maximum of 45 degrees maintaining ideal alignment. If your hip or knee posture is lost at some point in the range, do not squat below this point until you can maintain good alignment.

Perform sets of up to 30 repetitions or until technical fatigue.

The Step Down

Once you have good skill with the first two squat exercises, you can begin to emphasize the eccentric or ‘negative’ phase of landing. Set up on a short step, standing on one foot. Organize your alignment as you stand on one foot. Slowly and with control through your trunk, pelvis, hip and knee, lower yourself to a maximum of 45 degrees.

While it might seem strange that this could require any significant effort, note Cathy’s hand posture; whenever she is working hard, her hands become rigid and extended. For women with less than optimal trunk and pelvis control this is indeed a difficult exercise if done correctly.

Cathy tore her left ACL several years ago playing basketball. It is possible that her problems with pelvis control might have contributed to her injury.
Lunge

As with the squat and step down exercises, maintaining correct alignment is critical. Stand in front of a mirror with your arms at your sides. Take a slightly larger than normal step forward. As you take weight through the forward foot, keep perfect alignment throughout the lower body. Pelvis, hip, knee and ankle posture must be perfect. Your trunk should not be turning at all; it should stay square to the mirror and in line with your shoulders.

Your knee should not bend more than 90 degrees. Push back off the forward foot to the starting position. Perform sets of up to 20 repetitions, alternating sides with each repetition. Progress this exercise by stepping onto a foam mat, then to an inflatable disc.

Unstable Lunge

As with the initial lunge, set up in front of a mirror to monitor your technique. Your pelvis, hip and knee must be controlled as you step onto the inflated disc.

You may want to begin this exercise by taking a shorter stride onto the disc, then gradually increasing your stride length to just a little longer than a normal running stride.

This exercise may be performed using an inflatable disc, a half-ball or a piece of high-density foam.
Jump Down 1

These are the most challenging exercises in this series. The load going through the lower body and trunk is relatively high and the movement occurs very quickly. Begin by standing on both feet on a short step. Organize your alignment while at the top of the step.

Jump down and land on both feet. As you land be very careful to maintain excellent control through your trunk, pelvis, hip and knee. Keep your kneecaps over the space between your first and second toes - DO NOT ALLOW YOUR KNEES TO COLLAPSE INWARD.

Perform only as many repetitions of this as you can with perfect technique. Perform one repetition then take a short break, review the last repetition (think about what was good and not-so-good about it) and plan your next repetition before repeating.

Quality - not quantity - is the key to success with this approach. Start with a very short step and progress to as high as 18 inches.

Jump Down 2

Begin by standing on your right foot on a short step. Organize your alignment while at the top of the step as you did for the ‘step down’ exercise on page 118.

Jump down and land on the right foot. As you land be very careful to maintain excellent control through your trunk, pelvis, hip and knee. Perform only as many repetitions of this as you can with perfect technique. Perform one repetition then take a short break, review the last repetition and plan your next repetition before repeating.

Repeat several repetitions on one side then switch - or alternate sides with each repetition. Start with a very short step and progress to as high as 18 inches.

Quality is the key to success with this approach. Do not progress these exercises unless your technique and endurance is excellent over 25 repetitions per side.
Sample Program 7

45 minute Core & Lower Limb Mechanics Workout

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Seated on the Ball 3

The previous exercise is made more challenging by adding motion via the arms. The arms may be moved forward or to the side; they may be moved quickly or slowly and they may be moved together or independently.

Vary the arm motion pattern each day to make the exercise just a little different each time.

Hold the foot off the floor for up to 15 seconds while moving the arms. Remember to simply extend the knee rather than lifting from the hip. Perform the exercise in this way for up to 5 minutes or for a total of 20 repetitions.

Seated on the Ball 4

People are surprisingly dependent on their vision for balance. Therefore a great way to train for better balance is to perform exercises like this with the eyes closed.

Perform the exercise as in either # 2 or 3, but with your eyes closed.

WARNING: Some people will be very likely to fall when attempting exercises like this with their eyes closed. Be sure to make safety your first priority when exercising on the ball, the half-ball or any other unstable device!
3.3 advanced core work

Throughout the next several sections, the upper photo typically shows the start & end position and the bottom photo shows the mid-position of the exercise. In some cases, several photos are used to describe a single exercise. In these situations, the photos progress in a clock-wise fashion.

Back Bridge with Dynamic Leg Lift

These exercises require you to stabilize your core while moving some other part of your body.

To begin, weight shift slightly to one side - that is, take most of your weight through one foot before lifting the other leg. Once you feel solid on that foot, slowly and smoothly lift the other foot off the ball. Remember, it is not important to lift this foot a lot - just getting it off the ball so it can't help support you is sufficient. Slowly lift and lower the foot while maintaining good core control - your trunk should not move at all during this exercise - move in the hip while keeping your trunk still.

Perform up to 15 repetitions per side, but stop at the point of technical fatigue. You might also decide to slowly alternate between sides rather than doing an entire set on one side before switching off.
Back Bridge with Hamstring Curl 2

As with the previous exercise, a great core and hamstring exercise. Much more difficult with only two points of unstable contact.

As you perform the exercise, emphasize control as you return the ball to the starting position. This is the eccentric or 'negative' phase of the movement. Given the biomechanical role of the hamstrings, it is especially important to focus on their eccentric function.