

The Knee Injury Solution

Secrets to decreasing the risk of knee injury in athletes

BY KIM GOSS

continual concern in athletics is the risk of knee injury, and with good reason. Approximately 150,000 Americans will injure an ACL this year, and the majority of these injuries will occur to girls and women. In fact, in sports such as basketball and soccer, women are as much as eight times more likely than men to suffer a serious knee injury. But it doesn't have to be that way.

One popular theory as to why women have such a high risk of knee injury is that a woman's wider pelvis causes the upper thigh bones to angle inward and the lower legs and feet to turn outward. This creates a less stable alignment of the lower extremities. Although this anatomical difference can be a factor in the higher rates of knee injuries in women, a lack of appropriate strength training may be the major cause. Just ask Canadian strength coach Charles Poliquin. Poliquin was a strength coach for the Canadian National Ski Team; and when he joined the staff, the odds of a female athlete needing surgery within five years were 100 percent. "However, none of the athletes who started with me that first year had to have a knee surgery," says Charles. "In other sports I was involved with in Canada, we found the same conclusions – the ratio of male-to-female knee injuries was the same when they all followed the same strength training protocols." As for the theory that poor running and jumping mechanics is a primary cause of knee injuries, Coach Poliquin says that one of the causes of poor mechanics is lack of strength.

In regards to strength training, it's important to have

A simple test to determine the level of an athlete's knee stability is a single-leg squat.

strong hamstrings as well as strong quadriceps. However, if the quadriceps are much stronger than the hamstrings, the risk of knee injury is greater. A simple test to determine if an athlete's hamstrings are strong enough is to look at the ratio between their front squat and their back squat. "Your front squat should be 85 percent of your best back squat," says Poliquin. "From our experience this signifies the appropriate ratio between the quads and both the hip extension and knee flexion functions of the hamstrings." Further, having an imbalance between legs – for example, a condition where your right hamstring is significantly stronger than your left – can also increase your risk of injury.

To train the hamstrings, one of the best exercises is the glute-ham raise. And according to Canadian strength coach and posturologist Paul Gagné, it is also valuable for knee stability to perform additional work for the glutes and also the erector spinae muscles of the lower back, with such exercises as the reverse back extension. Says Gagné, who has his athletes perform both these exercises regularly in their training, "The glute-ham raise and the reverse back extension pack a powerful 'one-two' punch in helping to prevent knee injuries." But there is another factor in injury-proofing your knees that must be considered: knee stability.

The Stable-Knee Puzzle

Why is knee stability important? Sports expose your body to disruptive forces, many of which can be extreme, as with gymnastics, and unexpected, as with basketball



These photos show how a sound program of corrective exercises can quickly improve not only knee stability but also



overall posture. In the top series you'll see dramatic improvements in the posture of this athlete's spine, whereas in the series at left, you'll see how by using the singleleg squat test this athlete was able to make great improvements in knee and ankle stability. Such improvements can often be achieved within four to six weeks. The athlete pictured is Baylie Divino, a Level 10 gymnast who competed in the Junior Nationals this year and is on track for a spectacular 2009 season.



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and soccer. It's been estimated, for example, that the ground reaction forces in the lower extremities can be as much as five times bodyweight when a person drops from a height of just 12 inches. Similar forces occur when a soccer or basketball player has to "brake" when changing direction. If an athlete does not have sufficient knee stability, it will take longer for the athlete to change direction and it will expose knee ligaments to excessive stress. And if the stress is high enough, an injury will result.

A simple test to determine the level of an athlete's knee stability is a single-leg squat.

If an athlete's knee buckles inward excessively as the athlete squats down, this means the athlete cannot maintain proper knee alignment. Another test is the vertical jump with a step. If there is little or no difference between an athlete's standing vertical jump and their vertical jump with a step, this is also a sign that the athlete lacks knee stability.

In addition to stabilizing the knees by improving the strength of the hamstrings and glutes, Gagné uses many Posturology techniques to further help prevent and also rehabilitate knee injuries. "My progression with new athletes is to first address the postural system and then stabilize the joints and strengthen the muscles," says Gagné.



Vibration training as shown here on a BodyVibe® machine is one method of correcting postural problems that are a result of poor foot alignment.

needs postural insoles or vibration training (which stimulate the nerves of the feet) or orthotics to correct the feet.

After determining if an athlete needs medical intervention to correct a nervous-system inadequacy with the feet, Gagné's next step is to perform a progressive series of corrective exercises to improve the integrity of the joint. He starts with special exercises for the feet and ankles, then single-leg squat movements, and finally overhead squats (or as BFS Founder/CEO Greg Shepard calls them, *power balance drills*). Here are the details of some of these exercises.

SINGLE-LEG BALANCE. This exercise is designed to develop proprioception (i.e., body awareness) in the

For example, to correct postural problems Gagné will perform a postural assessment, focusing first on determining if the athlete's feet could be affecting knee alignment and the posture of the spine. "The feet are the first area we should look at when working with athletes, as they are the foundation of posture," says Gagné. "If there is a problem with the feet, then the posture of the entire body is affected - and it's doubtful that any special 'core training' exercises will resolve the resulting postural problems." Depending upon the result of his postural assessment, Gagné will determine if the athlete





The **single-leg balance** is a great exercise to improve stability in the feet and ankles.

feet and ankles. It's best to perform this exercise, and the single-leg hop exercise and single-leg squat to bench exercise that follows, in bare feet. However, wear shoes if the gym environment does not safely allow you to do so.

To perform the exercise you stand on one leg, with the other leg crossing behind the knee, tuck the pelvis under (to take the hips out of the exercise) and then unlock the knee (to work the knee joint). Don't bend the leg more than a few degrees, as this will also increase the involvement of the quadriceps. Now lift all the toes and attempt to balance for one minute. Repeat for both legs. When this becomes easy, increase the difficulty by closing your eyes.



The **single-leg hop** should be performed after a period of time working the single-leg balance exercise.

SINGLE-LEG HOP. After mastering the single-leg balance exercise, you progress to single-leg hops. Assuming the same position as with the single-leg balance, the athlete hops in a semicircle (right-center-left-center-right, etc.) for one minute on each leg. Start with small hops, and increase the rotation as your balance improves.



The **Single-Leg Squat** is a progressive exercise that focuses on knee alignment. As the athlete improves, the height of the platform (such as with the BFS 3-in-1 squat box) is lowered.

SINGLE-LEG SQUAT TO BENCH.

The next exercise is a single-leg squat to a bench, but performed in a progressive manner according to the abilities of the athlete. It requires the use of several boxes of various heights, such as the BFS Plyo Boxes, or a BFS 3-in-1 Squat Box.

Start by standing in front of the 3-in-1 box set at the highest setting (or use a high box). Lift the front leg, and then sit down on the box. As soon as your glutes touch, stand up. Throughout the exercise focus on keeping the knee in alignment with the long toe; if the knee buckles excessively, try lifting the big toe of the working leg to correct your alignment. Perform the exercise for 60 seconds. When you can perform the exercise with perfect knee alignment, use a lower box or move the 3-in-1 box down one adjustment.



The **assisted single-leg squat** enables most athletes, even those with knee instability, to perform a single-leg squat with perfect alignment.

ASSISTED SINGLE-LEG SQUAT.

This exercise is used to strengthen the leg muscles throughout a full range of motion. It can be performed either in a power rack or with a BFS Plyobar. With a power rack, you would place the barbell supports on the inside of the rack and place a barbell across it; stand outside the rack and grasp the bar with an overhead grip to assume the starting position. With a Plyobar, as shown, simply adjust the bar to waist height and grasp the bar with an overhand grip.

Begin the exercise by lifting one leg in front of you and then squatting down on the other leg, using your arms to assist you. Squat as low as comfortable and then return to the start – most individuals can squat all the way down and come up with the assistance of the arms. As you progress, use less upper body assistance to perform the movement, especially on the lowering phase – you can also try not holding the bar on the lowering phase, and then use the upper body to help you return to the start.



As with the assisted single-leg squat, the **single-leg squat with a medicine ball** enables many athletes with knee instability to perform single-leg work throughout a full range of motion.

SINGLE-LEG SIT-UP WITH

MEDICINE BALL. This exercise is a bit more dynamic than the assisted singleleg squat, but it also primarily works the leg muscles. Using a sit-up ladder, place the ladder at an incline and stand in front of the edge of the bench. From this position sit down on the bench, rock back, and then try to stand up on one leg – the momentum from the rocking will assist you in coming up. As this become easy, perform the exercise entirely on one leg – you can also throw the medicine ball to a partner at the top position, who will in turn throw it back to you as you sit down again holding the ball.



The single-leg squat with resistance is the most advanced knee stability exercise in this workout program.

SINGLE-LEG SQUAT WITH

RESISTANCE. This is simply a singleleg squat. Soon the single-leg squat with just bodyweight will become too easy. Just increase resistance by holding a weight in front of you at arms' length. You can start with a medicine ball; but as you get stronger, you may need to switch to a weight plate or a dumbbell. If your knee starts to buckle, the weight is too heavy.



The **overhead squat** is a great exercise for total body stability.

OVERHEAD SQUAT. The overhead squat works overall stability, in addition to being a great total body dynamic

stretch. Start with a light barbell (such as a 15-pound Aluma-Lite barbell), or even a PVC pipe. Lift the bar overhead using a wide grip (so your arms are at 45 degrees from horizontal) and assume an athletic stance. Squat down, pushing your knees out in line with your feet, and keep the bar over your hips - it will actually travel slightly backward when you reach the bottom position. Perform five repetitions. As the exercise becomes easier and you can use heavier weights, you will probably need to remove the bar from a squat rack, holding it behind your head on the top of your shoulders, and then press it overhead using a drive from your legs. As shown by the accompanying

As shown by the accompanying before-and-after photos, it's possible to make significant progress in knee stability within 4-6 weeks. Putting the program together, the progression over six weeks could look like this:

WEEK 1 (perform daily)

- Standing Support, 3 sets
- Bench Single-Leg Squat (highest position), 3 sets

WEEK 2 (perform daily)

• Standing Support, 2 sets

- Standing Support, Eyes Closed, 2 sets
- Single-Leg Squat to Bench (as low as good technique allows), 2 sets

WEEK 3 (perform 3x per week)

- Singe-Leg Hop, 2 sets
- Single-Leg Squat to Bench (as low as good technique allows), 2 sets
- Assisted Single-Leg Squat, 2 sets

WEEK 4 (perform 3x per week)

- Single-Leg Sit-up with Medicine Ball, 3 sets
- Single-Leg Squat with Resistance, 3 sets

WEEKS 5-6 (perform 2-3x per week)

- Overhead Squat, 2 sets
- Single-Leg Squat with Resistance, 4 sets

At the completion of this program, it would be a good idea to occasionally include a few of these exercises among your auxiliary exercises. Also, because proprioception and strength often decrease after an injury, after ankle or knee injuries it would be a good idea to at least perform some of the exercises in weeks one and two of this workout. Of course, after any injury a medical professional should be consulted about the best way to approach a rehabilitation program.

Although you could perform many of theses exercises while standing on a wobble board or air disk, Gagné says doing so carries a higher degree of risk, as these exercises are extremely unstable. Also, he says wobble boards and air disks do not necessarily duplicate the athlete's activities on the playing field – with these devices the foot essentially rotates around the lower leg; whereas in athletics the playing field is flat, and so the lower leg rotates around the foot. Unless you're an advanced athlete with exceptional ankle and knee stability, Gagné believes it's better to work on a flat, stable surface to avoid placing excessive, harmful stress on the joints and connective tissues.

There are always new, colorful exercise gimmicks, but they're usually not all that great for improving athletic performance and they may even increase the risk of injury. For the most bang for the buck, you simply can't beat these exercises for improving knee stability.



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