

# The Gait Cycle and Running Injuries

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"Its from overuse..." If you're a runner, you've probably heard this phrase before! Unfortunately, this doesn't really explain the cause of your running related injury. What specifically about your running has caused your injury? Well, I'm here to try and shed some light on this subject. Most injuries can be explained within the context of the running gait cycle. With this knowledge, you'll have the potential to better identify when it occurs and how it can be corrected by improving your form.

A complete gait cycle is defined as the movement from one foot strike to the successive foot strike on the same side. Within this cycle, there are 2 main phases; Stance and Swing. These can be further broken down into subdivisions. Each of which is an extremely complex activity involving the interaction of bony alignment, joint range of motion, neuromuscular coordination, and the physics that govern bodies in motion! To make it even more complicated, most of this is organized and implemented by the brain at an unconscious level!

For our purposes there are 3 important subdivisions of the stance phase that can be held responsible for the vast majority of common running ailments; Foot Strike, Mid Stance, and Toe Off. This is by no means an exhaustive list, but represents the majority of the commonly seen injuries in competitive and recreational runners.

## Foot Strike Injuries:

Unfortunately, many runners are making initial contact with their heels. "Heel-Strikers" has become a dirty word in many running circles, and with good reason. Heel striking is caused by over-striding and effectively applies the brakes each time you do it! With this comes a forceful contraction of your quadriceps muscle. This places enormous stress many times your body weight, on the knee cap. This stress can rapidly contribute to "Runners Knee" or "Patello-Femoral Syndrome" which includes Patellar Tendonitis, Chondromalacia (cartilage damage), and Quadriceps Tendonitis. Fortunately, you can correct heel striking by very gradually shortening your stride, increasing your cadence, and concentrating on gently foot striking immediately under your center of gravity with either your forefoot or mid-foot. This may become even more important with downhill training.

IT Band Syndrome, another very common running injury, has also been shown to occur just after foot strike. This occurs as the back edge of the ITB rubs on the underlying bony prominence at outer portion of the knee. ITB Syndrome develops more commonly with a reduced knee flexion angle at foot strike; usually around 20-30 degrees. Interestingly, this rubbing effect has been shown to occur more frequently when over-striding, heel striking, running downhill, and running at slower speeds. Conversely, sprinting, running at faster speeds, and mid-foot striking with a slightly greater flexion angle are associated with a lower rate of ITB Syndrome. I'm not suggesting you go out and sprint your next 10k, but I am suggesting you avoid heel striking and start shortening your stride! ITB stretching, foam rollers, and hip strengthening exercises also work great.

## Mid-Stance Injuries:

As we progress through the gait cycle, the foot and ankle go through a complex change in their biomechanical alignment called pronation. For the record, not all pronation is bad! Pronation not only helps to dissipate the initial forces of foot contact, but also helps to provide a smooth transition and adaptation to varying running terrain. With normal pronation and running, an eccentric muscle contraction is required of the soleus muscle in the calf to balance the biomechanical changes in alignment. As with most things in life; "better in moderation than excess!" Excessive pronation causes the soleus muscle to work overtime causing micro-tears at its bony attachment to the shin bone. What happens next? You guessed it... "Shin Splints", now known as MTSS (Medial Tibial Stress Syndrome)! MTSS can be improved by controlling pronation with foot and ankle strengthening exercises, mid-foot striking mechanics, calf stretching, orthotics, and a good pair of stability shoes which help to avoid over-pronation.

Mid-stance and over-pronation can also contribute to the previously mentioned runners knee. During pronation and stance in runners with weak hip muscles; the knee dips inward causing excessive stresses to be applied to the knee cap. Excessive pressure on the outer half of the knee cap develops and can contribute to patellofemoral syndrome. My recommendation in this case is to work on hip strengthening exercises that promote outward rotation

of the hips and knees during a single leg squat. Hip abduction machines and crab walks with a resistance band are a couple of my favorites! Again, focusing on form after this has been identified is extremely important. During stance, your knee should remain directly over your foot, or slightly to the outside of it! Anything toward the mid-line is less than ideal.

### **Toe Off Injuries:**

The culprit responsible for most injuries during the toe off portion of the gait cycle is actively pushing off too hard in order to achieve greater acceleration. Fairly straight forward when it comes to calf muscle strains and achilles problems. Pushing off forcibly creates a significant amount of force within the muscle and at the muscle-tendon-bone junctions. This is commonly seen in over-striders who heel strike which slows them down. Their only choice is to push off harder in order to get back up to speed! Over thousands of repetitions the calf muscles and tendons are working way harder than they were meant to, and eventually they fail under the extra stress.

More complicated is the cause of plantar fasciitis; my current demon! Yes, I get injured too! During a forceful toe off in a runner with tight heel cords, they are forced up onto their toes earlier than usual in the gait cycle. This causes something known as the "windlass mechanism" to prematurely tension your plantar fascia along the bottom of your foot! As tends to be the case, excessive tension leads to micro-tears, inflammation, and eventually pain!

Corrections in form for both of these problems start with a shorter stride and mid-foot strike to maintain forward momentum. This obviates the need for active push off to maintain speed. Thus, resulting in less calf contraction, and less tensioning of the plantar fascia during toe off. Calf stretching exercises after the muscles are warm is recommended for plantar fasciitis, but never during the early treatment for a calf strain or muscle tear. Trigger point massage and ice baths are also recommended for plantar fasciitis.

### **Summary:**

The above is a glimpse into how a critical evaluation of the gait cycle can help with the correction of common running ailments. If you suffer from one of these potentially disabling injuries, you may be able to better pinpoint the exact cause with the new knowledge you've acquired. That being said, gait analysis is difficult to self-assess and correct, and is best guided by an experienced sports medicine professional. When it comes to correcting your form, remember that rapid and improper changes in your running technique can be as detrimental as the improper form that you're trying to correct. As with all cases; proper gear and training environments are recommended in addition to proper technique.

Whether or not there is a singular "ideal running form" is up for debate. However a few things are certainly worth improving. Stay off your heels at foot strike, try to avoid dipping your ankles and knees inward during mid-stance, and ease up on forcibly pushing during toe off. These changes may be just what you need to stay injury free!

Dr. Bernardini is a former Division I Collegiate Academic All-American Football Player, and Track & Field Team captain. He is currently Co-Director of the Virtua sports medicine program and voted one of South Jersey Magazine's Best Sports Medicine Physicians as voted by its readers. He maintains his passion for athletics as a competitive Triathlete and three time Ironman finisher. He is the co-founder of the Jersey Devils Multisport Club, and has achieved distinction as a USA Triathlon Certified Level I Coach. He currently sees patients at his Vineland and Washington Township Offices, and has privileges in the Virtua, Inspira, and Kennedy Healthcare systems.



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