The Science Behind Training and Running Variability

My research group first introduced the concept of stride-to-stride variability as an indicator of a running injury back in 2010. We showed that when a runner has reduced gluteus medius muscle strength (the muscles on the side of your hip) your knee is not properly controlled when you run. You will demonstrate increased variability and an unpredictable running pattern; your knee might slightly collapse outwards during one footfall and inwards for the next…. it's unpredictable. However, once those muscles get stronger, you develop a more predictable pattern and stride-to-stride variability is reduced; so your body knows what to expect during the next footfall.

We've conducted a lot of research to confirm these findings. We repeated the above study with a larger group of runners and with runners who have different injuries. In another study we fatigued a key ankle stabilizing muscle: the tibialis posterior. This muscle runs on the inside of your ankle bone and fans out under your foot to support the arch and functions to control arch deformation and foot pronation. When this muscle became fatigued, the otherwise predictable motions between the heel bone, the arch, and the lower leg become very unpredictable. In another study, we injected lidocaine into the superior gluteal nerve to effectively "knock-out" the gluteus medius muscle. Our results were similar to what happens when the muscle is weak and variability in your gait pattern increased when the muscle cannot produce adequate force.

We use variability of biomechanical running patterns in the Running Injury Clinic as an indicator of injury status and to determine whether you're ready to hit the running trails after injury. So even though you might be pain-free, your stride-to-stride variability may still be high indicating you're prone to re-injury. We also use this information to predict your likelihood of injury and tailor your training program to reduce your potential of injury.

Variability in your training program has recently come into the spotlight with some excellent research coming out of Luxembourg. These researchers followed 264 recreational runners and recorded data on training volume, injury rate, cross-training, and shoe usage over 22-weeks. Of the 264 runners, about half of the runners completed 91% of their mileage in the same shoe and only went through 1.3 shoes over the 22 weeks. Sound like you? The other half of the runners took a "multi-shoe" approach and completed 58% of their mileage in a main shoe but they rotated among an average of 3.6 pairs of shoes. Interestingly, these multi-shoe runners had a 39% lower risk of developing a running injury as compared to the single-shoe runners.

There are plenty of reasons why running in multiple pairs of shoes are beneficial including different shoes distributing impact forces differently, and different

midsole height and firmness properties creating slight changes in your running gait.

What's also interesting is that these researchers also found that increasing the average distance of your runs, but reducing the number of weekly runs by participating in other recreational sports, also reduced your likelihood of injury by 15%-20%. They concluded that the "variation of the load applied to the musculoskeletal system" is injury protective.

So let's summarize this complex topic and talk about what to do when you're healthy and what to do when you're injured. When you're injured, your stride-to-stride variability is high and you have an unpredictable running gait pattern. So you want to focus on lowering your variability in all facets of your training. I recommend minimizing variability by running in one pair of shoes, run along a consistent route, keep your mileage low and pain-free, and focus on the rehabilitation. You should, of course, be seeking professional help from a sport physiotherapist or a clinician who is a running specialist.

However, when you're healthy, your stride-to-stride variability is low and you have a predictable running biomechanical gait pattern. You want to focus on increasing the variability of your training program to reduce your chances of injury. We always say, "swim, bike run, lift weights and buy at least two pair of shoes and switch between them." I always follow this by clearly stating I have no financial interest, shares, stocks, nor does any shoe company pay me. ;) I'll be changing that message to "buy at least 3.6 pairs of shoes" based on the research. Perhaps I should also buy some stocks in shoe companies if everyone follows my advice!

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The Running Injury Clinic is a world-leader in running-related research. Please visit our website at www.runninginjuryclinic.com to learn more about our world-class running injury research and clinical practice.

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