American Academy of Podiatric Sports Medicine

Treating Running Injuries: Form vs. Footwear

Foot strike, cadence, and posture are more important factors than shoe type.

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Running injuries can be very frustrating for physicians as they can be extremely time-consuming, and stereotypical runners will not curtail their running to resolve an injury. If you tell a runner not to run, most of the time, s(he) will not listen to you and not follow through with your prescribed treatment regimen. This challenge leads many physicians to not treat runners. Added to this frustration is the recommendation of footgear. Whether someone has been running for many years or just starting out, the runner tends to place a lot of emphasis on what shoes to wear. Form is traditionally ignored. Runners, as well as practitioners, will typically make a change of shoes in an attempt to fix an injury.

Heel Strike - *Incorrect Form*

Forefoot Strike - *Correct Form*

Figure 1: (Top photo) Heel-striking results in increased force being transmitted to the lower extremity. (Bottom Photo)—By adapting a foot strike, the lower extremity can absorb shock naturally and reduce the impact force.

What most practitioners do not realize is there is no evidence-based literature existing on recommending a running shoe to prevent or reduce injuries.[1-8] Following the popular paradigm of recommending a running shoe based on foot type leads to frustration as there are numerous models being introduced frequently. When we dissect the reasons that we use a particular shoe, the situation becomes even more blurred. There is no clear scientific basis for using one particular shoe model over another for given foot types or pathologies, despite what some manufacturers claim.[1] The term "appropriate shoe" is a misnomer when viewed by the outdated paradigm of selecting a shoe according to arch type, and many are still advocating shoes this way. Even the implementation of orthotics has little if any bearing on reducing or correcting injuries in runners.[9-12]

We also live in a society where people incorrectly believe they have a flat foot or over pronate. Associated with this is the stigma that foot types (especially flat feet) influence injury patterns.[13] This, however, is not true.[14] Evidence suggests that training patterns actually play more of a role in increasing the incidence of running injuries.[15,16] The key is understanding that form and training patterns play more of a role in improving one's running and at the same time reducing injury.[17]

Common Approach to Running Injuries

Before seeking treatment for an injury, most runners will run through pain thinking that it will eventually resolve. When it finally becomes too

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severe to continue, medical advice is usually sought. The standard protocol for a physician or sports medicine specialist treating a runner is as follows: 1. Question athletes about how many miles a week they are running 2. Evaluation of footgear 3. The number of miles on the current footgear 4. Biomechanical assessment of feet and lower extremities. If the runner is seen in a more specialized clinic, a gait analysis is sometimes performed. Overpronation is commonly diagnosed, and an effort to control this excessive motion is usually attempted with orthotics. High tech scans and pressure analysis may also be performed, although very little if any applicable information can be generated from this.

Form analysis, on the contrary, focuses more on the runner's style with respect to foot strike, cadence, and the runner's overall body posture. It is slowly becoming the panacea to help improve someone's running and reduce or resolve injuries.[17,18] Runners tend to develop injuries as a result of poor or incorrect form and overuse which many times overlap.[15,19] Debate exists as to what is the "proper form" for running. Proper form will certainly vary from one runner to the next making each runner's form "ideal" for that individual. There are, however, certain aspects of form a runner should strive to attain—adequate foot strike, cadence, and posture.

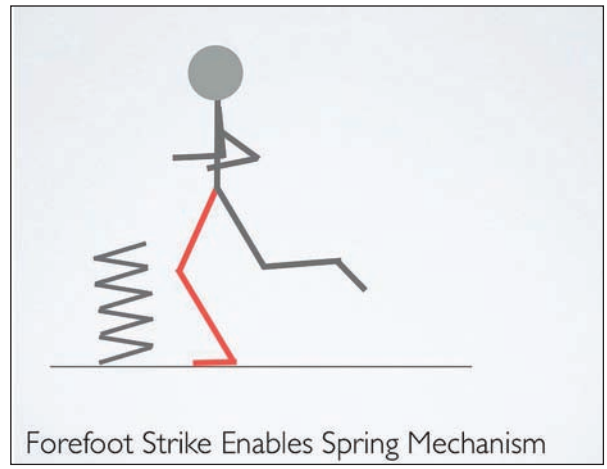

Figure 2: To increase efficiency and reduce shock to the lower extremity, the foot should be landing under the body's center of gravity or close to it. This engages the body's natural spring mechanism by utilizing eccentric contractions of the muscles at the ankle, knee, and hip during landing.

Foot Strike

Foot strike is the first aspect that needs to be addressed. There is a common misunderstanding that all aspects of gait, whether walking or running, should begin with a heel strike. Following heel strike, the force is carried laterally, transversing medially upon which it is increased at the 1st MPJ where the propulsion phase ends the final stage of the stance phase before leading into toe off.[20] Much of this thinking is attributed to Root, et al. Over the years, this idea has somehow carried over to running.[20]

The practitioner sometimes will examine the footgear to see if any wear patterns exist that would indicate increased pronation as indicated by wear seen more medially on the heel than laterally. The problem with this pathway is that we have no evidence-based studies to indicate that heel striking is the correct way to land when running. In fact, recent studies demonstrate higher injuries among collegiate cross country runners who heel strike as compared to those who forefoot strike.[21,22]

Numerous studies have compared shod and unshod runners and a forefoot strike pattern is adapted among those who run without shoes.[23-27] We all see that elite runners tend to forefoot strike more than slower recreational runners as demonstrated by Larson, et al.[28,29] Evidence exists that the human body has a natural tendency to fore-foot or mid-foot strike when running barefoot or in minimalist shoes.[23,26]

Heel Strike vs. Forefoot/Midfoot Strike

By striking the ground with the heel first, the subtalar joint takes the brunt of the force leading to possibly over-utilizing the posterior tibial tendon. We also see that during a rearfoot strike, the forefoot (including the toes) and midfoot joints really serve no purpose in absorbing shock. If, instead, we utilize these joints with a forefoot or midfoot strike, the entire foot can pronate instead of only the subtalar joint which can achieve more absorption of the impact force.[30] By avoiding heel strike, one can utilize the rest of the foot to absorb shock.

When we forefoot or midfoot strike, we can control the amount of pronation innately by activating our musculature (Figure 1). Consider that one common complaint of those who make the transition to minimalist shoes is "calf pain." This is due to the activation of the gastroc-soleus, posterior tibial, flexor digitorum longus, and flexor hallucis longus muscles in efforts to slow the heel from striking the ground. They are contracting eccentrically to "slow pronation". This does not need to be scientifically demonstrated in "future studies" as we already know that if pronation of the foot is dorsiflexion, eversion, and abduction, then these muscles collectively are contracting as they are lengthening in order to "slow" pronation. As they become strong enough, they will control the pronation that is occurring during foot strike.[31,32]

Running Shoes

Examining the categories of traditional running shoes reveals that manufacturers have created them according to three foot types—flat foot, normal arch, and high arch. The AAPSM has defined the categories as maximum stability, stability, and neutral. For example, ASICS defines their stability category shoe as "Structured Cushioning."[33] According to ASICS, "the structured cushioning is designed for runners who pronate slightly more than normal and generally have a normal arch." [33] This infers that the runner is heel striking. Otherwise, why would there be a need to control motion? Some of the normal pronation that is encountered when a runner forefoot or midfoot strikes could be inhibited by this mo-

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tion-controlling apparatus.

Why then are running shoes created with a thick cushioned heel and motion control support? That question is debatable, but it is clear that over the past 40 years we have seen no reduction in injury rates and marathon times have remained unchanged. Many physicians still abide by the rule of changing your shoes every 300-500 miles. This became popular after a study in 1984 that demonstrated shock absorption loss after 250-500 miles of running.[34] Since then, studies have actually demonstrated that as absorptive qualities of a shoe are lost, the foot becomes more stable, leading to the likelihood of reduced injury with more mileage.[35-37]

At the same time, the notion that runners with a high arch "need a great deal of shock attenuation because they don't absorb shock naturally through pronation," implies that we need to pronate to absorb shock. It becomes extremely crucial to look at pronation on terms of the entire foot as opposed to only the subtalar joint because more shock attenuation can be achieved utilizing the forefoot and midfoot.

Even if we consider implementing an orthotic into the shoe to control pronation, we have to consider the goal of this. The orthotic for an overpronator is typically designed to control motion at the subtalar joint that results in increased pronation. With forefoot striking, we have to look at this from an entirely different perspective in which the orthotic would not serve the same purpose; therefore, its use is questionable.

Landing

Where the foot strikes in relation to the rest of the body is also crucial. To increase efficiency and reduce shock to the lower extremity, the foot should be landing under the body's center of gravity or close to it. This engages the body's natural spring mechanism by utilizing eccentric contractions of the muscles at the ankle, knee, and hip, during landing (Figure 2). In contrast, heel striking with the leg reaching in front of the body's center of gravity results in the leg impacting in an extended position increasing the force to these joints (Figure 3). Even if one heel strikes with the foot below the center of gravity, one will lose part of the spring as the reduction of direct force by its conversion to rotational force through the ankle is lost.

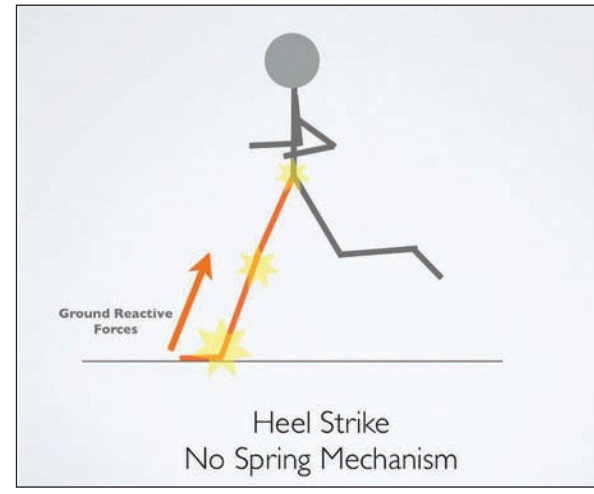

Figure 3: In contrast, heel striking with the leg reaching in front of the body's center of gravity results in the leg impacting in an extended position, increasing the force to those joints. Even if one heel strikes with the foot below the center of gravity, you will lose part of the spring, as the reduction of direct force by its conversion to rotational force through the ankle is lost.

Cadence

Cadence is another piece to the puzzle. Cadence is the number of steps a runner takes per minute. Examining elite runners and marathoners, it has been determined that achieving a cadence of 180 steps per minute or higher will result in increased efficiency.[38] Running with a forefoot strike pattern makes it easier for one to increase cadence.[23] This high cadence keeps the runner closer to the ground reducing vertical motion that is associated with increased impact forces.[23] Shorter strides are associated with a higher cadence, but as speed increases the stride length will also increase.[23,27,32]

It is important to understand that cadence should not vary with speed. For example, if running a 10 minute mile or slower, cadence should remain at 180 or greater. Faster paces such as 5:00 to 6:00 per mile can sometimes reach cadences of 200 or greater. The key is to understand that shorter strides and faster turnover will increase efficiency and reduce ground reactive forces.

Posture

Finally, the body's overall posture also needs to be assessed. This can be somewhat confusing because some running instructors advise to keep an upright posture while others will advise to "lean forward." Both are actually correct. The body's overall position should be erect, but it should be falling forward. The term "leaning" should not occur at the waist such as bending over but the entire body should be angled forward (Figure 4). Running in place and then leaning forward to begin movement will help to teach this concept. This increases efficiency by utilizing forward momentum as opposed to decelerating with each step, which recruits more musculature.

Conclusion

Focusing on these steps discussed will help to improve a runner's efficiency leading to reduced injury. New Balance has partnered with Kurt Munson, a well known running shoe retailer from Michigan, and created the educational concept known as Good Form Running.[18] Good Form Running teaches these steps in a simplistic manner, and specialty running shoe stores across the United States are holding clinics to instruct this.

Interestingly, children tend to run this way when they are unshod and playing outside.[39-41] The younger they are, the more noticeable this is as their gait has not been altered by wearing footgear. As for pediatric shoes, the American Academy of Pediatrics recommends not wearing shoes until it is necessitated by the environment.[42] This helps to encourage natural foot motion, thereby enabling adequate development and strength gains.

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A final point that is crucial in mentioning is training patterns. Most recreational runners and even elite runners tend to train too hard.[17] Improving the body's aerobic capacity means to continuously train at an aerobic rate.[17] This is best achieved through the use of a heart rate monitor. Training too much at too high of a heart rate can lead to overuse injuries.[17] Runners too often focus on maintaining a pace instead of listening to their body and their training becomes borderline anaerobic.[17]

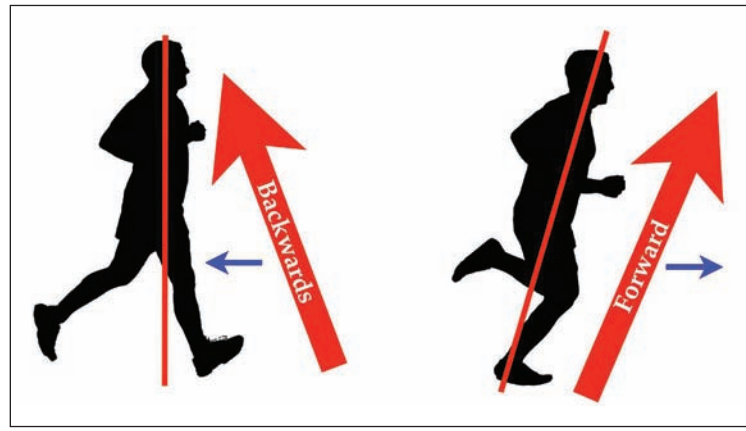

Figure 4: The body's overall position should be erect, but it should be falling forward. The term "leaning" should not occur at the waist, such as bending over, but the entire body should be leaning forward. Running in place and then leaning forward to begin the movement will help to teach this concept. This increases efficiency by utilizing forward momentum, as opposed to decelerating with each step, which recruits more musculature.

Obviously there is more to running than discussed here but having this, as a foundation, really helps anyone just beginning running or even those who have been running for many years. It is crucial for physicians treating running injuries to understand this.

In conclusion, it seems that most practitioners are straying from the path of helping a runner by focusing on shoes as opposed to form. The term "appropriate shoe" is a misnomer when viewed by the old paradigm of selecting a shoe according to arch type, and many are still advocating shoes this way. A running shoe should allow the foot to function as it was designed to—naturally without inhibiting motion. Adding cushioned heels and motion control mechanisms can inhibit this. By viewing shoes as the first line of treatment for most conditions, we must make sure this does not interfere with the foot's natural function.

The shoe should feel comfortable initially (not with time) without a need for the foot to "get used to the pressure pushing against the arch." A gradual adaptation to this way of running is obviously needed or injury can result as our feet and bodies may have been accustomed to a different form and supportive shoe. The approach is very similar to creating a program for someone just beginning to run. **PM**

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