Should You Change an Athlete's Natural Running Form?

By Thomas C. Michaud, DC

According to many running experts, making a few small changes in running form can improve speed, efficiency, and reduce injury rates. Alberto Salazar is famous for changing everything from the tilt of a runner's pelvis to the position of his or her thumbs (1). From a biomechanical perspective, it makes sense that nearly every runner has some slight imperfection in form that can detract from optimal performance. Think of the auto industry putting cars in wind tunnels and blowing streams of smoke over the cars' exteriors to identify design problems that could result in reduced gas mileage. As related to running, identifying and correcting slight biomechanical glitches should theoretically improve efficiency and increase speed.

Two Popular Running Techniques

Although there are dozens of running clinics out there, the most popular techniques for teaching running form are Chi Running (2) and Pose Running (3). The ideal running form that Chi and Pose Running recommend are very similar. Both techniques strongly discourage making initial ground contact with your heel. Chi runners are taught to strike the ground with the midfoot; while Pose runners make contact a little farther forward on the ball of the foot. Another key concept in Chi and Pose Running is that you must strike the ground with your lead foot directly beneath your pelvis. Chi and Pose advocates state that because this contact point shortens your stride, when you want to run faster, you must increase your step frequency (i.e., cadence). Overstriding is to be avoided at all costs. Both Chi and Pose say the ideal running cadence is approximately 180 steps per minute.

With more than 50% of runners getting injured each year, the notion that a recreational runner could reduce the risk of injury while becoming faster and more efficient is definitely appealing. The question is, do claims of improved efficiency and reduced injury rates have merit? In the past few years, several studies have evaluated Pose and Chi Running. In 2004, the prestigious journal *Medicine and Science in Sports and Exercise* published a paper in which 20 heel-toe runners were instructed to run using the Pose technique (4). Biomechanical analysis revealed that compared to conventional heel-toe running, Pose running resulted in shorter stride lengths and smaller vertical oscillations of the pelvis. Just as Romanov suggested, Pose runners reduced the magnitude of the initial impact force and also reduced stress on the knee. The only downside was that the Pose runners had increased stress at the ankle.

The results of this study were similar to a more recent study comparing impact forces and movement differences between conventional heel-strike runners and runners experienced in Chi running (5). As with the Pose study, the Chi runners had significant reductions in initial impact force and knee stress, but had to absorb more force with the ankle. Regardless of the added stress on the ankle, these two studies seem to confirm that Chi and Pose running do what they say: they reduce initial impact force while also lessening stress on the knee.

A problem with both of these studies is that the reduced impact forces and lessened knee strain associated with Chi and Pose running most likely had nothing to do with the changes in running form and everything to do with the fact that the Chi and Pose runners ran with shorter stride lengths. If the heel-strike runners would have shortened their strides the same amount as the Chi and Pose runners, they more than likely would have had the same reduction in impact forces, even if they were running with the worst running form possible.

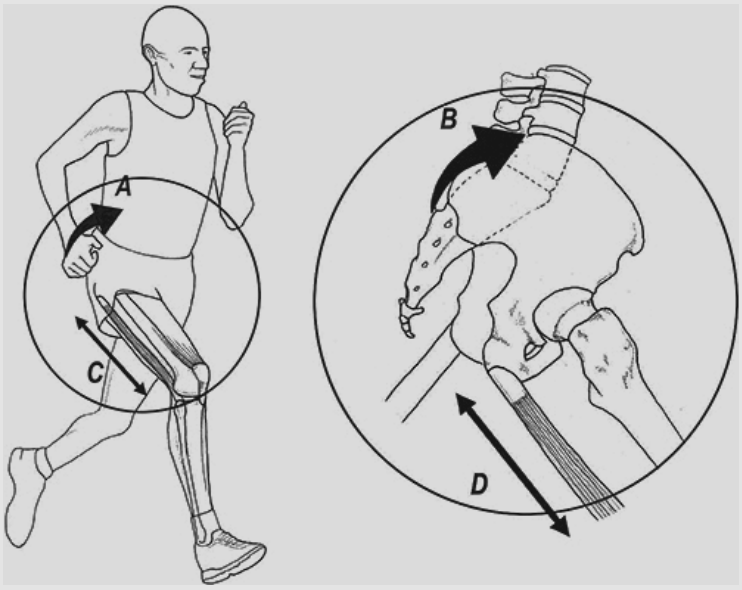

Fig. 1. By leaning slightly forward at the hips (arrows A and B), runners use their upper hamstrings (C and D) to absorb force that would normally be absorbed by the knee. Some great research proves that the world's best runners make initial ground contact with their upper bodies tilted slightly forward, while less efficient runners contact the ground with their spines almost vertical (12).

Impact Forces and Ground Contact

The reason stride length is so important is because impact forces are stride length dependent: the shorter you make your stride, the lower the initial impact force will be. In fact, researchers from the University of Wisconsin (6) prove that regardless of running form, runners who decrease their stride length while increasing their cadence can maintain the same running speed while reducing impact forces by as much as 20%. Rather than having a patient spend years trying to master a specific running form, these authors prove that impact forces can be dramatically reduced with a few simple changes in stride length and cadence.

Another common misconception regarding running form is that it is always better to make initial ground contact with the mid or forefoot. According to many running authorities, striking the ground with your heel should be avoided at all costs. Contrary to popular belief, studies involving thousands of athletes show there is no difference in injury rates between runners making initial contact with the heel and those striking with a more forward contact (7). Furthermore, the vast majority of recreational runners are more

continued on page 12

continued from page 11

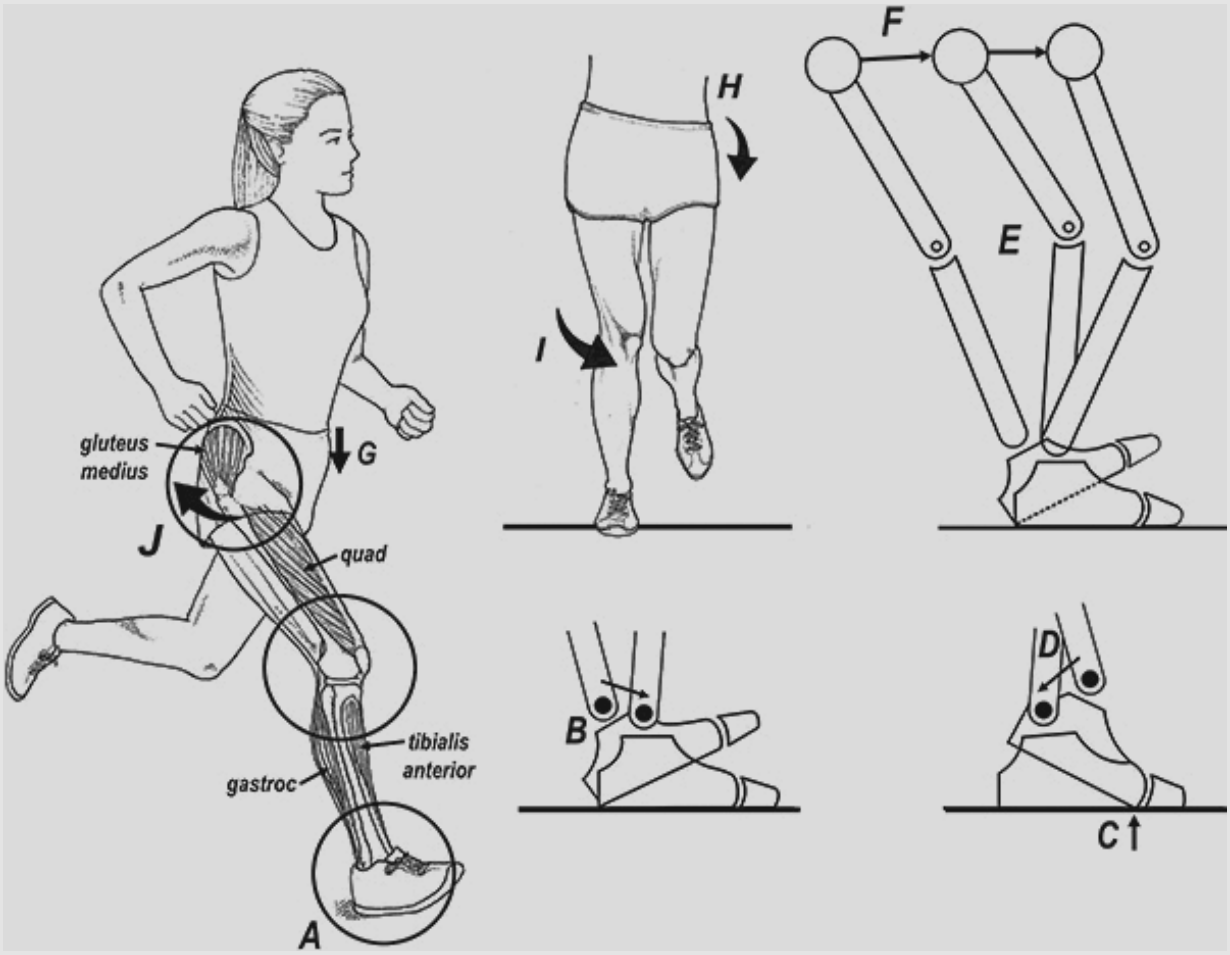

Fig. 2. Joint and muscle interactions present while running. Initial contact (A) can be made with the heel, midfoot, or forefoot. The upside of a heel contact is that it reduces stress on the Achilles tendon and arch and allows the foot to smoothly roll forward **(arrow B)**. The downside is that a heel contact increases force absorbed by the knee. Forefoot contact points (C) allow the gastroc muscle to absorb force, reducing stress absorbed by the knee by as much as 50%. The downside of the forefoot contact is that it can overload the Achilles tendon and the metatarsals. Also, because the initial point of contact acts as a pivot during ground contact (arrow), forefoot contact points cause the heel to initially drop down and back (D), temporarily acting as a brake. Although not illustrated, making contact along the outside of the entire foot (i.e., a midfoot contact point), is often considered the perfect contact point, representing a blend between forefoot and rearfoot contact points. This statement is controversial since 75% elite runners strike the ground along the outside of their heels (13).

Once past the ankle, impact forces travel at about 200 mph into the knee. In addition to allowing the quad to absorb force, bending the knee (E) prevents the hip and pelvis from moving up-and-down too much (F), which is important for injury prevention and efficiency. The gluteus medius muscle is also important for shock absorption because it prevents the opposite hip from lowering (G). The best runners maintain their pelvis in an almost horizontal line, with their knee pointing straight forward. In contrast, runners with poor form allow their opposite hip to drop (H) and their knee to twist in (I). Excessive inward rotation of the knee is one of the worst errors in running form and should be corrected with hip strengthening exercises and gait retraining (i.e., treadmill running in front of a mirror while deliberately keeping the knees moving in a straight line).

Though rarely discussed, backward rotation of the hip at impact (J) is the body's most important shock absorber (14). Excessively stiff and/or weak hips can lead to injuries by limiting the ability of the large hip muscles to absorb shock. Because of this, chiropractic treatments or other effective methods to enhance hip flexibility, especially in the posterior capsule, are important for improving shock absorption. Another common running form problem associated with tight hips is the crossover running gait. In this running form, the athlete allows his or her feet to crossover a midline while running. This style of running increases the risk of lower leg stress fractures and tendon injuries. Again, improving hip flexibility and strength is the key to correcting this running flaw.

If your goal is to have a running patient become fast and efficient, be cautious about making significant changes in form because runners intuitively pick the running style that works best for them.

efficient when striking the ground heel-first. In a recent study evaluating efficiency while running at different speeds, researchers from Spain prove that compared to mid and forefoot strikers, slower recreational runners are almost 10% more efficient when striking the ground with their heels (8). The benefits associated with heel striking continue until runners reach the 6:25 minute per mile pace, after which heel and midfoot contact points are equally efficient. The reduced efficiency associated with mid and forefoot contact points while running at slow speeds explains why Pose Runners, despite having reduced impact forces, are considerably less efficient than conventional heel-strike runners (9).

Studies comparing impact forces associated with different contact points consistently show that the same force is absorbed by your body whether you strike with your heel or forefoot, the force is just absorbed by different joints. Runners who strike the ground with the forefoot absorb more force with their arches and calves, while runners making initial contact with the heel absorb more force with their knees. Force absorption at different locations explains the higher prevalence of Achilles and plantar fascial injuries in mid and forefoot strikers and the higher prevalence of knee pain in heel strikers. This is the biomechanical version of "nobody rides for free." If you're treating a fast runner who has a tendency for knee pain, you might want to consider gradually transitioning the athlete to run with a more forward contact. Conversely, runners plagued by chronic Achilles injuries should be encouraged to run with a heel-first strike pattern in order to reduce the potential for reinjury.

An alternate option for a runner with knee pain is that rather than striking the ground along the midfoot, the athlete should lean slightly forward at the hips during stance phase. Researchers from the University of Southern California (10) prove that a slight forward lean while running transfers forces that would normally be absorbed by the knee into the upper hamstrings and hip with no added force being absorbed by the foot or ankle (Fig. 1). The authors point out that because distance runners rarely hurt their upper hamstrings, rather than increasing the risk of an Achilles injury by transitioning to a midfoot contact point, a better approach would be to incorporate a slight forward lean at the hips.

Keep in mind that while making subtle changes in running form can reduce the potential for injury, the majority of research suggests that making even a slight change in the way you run will reduce overall efficiency. Remember, although runners trained in the Pose style of running have significant reductions in impact forces traveling through the knee, they become significantly less efficient (9). According to exercise physiologist Tim Anderson (11), runners are able to critically evaluate the metabolic cost of every step while running to develop a unique running style that is most efficient for them.

Even though changing running form almost always results in reduced efficiency, there are certain movement patterns present in runners that greatly increase the risk of injury and should therefore be modified. Figure 2 reviews the basics of running form and describes common flaws that should be corrected. Excessive inward rotation of the hip during stance phase is especially problematic because it often results in chronic retropatellar pain.

Conclusion

In summary, the research on running form consistently shows that if your goal is to have a running patient become fast and efficient, be cautious about making significant changes in form because runners intuitively pick the running style that works best for them. The most effective way for advanced runners to improve form and efficiency is to perform high-intensity plyometric drills designed to increase tendon resiliency. Improvements in running form will naturally follow. Conversely, if your goal is to have a running patient avoid injury, the easiest way to do this is to reduce impact forces by shortening the overall stride length while increasing cadence. Because the best predictor of future injury is prior injury, you should encourage a running style that accommodates prior injuries; e.g., runners with a tendency for knee pain should consider making initial ground contact on their midfoot, while runners with a history of Achilles injuries should strike the ground heel first. The bottom line is that excluding a few obvious examples, such as excessive inward rotation of the knee and/or excessive frontal plane motion at the pelvis, the runner is almost always the best judge at choosing the running form that is right for them.

Dr. Thomas Michaud specializes in biomechanical and gait disorders and is the author of numerous book chapters and journal articles on a variety of subjects ranging from biomechanics of the first metatarsophalangeal joint and shoulder, to the pathomechanics and management of vertebral artery dissection. He is also the author of the textbook Foot Orthoses and Other Forms of Conservative Foot Care*, which has been translated into four languages and used in physical therapy, chiropractic, pedorthic, and podiatry schools around the world.*

REFERENCES

1. Kahn J. The Perfect Stride: Can Alberto Salazar straighten out American distance running? *The New Yorker*. November 8, 2010.

2. Dreyer D. (2004) *Chi Running: A Revolutionary Approach to Effortless, Injury-Free Running.* New York, NY: Simon & Schuster.

3. Romanov N. (2002) Pose Method of Running. Coral Gables, FL: Pose Tech Press. .

4. Regan A, Noakes T, Azevedo L, et al. Reduced eccentric loading of the knee with Pose Running method. *Med Sci Sports Exerc* 2004; 2:272-277.

5. Goss D, Gross M. A comparison of negative joint work and vertical ground reaction force loading rates in Chi runners and rearfoot-striking runners. *J Orthop Sports Phys Ther* 2013; 10:685-692.

6. Heiderscheit B, Chumanov E, Michalski M, et al. Effects of step rate manipulation on joint mechanics during running. *Med Sci Sports Exerc* 2011; 43:296-302.

7. Kleindienst F, Campe S, Graf E, et al. Differences between fore- and rearfoot strike running patterns based on kinetics and kinematics. XXV ISBS Symposium 2007, Ouro Preto, Brazil.

8. Ogueta-Alday A, Rodriguez-Marroyo J, Garcia-Lopez J. Rearfoot striking runners are more economical than midfoot strikers. *Med Sci Sports Exerc* 2014; 3:580-585.

9. Dallam G, Wilbur R, Jadels K, et al. Effect of global alteration of running technique on kinematics and economy. *J Sport Sci* 2005; 7:757-764.

10. Hsiang-Ling T, Powers C. Sagittal plane trunk posture influences patellofemoral joint stress during running. *J Orthop Sports Phys Ther* 2014; 10:785-792.

11. Anderson T. Biomechanics and running economy. *Sports Med* 1996; 22:76-89.

12. Williams K, Cavanagh P. Relationship between distance running mechanics, running economy, and performance *J Appl Physiol* 1987; 63:1236-1246.

13. Hesegawa H, Yamauchi T, Kraemer W. Foot strike patterns of runners at the 15-km point during an elite level half marathon. *J Strength Cond* 2007; 21:888-893.

14. Pandy M, Berme N. Quantitative assessment of gait determinants during single stance via a three-dimensional model-Part 1. Normal gait. *J Biomech* 1989; 22:717- 724.

Reprinted with permission from Dynamic Chiropractic *2015; (33)13.*