Is There An Ideal Running Form?

Making a few small changes in the way you run can make you faster, more efficient and possibly less injury-prone. But how do you know which changes to make?

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The best running coaches in the world continually have their athletes work on their running form, either through daily drills or through significant biomechanical adjustments. Nike Oregon Project coach Alberto Salazar is famous for changing everything from the tilt of a runner's pelvis to the position of his or her thumbs.

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 how automakers blow streams of smoke over a car's exterior in a wind tunnel to identify design inefficiencies that could result in reduced gas mileage. As related to running, identifying and correcting slight biomechanical glitches should theoretically improve efficiency and increase speed.

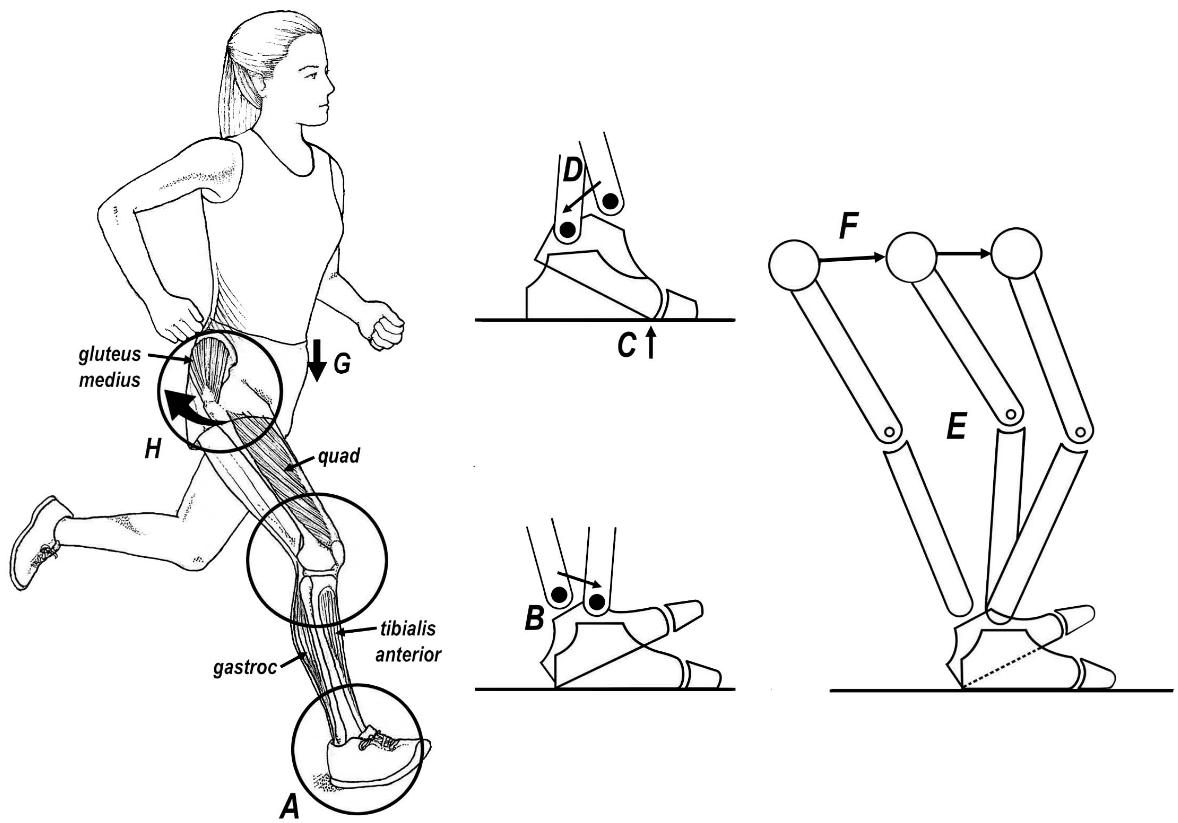
With more than 50 percent of runners getting injured each year, the notion that you can reduce your risk of injury while becoming faster and more efficient is definitely appealing. The question is, do claims of improved efficiency and reduced injury rates have merit?

In the past decade, several studies have evaluated two of the most popular running form techniques, the Pose Method and Chi Running. In 2004, the prestigious journal Medicine and Science in Sports and Exercise published a paper in which 20 runners with heel-striking gaits were instructed to run using the Pose technique. 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 Dr. Nicholas Romanov, founder of the Pose method 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. 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: reduce initial impact force while also lessening stress on the knee.

A problem with both of these studies, however, 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 were trained to run 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. 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, in 2011, researchers from the University of Wisconsin proved 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

Joint and Muscle Interaction Necessary to Absorb Force



Heel Strike. 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 Strike. Forefoot contact points (**C**) allow the gastroc muscle to absorb force, reducing stress absorbed by the knee by as much as 50 percent. 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.

Bent Knees. Once past the ankle, impact forces travel at about 200 miles per hour 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.

Gluteus Medius. The gluteus medius muscle is also important for shock absorption because it prevents the opposite hip from lowering (**G**).

Pelvis and Knee Rotation. 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 almost always be corrected with gait retraining (i.e. treadmill running in front of a mirror while deliberately keeping your knees moving in a straight line) and specific strengthening exercises.

Hip Rotation. Though rarely discussed, backward rotation of the hip at impact (**w**) is the body's most important shock absorber. 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, world-class runners spend a lot of time keeping their hips flexible and strong.

percent. Translated: Rather than spending years trying to master a specific running form, you can dramatically reduce impact forces by making the simple changes of reducing your stride length and increasing your cadence.

You can only shorten your stride length and increase your cadence so much, however. Many running experts tell you that you can run faster and more efficiently by only increasing your cadence. This is not the case. Rapidly accelerating and decelerating each leg causes the hip muscles to burn so many calories that the metabolic cost of running (the amount of caloric energy required for those movements) skyrockets. Because distance runners can't afford to spend any extra energy getting to the finish line, they almost always increase stride lengths when they need to run faster. In a classic study evaluating stride lengths and cadences at different running speeds, physiologist Peter Weyand and his colleagues showed that experienced runners increase from a slow jog to a 6:45 minute-mile pace by increasing stride length only. After that, faster running speeds are achieved by mostly increasing stride length with only slight increases in cadence. It isn't until you reach an all-out sprint that stride length is maximized and the final burst of speed is accomplished by a rapid increase in cadence. To sum it up: moving the swinging leg back and forth is a metabolically expensive option that you try to avoid.

Fast runners have to make ground contact with the foot positioned well in front of them to achieve a longer stride length. The more forward contact point produces an unavoidable increase in impact forces as the lead leg acts as a brake to stop the runner's forward motion. Unfortunately, these longer stride lengths increase impact force from 1.5 to 5 times a runner's body weight with each foot strike, translating into an additional 5,000 tons of force that the elites must absorb during the course of the marathon. Despite the added stress, however, these athletes manage to run 26.2 miles with relatively few signs of distress.

Elites prove that it's not the degree of impact force that does the damage—it's how you absorb the force. Think about the way you would catch a baseball thrown at you at 90 mph with your bare hands; if you held your arms and shoulders stiff, the ball might break your hand. Conversely, if you move your shoulders, elbows and wrists just right, you can catch even the fastest pitches without a problem because you're softening the impact. That's essentially what elite runners do: they smoothly absorb impact forces that would break bones in recreational runners by moving their feet, legs, knees and hips with the perfect series of movements.

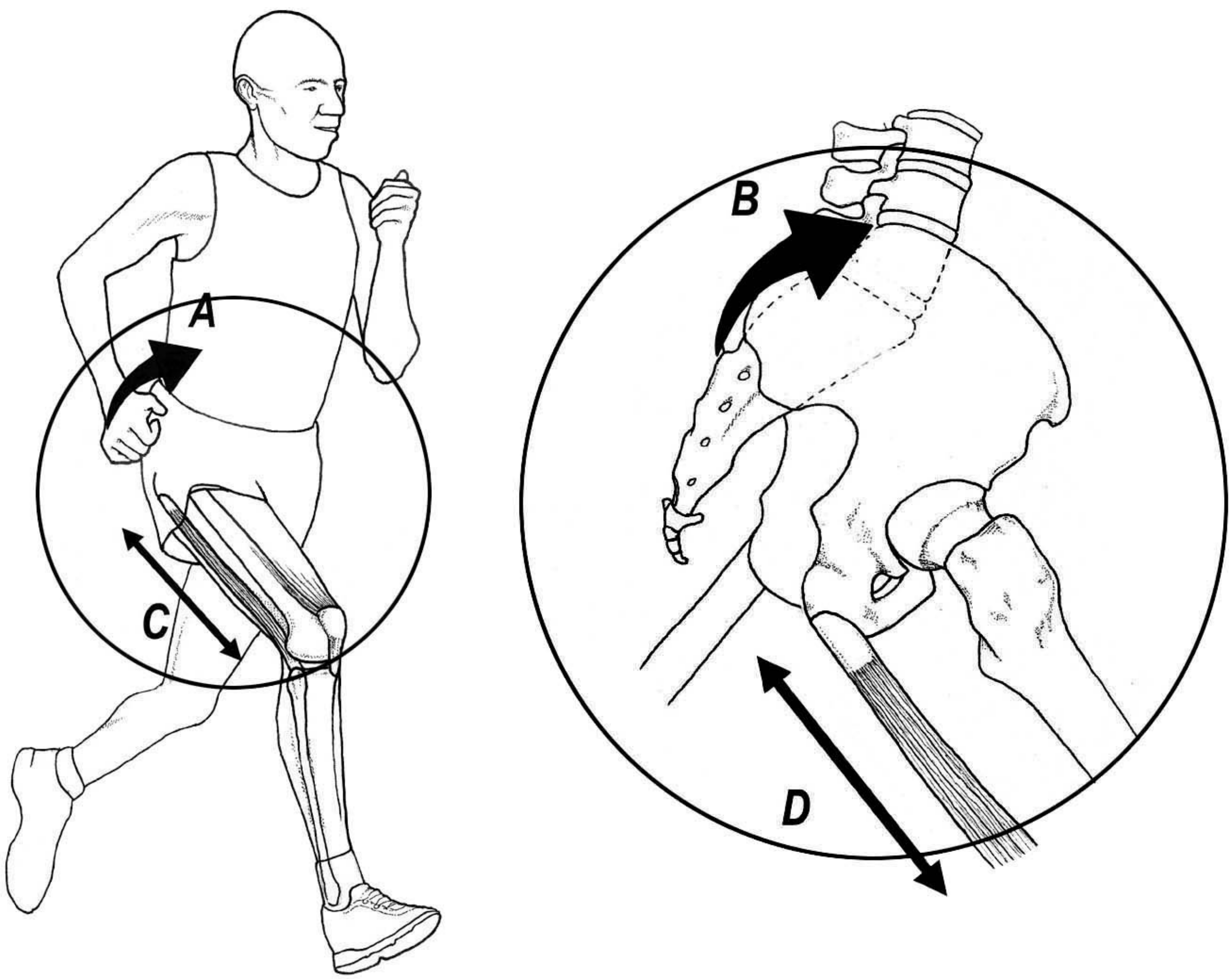
Putting aside the incorrect notion that in order to run fast all you need to do is increase your cadence, another common misconception regarding running form is that it is always better to make initial ground contact with the mid-foot or forefoot—that striking the ground with your heel should be avoided 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. The vast majority of recreational runners are actually more efficient when heel striking. In a recent study evaluating efficiency while running at different speeds, researchers from Spain proved that compared to mid-foot and forefoot strikers, slower recreational runners are almost 10 percent more efficient when striking the ground with their heels. 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 midfoot 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.

Studies comparing impact forces associated with different contact points consistently show that the same force is absorbed by your body, regardless of how your foot strikes the ground. 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 midfoot 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 a fast runner and you have a tendency for knee pain, you might want to consider gradually transitioning into a more forward contact. Conversely, if you've been plagued by chronic Achilles injuries, a shift to a heel-first strike could reduce your potential for reinjury.

Keep in mind that while making subtle changes in running form can reduce your potential for injury, the majority of research suggests that making even a slight change in the way you run will reduce your overall efficiency.

A recent paper published in the Journal of Strength and Conditioning showed that by incorporating explosive plyometric drills into their routines, runners were able to improve endurance 6 percent across three different running speeds with a 3 percent increase in 3K race performance. The authors attributed the improved performance and speed to an enhanced ability of muscles and tendons to store and return energy following completion of the plyometric drills.

In another paper, Australian researchers had high-level runners perform a series of six, 10-second strides while wearing a weighted vest (fitted with 20 percent of their body weight). A control group of runners performed the



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.

same running drills without the weighted vests. The researchers noted that shortly after performing the drills, the runners who performed the drills while wearing the weighted vests had huge improvements in peak running speed and economy. Apparently, the weighted vests allowed for faster running times and improved efficiency because the vests forced the runners to stiffen their knees and hips in order to absorb forces associated with carrying the added weight. The increase in leg stiffness resulted in large improvements in performance and economy because stiff muscles are more efficient at storing and returning energy. The improved form persists even after the weights are no longer worn. Runners can increase leg stiffness after just a few weeks of strength and plyometric training, and by performing high-intensity uphill interval training.

It's hard to argue with the research on running form. If your goal is to become fast and efficient, be cautious about making significant changes in form because you intuitively pick the running style that works best for you. Conversely, if your goal is to remain injury-free, the easiest way to do this is to reduce impact forces by shortening your stride length and increasing your cadence. Because the best predictor of future injury is prior injury, you should also develop a running style that accommodates your 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, in spite of what many running experts tell you, you will always be the best judge of choosing the running form that is right for you.

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