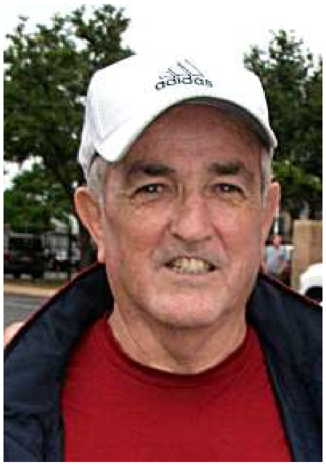
THE PERFECT STRIDE – Part 1I

FIVE CHARACTERISTICS OF GOOD RUNNING TECHNIQUE



The use of technique drills in run training is not nearly as radical as the constant use of proprioceptive cues, but even so, technique drills are under-utilized by most runners. There are basically six drills that specifically enhance each of the five characteristics of good running form.

There is no single, unified standard that defines “correct” running technique. Individual runners achieve success in running with disparate strides, just as individual baseball players achieve success as batters with distinctive swings. But there is a core set of stride characteristics that are common to all of the best distance runners----that is, all of the fastest and least injury-prone runners. These characteristics are seen in tall elite runners, such as the marathon world record holder Paul Tergat; in short elite runners, such as Kenenisa Bekele (the world record holder at 5,000 and 10,000 meters); and in both male elites and female elites, such as Meseret Defar (the women’s world record holder at 5,000m). They represent one of the major factors that make elite runners elite runners. And the absence of these characteristics (or an insufficiency thereof) is a major factor that makes the rest of the running population non-elite.

The five core characteristics of a world-class stride are stiffness, ballistic action, compactness, stability, and symmetry. Let’s take a closer look at each of the five characteristics of the world-class running stride, and at the common deviations from these characteristics that everyone should work on.

Stiffness

When you watch world-class runners like Kenenisa Bekele and Meseret Defar in action, the last word you might think have using to describe their running style is “stiff.” These runners look smooth and fluid, not stiff. It’s the back-of-the-pack runners shuffling along in their lock-kneed manner who look stiff.

Nevertheless, a certain type of stiffness is actually a hallmark characteristic of the best runners’ strides. Elite runners have the most stiffness, while lesser runners could use a lot more of it. The type of stiffness I am referring to is the type that physicist talk about in relation to springs. The human body does in fact function as a sort of spring during running, and just as a spring with adequate stiffness will bounce more efficiently than a spring that’s too loose, a runner who exhibits sufficient muscular stiffness when his or her foot strikes the ground will run more efficiently than a runner whose muscles are too loose on impact.

A spring works by reusing energy. When it falls to the ground from a given height it compresses, which converts the “kinetic” energy of the fall into “potential” energy stored in the form of tension in the spring. As the spring returns to its natural length it converts this potential energy back into kinetic energy in the form of a vector force directed into the ground. As a result, the spring bounces back up into the air.

Something very similar happens when we run. The difference is that whereas a spring-powered device such as a pogo stick achieves movement with energy that is release when its spring is *compressed* on impact and then *expands* back to its natural length, a runner's legs do the opposite. As the runner's foot makes contact with the ground, tendons and elastic components of certain muscles stretch beyond their natural length, thereby capturing and storing energy from the impact. As these tissues return to their natural length, this energy is released. Precisely timed and intricately coordinated muscle actions direct the energy back into the ground, sending the runner's body upward and forward.

Few runners realize just how much energy they are able to reuse thanks to this spring effect. Research has shown that runners consume oxygen at a rate that is sufficient to produce only about half of the energy needed to run at any given speed. The other half is provided by the spring effect.

A stiffer spring is able to reuse more energy than a looser spring because it returns energy to the ground faster. A looser spring stretches and compresses too slowly, allowing more stored energy to dissipate as heat or friction. Top runners spend less time with each foot on the ground than average runners, in part because their superior stride stiffness allows them to return more energy to the ground faster. Ironically, this is one reason why the elite runner's stride looks smoother and more fluid. These runners spend more time "floating" in the air and get more of their energy for free, so they don't have to produce as much energy through muscle contractions to propel forward movement.

What contributes to stride stiffness? Part of it comes from the actual elastic properties of the muscles and tendons themselves. These properties can be enhanced through proper training. The other part comes from running technique. A runner with excellent technique is able to coordinate his or her muscle actions in a way that increases the amount of energy that is reused for forward thrust. For example, top runners do a better job of prestretching and stiffening certain muscles (particularly the hamstrings) just before the foot makes contact with the ground, which enables the runner to capture more energy in the muscles and tendons, return it to the ground more quickly, and direct more energy backward, resulting in more forward thrust.

Compactness

There are two variables that determine running speed: stride length and stride rate. The longer your stride is at any given striding rate, or cadence, the faster you run. Likewise, the higher your cadence is at any given striding length, the faster you run. The best runners tend to make shorter strides (and hence have a higher stride rate) at any given speed than average runners. This style of running is often referred to as a "compact" stride.

The compactness of a stride is determined primarily by where the foot lands (or, more precisely, by the placement of the foot when the support leg becomes fully weighted). If the foot is directly underneath the hips, the stride is compact. If the foot is in front of the hips, the runner is over striding.

When the foot lands in front of the body there is a lack of stability. To understand why, perform the following test. Stand normally, and then lift one foot off the ground. Is it difficult to balance in this position? (Not terribly). Now stand in a split stance with one foot half a pace in front of the other. Lift your rear foot off the floor. Can you balance in this position? (Impossible) Your point of support is not aligned with your center of gravity.

This is essentially the problem faced by runners whose feel land ahead of their hips. Due to the difficulty of balancing in this position, runners who over stride have to put a lot of energy into stabilizing the body against impact forces and gravity before they can begin to generate thrust. Consequently, the foot must remain in contact with the ground longer. The thrust phase will not really begin until the foot is behind the body's center of gravity, which is bad, because in this position the support leg's joint angles and muscle lengths are not optimal for generating power.

Over striding also produces a breaking effect that kills forward momentum and increases the amount of thrust energy that is required to sustain any given running speed; Thus, when your forward leg is reaching ahead on foot strike, the impact forces that travel up your leg move *backward*, against your direction of travel. By contrast, when your foot lands underneath your hips, the impact forces that travel up your leg move more or less straight up, neutral to your direction of travel. To minimize the breaking effect of over striding, runners who possess this particular stride flaw unconsciously try to land softly. Unfortunately, the softer you land, the more "free" elastic energy you waste, because it dissipates before you can reuse it. You transform yourself into a loose spring.

When your foot touches down beneath your body, you can begin to generate thrust immediately. In fact, the best runners begin to generate backward thrust *before* their foot even touches the ground. As a result, they are able to minimize the amount of energy they put into stabilization, use more free elastic energy provided by muscle and tendon pre-stretch and by ground impact forces, minimize ground impact time, and push off with more force. Because they begin to generate thrust when the foot is directly underneath the hips, they are able to create more power because their joints are at the optimal angles and their muscles are at the optimal lengths for power production. They are also able to push off sooner, with the foot not as far behind the body, thus enhancing the stride's compactness.

It's important to note that while compact runners tend to make shorter strides than over striders at any given running speed, compact runners are generally *able* to run with much longer strides than over striders. This is just another way of saying that compact runners are able to run faster. As runners increase speed, their stride length changes much more than their stride rate. The stability and power of a compact stride enable a compact runner to cover huge distances in the air between foot strikes compared to over striders. (Below, look at Dawn Grunnagle below leading the pack at the Music City Mile in 2014, and a younger Joe Boyle -- both springing off the ground).

Ballistic Action

Ballistic muscle actions are short and fast rather than sustained and gentle. Many distance runners believe that the ideal pattern of muscle action during running is sustained and gentle. The idea is to use energy evenly throughout the stride, landing softly, staying relaxed, and avoiding wasteful "peaks" and lazy "valleys" in muscle work. In reality, the best runners have a ballistic style of running. They contract their muscles extremely forcefully---much more forcefully than average runners do---during a small slice of the overall stride that begins in the moment of bracing for impact, continues through a very brief ground contact phase, and terminates at push-off. (This anticipatory tensing of the muscles is a major factor in creating the stiffness that enables particular leg muscles and tendons to capture more elastic energy when they are forced to stretch on foot strike.) They then relax their muscles as they float in the air between foot strikes---and they spend much more time floating between foot strikes than average runners do.

Ballistic runners use more energy during that sliver of the stride when their muscles are working the hardest, but they use less energy overall, because they get more free elastic energy and they spend more time floating and relaxing. If you closely watch elite runners in competition this ballistic pattern will be quite evident. You will see them stiffen their leg before foot strike and then drive their foot into the ground, almost seeming to bounce off it. A noticeable relaxation of the muscles follows as the runner floats airborne before stiffening once more in anticipation of the next foot strike.

Stability

Running subjects the joints of the body to tremendous downward-pulling forces. Half of the energy we use to run goes toward simply preventing our bodies from collapsing to the ground each time our feet make contact with it. The best runners are able to prevent joint collapse better than average runners. If you watch average runners in action you will see that they tend to bend the knee of their support leg more on impact and also that the hip of the unsupported (swing) leg dips toward the ground while the support foot is planted. And if you're really observant, you'll notice that the pelvis tips forward more on impact in average runners. These excessive joint movements waste a lot of energy and put extra strain on the joints that can lead to injuries.

Joint collapse is a type of stride flaw that tends to result from other stride flaws. Over striding is the big one. When your foot lands out in front of your body, your muscles are not in a good position to absorb the impact forces that the ground sends shooting up your legs and by the time your body has caught up to your foot, these forces will have had time to pull you toward the ground at your most susceptible points: the knees, pelvis, and hips.

Symmetry

No runner runs with perfect left-right symmetry, however the best runners tend to run more symmetrically than others. All kinds of different asymmetries may crop up in a runner's stride, from the shoulders all the way down to the feet. One foot usually lands harder than the other and one foot usually pronates more than the other. The angles of the knee and hip on impact are different in the right leg than they are in the left. One leg produces more thrust than the other and the same muscles are activated to different degrees on either side of the body to produce this thrust. As long as such discrepancies are small, they are nothing to worry about. But large asymmetries are always wasteful and also tend to increase injury risk.

One of the most problematic asymmetries is long axis rotation, or twisting of the spine. Long axis rotation tends to develop in runners who are not able to begin the thrusting phase of the stride until late in the stance phase, when the body has already passed ahead of the foot. To make up for the inability of the muscles to develop adequate force in this position, the runner must keep the foot in contact with the ground longer for an extra last-moment push-off. And to keep the foot on the ground longer, the runner must rotate the pelvis in the direction of the trailing leg, which in effect makes this leg longer. Finally, to compensate for this movement, the runner must throw the opposite shoulder forward. As a result the lower (lumbar) spine twists in one direction and the upper (thoracic) spine twists in the opposite direction.

These rotational movements are very wasteful. In most runners who exhibit them, they are more pronounced on one side of the body than on the other. Top runners typically run with their hips and shoulders more square to their direction of travel. They are able to keep their pelvis fairly neutral by generating thrust early, when the foot is still underneath the body.

As you have probably noticed, the five characteristics of good running form are interconnected. Any specific movement pattern that enhances one characteristic is likely to affect most if not all of them. On the other hand, any specific deviation from good form that affects one characteristic is likely to affect most if not all of them.

For example, suppose you change your stride by stiffening your leg more in the moment preceding impact. This one change will enhance the stability of your joints in absorbing impact, reducing energy waste and increasing the amount of free elastic energy you are able to reuse for the thrust. Due to greater stiffness and stability, you will be able to generate thrust earlier, thus reducing ground contact time and increasing float. The ability to generate thrust more quickly will also reduce tendencies toward asymmetrical torso rotations and over striding. Your stride is also now inherently more ballistic, because you are concentrating more muscle work within smaller slices of the overall stride.

Some experts in the biomechanics of running now view the stride as a *complex dynamical system*, much like climatic systems and market economies, where one small change can have system-wide effects. From our perspective as runners trying to improve our stride this is a good thing, because it means we can improve our entire stride by working on one aspect of it at a time