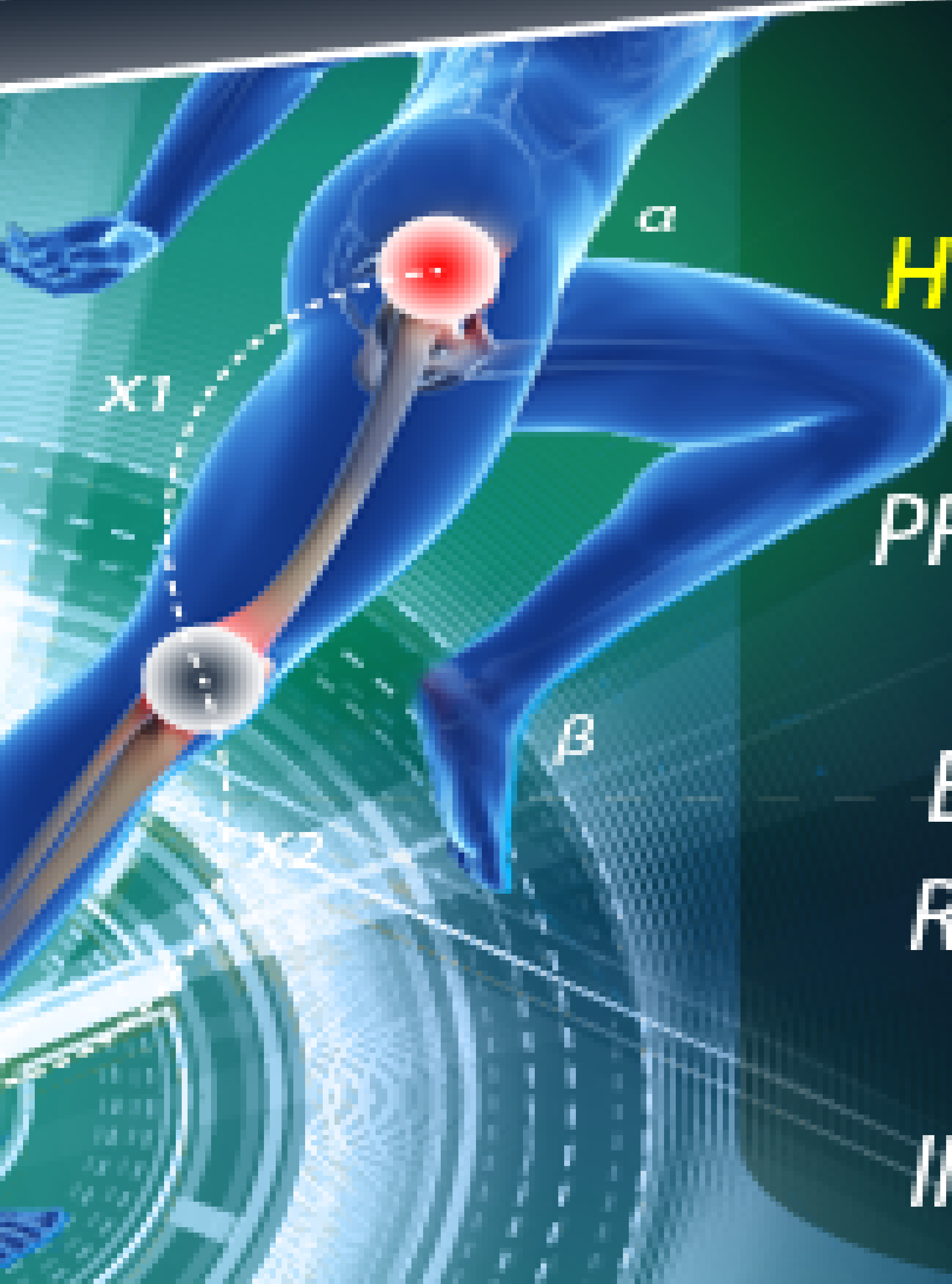
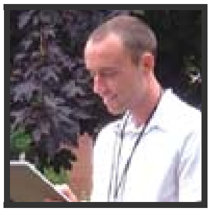
RUNNING FORM COURSE



Learn
HOW TO RUN
with
PROPER FORM
to Increase
EFFICIENCY,
RUN FASTER,
and Stay
INJURY-FREE

Introduction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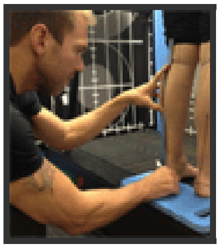
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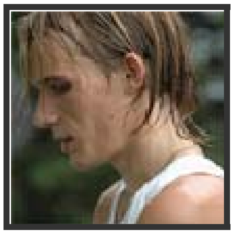
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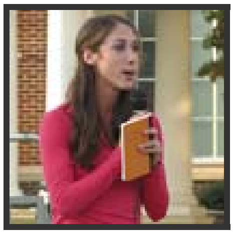
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First, we wanted to say thank you for downloading the Running Form eBook. This guide has been a labor of love and a collection of research, personal experience, and conversations with some of the best coaches and minds in our sport. By following the principles outlined in this eBook, we are confident you can become a stronger, healthier and faster runner and achieve the results you're looking for.

One of our my main reasons for writing this guide was to help broaden your knowledge and dispel some of the myths about what proper form is and isn't – and how you can improve it. This eBook also serves as a great precursor to our Running Form Course.

We've tried our best to detail and outline the research available so you can be confident that the time you're investing in improving your form will pay off. If you have any questions or read anything you want to discuss in more detail, please don't hesitate to e-mail me at jeff@runnersconnect.net.

Finally, we want this information to benefit as many runners as possible. So, please feel free to e-mail it to all your running friends, share it via Facebook and Twitter, and get the word out. For the latest updates and information, you can visit our website: http://runnersconnect.net; follow us on Twitter @runners_connect; or join us on Facebook . Enjoy!

The RunnersConnect Team

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Introduction to Running Biomechanics

bi·o·me·chan·ics

/ˌbīōməˈkaniks/

Noun

The study of the mechanical laws relating to the movement or structure of living organisms.

If the above has turned you off slightly, I totally understand. It's hard to go for a run these days without worrying about where our foot is landing, what shoe we're wearing, or optimal stride frequency.

Surely running can't be so complicated! The good news is, it doesn't have to be!

The first thing you can do is discount anybody out there who tells you that *their* way is the *only* way. If that were the case, all elite, world-class runners would have the same running style, and quite simply they don't.

Running, like any sport, is a skill for which improvement will depend on suitable conditioning and active development, but it's about building on *your* individual running style, as opposed to basing your training regime on what happens to work well for somebody else.

Having a basic understanding of the biomechanics of running can help you appreciate your own running form and see where you may be able to make improvements. It can also help you make more sense of what you read and hear with regards to running styles, training programs, conditioning exercises, footwear, etc.

Although running most definitely depends on *whole body interaction*, dividing the running stride up into individual components or "phases" can help us understand how slight changes can help improve performance and reduce susceptibility to injury.

Getting Started: The Gait Cycle

Our introduction to running biomechanics can begin by looking at what we call The Gait Cycle. This cycle starts when one foot makes contact with the ground, and ends when that *same* foot makes contact with the ground again.

It can be divided up into two "phases" – the *stance phase* (during which the foot is in contact with the ground) and the *swing phase* (during which the foot is *not* in contact with the ground).

The stance phase is typically considered as the more important of the two as it is when the foot and leg bear the body weight. The swing phase is (or rather should be) *passive*, i.e. not consciously controlled.

Trying to actively help the leg move through the swing phase is an example of where runners can waste energy, e.g. by consciously trying to lift the heel higher towards the backside, or trying to lift the front knee higher. We'll look at that in more detail in weeks to come. For now, let's look at the components that make up the stance phase.

The Stance Phase

This can be divided into four stages: initial contact, braking (absorption), midstance, and propulsion.

1. Initial contact

Let's imagine you are at that moment in your stride when both feet are off the floor (sometimes referred to as *float phase*). Your left leg is out in front of you and about to touch the ground. This moment (whether you land on heel, midfoot, or forefoot) is called *initial contact* and marks the beginning of the stance phase. Your right foot behind you is off the floor and in swing phase.

2. Braking (absorption)

As soon as your left foot makes contact with the ground in front of you, your body is in effect performing a *controlled landing*, managed via deceleration and braking. Your left knee and ankle flex (the opposite of straighten) and the left foot rolls in (pronates) to *absorb* impact forces. During this process of absorption, the tendons and connective tissue within the muscles store elastic energy for use later in the *propulsion phase*.

3. Midstance

The braking phase above continues until the left leg is directly under the hips taking maximum load (maximum risk of injury) as the body weight passes over it. The left ankle and knee are at maximum flexion angle. This moment is called midstance (you may also hear it referred to as single support phase).

4. Propulsion

Now that your left leg has made a controlled landing and absorbed as much energy as it's going to get, it starts to propel you forwards. This is achieved by your left ankle, knee and hip all *extending* (straightening) to push the body up and forwards, using the elastic energy stored during the braking phase above. The more elastic energy available at this stage, the less your body has to use the muscles.

The propulsion phase ends when the toe of your left foot (now behind you) leaves the ground, commonly referred to as "*toe off*" (TO). At this point, both of your feet are off the ground so you are once again in *float phase*.

Research shows that at least 50% of the elastic energy comes from the Achilles and tendons in the foot.

The Swing Phase

At the moment of *toe off*, your left leg has travelled as far back as its going to and the heel starts to lift towards your backside. As I mentioned earlier, this is a passive movement (as opposed to a conscious effort), with the height that the heel reaches depending on the degree of hip extension achieved and the speed you are running at.

Steve Magness, Head Cross Country Coach at University of Houston, compares this *stretch reflex mechanism* to the stretching back of a sling shot and then letting go. Extension of the hip (as your back leg moves behind you prior to toe off) is equivalent to pulling back on the sling shot.

Letting go results in the leg firing forwards rapidly, leading with the knee. Any conscious attempt to move the leg through the swing phase (Steve refers to it as the "recovery phase") results in wasted energy and a less powerful firing of the slingshot.

Once the knee has passed under the hips, the lower leg unfolds in preparation once again for initial contact, marking the end of the swing phase.

Upper body and arm mechanics

The interaction between the upper and lower body plays a vital role in running, the upper body and arm action providing balance and promoting efficient movement. This balance is achieved by the arms and upper body effectively working in direct opposition to the legs. Bringing the left arm forward opposes the forward drive of the right leg, and vice versa.

During the braking (absorption) stage described above (initial contact to midstance), the arms and upper body produce a propulsive force.

During the propulsion stage (midstance to toe off), the arms and upper body produce a braking force.

By working as opposites, forward momentum is maintained. The arms and upper body also counterbalance rotation in the midsection. For example, as the right knee is fired through in front of the body (right swing phase) an anticlockwise momentum is created. To counterbalance this, the left arm and shoulder move forwards to create a clockwise momentum to reduce rotational forces.

To help the above occur as efficiently as possible, arm swing should be initiated at and through the shoulders. Driving the elbows *down* as well as back can help avoid elevation of the shoulders, which in itself causes tightness and limits range of motion.

Just as bringing the knee through in swing phase needs to be a passive movement, so does the forward movement of the arm. Driving your arms up and forwards wastes energy and reduces the efficiency of the *stretch reflex mechanism* in the shoulders. Your hands crossing the midline of the body is a sign that you may be driving the arms forwards instead of backwards, or that you have tightness in the chest.

Correcting arm crossing can increase efficiency, as can ensuring that the elbow angle only changes slightly (as a result of elastic response as opposed to active movement)

On a final note, bringing the arm too far back (or forwards) can lead to over striding which, as will be discussed in future articles, can cause excessive braking and lead to injury.

Improving your mechanics

There are many suggested methods out there – isolated exercise, functional exercise, drills, cues, etc. so we will take time to consider them in more detail. Before we get to that, we want to round out your understanding of the gait cycle.

I will leave you with one final tidbit though: It is generally agreed that changes to habit, and therefore running form, cannot happen through *consciously* forced technique changes. Instead, they need to be learned over time through an unconscious evolution that can be broken down into the following four-stage process:

1. Unconscious Incompetence

At this beginning stage, you are unaware of any need to improve and so cover your running distance without suspecting anything needs changing.

2. Conscious Incompetence

Armed with your new knowledge of biomechanics, you now run conscious of where you could be improving your efficiency. By performing suitable strength & conditioning and/or working with a coach, you can begin to make modifications.

3. Conscious Competence

Through adequate conditioning & correction, you now run with awareness of what you are doing better. There are times when you still need to think about your running form so it is not yet coming completely naturally.

4. Unconscious Competence

Congratulations! You have managed to change your form and do not have to think about it whilst running.

Heel Striking, Overstriding, and Cadence

Now that we've taken a look at the individual components that make up a single stride, collectively referred to as the *Gait Cycle*, we can begin to examine each of those phases in more depth.

Although running depends on *whole body interaction*, being aware of the individual components of the Gait Cycle can help you appreciate how slight modifications to *your* running form can have a knock on effect that can lead to overall improvement in performance and less susceptibility to injury. **The key words in that sentence are YOUR RUNNING FORM**

Despite claims made by marketed running styles like *Chi*, *Pose* and *Evolution*, differences in our biological make-up strongly suggests that what works for one runner will not necessarily work for everybody.

The fact that elite, world class runners possess different running styles strengthens the argument against a *one-style-fits-all* approach. However, there *are* some elements common to almost all successful running styles, and it is these that we shall begin to look at in this week's article.

Initial contact

Over the last couple of years, the rise in popularity for barefoot running and minimalistic shoes has fueled debate over what part of the foot should touch the ground first – the *heel*, the *midfoot* or the *forefoot*.

We'll discuss this in much more depth momentarily, but as you will see from his article, much of the data seems to contradict itself, advantages being uncovered only to later reveal disadvantages. **However, what studies *do* suggest is that the issue is not so**

much what part of your foot touches the ground first, but how *close* that initial contact is to underneath your hips, i.e. your centre of mass.

Heel striking

Over the last couple of years, the heel strike (also known as a *rearfoot* strike) has been increasingly labelled as the chief perpetrator of running injury. This is curious when we consider the results of a study done by Pete Larson at the 2009 Manchester City Marathon. Using a high speed camera, Larson filmed runners at the 10km and 32km points of the race, and later classified them according to their foot strike.

At the 10K mark, his results for 936 runners were as follows:

Heel strike: 88.9%; midfoot: 3.4%; forefoot: 1.8%; asymmetrical 5.9%

At the 32K mark, Larson identified 286 runners of the above runners, displaying the following:

Heel strike: 93% (87.8% were also heel striking at 10k.). Forefoot: 0%

In light of these performance results, how can heel striking be regarded as inefficient?

The answer could well be in what we saw earlier: running efficiency is not so much a question of what part of the foot touches the ground first, but how *close* initial contact is to underneath the hips, i.e. your centre of mass.

In other words, a heel strike that lands *close* to the hips and on a bent knee causes no significant over-braking or over-loading to the knee.

It is what coaches often refer to as a “glancing” or “proprioceptive” heel strike and should *not* be primary cause for concern or preoccupation. This is the heel-strike sometimes seen in elite athletes, a classic example being that of American long distance specialist Mebrahtom "Meb" Keflezighi, silver medalist in the 2004 Olympics men's marathon, winner of the 2009 New York City Marathon, 4th place in the 2012 Olympics.)

Overstriding

In contrast to the above is the act of *overstriding*, where the foot comes into contact with the ground well ahead of the hips.

More often than not with overstriding, it is the heel that strikes first but of more relevance is the fact that, as seen in the photo below, the knee is straight and locked out.

Overstriding is commonly associated with the creation of greater braking forces and excessive impact. Research has shown that a more extended knee contact angle can increase the forces experienced by the body and therefore increase injury potential.

An interesting observation of runners who overstride is the fact that they take fewer *steps per minute* (at a given running speed) than runners who do not over-stride. In other words, they have a lower *stride-rate*.

In the 2011 paper "*Effects of step rate manipulation on joint mechanics during running*", researchers from the University of Wisconsin-Madison investigated whether they could *reduce* impact forces in runners by increasing their stride rate.

By monitoring load changes following +/-5% and +/-10% modifications to stride rate, they concluded that "**subtle increases in step rate can substantially reduce the loading to the hip and knee joints during running and may prove beneficial in the prevention and treatment of common running-related injuries**."

Cadence

Another word for stride rate is *cadence*. It is measured in strides per minute (spm). You can easily determine your own cadence by counting the number of times your left foot hits the ground whilst running for 30 seconds. Let's imagine yours was 40. Double that to get the total for 60 seconds (80); then double it again to get the total for both feet (160). Your cadence (for that particular running speed) is therefore 160spm.

A cadence of *less* than 160spm is typically seen in runners who overstride.

It is important that we make a distinction between jogging and running. Jogging (including warming up) is performed at a lower speed and is bound to involve a lower cadence. Though some *one-size-fits-all* running styles pitch an optimum cadence that should be maintained at *all* speeds, even elite athletes are seen to drop their cadence slightly for different running paces.

What cadence should I aim for?

Once again, you have to be careful what you read.

As the subject of cadence has become more main-stream, so too has the emergence of the "magic" optimum stride-rate of 180spm. The reason for this is as follows: at the

1984 Olympics, famous running coach Jack Daniels counted the stride rates among elite distance runners. Of the 46 he studied, only one took less than 180spm (176spm). Daniels also noted that in his 20 years of coaching college students, he never had a beginner runner with a stride rate of over 180spm.

Unfortunately, Daniels' studies have been misquoted and as a result lead to all too frequent claims that everybody should be running at 180spm. These claims ignore the fact that Daniels noted stride rates of *at least* 180spm, not exactly 180spm. History clearly shows Haile Gebrselassie running 197spm en route to his world record time of 2:03:59 at the 2008 Berlin Marathon, and Abebe Bikila used a 217spm to become the first man to run a 2:12 marathon (2:12:13, Tokyo 1964).

As was suggested at the beginning of this article, differences in our biological make-up means what works for one runner will *not* necessarily work for all. If you do one day become an elite distance runner (and we sincerely hope you do!) it is highly likely your race cadence will be over 180spm. However, and this is the important part, your journey to 180spm and beyond needs to be gradual.

The average recreational runner has a cadence closer to 150-170 spm. How quickly you progress and in what direction your running form develops will be affected by factors unique to you – your height, hip mobility, level of general fitness, to name a few.

The safest and most appropriate way to increase your cadence is in the University of Wisconsin-Madison paper we considered earlier: increase your cadence by 5% to 10% at a time.

How do I increase my cadence gradually?

1. Using the counting your steps method described above, determine your current cadence for a speed you would use for a 5km+ race. Let's imagine it is 160spm.

Adding the 5% increase (10% could well be too much of a jump), your new target is 168spm.

2. Start by adding short distances into your runs in which you try to maintain your new target. This can be done through use of a metronome (available from Amazon or downloadable as an app for your phone). Be careful as many of these gadgets still regard 180spm as the "magic" number and will only provide beats of 180spm+. Sites like JogTunes can be used to find music with *beats per minute* (bpm) to match your desired spm. Otherwise, you can always just monitor your progress with a 30-second one foot count (then multiply it by 4).
3. Practicing your new stride rate on a treadmill can sometimes be handy as you can set the speed to stay the same.
4. Once you have can comfortably run your a 5km+ pace at your new spm (without thinking about it – remember we are seeking *unconscious* competence), add another 5% and repeat the process.

The Importance of Hip Extension, Leaning from the Ankles, and How to Improve your Efficiency

As we've no beaten over your head, "correct" running form is very much individualized; what works for one will not necessarily work for all.

One idea that has gained popularity through the emergence of structured running styles is that by leaning forwards when we run we encourage "gravity to help propulsion."

Although I am of agreement that a slight forward lean can indeed help increase running efficiency, I sometimes feel that attributing it to "getting help from gravity" can mask what I regard as a more beneficial explanation of the purpose of a forward lean, and **help runners avoid the common error of leaning forwards from the waist as opposed to leaning the whole body slightly forwards in a straight line, from ankle to shoulder**.

When Amby Burfoot, Editor-at-Large for Runner's World, asked running expert panelists Michael Tammaro, Ph.D. (Physicist), Steve Magness (assistant coach to Alberto Salazar at Nike's Oregon Project), and biomechanist Irene Davis, Ph.D. (director of the new National Running Center at the Spaulding Rehabiltation Hospital in Boston) if leaning forwards helps you run more efficiently by letting gravity do some of the work, the consensus was:

"Gravity can do nothing to improve your running efficiency on a flat surface. That's because gravity provides no horizontal force; it simply pulls you back down to the earth."

All three of the panel did however favour a slight forward lean while running.

So what's it all about?

The importance of hip extension

Last week we saw that during swing phase (when the foot is in the air, from toe-off to foot strike), propulsion of the leg forwards is a passive movement (i.e. with no conscious effort) using a stretch-reflex similar to a sling-shot (catapult in British English).

The drawing back of the slingshot is equivalent to the hip flexors (at the front of the hip) lengthening under tension. As the body moves over the weight-bearing foot, the hip flexors store elastic energy that will later be used for propulsion. In other words, the more we manage to lengthen the hip flexors under tension, the stronger the forward propulsion (firing) of the leg will be.

So, let's imagine what happens if you bend forwards at the waist whilst running. You are in effect reducing the range of movement available in the hip flexors, reducing the amount of tension you can achieve, and thus reducing the level of propulsion. In other words, you are reducing the power of the sling-shot.

This is why having restricted range of movement in the hip flexors can limit running efficiency. The level of propulsion is limited by the amount of elastic energy you are able to store in the hip flexors during hip extension (and likewise during knee and ankle extension where the stretch reflex is also used).

Use it or lose it

Unfortunately, making a living for most of us involves holding the pelvis in a relatively fixed position throughout the day, be it sitting in front of a computer, at the wheel of a car or standing in front of a whiteboard.

The static nature of our daily life is one reason why the hip flexors (at the front of the hip) lose the dynamic mobility required for optimum running efficiency. As a result, runners with restricted hip flexors typically tend to achieve hip extension (get the supporting leg behind them) by dropping the pelvis forward and arching the lower back. This allows the body to pass over the weight bearing foot without the hip flexor needing to lengthen so much.

However, as we have seen, less lengthening of the hip flexors under tension means less storing of elastic energy, meaning less propulsion. By reducing the efficiency of the running action, the lack of pelvic stability can create extra loads on the leg muscles and/or increase stress through the lumbar spine and pelvis. Either of these may increase the chances of injury.

Lean from the ankles, not the waist

Promoting efficient hip extension is one of the main rationales behind adopting a slight forward lean when running. The lean itself needs to start at the ankles and promote alignment of the whole body in a straight line, all the way up to the shoulders.

Maintaining this alignment over long distances however does require a certain level of conditioning, which is why strength and mobility exercises play such an important role in improving running performance.

Weak hamstrings, glutes and lower back can lead to too much of a forward lean, whilst tight quadriceps and hip flexors can encourage leaning forwards from the waist.

Typical cues include “lead with the hips”, “keep your hips pressed forward” and “tuck your backside under your hips” but unless you have sufficient strength and dynamic mobility to maintain such alignment, the coach can keep shouting as much as they want.

Running Biomechanics researcher Jay Dicharry describes how restricted hip extension can also cause runners to run in the “back seat” with their weight over the heel. According to Jay’s studies, this can promote overstriding.

Testing your hip flexor mobility

A good way to test your range of movement in the hip flexors (all be it in a static environment) is the kneeling tilt. Normally, this is how it goes:

1. When you first get into the kneeling position (see photo below), note how much tension you feel up the back leg, from the knee to up the thigh and across the hip. The chances are you will not feel too much (as your body will tend to hold your pelvis in a position that avoids tension).

2. Try and tilt the pelvis upwards, such that the waistline at the front of your trousers moves to level or a little higher than the line at the back (as in the right photo below).
3. In other words, tuck your backside under your hips. For many, this movement will not come easily as it requires a coordination of muscle recruitment that your body is probably not familiar with. You may need to practice the movement lying down (tilting your pelvis so your lower back touches the floor) in order to engage the necessary muscles, and then try it again in a kneeling position.
4. Those of you of who can tilt the pelvis upwards (without moving the rest of the body) should now get an indication of any restrictions you may have in hip flexion.

As is often the case, the test becomes the exercise to reduce restrictions. Don't forget to test and compare both sides!

No one running style reigns supreme

Having given so much weight to the benefits of a slight forward lean from the ankles, it is once again important for us to remember that no one running style suits everybody or indeed wins all races, even at elite level.

The screenshot below taken from the Boston 2011 Marathon shows Gebre Gebremariam (in the green singlet) who finished third with a personal best of 2:04:53

(third also in 2013 with a time of 2:10:38), and Ryan Hall (blue/red singlet) who finished 4th with an American record time of 2:04:58 (but sadly had to pull from Boston 2013).

Just 5 seconds between them, and yet the differences in style are obvious: Hall showing a slight forward lean whilst Gebremariam exhibits a very upright torso.

Photo Courtesy of Pete Larson

“What about the 2011 winner and runner up?” I hear you say. Well, in the photo below, you can see Geoffrey Mutai (in the green singlet) who won with a time of 2:03:02, and Moses Mosop (black/red singlet) who came second in 2:03:06. Maybe a slight forward lean is the way to go for the majority of us!

Photo Courtesy of Pete Larson

Push or Pull? A Look at Running Propulsion

Now that you better understand hip extension and leaning forward, we will take a look at two contrasting theories on how PROPULSION is generated in running and how they lead to the promotion of different running techniques supported by different coaching cues and drills.

As you read, bear in mind that I am not advocating any conscious attempt to modify your form whilst out running. Safe, effective modification to running form comes via *drills* and *ancillary strength & conditioning*, not by trying to change an isolated movement whilst out running.

Push

For many, the role of the Gluteus Maximus in hip extension is seen as paramount in driving the body forwards during running. This hip extension begins the moment the foot starts its journey towards the ground. Elite run coach Bobby McGee can be seen explaining this in his USA Triathlon Training Series stressing that in order for elastic return (stretch reflex) to occur the leading leg can not just “fall” to the ground. He compares propulsion to the loading of a pogo stick, with the propulsive phase of the leg action being hip extension whilst the leg is unloaded. The leg and knee extend by *pushing* the foot downwards under the body using the glute & quad muscles from the highest position the knee reached, until the foot is applied to the surface. McGee points out that force plate research shows how a downward force must be applied to load the leg for rapid return:

“*The trick is to apply the downward extension of the leg early enough, i.e. from the point where the knee has reached its highest point on the forward swing phase til the foot contacts the surface. As soon as contact with the ground is made, the structure is held rigid so that the musculature can load elastically and when momentum aided by the correct lean places the body sufficiently past its centre of mass, the spring can unload and power the body forward.*”

Steve Magness, Head Cross Country Coach at University of Houston , points out that often the mistake is made to try and get the foot off the ground as quickly as possible. While having a short ground contact time is beneficial, it needs to be the result of transferring force faster rather than trying to get quick with the foot.

“*Loading up the foot means allowing it to move through the cycle of initial contact to fully supporting the body*.”

Magness argues that a combination of the stretch reflex and the basic passive mechanical properties of the lower leg means that the lower leg will lift off the ground and fold up (towards the buttocks) without the need for any conscious hamstring recruitment. How close the lower leg comes to the buttocks depends on the amount of hip extension and should not be actively enforced.

Pull

Other schools of thought do not give as much importance to the role of the Gluteus Maximus in propulsion during running. A good example can be seen in the teachings of the Pose Method of running, developed by 2-time Olympic Coach Dr. Nicholas S. Romanov. Romanov explains:

"*Glutes keep your hips, i.e. your GCM (general centre of mass) stable, centered and straight – exactly where the hips should be during running. That's it. If anybody assigns any other "important role" to the glutes' work in running, he or she simply does not know or understand the anatomical and biomechanical functions, characteristics and intended work of the glutes. Glutes, as well as any other muscles or muscle groups, do not directly create the propulsion of the body forward.*"

The Pose Method believes efficient propulsion is achieved by making use of *gravity*. The theory is that by attaining optimum body alignment and lean angle (the "*pose*"), the body "*falls*" to a certain point (a critical range from ~5° to ~30° depending on the athlete's objectives), which when combined with a suitably timed "*pulling*" of the weighted foot (a swift hamstring contraction pulling the foot towards the buttocks) the runner manages to swiftly change support to the other foot, and so the cycle repeats.

The "*pull*" of this "*Pose-Fall-Pull*" technique is said to be the only part of running that requires effort, arguing that the traditional teachings of *pushing* in order to maximise hip extension waste energy and are counter-productive. We can see how this contrasts with the methodology described earlier by McGee and Magness. In the words of Dr. Romanov:

"*In the Pose Method, the concept of gravity as a motive force for the forward movement is the most fundamental one, and the data from the extensor's paradox article confirm this idea. / The commonly accepted understanding of the leg extension as a forward* *propulsive force in running is not supported by the data of the electrical activity of the muscles responsible for the knee extension in this research. But at the same time it did not come to any conclusion about the role of gravity, as well. / Most runners sincerely believe in 'push off efficiency' and its necessity in order to run, because of their perception and seemingly true visual appearance."*

Discussion

The initial obstacle that people often have with the PULL theory presented by Pose is the concept that gravity can help horizontal propulsion. After all, most of us recall being taught that gravity pulls you *down* to the earth, so how it can help you move forward (unless of course you are running downhill)?

- Understanding the concept of gravity as a motive force for forward movement is, as Romanov states, fundamental to Pose but for the purpose of this article I suggest we put it aside for now and focus on just the action of PULLING.

- The PULL is essentially a swift hamstring contraction at the end of midstance to aid rapid lifting of the toe off the ground as opposed to trying to push off. Though some translate that as an effort to pull the foot right up to the buttocks, it is worth pointing out that in Pose the "pull" is only meant to be enough to break ground contact.

- In practice, it does seem true that excessive focus on pushing can lead to especially beginner runners maintaining ground contact time for too long, developing a slower cadence and potentially overstriding.

- Late pushing can also increase vertical propulsion to an extent that energy is being wasted. For athletes susceptible to this, the PULL method could be a useful cue to avoid such over-pushing. However, if you are dealing with a runner who has a high cadence but is failing to apply much force during each stride, encouraging a PULL may not help.

Canute's Efficient Running site provides an interesting theory into how the PULL method achieves a shorter time in stance phase. (For those of you interested in a detailed, objective look at the Pose Method, I recommend a look through Canute's site.) It suggests that the "*conscious focus on rapid lift off leads to tensioning of the major muscles of the leg at point of impact thereby facilitating efficient capture and recovery of impact energy via elastic recoil.*"

This links in with reasoning given by McGee and Magness in focussing on PUSH, and as Canute mentions later in his article reigning Olympic champion Usain Bolt (whose style is said by advocates of Pose to exemplify the effectiveness of the Pose Method) describes his own focus whilst running as "*After completing the drive, get tall, knees up, dorsiflex, get your toes up, plant, push again.*" Canute goes on to suggest that for less finely tuned runners, conscious focus on pushing can result in too long a delay on stance so in other words he does not recommend it for everybody.

Conclusions

The aim of this brief look at two differing schools of thought has not been to say one is better than the other. You do not *need* to know any of the above in order to run. However, running is a skill and for those of you looking to improve your distances and times, you will eventually need to consider your running technique. In a world where so much information is available for free at the click of a button, it is easy to become overwhelmed with an abundance of contrasting advice and promises.

Examining different theories like we have done above reinforces our belief that there is no one running style that can guarantee you success, no super-secret, hidden formula that will transform you into a running god or goddess. What you can look for however is a coach who will look at YOU as an individual and then select appropriate elements from the various successful running styles that exist.

There is no one optimum way to run, but every runner has an optimum way of running inside them. Movement specialist Ben Cormack of Cor-Kinetic.com summed it up nicely:

"The role of a coach or trainer is not to fit you into a system but to rather fit the system around you."

Is There an Ideal Footstrike for Runners?

A topic that's probably crossed every runner's mind in the past year or two is footstrike style. With the rise of barefoot running and minimalist shoes, there's an inevitable debate going on about the risks and benefits of the various types of footstrikes.

Instead of investigating the wide range of claims made by minimalist proponents or opponents, in this article **we'll just take a look at what we *do* know about footstrike styles and injuries from the scientific literature**.

Defining the three types of footstrike

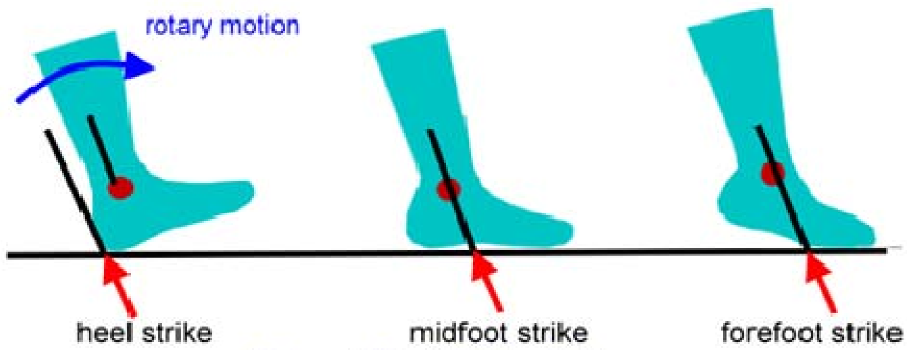
Broadly, there are three ways that your foot can hit the ground.

- In a heelstrike style (rearfoot), which is by far the most common (accounting for 75-90% of runners, depending on your source), your heel contacts the ground first followed by the rest of your foot, which pivots downward from your previously dorsiflexed ankle.
- In a midfoot strike, the ankle is more plantarflexed, and the outside edge of your whole foot contacts the ground first.

- Finally, in a forefoot strike, the outside edge of the forefoot contacts the ground first, with the ankle dorsiflexing to pivot the midfoot and heel down to the ground afterward.

The classic “advantage” cited for forefoot striking is a lower impact force when the foot hits the ground, probably because the ankle temporarily turns the vertical impact force at the forefoot into rotational force. Impact forces have been implicated in a few injuries, though certainly not all or even most.

Forefoot striking also appears to become more common the faster you go—almost all middle-distance runners forefoot strike in their races, for example, and every international sprinter lands on the forefoot while sprinting.



Different Foot Strike Patterns

While the three footstrike styles are visually different, what are the differences on the biomechanical level?

Unfortunately, most of the research which answers this uses rearfoot strikers who have been instructed in forefoot striking, not natural forefoot strikers. However, these studies justify this by citing a 1998 study by Irene Davis and Dorsey Williams that demonstrated no statistical differences in “converted” forefoot strikers when compared to natural forefoot strikers.

Additionally, there is almost no research on midfoot striking, perhaps because of the difficulty of pinning down what exactly constitutes a “midfoot strike.”

Footstrike in focus

The first study we’ll examine is a 2004 paper by Carrie Laughton Stackhouse et al. The intent of the paper was to examine the effects of both footstrike pattern and orthotics on the motion of the foot while running; we’re only interested in the effects of footstrike. Using fifteen runners, Stackhouse et al. examined their foot and lower leg motion while running on a treadmill at 7:15 mile pace.

- **A large difference was observed between forefoot striking and heelstriking when it came to ankle dorsiflexion**—this makes sense, because there’s no way you can forefoot strike without having a plantarflexed ankle when you hit the ground!

- **Forefoot striking also resulted in greater rearfoot eversion, meaning the runners pronated somewhat more when forefoot striking**. But this difference was only mild, and none of what we’ve seen is directly correlated with injury, barring perhaps a weak relationship with pronation and a few injuries like shin splints, so we’ll have to look elsewhere for clues on how footstrike could affect injury rates.

In a later study conducted in 2007 by F.I. Kleindienst and coworkers in Germany, nineteen serious male runners averaging 35 miles a week were analyzed in a similar fashion as Stackhouse et al.

The runners were all rearfoot strikers and were measured first while in their natural strike pattern and later in a converted forefoot strike pattern. The results were largely in agreement with Stackhouse et al., but fortunately, Kleindienst and the other researchers took the additional step of calculating the work done by the forefoot, ankle, and knee joints.

Higher work done at a joint means more energy is being absorbed: Doing a calf raise off a step, for example, involves more work at the ankle joint than doing one on flat ground or while wearing shoes with an elevated heel.

- To this end, Kleindienst et al. **found that the converted forefoot strike pattern increased the work at the forefoot and ankle, but decreased the work done at the knee**.
- There were also differences noted in knee abduction and rotation—**forefoot striking also seemed to increase abduction and internal rotation at the knee**, which is a bad thing when it comes to injury. However, this is likely offset by the lower overall work being done at the knee joint.
- Additionally, while the classic impact peak was gone in the forefoot striking pattern (as we would expect), the overall forces hit a higher peak when the runners were striking with their forefoot first. **This, plus some of the discrepancies in Stackhouse et al., makes me wonder whether a "converted" footstrike style is truly equal to one that occurs naturally or has been practiced for many months or years.**

Impact and loading rate

Most runners believe that landing on the forefoot or on the mid-foot automatically reduces impact loading rates compared to heel-striking. However, bio-mechanical analysis reveals that this assumption is false. Consider these two graphs of impact force conducted by Jay Dicharry

In this first image, you'll notice the runner has a midfoot strike. As such, you would expect a small loading rate and only one impact peak. However, as you'll notice, there are two impact peaks and the slope of the first impact is very steep (suggesting that the impact was quite forceful).

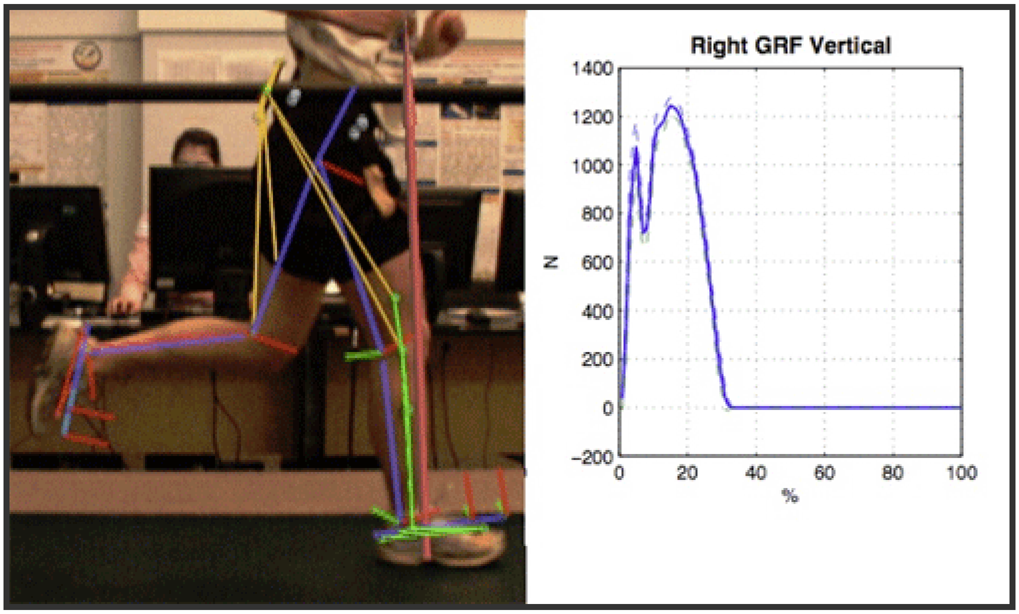


Image courtesy of Jay Dicharry: http://bit.ly/XkD9kt

Now, let's compare that midfoot strike to a classic heel striker. In this graph, you see that there is only one impact peak and the slope of the impact is much more gradual than the above mid-foot strike (suggesting the impact was less jarring).

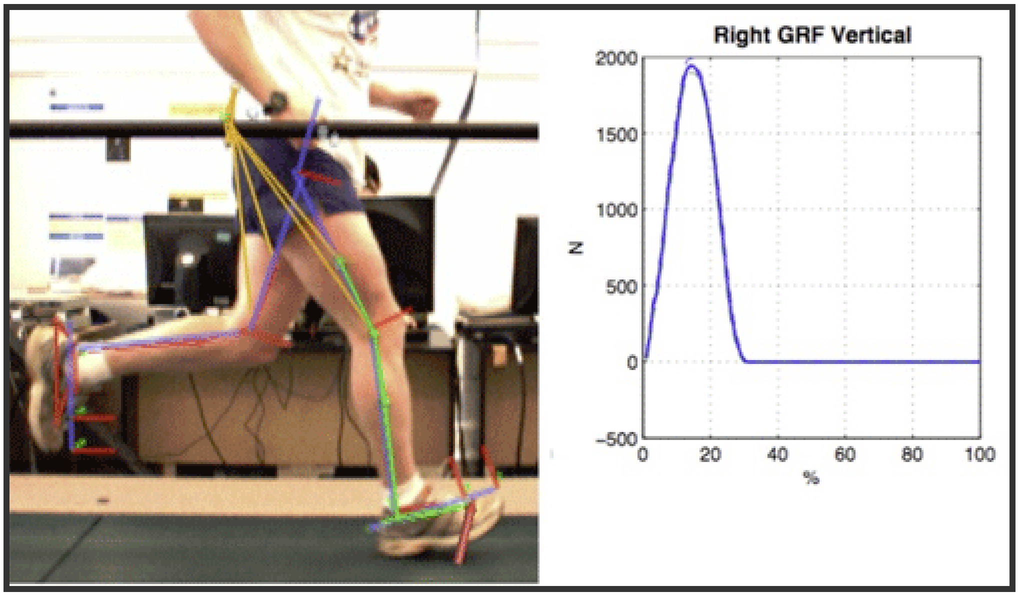


Image courtesy of Jay Dicharry: http://bit.ly/XkD9kt

Jay Dicharry suggests that this difference has to do not with footsrike, but rather with where the foot lands in conjunction with the body's center of mass. Generally, heel striking occurs when you "reach out" with your leg and strike the ground in front of your center of mass. However, heel-striking doesn't always occur in this fashion. Case in point: Meb Keflezighi, who is a heel striker (and a fast one), but whose foot lands under his center of mass.

In summary, footstrike itself is not the only factor that influences loading and impact rates. Perhaps more important is where the foot strikes the ground in relation to your center of mass.

Is footstrike a factor in running injuries?

When it comes to actual injury rates in forefoot and heelstrikers, there is relatively limited information.

A small study on college distance runners at Harvard University found a higher injury rate among heelstrikers, but Kleindienst cites two much larger studies (unfortunately published only in German) which found no difference in overall injury rates. One, however, did find a difference in *types* of injury.

No further evidence was provided on this front, but this would make sense given what we know about impact forces and the work done at the forefoot, ankle, and knee during forefoot and heel striking.

A forefoot strike would reduce the impact force and offload the knee, but at the expense of additional loading on the forefoot and ankle joints. A heelstrike would in turn offload the forefoot and ankle, but increase the impact force going up the heel and shin and also increase the work done by the knee joint. Kleindienst et al. agree, writing:

It is concluded, that the "conventional" dynamic variables does not lead necessarily to a lower risk of FFS [forefoot striking] regarding the development of running related injuries. It is likely that the location of the injuries/complaints can be influenced by the strike pattern. It has been suggested that altering the strike pattern may decrease the risk of developing certain injuries [and presumably increase the risk of developing others].

Should you work to change your footstrike?

Unless you've battled chronic injuries in your knee or shin for months or years, it probably makes sense to try less drastic things like increasing your stride frequency or doing some stretching and strengthening exercises before you consider altering your footstrike.

Podiatrists have begun to report seeing patients with foot injuries that develop after they switch to very minimal shoes or forefoot striking patterns, so keep in mind that changing how you run is not a risk-free decision.

Finally, do keep in mind that changing your foot strike pattern is a major endeavor. It will take a lot of practice to get it right, and as you change your foot strike pattern, you will be rapidly introducing brand-new stresses onto your body. So, while converting to a forefoot strike might help you take some strain off an aching knee, it will put a lot of stress onto your forefoot and ankle, which you likely are not prepared for.

In addition, changing one piece of your running form does not occur in isolation. Changing the position of your footstrike impacts your hip flexion, cadence, stride length and almost everything in the bio-mechanical chain. As such, you need to keep the entire body in mind if you plan to make changes to your form.

For example, when many runners hear they *need* to forefoot strike, they begin prancing on the balls of their feet without correcting their over-striding or properly extending their hips and driving from the hip and glute.

Improving Your Speed: Step Frequency and Step Length

Logic suggests there are two ways you can cover a specified distance in less time:

1. Move your legs faster, i.e. increase step frequency
2. Travel further with each step, i.e. increase step length.

At this point, shorter runners will probably be looking at option 1 and thinking, “Yep, that’s where I can shine!” whilst the taller of you will smile at option 2 in the thought that being lanky does have its advantages! And yet, in reality, research suggests that the secret of covering more ground in less time boils down to an ability to excel in both options.

Step vs. stride

Before we continue, I feel it may be useful to point out a little clarification regarding terminology. Though in practice you will see the words "*step*" and "*stride*" used interchangeably (e.g. *stride* frequency and *stride* length), technically speaking they are different.

A *stride* incorporates *two* steps, the left and the right. Stride length is therefore actually *double* the step length (assuming the left step is more or less the same as the right step). In other words, stride length is the distance covered between initial contact (IC) of one foot and the consecutive IC of that *same* foot. Step length, on the other hand, is the distance covered between IC of one foot and IC of the *opposite* foot, i.e. half.

By the same reasoning, you will take twice as many steps per minute as strides, so stride frequency will be *half* that of step frequency. It's not a biggie as in literature you will commonly see the two words used interchangeably, but next time you do see Usain Bolt being quoted as running the 100m in 41 strides with a stride length (SL) of 2.44m and a stride frequency (SF) of 256spm, you will now know the "strides" they refer to are actually "steps".

Step frequency

"Move your legs faster" sounds an obvious way of increasing speed but it is in fact a skill that requires not only increased aerobic capacity but also progressive neuromuscular training and more often than not lead to modifications in your running form.

The speed your legs move is measured in number of *steps* per minute (spm), often referred to as *cadence*. The average recreational runner has a cadence of about 150-

170spm, with variance due to factors such as individual height, level of general fitness, hip strength, running form, speed, etc.

As we saw previously, research shows that elite runners at race pace also vary in their cadence, but they are always in excess of 180spm. Though this does *not* mean you should directly go out and try running in excess of 180spm, being aware of your current cadence and experimenting with runs at a 5% increase may well be worth considering.

To determine your own cadence, simply count the number of times your left foot hits the ground whilst running for 30 seconds. Let's imagine yours turned out to be 40. Double that to get the total for 60 seconds (80); then double it again to get the total for both feet (160). Your cadence (for that particular running speed) is therefore 160spm. For more information on such, see the aforementioned article.

Step length

When one suggests increasing step length, the immediate thought is to try and reach further in front of you. After all, that is what you would do if you were walking. The problem with doing this when running is two fold.

Firstly, landing your foot way out in front of your body (centre of mass) can in effect act as a brake with every step you take, especially if you are landing on a locked knee and heel. This is where all the fuss about heel striking stems from, even though the issue is not that you are landing on your heel but the fact you are jamming your leg out in front of you and decelerating each step.

Given that we are looking at ways to help you run *faster*, this is obviously not a great idea.

The second problem is to do with injury. Though the exact mechanism is as yet unknown, there does seem to be a correlation with the above and picking up lower limb injury. It may be something to with efficiency of load absorption and transference, and is very likely dependent on the individual, but if you are over striding *and* suffering from injury it may well be an area to address.

So, if reaching out in front of you is not the best way to increase step length, how about increasing the distance your leg travels behind you before leaving the ground? How far your leg gets behind you is a product of hip extension.

Though inflexibility in the hip flexors (front of the hip) is often blamed for limiting hip extension in running, in actual fact the maximum angle of 10-12^{o} is not that hard to achieve, so it could be argued that for most runners, limited hip extension is not an issue. Greg Lehman, a specialist in Running Injury/Biomechanics, has a detailed look in his article here**.**

In practice, elite athletes do not have greater hip extension. Their incredible step length comes from the ground they manage to cover whilst both feet are *off* the floor, also known as *flight time*. This is a product of the power they manage to generate pre-take off, bearing in mind we are talking about forward propulsion and not vertical propulsion.

In future articles we shall take a look at where this power comes from and what we can do to increase it, but for now we will turn our attention to how elite runners use both step length and step frequency to win races!

A study of step length and step frequency

In his excellent article Understanding Stride Rate and Stride Length, coach Steve Magness considers a study done by Enomoto et al. in 2008 which included a look at the stride (step) length and stride (step) frequency of the 3 medallists in the 10,000m at the 2007 World Championships of Athletics. The runners were Kenenisa Bekele (1st), Sileshi Sihine (2nd) and Martin Mathathi (3rd).

In summary, analysis of the 10,000m race revealed the following:

For the first 9km of the 10k race (approximately 23 laps of 25), all three athletes ran at more or less the same speed. However, the step frequency and step stride used by each of them to maintain that speed did vary:

- Bekele, out of the three athletes, had the lowest step frequency (190spm) but the longest step length (despite being 7-11cm shorter than the other two athletes!)
- Sihine's had a higher step frequency than Bekele but a lower step length.
- Mathathi had the highest step frequency of all three runners, but the shortest stride length.

During the final km, all three athletes managed to increase their speed, but using different modifications to their step frequency and length:

- Bekele went from having the lowest stride frequency (190spm) to having the highest at 216spm, and did not lose hardly any step length whatsoever. The resulting increase in speed won him the race.
- Sihine managed to increase his moderate step frequency, and in the last lap also managed to significantly increase his step length. The overall increase in speed was enough to bring him 2nd place.
- Mathathi managed to increase his shorter step length but in doing so *lost* some of his high step frequency. As a result his speed stayed more or less the same and for that reason he came in 3rd.

Points to take away from the study

As Magness points out, the most important thing to take away from this study is that all three medalists sustained and increased their speed using distinct, individual methods. **At Runners Connect we cannot stress enough how important it is to recognize that all**

runners are *individuals* with unique strengths and weaknesses, physical and mental attributes, physiological response to exercise, etc.

The elites succeed by developing a running form that suits their unique characteristics, and so should we. Make a note of what works for others and how they got they got there, by all means try it yourself, but never expect a one-size-fits all solution based on the success of another runner/s.

For mere mortals like ourselves, the study serves as a reminder of the relevance of both step rate and step length in maintaining and increasing speed.

Being aware of our performance for each may open the door to pin pointing where we should be directing our efforts. If we discover that our step length is low, that could be a sign that we need to do more strength/power work. If we notice our step frequency (cadence) is low, maybe some cadence/neuromuscular work are called for.

Bekele excels in being able to sustain an impressive stride length, but when the moment comes he can also increase his step rate by some 16spm. The implications for running coaches could be many.

In a future article we will look at greater detail on how to improve both step frequency and step length. We will see that in fact the two are very related. For many runners, increasing step rate is in itself one way to develop the power that is needed for increased step length.

As always, changes to running form including step length and step frequency are typically best addressed via ancillary exercise and drills.

Trying to continuously modify either whilst running is never a good idea as any changes you do achieve will remain the isolated product of conscious effort, as opposed to learning, practicing, drilling and being cued *outside* of your normal runs, so that the modifications take place unconsciously whilst running, which is how it needs to be.

And as always, the goal is to gradually optimize *your* unique step length and step frequency, not imitate someone else's. And do not expect any magic formulas. If you make a sufficient effort at doing the hill work, interval training and strength conditioning (including plyometric exercise) that are recommended for so many aspects of running performance, both your step length and step frequency will naturally develop. Stretching those hip flexors may be less work, but when has less work ever paid off?

The Impact of Footwear and Foot Type on Injury Prevention

"***Always Evolve***" – one of my favourite valedictions used by esteemed physical therapist and blogger Mike Scott, DPT at the end of posts in his weekly series "*Educainment.*"

Running has certainly seen some evolution of thought over the last few years, much of it following the publication in May 2009 of Christopher McDougal's best seller *Born To Run*, bringing with it bold claims that running barefoot (or wearing something as close as possible to barefoot while protecting you from environmental elements) can strengthen your feet, reduce running injuries, encourage proper running form, and improve performance.

Until then, the only experience many of us had of barefoot running was seeing the South African teenager Zola Budd on our television sets, running barefoot in the women's 3000 meter race at the 1984 Los Angeles Olympics.

Barefoot running

Whilst some runners have praised a transition to barefoot running (along with the typical shift to forefoot striking that barefoot running encourages) as a cure for an injury they were suffering, others have not been so fortunate and have seen it bring the onset of new injury, despite religiously following a slow, progressive transition period.

Clinical tests to date have also produced conflicting results. Barefoot running has been seen to reduce the risk of certain running related injuries, but increase the risk of others. It's as if what works for some does not necessarily work for others. Sound familiar?

Regardless of personal experience, production of conclusive evidence for the benefits of barefoot running is still an ongoing project.

Minimalistic footwear

The increased profile and interest in barefoot running brought with it demand for less restrictive, less cushioned footwear, with the idea of allowing the foot to move and work in a more *natural* fashion whilst still providing a certain amount of protection.

As a result, today there is a wide spectrum of *minimalistic* footwear that, though not as extreme as barefoot style shoes like the Vibram FiveFingers, typically aim to provide less *drop* (difference between heel height and toe height), less cushioning, a wider toe box (more room for the toes) and more flexibility.

Like barefoot running, conclusive evidence for the benefits of *minimalistic* footwear is still a work in practice. A 2012 review in the *Journal of Strength & Conditioning* titled: *"Running Barefoot or in Minimalist Shoes: Evidence or Conjecture?"* concluded:

"*Running barefoot or in minimalist footwear has become a popular trend. Whether this trend is supported by the evidence or conjecture has yet to be determined.*"

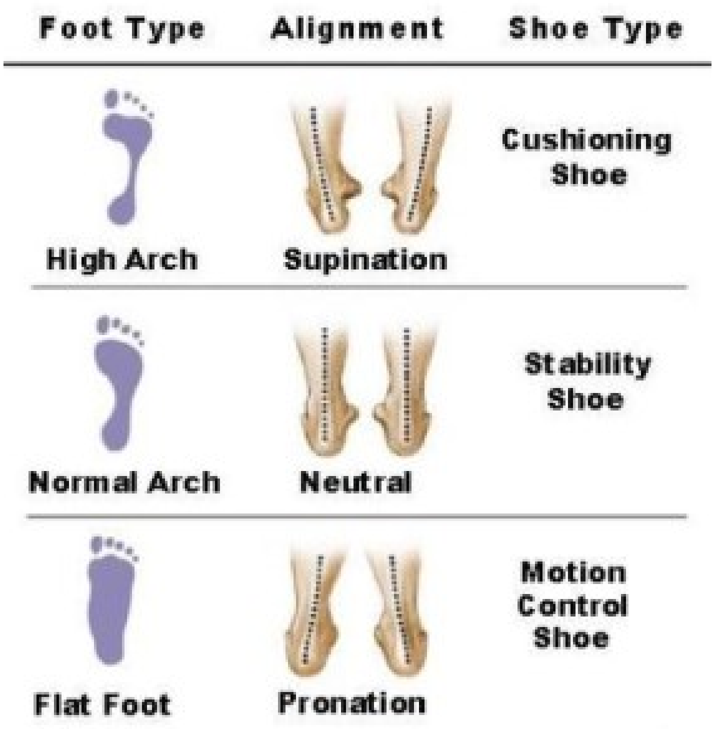
Traditional footwear

Before any of you take “lack of conclusive evidence” as a reason to dismiss the possible benefits of barefoot running or minimalist shoes, I should point out – and this may come as a shock to you – that there is *no* evidence either that *traditional* running shoes can reduce injury or improve running performance.

Yes, you read that right. Though you were maybe told in the sports shop that your cushioned, stability or motion control trainer will help prevent injury, there is no evidence to support it. The problem is, the model that has been used for the last sixty years and more often than not is *still* used to help you select which trainers suit you is based on, well… not a lot.

Foot types

If you have ever been to a sports shop to buy a pair of running shoes (or have received an “ankle-down” gait analysis), chances are you are familiar with the diagram below, or something very similar. It links three “foot types” (based on the height of the medial arch) with three corresponding types of recommended running shoe:



The origin of the idea to group feet according to the height of the medial arch is not clear. **Ian Griffiths**, Director of Sports Podiatry Info Ltd suggests it may stem from a method of assessing footprints devised in 1947 by Colonel Harris and Major Beath as part of an Army foot survey. The first time an image associating medial arch height with shoe type actually appeared in print could have been the 1980 *"The Running Shoe Book"* by Peter R Cavanagh.

What we do know is that since 1980, running shoes all over the world have been recommended and sold using the Foot Type model. Selection typically follows an "assessment" (often involving the subject stepping onto a pressure pad or being filmed from the ankle down whilst running) of how much the medial arch drops (referred to in the diagram as "pronation") or doesn't drop ("supination"), along with the idea that somewhere in the middle ("neutral") is normal, healthy and necessary for injury prevention (more on that later).

- If the arch of your supporting leg drops "*too much*", you are labelled an "*overpronator*" and assigned a motion-control shoe that will in theory reduce the "overpronation". If your arch does not drop "*enough*", you are said to be an *underpronator* (or *supinator*), and assigned a flexible, cushioned shoe to absorb some of the shock that *underpronator* is said to cause.
- If you are somewhere in the middle, you are said to have *normal pronation* and are recommended a "neutral" shoe that in theory provides just the right amount of stability and cushioning. Leaving aside the question of who decides "how much" dropping is normal, it is important at this stage to remind ourselves that both pronation and supination are *natural*, *integral* parts of foot biomechanics.

Dr Shawn Allen, Diplomate of American Board of Chiropractic Orthopaedists explains:

"The foot is a biomechanical marvel. 26 bones and 31 joints, working together in concert to provide balance, stability, and locomotion. As we walk or run, the foot is supposed to go through a series of biomechanical changes, so that it can either adapt to the environment or become a rigid lever for propulsion. When these mechanisms fail, problems usually arise. When the heel hits the ground, the arch of the foot is supposed to partially collapse (pronation), so that the foot can adapt to the ground; in this position, it is flexible and "unlocked". After the weight of the body passes over the foot, the arch is supposed to retract, and the foot becomes more rigid or "locked" (supination), so that you can use it to propel yourself forward. If the foot remains in pronation for too long, or does not supinate correctly, problems will develop over time."

Problems with assigning shoes according to degree of pronation

So, the running shoe recommendation model is based on the idea that at midstance, just before the full weight of the body passes over the foot, the best position of the *subtalar joint* is "neutral", i.e. the foot perpendicular to the horizontal ground.

The argument is that this “neutral” position signifies optimum functioning of the foot, optimum pronation and supination. One problem with this is the fact that the subtalar joint has *variable* anatomy. In other words, function will vary from person to person, so the ‘optimum’ position to be in will also vary. Ian Griffiths explains:

“*Studies have shown that the structural anatomy of the human subtalar joint varies from person to person and it has also been shown that the location of the axis of the joint can and does vary from person to person; this will of course directly influence the magnitude of pronation and supination seen. In light of this sort of evidence it seems odd that there would be an expectation that all individuals could or should function similarly or identically*.”

Taking the above into consideration, it should come as no surprise that there is no data or evidence that suggests “neutral” STJ alignment is linked with injury and/or pain free running. One study examined 120 healthy individuals both non weight-bearing and weight-bearing. Not one subject conformed to the criteria of “neutral” alignment.

Is there any evidence that “over-pronation” increases injury?

Almost all studies to date on “over-pronation” have found no evidence that it increases the risk of injury. A 2010 study concluded that the prescription of shoes with elevated cushioned heels and pronation control systems tailored to an individual’s foot type was not evidence based.

Another piece of research suggested the running shoe model was overly simplistic and potentially injurious. In fact, in this research, every ‘overpronated’ runner put into a motion control shoe during a 13 week half marathon training programme reported an injury.

Craig Payne, DipPod MPH, University lecturer and famed *Running Research Junkie* points out that lack of evidence for linking overpronation to injury may well be down to the *methods* used to measure pronation:

"The weakness of many of those studies is how they measured "pronation"; for example, some measure calcaneal eversion; some measure navicular drop; some do a footprint analysis; and some use a dynamic 3D kinematic analysis. The problem with that is that someone may be 'overpronated' on the measurement of one parameter and not 'overpronated' on another parameter."

A study published this month by Teyhen DS. titled "*Impact of Foot Type on Cost of Lower Extremity Injury*" set out to determine the relationship between foot type and medical costs associated with lower extremity musculoskeletal injury, using a population of 668 healthy U.S. military healthcare beneficiaries in active military service for at least 18 months of the 31 month study.

It quantified level of pronation using the *Foot Posture Index*, a measurement of static foot posture that takes into account not one but multiple components that go into "overpronation", devised by Dr Anthony Redmond, Arthritis Research Campaign Lecturer at the University of Leeds.

Whether static foot posture has much to do with foot posture whilst moving (e.g. running) is a discussion for another day. What the study did show is that of the 336 participants (out of the total 668) who sought medical care for lower extremity musculoskeletal injuries, a high percentage (no exact value available at this time) were those who had been listed as "extreme pronated feet" via the *Foot Posture Index*.

Future research will be needed to help see if degree of pronation via multiple component assessment (e.g. the Foot Posture Index) can be linked to injury. In the meantime, using just one component of "over-pronation" (e.g. medial arch height) to assign suitable footwear will continue to be a game of hit and miss.

Concluding considerations

- Is the whole running shoe recommendation model based on misconception?
- If it is, what model should be used, if any?
- There are certifications out there teaching shop staff how to sell running shoes. What are they based on?
- As a result of this debate, some are suggesting that runners should buy trainers based on “comfort” alone. Hard to imagine?

As I see it, just because an injury is present on someone with an “excessive” level of pronation (whatever that is…), it does necessarily mean that the level of pronation is the cause of the injury (correlation vs. causation).

It is imperative to consider and understand the biomechanics of the rest of the body (as well as foot posture) before reaching any conclusions. And even with all of that knowledge, it will *still* be a daunting task to be able to say “this is the running shoe you need!”

What's the next step?

So far, we’ve outlined a lot of the general ideas and concepts around good running form. But, as should be well ingrained now, there is no simple template to follow. So, how do you take the next step towards creating the perfect form for you?

Since this is an individual answer that requires learning, a deep level of understanding, and a unique prescription of mental cues, form drills, stretches and strength exercises specifically tailored to you, we created a one-of-a-kind 6-week course.

The online course will help you run with proper form by first teaching you the science of running biomechanics (to progress from unconscious incompetence to conscious competence) and then provide you with a simple-to-follow, progressive set of exercises, drills and mental cues to help you make lasting changes to your form.

How does it work?

We start by teaching you the basics of running biomechanics. Each week you'll have a short lesson on the basics of a specific aspect of running form.

Then, you'll receive a high-level discussion with one of our expert guest lectures (Pete Larson, Jay Dicharry, Irene Davis, Daniel Lieberman...and more) that takes your understanding and knowledge to the next level.

This allows you to have an easy-to-follow, step-by-step process that breaks down each aspect of the gait cycle into simple to understand sections. No marketing, no bullshit. Just proven information verified by the latest research on running mechanics.

Once you understand the elements of proper form, we'll assign you very specific drills, strength exercises, and dynamic stretches designed to help your body develop the strength, flexibility and awareness to move through the gait cycle as it was designed.

This structure and progression will address your strengths and weaknesses to develop a biomechanically sound running style adapted to your biological uniqueness.

But don't worry, you don't need to be an exercise scientist for this course.

This course IS NOT designed for runners with advanced degrees in kinesiology or anatomy, or those that have published papers in research journals.

While we utilize the latest research to support every claim and recommendation, we keep it simple by using relevant examples (including video), demonstrating every movement (using both good and bad examples) and not getting bogged down in technical jargon.

We tell you what you need to know in a simple, easy to understand way.

What's included in this course?

This course is set into six modules so that you can make gradual, lasting changes to your form. Each module includes:

- A video lecture on the basics and science behind each movement in the gait cycle. Using video helps provide examples and show you exactly how things should work.
- An advanced discussion with a guest instructor that explores your questions and digs deep into the specific topic.
- An outline for the week on when to perform each drill and exercise routine assigned with video and PDF demonstrations for every exercise.
- That's 6 video lectures, 7 guest lectures, a total of 17 strength, stretching and drill routines (with exact instructions for when and how to do each) and more being added all the time.

How to get this course now

The course is available to those on our email list and who download this eBook for for one payment of $69.

We will also have a special forum for those who signup for the course via our emails and eBook. You can ask your questions and get the answers you need at no extra cost. Only those who signup through these links will gain special access to the forum.

To take advantage of this special offer and get started learning now,

You Can Purchase Directly Here

As always, I'm not happy if you're not happy, so we offer a full, 100% refund if you're not satisfied. No fine print. Just email me and I'll refund your payment immediately.

If you're still unsure and want a more in-depth breakdown of what's included, you can read more here.

If you've been suffering from injuries, confused about all the talk on proper running form or want to take your performance to the next level, don't wait around. Take advantage of this offer and start improving your form today.