Stride Faster, Run Faster.

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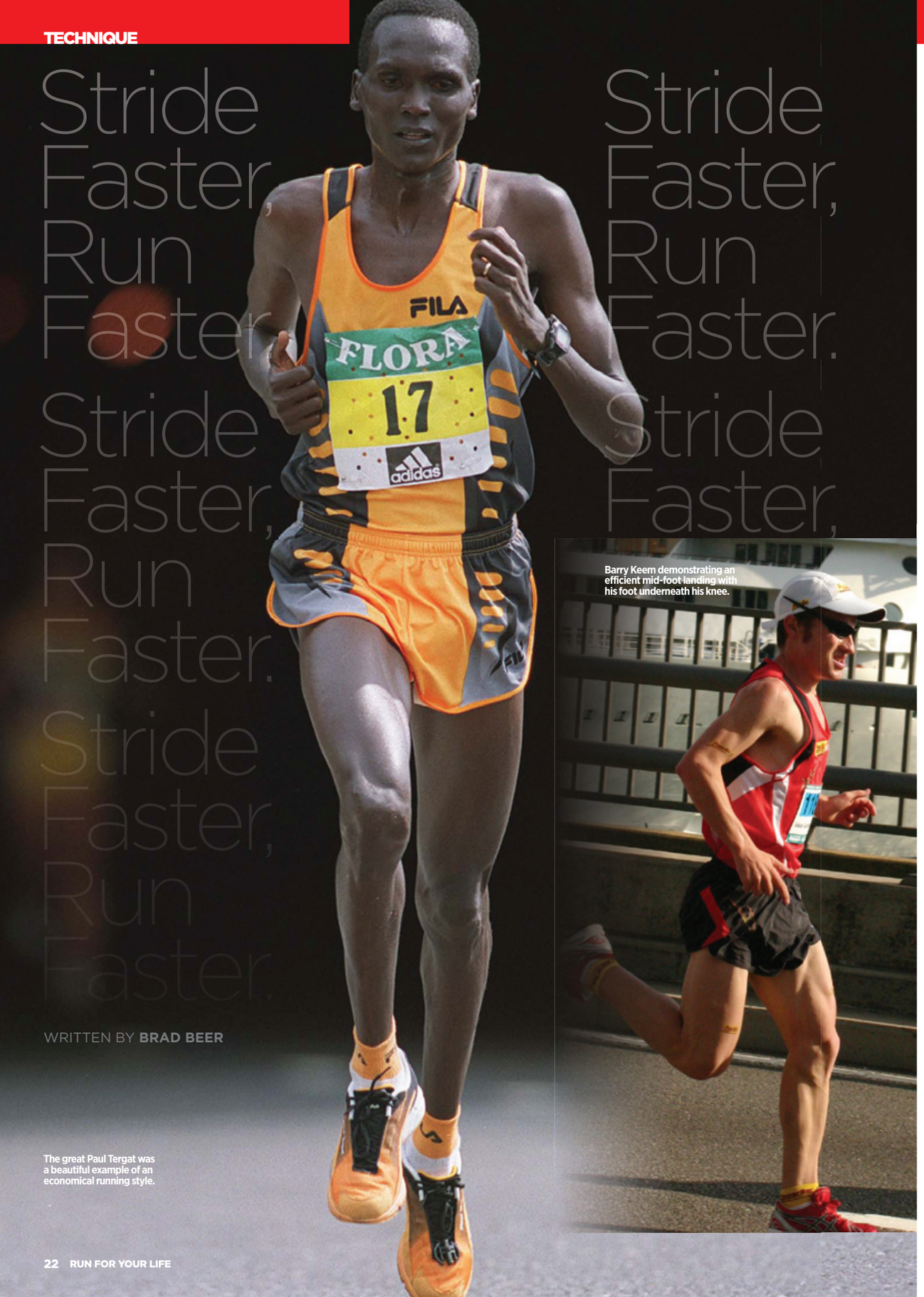
The Importance of OPTIMAL TURN-OVER RATE

WRITTEN BY **BRAD BEER**



The great Paul Tergat was a beautiful example of an economical running style.

Barry Keem demonstrating an efficient mid-foot landing with his foot underneath his knee.

Injury – The Plague of Every Runner

As a physiotherapist I consult many injured runners. These injured runners seek to understand the underlying causation for the development of their injury. It is best practice for me to spend time educating these runners that in virtually all circumstances there is not a single isolated factor that has produced their injury, but rather a combination of contributory factors that have coalesced to produce their injury. In essence, injury onset is a bit like baking a cake. That is the contributing factors that combine to produce running injuries are analogous to the ingredients that get 'mixed' together at various quantities to bake the cake. Standard injury risk factors typically include: poor footwear selection, poor hip stability, inappropriate training intensity, inappropriate training volume and biomechanical abnormalities, to name but a few. Whilst the contribution from these injury risk factors can be significant, I believe the single greatest injury risk a runner faces is that which comes from running with poor technique.

Throughout the rehabilitation pathway I spend time highlighting the importance of detecting and addressing any technique flaws that may be evident in the injured runner's gait. Whilst it has routinely been my observation in clinical practice that poor running technique can play a major role in injury development there also exists research which verifies the correlation between poor running technique and injury development[1,2]. I would go so far as to say that I do not believe that any lower-limb running injury develops without poor running technique as a likely contributing factor to the injury aetiology.

One of the simplest signs to indicate over-striding is landing heel first with your foot in front of your knee.

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Technique Is Critical

It is interesting to note that athletes in every sport devote enormous attention to perfecting and fine-tuning the techniques of their respective sports. Runners however, will often ignore their technique in favour of focusing on the more traditional and seemingly beneficial methods to improve their speed and fitness; by either logging more kilometres or training harder at greater intensity. Few if any runners schedule a 'practice session' to improve their technique. While we all want to run faster and we train to get faster we largely and sadly ignore improving our running technique.

Whilst ignoring the importance of technique in a training program may seem like nothing more than a small oversight, continued running with poor technique over time will inevitably culminate in injury and lost potential in athletic performance by way of less efficient and slower running. Just as technique has been linked in research to reduce injury risk, running with good technique has also been shown to improve speed and efficiency[3].

It has been found that runners of all levels can improve their efficiency (amount of energy used for a given work output) by somewhere between 4.5 – 8% by simply improving their technique[4]. Projecting this improvement in running efficiency, by way of the development of good running technique, into real-time gains would potentially equate to a two minute and forty two second (2.42) saving per hour of running. In fact, well known American middle distance running coach, Ken Mierke, was once quoted as saying, "differences between runners are consistently due to technique more than to fitness. Faster runners are more fit but technique plays a greater role in sustained fast running than fitness does."

A Change in Awareness

Refreshingly, over the last decade there has been a steady emerging interest on the importance of running technique. I attribute this largely to the growing trend and interest in minimalist footwear and the barefoot running ideologies. The advent of the VIBRAM 5 Finger and Nike Free footwear, as well as the release of Christopher McDougall's best-selling book, *Born to Run* have spawned a movement of runners who have developed an interest in exploring and integrating barefoot running techniques into their own running. One way that runners have moved towards the adoption of barefoot running is to slowly modify the thickness of the shoes they run in. That is, over time runners wanting to benefit from barefoot running principles (without abandoning the safety and benefits of shoes) will begin to run in shoes that are typically lighter in weight, less

Table 1:

Single leg foot strikes per minute	90-92 foot strikes per minute	< 90 foot strikes per minute	> 92 foot strikes per minute
Interpretation of the number of foot strikes per minute	• Ideal turnover rate • Foot lands directly under knee • Likely mid-foot landing at impact • Better recruitment of gluteals and hamstrings and use of stored energy in tendons • Efficient running	• Over-striding as the runner can't get enough foot strikes per minute, the stride length is most likely too long • Foot likely heel strike landing • Results in an added energy cost and increased injury risk	• Small steps, but no longer efficient • Possibly landing on forefoot instead of mid-foot • 'wheel spinning' creates an additional energy cost • No longer efficient

> **It is through good running technique and in particular running with optimal turn-over rate...that the effect of the tendons is maximized.**

rigid and tend to feature a much smaller heel (i.e. less bulky). Such a transition in footwear can be one method of assisting runners to run with sound technique by way of offering runners greater 'feedback' through their feet. However, it should be noted that running with good technique requires more than just a change in footwear away from bulky shoes to a more minimalist shoe.

In this article I aim to introduce you to what many consider to be the key component of good running technique, that is, running with the optimal turn-over rate. I will also outline practical ways that will assist you as you endeavour to put what you read into practice.

Running with the Optimal Turn-Over Rate

There exists a pitfall that plagues many runners of all levels. Whilst there are many technique flaws that exist, one of the major flaws is the adoption of an over-striding running gait. What defines over-striding? While over-striding is hallmarked by a variety of biomechanical markers it is not possible to objectify a stride as being too 'long'. This is because a runner's stride length will vary depending on the speed or velocity that the runner is running at. Therefore, it is perhaps easiest to identify an over-stride by what happens when the foot contacts the ground. Typically, when a runner over-strides their foot, at the point of impacting the ground, will land in front of their knee. Invariably this occurs with the leg in its extended (or straight-ened) position and the runner's heel will be the first point of contact.

The problems with heel striking are numerous. The most obvious and well-researched problem is the increased impact stress on the lower limbs. This increased stress results in an associated exponential injury risk. Interestingly, this increased impact stress has been validated in research with both barefoot running and running in shoes[5,6]. The take home message is simple, avoid heel striking, the heel is not a shock absorbing anatomical structure!

A second problem associated with a heel strike running pattern is the high energy cost that it produces. When we land with a heel strike position we encounter a large equal and opposite force (ground reaction force) that travels straight up the leg. Hitting the ground with a stiff leg then requires extra energy output, at every stride, to overcome the 'braking force' that the ground exerts on the runner's body.

The third problem with heel strike running is that we in essence, bypass our body's own natural shock absorbers when we land heel first. These shock absorbers are the tendinous (i.e. comprised of tendon) structures namely the Achilles tendon, calf muscle complex and plantar fascia of the foot. When we land with our mid-foot or even fore-foot as opposed to landing on the heel, these tendinous structures actually generate energy and propulsion as they are stretched and then released. Think of a rubber band when stretched, it releases and returns to its original shape. The same thing occurs with the plantar fascia of our feet, the Achilles tendon and the tendons in the calf complex. This principle in biomechanics is known as elastic recoil (or depending on the time frame, stretch-shortening cycle). Elastic recoil requires very little energy and the good news is that it is available for us to use as runners, unless of course we land heel first!

So in essence when we heel strike we also rob ourselves of this free propulsive energy. Efficient runners store energy from one stride to the next and release it for push-off on the next stride, almost as if have springs in their shoes. The role that our tendons play in efficient running can be evidenced by looking at the body frames of elite distance runners. Typically an elite distance runner's frame is composed of very little muscle mass, leaving bones and tendons as the main propulsive structures. It is through good running technique and in particular running with optimal turn-over rate, and therefore not heel striking, that the effect of the tendons is maximized. In elite running this allows for the maintenance of very high speeds over longer time frames.

Google

An alternative for runners who run with music is to do a Google search for songs with 90 beats per minute. These songs can provide an easy and helpful tool to keep you running at the right cadence.

songs with 90 beats per minute

Contrasting frames of a world-class sprinter and marathon runner.

Why Do We Over-stride?

I believe there are two primary reasons why many runners over-stride. Firstly, there is something that seems intuitive about taking bigger strides to run faster. When we wish to run faster we begin to 'stride-out'. Sound familiar? Have you ever heard yourself saying this to yourself when you were attempting to run faster? Perhaps it is the observations we make of the African greats or the elite road runners as they seem to showcase almost impossibly long strides and effortlessly propel themselves at rapid speeds. While such a theory is yet to be validated by research, having addressed the issue of over-striding as an injury risk factor with hundreds of injured runners, a common rebuttal on the adoption of shorter stride lengths is the perceived fear of running slower as a result. When an injured runner comments that they fear slowing down if they take shorter strides, then it is clear that the reverse paradigm holds true for them, that is, they believe that to run faster their stride length must increase.

The second major reason why I believe runners over-stride is correlated with the advent of the modern running shoe. In the 1970's shoe manufacturers began to release 'motion control' shoes with various components that were designed to assist runners who needed 'support'. These shoes featured elevated and cushioned heels and were made of materials that provided stiffness. The majority of footwear available today is characterised by motion control components and a typically stiff shoe that has little ability to bend or flex.

Many believe that if we took our shoes off and ran barefoot we would shift to a more mid-foot landing pattern of running, as opposed to a heel strike pattern. This would occur as we could not tolerate the shock through our legs that would result with heel strike running. It follows that when running in shoes we can easily 'default' to a heel strike pattern because our bodies intuitively know that the shoe will absorb the shock that would otherwise be transmitted through the heel if we were running bare-footed. But don't go and throw away your motion control shoes just yet as you will discover in reading on, correcting over-striding involves adopting barefoot running principles while still running in your shoes.

Correcting Over-Striding

In order to not over-stride we should be aiming to run with a turn-over rate of 180-182 foot contacts per minute[4]. This is equivalent to one foot contacting the ground 90 times per minute. By running with a cadence of 180-182 steps/minute we will find that our foot will begin to land more directly underneath our knee at foot strike.

The first step in correcting your running cadence is to discover what your existing turn-over rate is. Perhaps the easiest way to decipher this is to do a manual count over a one minute interval on your next run. To do this simply count the number of times your left (or right) foot contacts the ground inside a minute. Use your stop watch to ensure you get an accurate one minute count.

Most runners will report an initial turn-over rate of less than 90 foot strikes/minute. This correlates to them taking stride lengths that are too long, hence they are not able to get the required number of strides completed inside the assigned one minute time interval.

Table 1 provides an easy to use reference guide to interpreting your turnover rate count. It is important to count the turn-over rate numerous times when on a training run. For example, over the course of a one hour run I would encourage a runner to count their turn-over rate for one minute at least every five minutes. Typically, as we fatigue toward the latter stages of a run we get lazy, and as a result of the fatigue develop an even greater stride length and heel strike pattern. Take note on your next long run, the last counts of your turn-over rate will likely be lower (i.e. fewer foot strikes per minute) than your initial counts at the beginning of your run.

Armed now with knowledge of your existing turn-over rate let's look at practical ways to increase your turn-over rate. There are a variety of methods that can be used in attempting to increase turn-over rate and in no particular order they include:

- Begin to shorten your stride by imagining you are running on ice – i.e. you are leaning slightly forward and your foot must stay under your knee as it hits the ground to avoid slipping!
- Running between the rungs of a ladder – this is a drill that the football teams now use regularly. To perform the drill you will need a 'Jacob's ladder' and you will need to run through the rungs laid out on the ground with one foot per rung space, before repeating it. These ladders can be purchased at sports stores.
- Run like Cliff Young – whilst I don't endorse that you run your next 10km or half marathon in true Cliff Young shuffle style, I do point out that by not over-striding Young modelled exceptional efficiency in setting a new course record for the 1983 Sydney to Melbourne ultra marathon. He certainly did not achieve this extraordinary result by over-striding.
- Count, count, count – make it a habit on every run that you count your turn-over rate throughout the run at various one minute intervals. Pay particular attention to your turn-over rate as you fatigue.
- Persist with it – if you do, you will reap the rewards of running faster and with less injury risk. Typically, it can take anywhere from 3-6 months for runners to have mastered running with a optimal turn-over rate.

Having witnessed hundreds of runners implement shorter strides into their running technique as a way of assisting with injury rehabilitation and injury risk minimisation, I can safely conclude that the best results are reported by those who stick with it and adopt a faster leg turn-over rate. It is nice to hear reports of previously injury plagued runners who now largely run injury free. It is however far nicer to hear of their reports of PBs as they tap into their new found speed and efficiency. Good luck with your running! ■

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