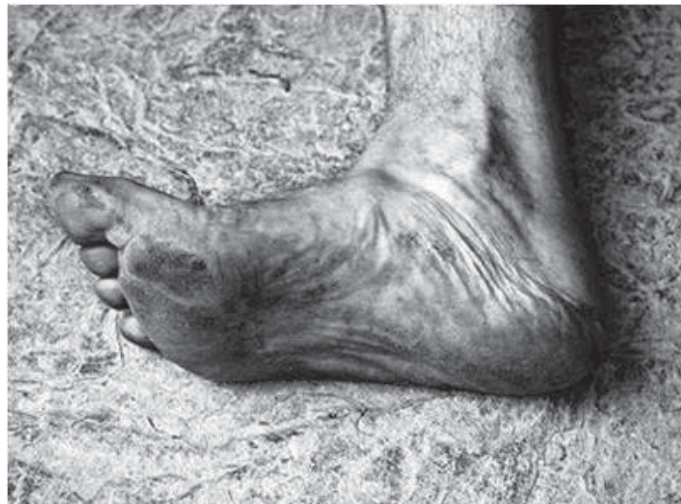


## CLINICAL BIOMECHANICS:

# Barefoot Running: A Biomechanist's Perspective

By: Dr. Christopher MacLean, Ph.D.

.....



In the fall of 2009, we began receiving inquiries about the increased *chatter* surrounding barefoot running or running in minimalist footwear. Specifically, patients presenting to clinics inquiring about what they had read in the newspaper regarding barefoot running and what potential benefits may exist. This periodic interest in barefoot running was prompted by a book that was recently published entitled *Born To Run*, by Christopher McDougall.

Although there was significant *chatter* at that time, it died down only to re-emerge in January when a research paper was published in by Kerrigan et al. (2009) who suggested that knee and hip joint moments (torques) increase when running in running shoes when compared to barefoot. The reason this is important is that increasing joint moments *might lead* to increased joint loads and particularly those that have been associated with the development of medial knee osteoarthritis. Similar to the release of *Born to Run*, this study was followed by a plethora of newspaper articles.

So why is this important? To the untrained eye, these two recent publications may suggest that footwear interventions are part of the problem rather than the solution when it comes to running injuries. Obviously, we need running shoes for protection but how varying design parameters influence running dynamics is still a mystery. Interestingly, McDougall's book was not strongly based on scientific evidence but it does raise some interesting questions.

In this *Clinical Biomechanics*, we thought it might be interesting to provide our customers with some of the scientific information that we do know about the differences between Barefoot and Shod (or running in running shoes) running. This may help when fielding questions on the topic. In addition, there are already some minimalist running shoes on the market that are designed to mimic the barefoot running technique. We will present those so that you are familiar with them.

If there is such a thing as a healthy runner, they probably aren't showing up in your clinic unless they are trying to improve performance. We know that there have been individuals who have performed at a high level in distance running while running barefoot so people can compete and be very successful without running shoes. The two individuals that come to mind are Abebe Bikila (Ethiopian marathoner; Olympic marathon gold medal winner in 1964) and Zola Budd (broke the world record in the 5000 m). Nevertheless, the vast majority of competitive, distance runners perform while wearing performance running shoes.

### **So, what are the biomechanical differences between running Barefoot running (BFR) in running shoes (Shod)?**

When running barefoot and striking initially with the rearfoot, it has been reported that vertical loading rate is increased when compared to Shod running (DeWit et al., 2000). Vertical loading rate is a variable that has long been associated with stress fractures and impact-type injuries.

## CLINICAL BIOMECHANICS:

# Barefoot Running (cont'd)

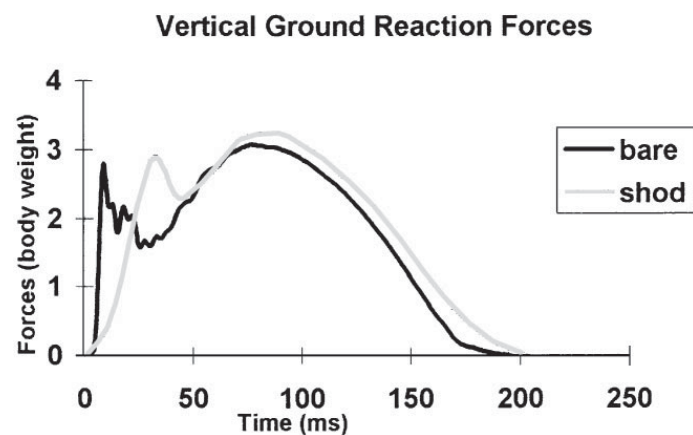


Figure 1

Recently, Milner et al. (2006) revealed that a sample of runners with a history of tibial stress fractures (TSF) exhibited greater vertical loading rate than a control group. **Are you more likely to sustain TSF if you run barefoot?** The short answer is no. In fact, people who are habitual barefoot runners (or who run with *minimalist* footwear) don't typically heel strike. Foot contact is entirely different with most BFRs.

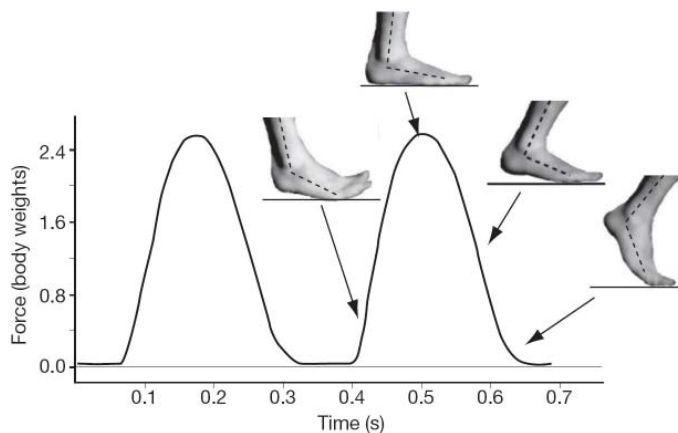


Figure 2

Lieberman and colleagues (2010) have reported that habitual BFRs contact the ground with either the midfoot or forefoot. This is followed by heel contact, forefoot contact and toe-off (Figure 2). What is also interesting, is that these runners exhibit no **impact peak** as is seen when we compare Figure 1 to Figure 2. As far as **foot eversion (pronation)** and **tibial rotation** there appears to be no difference (Nigg, 2009). Lastly, there have been reports that the stiffness of the ankle joint in the

sagittal plane appears to be greater for BFR while the knee stiffness is lesser (Coyles et al., 2001).

Regarding injury pattern differences between BFR and Shod running, we do not have any evidence supporting that BFRs sustain less injuries (Nigg, 2009). However, it has been speculated that BFRs may be more susceptible to Achilles injuries based on the assumption that there would be increased eccentric demands on the gastroc-soleus complex, and thus the Achilles tendon. In summary, we have gathered some information on the dynamic differences between the two methods of running but there is a great deal of work that remains.

There are some types of minimalist footwear on the market that are designed to *mimick* the dynamics of BFR. The Nike Free shoes and the Vibram Five Fingers (Figure 3) are the two most commonly discussed.



Figure 3

Some of the most established distance runners do incorporate BFR into their training and this may very well be where incorporating some BFR into a running program may be beneficial. The runner might not run barefoot all of the time or during races but they may train in this manner on a controlled surface, i.e. track or field. Barefoot training techniques have been used for years. Perhaps, most notably by Vin Lahanna (at Stanford and Oregon) who contributed originally to the concept of the Nike Free.

If you do have someone who wants to incorporate BFR in their training or switch altogether, it is important that they make the transition gradually. Obviously, BFR is not for everyone but there is some information available on how to transition from Shod to BFR at: [http://www.runninginjuryclinic.com/media/Strengthening\\_Barefoot\\_Schedule.pdf](http://www.runninginjuryclinic.com/media/Strengthening_Barefoot_Schedule.pdf)