Running Economics: Are Running Shoes Worth the Money?

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Introduction

This article will discuss biomechanics, in the context of how the analysis of a particular movement to be discussed later, will help researchers in general terms, to better understand why the human body moves and responses in certain way, and more specifically in sports, how this better understanding will enable better training protocols to improve athletic performance.

The primary focus of this report will be on the merits of a hotly debated topic of barefoot versus shoed running. There have been quite a fair bit of research on the area of barefoot running; however, this author believes that the true area deserving considerable research is not as simple as night is from day.

While it is interesting to note that most of the literature to date focuses on barefoot running as a physiologically better way to run in terms of its biomechanics, there seems to be a considerable lack of literature that reviews whether the many different "technologies" that are available to athletes today to help them return to their "barefooted" running, will truly benefit them by the introduction of artificially engineered running shoes that promises better performance and more.

This author therefore believes that such a comparative study will not only answer this sport industry's multi-million dollar question, but will also help to shape how future research into the field of athletic shoes development will continue, and help to further better understand the biomechanical implications of human movement in sports and daily life.

Biomechanics Primer

In Biomechanics, ***Bio*** means the biological study of structure and function of biological systems, while ***mechanics*** refers to the discipline of physics that studies the actions resulting from physical forces.

According to Boone & Birnbaum (n.d.), the field of mechanics itself, comprises of two sub-disciplines; namely statics and dynamics. As the name implies, statics involves the study of systems "in a state of constant motion" – either at rest or moving at a constant velocity, whereas in dynamics, it involves the study of systems in motion where acceleration involving kinematics and kinetics is present.

In short, biomechanics is not the same as the field of kinesiology – or more commonly known as physical education.

Literature Review

Nigg, B. (2009). Biomechanical considerations on barefoot movement and barefoot shoe concepts. *Footwear Science*, *1*(2), 73-79. doi:10.1080/19424280903204036.

In this article, the author discusses biomechanical differences from barefoot running to shoe that claims to offer a pseudo "barefoot" advantage.

Proposed biomechanical differences include increase rate in external force loading, flatter foot placement, higher tibial acceleration, high ankle joint stiffness, and earlier EMG intensity for the tibialis anterior.

The author claims that this indirectly validates the fact that barefoot training helps in strengthening the smaller and large muscles crossing the ankle point, and also concur that barefoot running has energetic advantages over shod running. However, the author refutes the claim that barefoot running would have a greater protection against injury over shod running.

The author went on to describe the three main types of "barefoot shoes" currently available in the market. They are namely, 1) where the shape of the foot is mimicked in making the shoe, 2) the "Nike Free" concept, where the kinematics of barefoot running are mimicked, and 3) the Masai Barefoot Technology (MBT), where the feeling of barefoot walking is mimicked.

Although these products were developed with very different conceptual ideas, they however, appear to provide some form of benefit to the athletes, no matter whether they were based on copying the shape of the human foot, the movement during barefoot running, or the feeling of barefoot movement on soft ground.

The author further argues that just because one of these factors of barefoot running is implemented into a shoe design, does not merit it to the claim that the shoe provides

“barefoot running or movement”. In other words, the author believes that all these claims are nothing more than just marketing conjecture.

Fukano, M., Nagano, Y., Ida, H., & Fukubayashi, T. (2009). Change in tibial rotation of barefoot versus shod running. *Footwear Science*, *1*(1), 19-23. doi:10.1080/19424280902950456.

Tibial rotation during foot pronation such as running has been proposed as a key factor in running related injuries. Therefore, the author seeks to determine the effects of wearing shoes in reducing tibial rotation during running.

The authors recruited nine male and six female subjects, and 25 markers were secured on the left lower extremity of each subject. A MAC3D System was used to collect 3D kinematic data, and the data were subsequently processed using a predefined point cluster technique.

Subjects were required to run in two different scenarios; 1) barefoot and 2) while wearing running shoes (the Adidas Response Cushion model was used in the study).

From there, tibial motion in respect to the femur were assessed during the stance phase, while internal/external rotation, adduction/abduction and flexion of knee joint were analysed for a period of 100ms after foot strike. The authors reported that under both conditions, all subjects experienced internal tibial rotation after foot strike. During the 100ms period after foot strike, the shoes assisted in reducing the amount of tibial rotation during running. Furthermore, the angular change of the knee flexion was increased with running shoe. These findings, the authors asserts, suggests that tibial rotation could be reduced by wearing athletic running shoes.

Romkes, J., Rudmann, C., & Brunner, R. (2006). Changes in gait and EMG when walking with the Masai Barefoot Technique. Clinical Biomechanics, 21(1), 75-81. doi:10.1016/j.clinbiomech.2005.08.003.

The Masai Barefoot Technology (MBT) has been believed to be beneficial in physical therapy for the treatment of leg, back, and/or foot problems. However, there is a lack of research in the literature of its implications on how MBT impact changes in gait or muscle activity.

The authors recruited twelve subjects and sent them through a 3D gait analysis while simultaneously collecting surface electromyography data of the leg muscles when they were required to walk with both MBT equipped shoes and while barefooted.

To ensure accuracy, each subject was properly trained in the Masai Barefoot Technology, and a further within-subjects study-design was used to compare walking with regular shoes and MBT.

At the conclusion of the study, the authors found that with MBT, subjects were able to walk slower and with smaller steps. Movement pattern showed major changes at the ankle, with increased dorsiflexion angle at initial contact and a continuous plantarflexion movement until the terminal stance phase.

With the resulting changed kinematics, alterations in tibialis anterior and gastrocnemius muscle activities were observed. Further smaller differences in movement and muscle activity were also seen at the knee and hip level.

The authors went on to conclude that their study found that MBT changes movement patterns, especially at the ankle, and increases muscle activity. Therefore, they assert that the MBT may be a useful modality for strengthening the muscle groups of the lower leg. Further, they

emphasise that although the findings found considerable changes to walking in regular shoes, its clinical relevance of those changes are yet to be determined.

Purpose of Analysis / Conclusion

From these peer-reviewed journals and many of their counterparts within the field, it can be concluded that there still exist many differing opinions of the running gait debate. And that there does not (yet) exist a clear-cut answer to the question of which is better.

What is interesting however is that most of the literatures reviewed are concentrating their focus on barefoot versus shoed running, and none has yet to conduct a large scale analysis of whether the efficacy of these so-called "barefoot shoes" truly affect running biomechanics, and whether there is any particular one of the proposed mechanisms that is able to provide the best results.

Such an analysis would also be able to determine whether a combination of the various proposed alterations to the running shoe would increase biomechanical efficiency further, as a combination of the different factors, or through just a single factor.

And if in the event that the final analysis proves that the efficiency is only marginally significant, then at least, we will be able to conclude that "barefoot shoes" are nothing more than just another marketing hype.

About the Author

Edward Yah is a Master Fitness Instructor certified through the IFA, and holds a graduate diploma in Sports and Exercise Science from Republic Polytechnic in Singapore. Edward hopes to bridge the gap between theoretical frameworks and the practical application of sports science to the benefit of both the recreational and professional athlete. A marketing communications consultant by profession, Edward also holds a BA in Communication from the University of South Australia, and an MSc in Marketing from the National University of Ireland, Dublin. Edward can be contacted at edyah@edyah.com.

References

Boone, T., Birnbaum, L. (n.d.). Chapter 24 – Basic Concepts of Sports Biomechanics. Retrieved Nov 7, 2010, http://www.exercisephysiologists.com/BiomechanicalCONCEPTS/index.html

Fukano, M., Nagano, Y., Ida, H., & Fukubayashi, T. (2009). Change in tibial rotation of barefoot versus shod running. Footwear Science, 1(1), 19-23. doi:10.1080/19424280902950456.

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