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Published: 25/07/2021

Document Version
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Publisher's PDF, also known as Version of record

Analysis of Biomechanical Characteristics during the Drop-Landing Phase with Bionic Shoes: A Pilot Study

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Summary

Traditionally, shoes have been used for protecting the foot and providing functional support. Normal footwear that provides stability and support functions for the foot could result in overprotection. Consequences of this may include that overprotection influences and reduces the function of lower limbs.

Introduction

This study is motivated by an original idea of "Barefoot shoes" which has led to the creation of unstable shoes [1]. After years of evolution, the cuticle of the human foot has gradually degraded, suggesting that the protection and advancement in footwear is still of importance. Based on these necessary factors, we have designed bionic shoes (BS) by combining the functions of barefoot and shoe protection. The objective of this study was to investigate possible differences in the lower limb kinetics and kinematics based on single-leg landing (SLL) when using normal shoes (NS) and BS. We hypothesized that BS will result in higher knee joint angles, compared with NS during a SLL phase.

Methods

15 male subjects volunteered for the study (Age 23.4 ± 1.14 years, height 177.6 ± 4.83cm, body weight (BW) 73.6 ± 7.02kg). There were two kinds of experimental shoes used in the landing experiments to detect the changes in the lower limbs whilst performing the landing task.

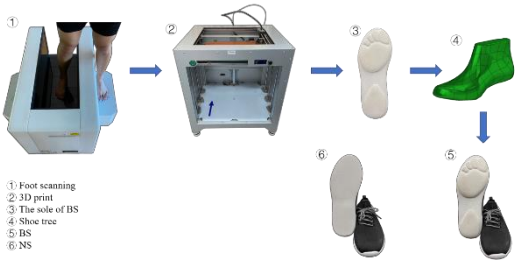

Figure 1: Illustration of shoe making procedure from initial idea to finished product.

Results and Discussion

The statistical parametric mapping (SPM) analysis using paired t-tests in figure 2 shows the significant differences between the NS and BS during the SLL phase.

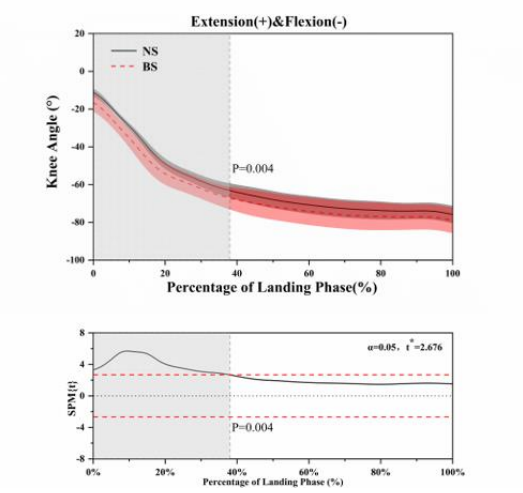

Figure 2: shows the kinematic differences using NS and BS in the knee angle. For the knee angle during extension and flexion, significant differences (p=0.004) between NS and BS were found during the SLL phase.

The soft landing could increase knee flexion angles and reduce impact forces. This may provide more landing velocities over a longer time period, which could result in decreased anterior cruciate ligament injuries [2]. We can conclude that BS may reduce lower limb injuries in the knee joint when performing a drop SLL from a 40cm height.

Conclusions

We found that when using BS to perform a SLL phase, the knee flexion angles have bigger flexion angles than those observed using NS.

Acknowledgments

This study was funded by the by Key Project of the National Social Science Foundation of China (19ZDA352), National Natural Science Foundation of China (No. 81772423), NSFC-RSE Joint Project (81911530253), and K. C. Wong Magna Fund in Ningbo University.

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