Opponent's Report on Ph.D.Thesis Final Defense

Wenjing Quan: Effect of footwear drop on running biomechanics and finite element analysis in recreational runners

Opponent: Dr. Singh Tej

Faculty of Informatics, Eötvös Loránd University

I. Structural aspects

The dissertation is written in English and complies with the rules set out by the Doctoral School of the University of Pannonia. The document comprises 95 pages and contains acknowledgements, a table of contents, an abstract, a list of abbreviations, figures, tables, and equations. The dissertation is structured into five primary sections without any appendices. The writing style exhibits a coherent and lucid approach, with each chapter systematically addressing the three main questions introduced at the beginning. The figures and tables are well-designed, with 38 figures and 15 tables. I encountered no issues with the figures, tables, or overall context. The references in the text are accurate and precise. Additionally, the author includes a section at the end of the dissertation highlighting their publications, which consist of 24 publications and three conference proceedings. The total Impact Factor (Web of Science) is 50.508.

II. Contextual aspects

The dissertation assesses and examines the biomechanical impacts of running shoes with varying heel disparities on the lower limbs. The research topic is innovative, and the study incorporates the finite element analysis method to analyze the internal stress distribution of the foot. This study provides insight into shoe innovation by analyzing stress distribution on the metatarsal and midfoot bones caused by running shoes with varying heel heights. It offers a theoretical foundation for runners to mitigate sports injuries.

The applicant dedicated their attention to three primary chapters during the thesis study. The first chapter investigated the impact of fatigue on the workload distribution

in the lower limbs of female amateur runners. This study addressed fatigue's influence on female amateur runners' injury mechanisms.

The second chapter used OpenSim and biomechanical acquisition techniques to examine the alterations in biomechanical parameters and muscular strength in the lower extremities during normal-speed running with varying heel disparities in running footwear. By examining the musculoskeletal changes in the lower limbs, this research aims to contribute to developing scientific sports training for runners.

The third chapter employed innovative finite element analysis methods to compare the stress changes in the forefoot and midfoot bones during running with different heel differences in running shoes. This analysis focused exclusively on the stress distribution within the foot, providing valuable insights for future research.

III. Scientific thesis points

1.1st thesis point: The candidate's experimental investigation showed that after prolonged running, the ankle's range of motion, dorsiflexion at first contact, maximal dorsiflexion angle, and absolute positive ankle power decreased significantly. The effects of fatigue on running mechanics are also investigated in this study's primary result. This novel scientific result is deemed credible.

2. 2nd thesis point: The candidate employed a novel approach to compare the muscle force between minimalist and conventional shoes. The findings revealed that minimalist running shoes potentially alter the footstrike pattern from rearfoot to forefoot strike and can significantly decrease knee loading force. The results may be a novel scientific finding.

3. 3rd thesis point: Using a detailed foot-shoe finite element model, the applicant evaluates the effects of different heel-drop shoes on internal foot biomechanics. By analyzing experimental data, it was observed that minimalist shoes exhibited greater von Mises stresses within the metatarsal segment across all four running stance phases compared to conventional shoes. This study may serve as a theoretical framework for future shoe design.

Specific questions

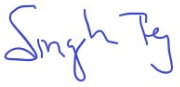
1. This dissertation used the finite element approach to examine the internal biomechanics of the foot across the four stance stages. Therefore, my first question is, what is the basis for examining the four posture stages concerning the variables? Furthermore, what roles do metatarsal and mid-foot bones play in running?

2. This dissertation primarily examines the disparities in biomechanical factors between various types of heel-drop shoes. My second issue pertains to the design process of running shoes. Specifically, how should the shoes' heel difference be constructed to minimize sports injuries and enhance sports performance? Can the notion of heel difference in running shoes be extended to the design of basketball/badminton shoes?

Statement

I suggest submitting this dissertation to the final defense.

Szombathely, 2023.11.28



Dr. Singh Tej
Associate Professor
Savaria Institute of Technology
Faculty of Informatics
Eötvös Loránd University
Email: sht@inf.elte.hu