

Opponent's Report on PhD thesis for public defense

Sun Dong: Gait analysis and musculoskeletal modeling used in athletes recovery
from Achilles tendon rupture

Opponent: Dr. habil. Krisztián ANDOR

The topic of the dissertation:

The submitted thesis presents an original work on biomechanical analysis on athletes' recovery from Achilles tendon rupture (ATR). The mechanism of ATR is not yet fully known in details today. This study developed and validated an experimental and computational workflow, which can determine the gait asymmetry and abnormality based on the Achilles tendon geometry measured from medical images. To get a better understanding of the injury mechanism and rehabilitation process, it is important to know the muscular contribution and joint loading which has been addressed by a modified musculoskeletal model.

This work provides new scientific results to the knowledge of the ATR mechanism and giving some guidance for designing optimal rehabilitation exercises. The results are worked out by combining experiments and simulations.

Formal, quantitative requirements:

The dissertation consists of 5 main parts, in 113 pages, 34 figures and 5 tables help the understanding of the work. The introduction takes 28 pages, so the rate of the introduction and their work is right, and they can be separated clearly from each other.

Style:

The composition, the style is logical and understandable. The construction, the design of the figures, and tables are good with several exceptions, which will be detailed in the critics of the different parts.

Literature and publications:

The references are edited to the end of the thesis. It meets the general requirement of the PhD dissertations in Hungary. The references are shown and cited from the international literature including the most relevant research studies.

The dissertation mentions 30 own, peer-reviewed publications including 12 of them with impact factor, furthermore 3 conference proceedings, and 19 independent citations in total from Scopus database.

Thesis points

- The 1st thesis point: The candidate created an augmented musculoskeletal model, and validated this model by comparing with the previous studies. The candidate verifies that modification of the Achilles tendon related musculo-tendon parameters can improve the model prediction accuracy. This is an acceptable new scientific result.
- The 2nd thesis point: The candidate found that the knee joint will be overloaded on the injured side, due to the effect of ATR. He also proved that this phenomenon is based on a lateral shift in center of pressure, which will increase the moment arm of the ground reaction forces, resulting in higher abduction moments in the knee joint. This is an acceptable new scientific result.
- The 3rd thesis point: The candidate found that there is a direct relationship between the ankle joint inversion moment of the injured leg, and the lateral excursion of the center of pressure. This excursion or shift not only effects the knee but it can also raise the chance of ankle sprain injury on the injured side. This is an acceptable new scientific result.

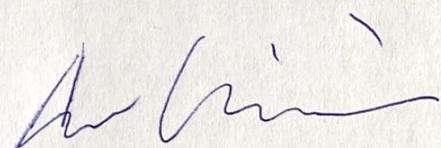
Specific Questions:

1. In the Data analysis part, “To detect significant differences between the normalized waveforms of injured and uninjured sides, the open-source (www.spm1d.org) one-dimensional statistical parametric mapping was (SPM1d 0.4) applied to independent two-sample t-tests”. Why did you apply this specific method?
2. In the “Plantar pressures collection” part, why the foot was divided into 7 anatomical sub-areas, including big toe, other toes, medial forefoot, central forefoot, lateral forefoot, midfoot and heel. How did the plantar pressure system testing the plantar pressures under different regions?

Three significant new scientific thesis points and results are proven in this PhD dissertation. These new findings are supported by journal papers with impact factor.

I suggest submitting this dissertation to the final defense.

Sopron, 2020/06/05



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