www.elsevier.com/locate/jbiomech

Soft Tissues Store and Return Mechanical Energy in Human Running

R.C. Riddick, A.D. Kuo

PII: S0021-9290(16)00010-5
DOI: http://dx.doi.org/10.1016/j.jbiomech.2016.01.001
Reference: BM7520

To appear in: *Journal of Biomechanics*

Received date: 17 April 2015
Revised date: 10 November 2015
Accepted date: 4 January 2016

Cite this article as: R.C. Riddick and A.D. Kuo, Soft Tissues Store and Retur Mechanical Energy in Human Running, *Journal of Biomechanics* http://dx.doi.org/10.1016/j.jbiomech.2016.01.001

Soft Tissues Store and Return Mechanical Energy in Human Running

Riddick, RC, Kuo, AD.
University of Michigan, G.G. Brown Laboratory, 2350 Hayward St., Ann Arbor MI 48109

Ryan Riddick: *riddryan@umich.edu*, 240-688-1708
Art Kuo: *artkuo@umich.edu*, 734-764-1817

Abstract

During human running, softer parts of the body may deform under load and dissipate mechanical energy. Although tissues such as the heel pad have been characterized individually, the aggregate work performed by all soft tissues during running is unknown. We therefore estimated the work performed by soft tissues (N = 8 healthy adults) at running speeds ranging 2 – 5 m· s^{-1}, computed as the difference between joint work performed on rigid segments, and whole-body estimates of work performed on the (non-rigid) body center of mass (COM) and peripheral to the COM. Soft tissues performed aggregate negative work, with magnitude increasing linearly with speed. The amount was about -19 J per stance phase at a nominal 3 m· s^{-1}, accounting for more than 25% of stance phase negative work performed by the entire body. Fluctuations in soft tissue mechanical power over time resembled a damped oscillation starting at ground contact, with peak negative power comparable to that for the knee joint (about –500 W). Even the positive work from soft tissue rebound was significant, about 13 J per stance phase (about 17% of the positive work of the entire body). Assuming that the net dissipative work is offset by an equal amount of active, positive muscle work performed at 25% efficiency, soft tissue dissipation could account for about 29% of the net metabolic expenditure for running at 5 m· s^{-1}. During running, soft tissue deformations dissipate mechanical energy that must be offset by active muscle work at non-negligible metabolic cost.

Keywords
Mechanical work, soft tissues, energetics, deformation, metabolic cost