Walking with elastic fascia: Saving energy by maintaining balance

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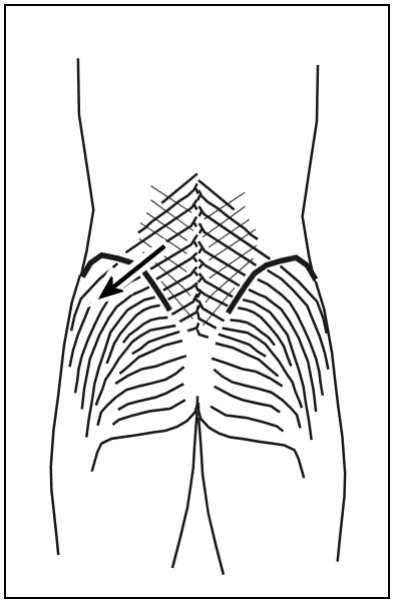
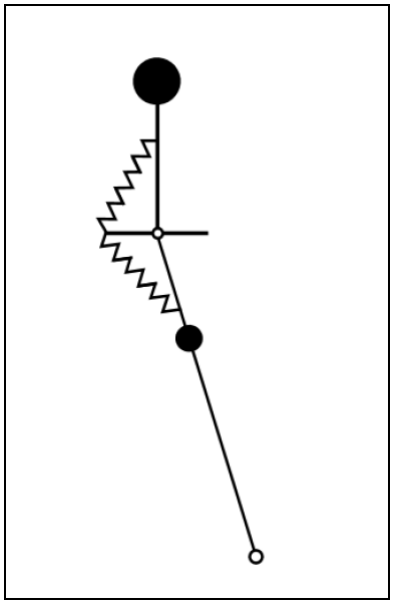
Purpose
The lumbodorsal fascia has been widely ignored by researchers in the fields of back pain and biomechanics of human locomotion alike. We suggest a new model showing how the lumbodorsal fascia might be part of a natural, energy-efficient gait.



Relevance
If the lumbodorsal fascia is able to act as a source of pain the understanding of its functional role in human walking might contribute to the avoidance of back pain.

Methods
We explored a new model of human walking in which the lumbodorsal fascia acts as a tendon of the gluteus maximus muscle. Besides this, the lumbodorsal fascia works as an elastic spring which is held at its optimum working point by this muscle. The muscle itself performs highly efficiently in a clear sub-tetanic, strict isometric mode. We used a mathematical tool of applied mechanics, the Lagrange formalism, in order to explore the dynamic properties of this model.

Analysis
Two mechanisms occurring during each step are traditionally made responsible for the energy cost of human walking: the up and down of the body mass and the acceleration and deceleration of the upper body in order to maintain balance. By assuming that the lumbodorsal fascia performs as an elastic spring these two mechanisms cancel each other out instead of adding up. We explored the existence and stability criteria of this model.



Results
We could show such a model is indeed able to work in principle. During the single stance phase this model is a passive dynamic walker, i.e. it does not need to spend any energy by additional muscle contraction. Just by changing the muscle lengths (resonance frequencies) it can adapt to various anthropometric parameters and walking velocities. It can even carry a minor amount of weight without spending any additional energy.

Conclusion
This model is able to explain several unique features of human gait like the straight knee of the stance leg, the high position of the center of mass and the heavy feet. It is extremely sensitive to skilful adjustment (motor coordination).

Implications
Because a natural usage of the lumbodorsal fascia demands experienced motor coordination, we hypothesize many people in western civilization might have never had the chance to learn the natural usage of the lumbodorsal fascia and that its neglected function contributes to back pain. Hopefully, learning how to change walking patterns might become a successful treatment of back pain in the future.

Keywords
lumbar fascia, walking, back stability