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Muscle-tendon unit function in response to surface slope perturbations in hopping kangaroo rats

The natural terrains on which animals locomote present multiple types of perturbations, including changes in substrate properties, elevation, and slope. The mechanisms animals use to mitigate these perturbations are not well understood, and may include a combination of cortical control, spinal level reflexes, and intrinsic muscle-tendon properties. Kangaroo rats are an excellent model to explore these mechanisms because their bipedal hopping locomotion constrains ground contact to a small base of support and their relatively short stance phase limits the time for cortical input and perhaps even reflexes. In this study, we examine how changes in muscle mechanics of the ankle plantar flexors of desert kangaroo rats contribute to maintaining locomotor stability during a surface slope perturbation. Animals hopped at a steady speed (1.77m/s) on our custom-built variable terrain rotary treadmill that was instrumented with a 12 degree up-slope wedge. Using a combination of sonomicrometry, tendon force buckles, and electromyography, in the lateral gastrocnemius (LG) muscle, we examined changes in muscle dynamics in response to hitting the slope. Preliminary analysis showed that LG lengthening strain tended to increase during perturbed trials, relative to level hopping (0.19 vs. 0.11) but muscle-tendon unit force was not different (17.9 N vs 18.5 N). Further analysis is needed to determine if the PL muscle, which inserts on the toes, is more affected by the slope perturbations.