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Jumping mechanics of desert kangaroo rats (Dipodomys deserti): The role of the tarsometatarsal joint

Desert kangaroo rats (*Dipodomys deserti*) can jump vertically to over 10-times their standing hip height. Previously, inverse dynamics analyses revealed that net joint work is not evenly distributed across the hindlimb during vertical jumping and is higher at the ankle and tarsometatarsal (TMT) joints where there is relatively little muscle but a dense assembly of connective tissue. To study this phenomenon, we revised a model of *D. deserti* in OpenSim using high resolution CT scans of the foot, which improved definition of the skeletal geometry and muscle paths. Furthermore, the model has been updated to feature the plantaris and flexor digitorum tendons wrapping around the bony prominences of the TMT joint across different leg postures and joint angles. To validate the model, we estimated the moment arms and muscle length changes across a gradient of joint angles and found realistic ranges for both across the physiological range of motion at the metatarsophalangeal (MTP) and TMT joints. Relative to excluding it, adding the TMT joint renders our biomechanical model of *D. deserti* more realistic, decreases the estimated moments at the MTP and ankle joints, and reduces the net joint work contribution of both by ~10%. With this more realistic model, we will use musculoskeletal modelling in OpenSim Moco to determine how the inclusion of the midfoot joint affects predictions of muscle activations patterns during vertical jumps.