Impacts of tail loss and surface breadth on running stability in a tree-dwelling lizard

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***Abstract*—Tails are important for dynamic stabilization during falling and jumping in lizards. Yet, tail autotomy (the voluntary loss of an appendage) is commonly used for predator evasion. How tail autotomy affects locomotor performance and stability remains poorly understood. Here, we challenge an arboreal lizard to run along surfaces of different breadths with and without an intact tail. Results indicate that the tail appears to play a more important role during dynamic maneuvers requiring dramatic changes in whole body orientation or center of mass trajectories, rather than for general maintenance of running stability.**

Keywords: tail autotomy; stability; kinematics; locomotion

I. Introduction

Recent studies have demonstrated the importance of tails for inertial stabilization during falling [1,2] and jumping [3–5] in geckos and anole lizards, as well as arboreal turning and running in primates [6]. Yet, the impacts of tail loss on running performance is contradictory, with some studies documenting faster [7], slower [8], or no change [9] in running speed following tail loss. Additionally, tail length has often been associated with locomotor style and frequented surface breadth [10], although these conclusions remain largely correlative. The goal of this study was to determine how tail loss impacts running kinematics and performance in a lizard specialized for arboreal environments.

II. Materials and Methods

Adult, male green anole lizards (*Anolis carolinensis*) were run along surfaces of different breadths with intact and 75% autotomized tails. Surfaces comprised dowels of three diameters (9.5 mm, 15.9 mm, and 19.0 mm) and a flat surface. Trials were recorded using a six-camera infrared video system (Motion Analysis Corporation), filming at 500 fps. The associated software (Cortex v2.5.0.1160) auto-tracked landmarks on the body and reconstructed their three-dimensional locations with 0.2 mm accuracy.

III. Results and Discussion

Whereas lizards ran more slowly on narrow surfaces, tail loss was associated with a consistent and significant increase in running speed. Although both manipulations negatively affected running stability – as evidenced by kinematic changes – surface breadth manipulations did so by narrowing the base of support and thereby the stability margins. How tail autotomy affects locomotor stability is more difficult to assess, and is likely dependent on dynamic center of mass movements. Collectively, these results suggest that the primary stabilizing function of the tail is more for dynamic reorientations of whole body position and/or center of mass trajectory, rather than for the maintenance of steady-state running.

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