Aerial Phase during Stumble Recovery: Causes, Effects, and Implications

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Characterizing stumble recovery responses is essential to better understanding the reflexive mechanisms that help prevent falls. It has been established that healthy individuals employ one of three strategies to recover from a stumble: elevating, lowering, or delayed lowering. However, we observed during testing that participants used one of two sub-strategies: with or without an aerial phase (i.e., jump). Very few prior studies have mentioned an aerial phase [1]; thus the causes, effects, and implications of these sub-strategies are unknown. **PURPOSE**: To provide the first exploration of these sub-strategies by (i) presenting a kinematic characterization of recovering with vs. without an aerial phase and (ii) investigating what perturbation characteristics might cause an individual to jump. **METHODS:** Seven healthy individuals experienced 28 obstacle perturbations each [2]. Ground-reaction force and full-body kinematics were collected, and the strategy/sub-strategy of each was recorded. For aim (i), peak joint kinematics were calculated for each recovery. For aim (ii), perturbation characteristics were used in a logistic regression classifier to measure how well they determine aerial vs. non-aerial. **RESULTS:** The breakdown of strategies/sub-strategies used is shown in Figure 1 (left). Regarding (i), the presence of the aerial phase significantly altered the biomechanics within each strategy (e.g., Figure 1 (right)). Regarding (ii), foot acceleration predicted aerial vs. non-aerial best, with 83.4% classification accuracy. **CONCLUSION:** Employing an aerial phase during recovery significantly alters recovery kinematics for each strategy, which may affect design of lower-limb prostheses; however, the reasons for aerial versus non-aerial are still unclear, motivating further studies.

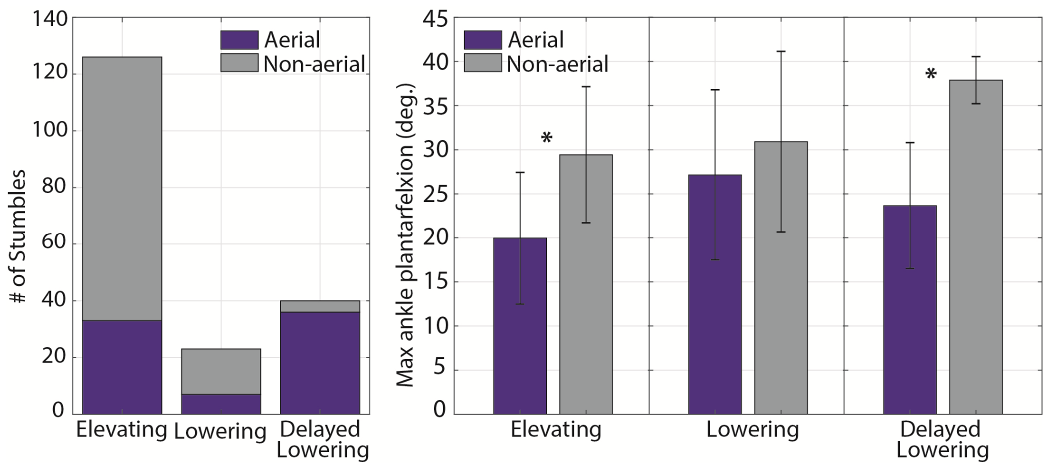

Figure 1. Breakdown of recovery strategies and sub-strategies completed in the 7-subject obstacle perturbation study (left). Maximum plantarflexion of the tripped ankle (average across trials) during recovery for each sub-strategy (right). Asterisk indicates significant difference between sub-strategies ($p < 0.05$).

References

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