Natural arm swing as produced through passive dynamics aid locomotor stability by minimizing:

- Body angular momentum [1]
- Ground reaction moments [2]
- Energy expenditure [3]
- Body center-of-mass (CoM) excursion [4]

Persons with upper-limb loss switch between walking with and without a prosthesis on a given day, or do not wear a prosthesis at all.

No studies have investigated effects of upper-limb prosthesis use on gait stability, which is relevant to fall risk in this patient group.

Purpose: Investigate the effects of upper-limb prosthesis use and inertial properties on locomotor stability.

Methods

Repeated-measures analysis on 10 subjects (7 male, 3 above / 7 below elbow amputation, 50±19 years, 75±19 kg, 1.8±0.1 m).

Procedure

Walking at customary self-selected (1.2±0.2 m/s) speeds with three (randomized) prosthesis conditions:

1. Without prosthesis
2. Mock prosthesis (inertia/mass matched to sound limb)
3. Customary prosthesis (or mock without mass, n=4)

Data Collection and Analysis

- **Equipment**: Optical motion capture (Motion Analysis Corp.); six embedded force plates (AMTI).
- **Trunk kinematics**: 3-D Rotations (mean or range-of-motion).
- **Margin of Stability**: Minimum distance between 5th metatarsal head and extrapolated CoM [5].
- **Temporal-spatial measures**: Step width and standard deviation of step length and time.

Results

- Minimal changes in trunk kinematics suggest that added mass up to that of sound limb may not affect upper body gait dynamics.
- Proxy measures of locomotor stability did not change greatly with mock prosthesis but generally became more symmetric bilaterally.
- Small but noticeable decrease in step width with use of mock prosthesis suggest increased perception of locomotor stability [6].
- Stability in persons with upper-limb loss may not be acutely affected by use of prosthesis matched to sound limb characteristics.

Discussion

- Proxy measures of locomotor stability did not change greatly with mock prosthesis but generally became more symmetric bilaterally.
- Small but noticeable decrease in step width with use of mock prosthesis suggest increased perception of locomotor stability [6].
- Stability in persons with upper-limb loss may not be acutely affected by use of prosthesis matched to sound limb characteristics.

References


Acknowledgements

Thank you to José Luis Zavaleta, BSc, MPO, for assistance with data analysis. This work was supported by the U.S. Department of Veterans Affairs Rehabilitation Research and Development Service (Awards 1I21RX001388 and 1IK2RX001322-01A1).