Asymmetric Gait Training with a Tied-Belt Treadmill

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**Question**

Can tied-belt (i.e. single belt) treadmill training elicit between-leg differences in walking mechanics?

**Results**

- **Peak Propulsive Force (% Body Weight)**
  - Dynamic Treadmill
    - 0.75 m/s: Left 21.6\% ± 5.0\%, Right 22.2\% ± 5.5\%
    - 1.00 m/s: Left 21.6\% ± 5.0\%, Right 22.2\% ± 5.5\%
    - 1.25 m/s: Left 21.6\% ± 5.0\%, Right 22.2\% ± 5.5\%
    - 1.50 m/s: Left 21.6\% ± 5.0\%, Right 22.2\% ± 5.5\%

- **Stance Time (s)**
  - Dynamic Treadmill
    - 0.75 m/s: Left 0.78 ± 0.03 s, Right 0.78 ± 0.03 s
    - 1.00 m/s: Left 0.78 ± 0.03 s, Right 0.78 ± 0.03 s
    - 1.25 m/s: Left 0.78 ± 0.03 s, Right 0.78 ± 0.03 s
    - 1.50 m/s: Left 0.78 ± 0.03 s, Right 0.78 ± 0.03 s

- **Step Length (m)**
  - Dynamic Treadmill
    - 0.75 m/s: Left 0.43 ± 0.06 m, Right 0.43 ± 0.06 m
    - 1.00 m/s: Left 0.43 ± 0.06 m, Right 0.43 ± 0.06 m
    - 1.25 m/s: Left 0.43 ± 0.06 m, Right 0.43 ± 0.06 m
    - 1.50 m/s: Left 0.43 ± 0.06 m, Right 0.43 ± 0.06 m

- **Leading Limb Angle (degrees)**
  - Dynamic Treadmill
    - 0.75 m/s: Left 1.4° ± 0.5°, Right 1.4° ± 0.5°
    - 1.00 m/s: Left 1.4° ± 0.5°, Right 1.4° ± 0.5°
    - 1.25 m/s: Left 1.4° ± 0.5°, Right 1.4° ± 0.5°
    - 1.50 m/s: Left 1.4° ± 0.5°, Right 1.4° ± 0.5°

- **Trailing Limb Angle (degrees)**
  - Dynamic Treadmill
    - 0.75 m/s: Left 3.6° ± 1.2°, Right 3.6° ± 1.2°
    - 1.00 m/s: Left 3.6° ± 1.2°, Right 3.6° ± 1.2°
    - 1.25 m/s: Left 3.6° ± 1.2°, Right 3.6° ± 1.2°
    - 1.50 m/s: Left 3.6° ± 1.2°, Right 3.6° ± 1.2°

**Discussion**

- Contrary to predictions, push-off was increased in the left (slow) leg compared to the right (fast)
- Treadmill (de)acceleration seemingly increased (alleviated) the need for a large push-off due to an induced redirection of the center of mass

**Future Directions**

- Modulate onset and duration of speed increase
- Analyze impact on metabolic energy expenditure
- Open loop treadmill controller with feedback
- Customized stroke rehabilitation to restore paretic push-off magnitude and timing
- Model predictions to minimize metabolic and/or mechanical power

*A tied-belt treadmill can independently modulate push-off magnitude, limb orientation, and stance timing simply with within-stride changes in belt speed.*