

The effects of toe joint stiffness and toe shape on bipedal walking

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How can toes improve gait?

Known

Toe joint dynamics
impact performance
[Oh 2017, Zhu 2014, Huang 2014]

Unknown

Which toe parameters most
influence walking performance?
(e.g., joint stiffness, shape)

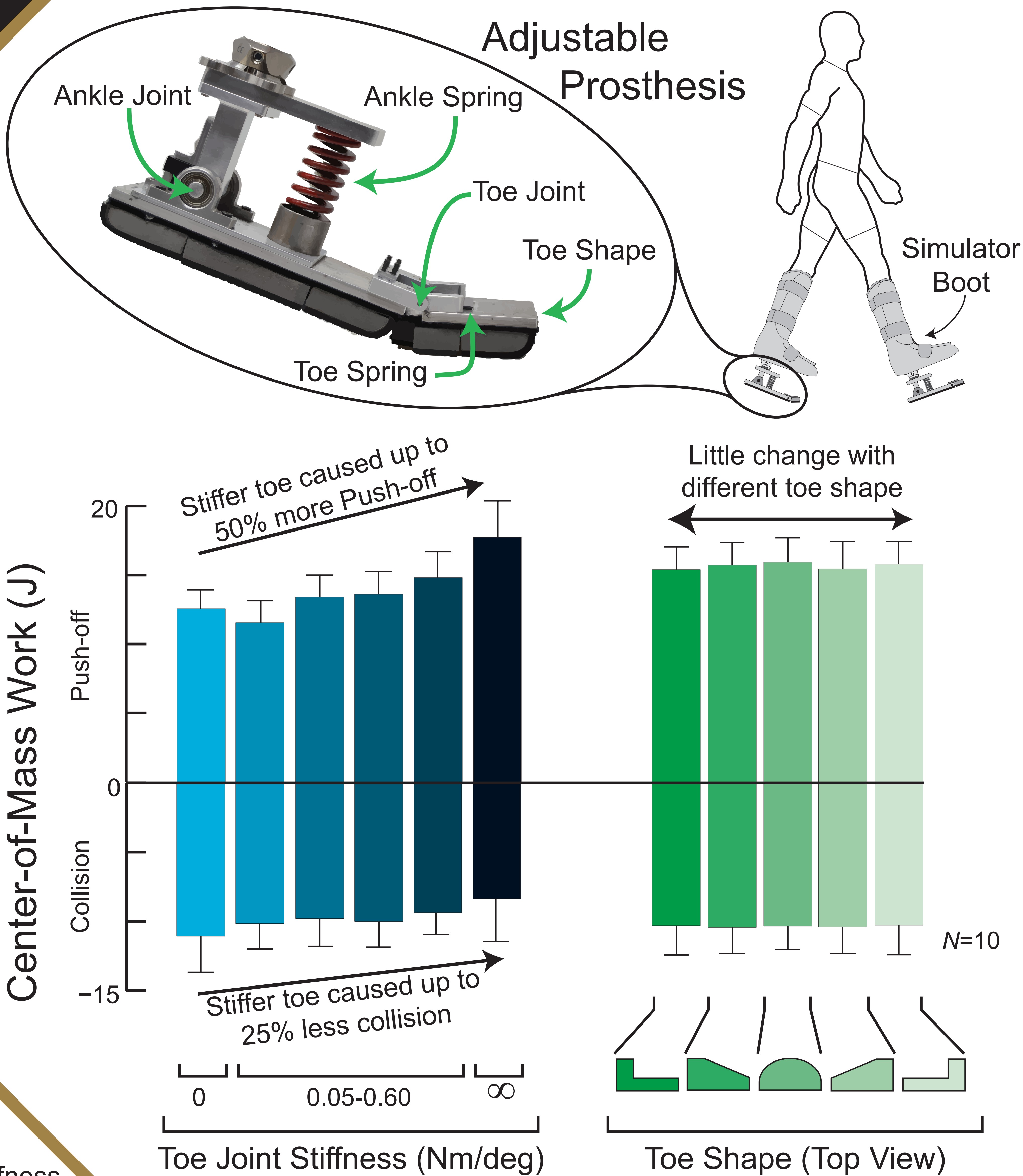
Objective

Systematically characterize effect
of various toe parameters on
walking using adjustable prosthesis

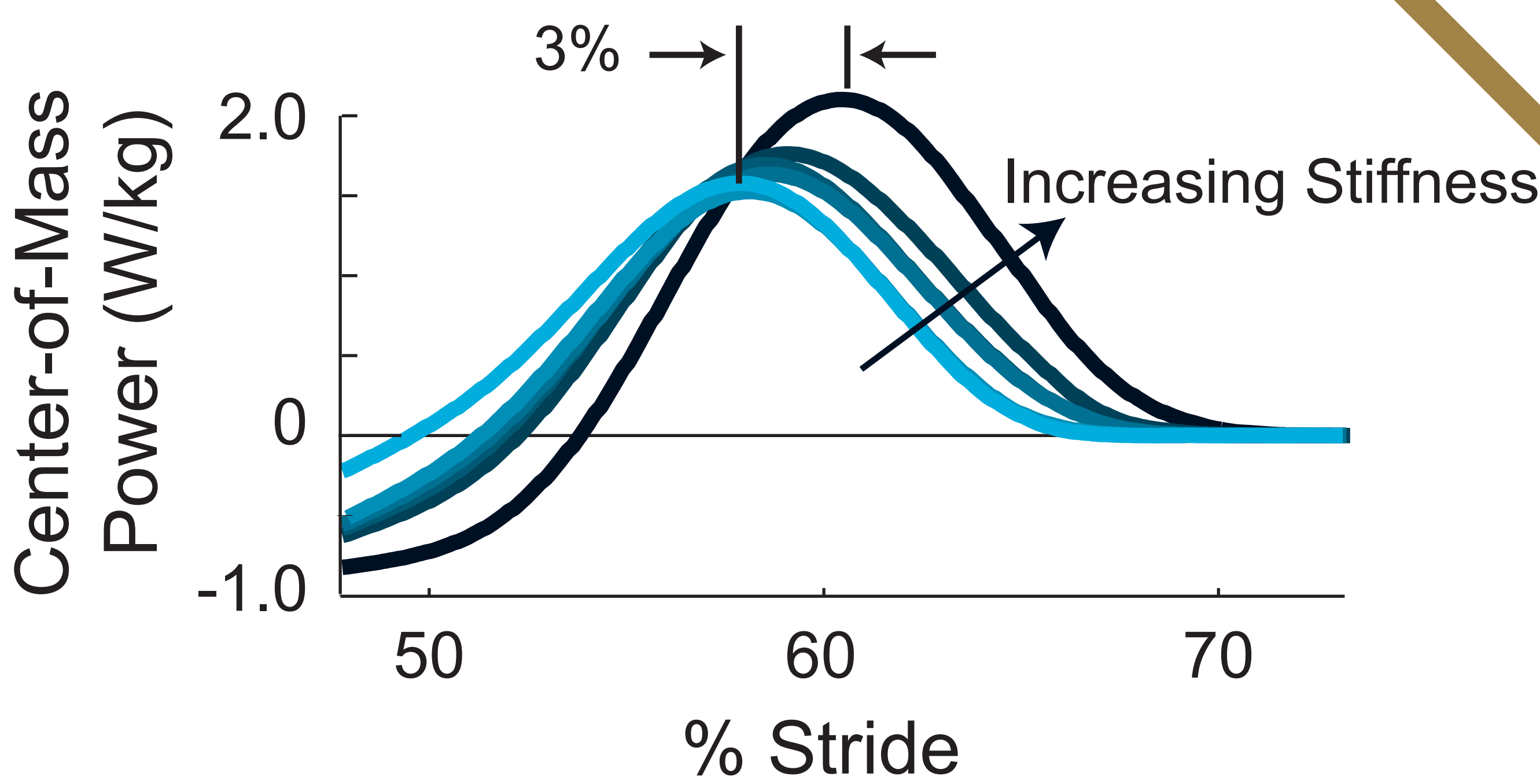
Vision

Optimize toe joint dynamics in
prosthetic feet to aid users

Toe stiffness, not shape, affected COM work



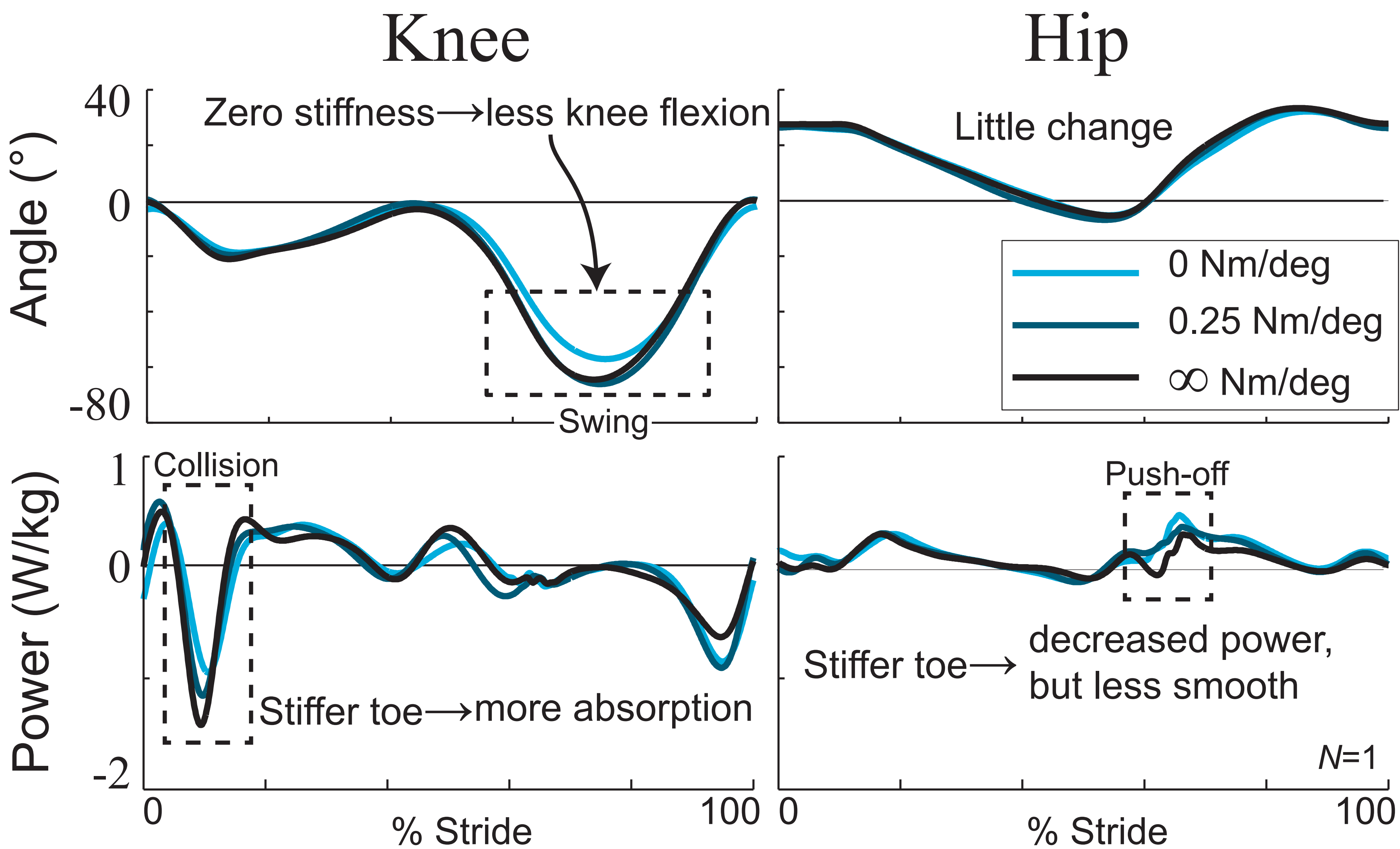
Stiffer toe, later Push-off



9/10 subjects did not prefer ∞ stiffness toe

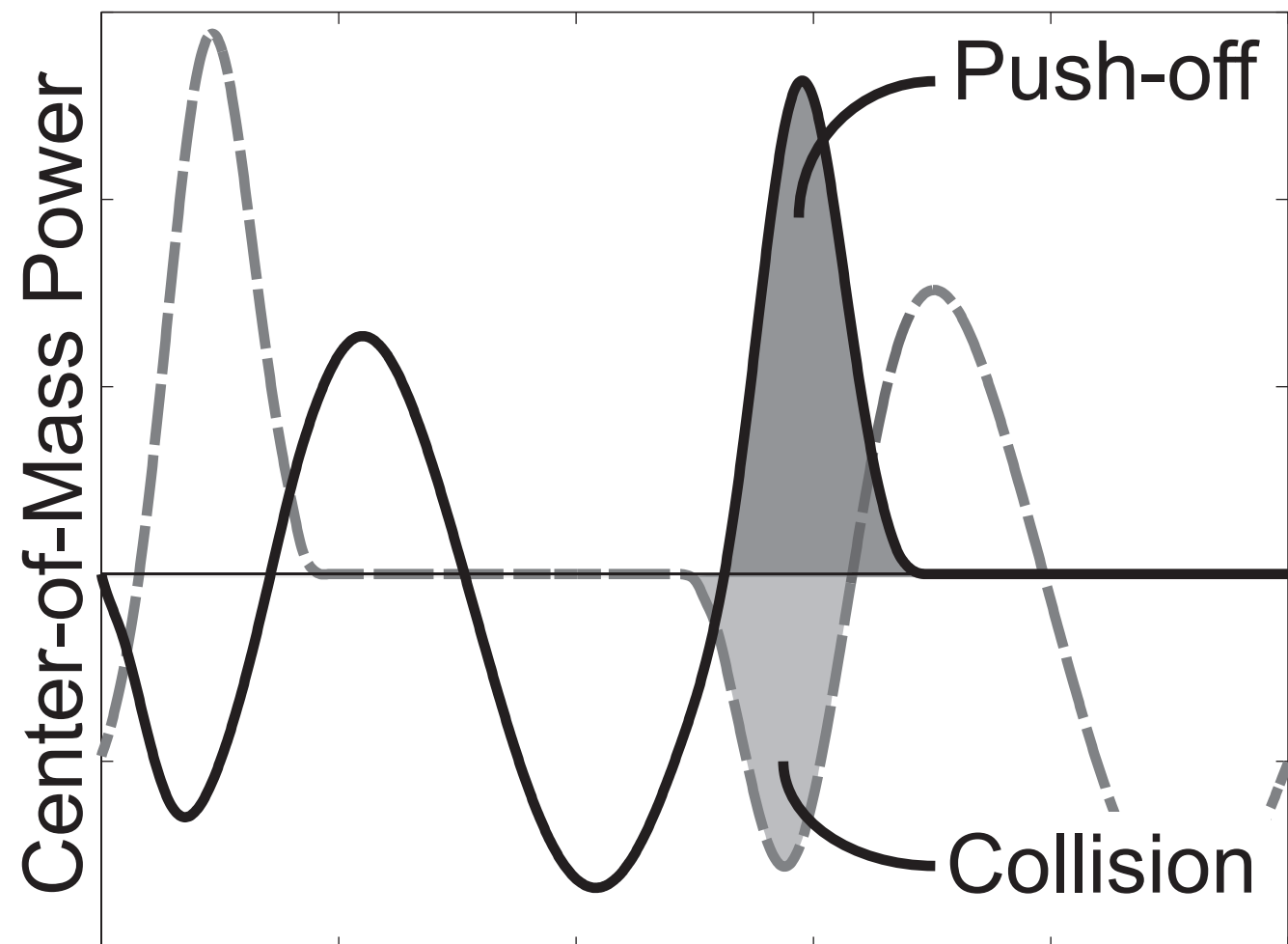
But why? Increased Push-off generally considered beneficial

Toe joint stiffness affected knee & hip power



Data collection and processing

- 10 subjects walked at 1.0 m/s
- Wore simulator boots with adjustable prostheses
- 5 toe shapes randomized
- 6 toe joint stiffnesses randomized
- Collected and analyzed bilateral, lower limb kinematics & kinetics
- Evaluated Center-of-Mass (COM) Push-off & Collision work



Future: more sweeps & metabolics

- Testing other toe parameters (e.g. length, range of motion, etc.)
- Metabolic study
- Analogous testing with transtibial prosthetic users



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