Study finds surprising way to make walking easier

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Credit: University of Nebraska at Omaha

Findings describe a novel way to reduce the energy people spend to walk, as much as by half, which could have applications for therapy received by patients with impaired walking abilities.

The research, conducted at the University of Nebraska at Omaha and published in the journal *Science Robotics*, demonstrates that the optimal way to assist with a wearable device does not always align with intuition.

Based on previous literature, the researchers believed they would see the highest energy savings by pulling with a waist tether when the individual is trying to propel forward against the ground. That hypothesis was based on a bioinspired assistance strategy, meaning it is inspired by how our biological muscles work during walking.

"Although bioinspired actuation can have certain benefits, our study demonstrates that this is not necessarily the best strategy for providing the greatest reduction in metabolic cost or energy expended," said Prokopios Antonellis, Ph.D., first author of the study and now a postdoctoral fellow at Oregon Health & Science University. "This finding supports a greater emphasis on biomechanical testing rather than trying to predict optimal bioinspired strategies," said Antonellis, who performed the research during his doctoral program at UNO.

The approach of using biomechanical testing to optimize a robotic waist tether is highlighted as one of different unique approaches for designing personalized assistance in an editorial published March 30 by Amos Matsiko, Ph.D., senior editor of *Science Robotics*.

The timing

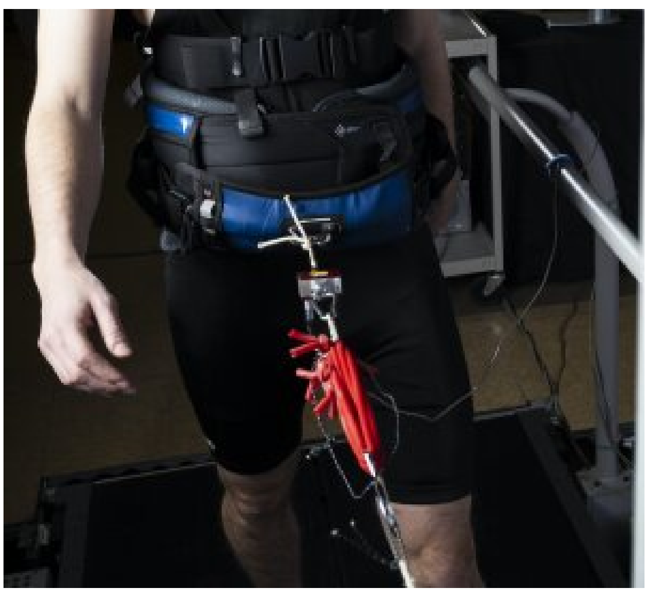
This research shows that a strategically-timed pull from a waist belt connected to a pulley can help an individual use less energy for each step while walking. However, the optimal timing of that forward pull was what came as a surprise.

"When we walk, there is a short period between steps where one foot is stopping its forward motion while the other is preparing to accelerate to take the next step forward. Our research shows that this brief window where both feet are on the ground is the best time to apply force to assist walking most efficiently," said Philippe Malcolm, Ph.D., assistant professor in biomechanics at UNO.

The device works by providing timed pulls from a motorized pulley while an individual walks on a treadmill. Since it only requires wearing a waist belt, it is relatively easy to make individualized adjustments compared to more complicated devices.

Clinical implications

The findings about optimal timing could have applications for exercise therapists in clinical settings providing care for patients with conditions such as peripheral artery disease. Iraklis Pipinos, M.D., a vascular surgeon at the University of Nebraska Medical Center and the Omaha VA Medical Center, who collaborated with the study team, sees the benefits of this research.



The device works by providing timed pulls from a motorized pulley while an individual walks on a treadmill. Credit: University of Nebraska at Omaha

"My patients have hardening of their arteries causing problems in the circulation to their legs, resulting in leg pain and reduced mobility," said Pipinos. "I was touched to hear that certain patients felt relief in their legs for the first time when they tried the device. We are now thinking of ways these methods can be used in everyday practice, for example, by using systems for assisted walking exercise therapy at physical therapy clinics."

More information: Prokopios Antonellis et al, Metabolically efficient walking assistance using optimized timed forces at the waist, *Science Robotics* (2022). DOI: 10.1126/scirobotics.abh1925

Amos Matsiko, Robotic assistive technologies get more personal, *Science Robotics* (2022). DOI: 10.1126/scirobotics.abo5528

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