Research Project Summary:

Gait changes of older adults through use of a novel gait training device (Vizziq NT)

As the result of age-related decreases in leg strength, proprioceptive feedback, and interlimb coordination, older individuals walk more slowly – taking shorter, wider, less coordinated and less symmetrical steps. Unfortunately, conventional walkers (assistive devices) restrict normal alternating arm and leg movements, further degrading gait. Slower, less symmetrical and less coordinated gait greatly increases the risk of falling, frequently causing injuries that lead to serious, life-altering consequences.

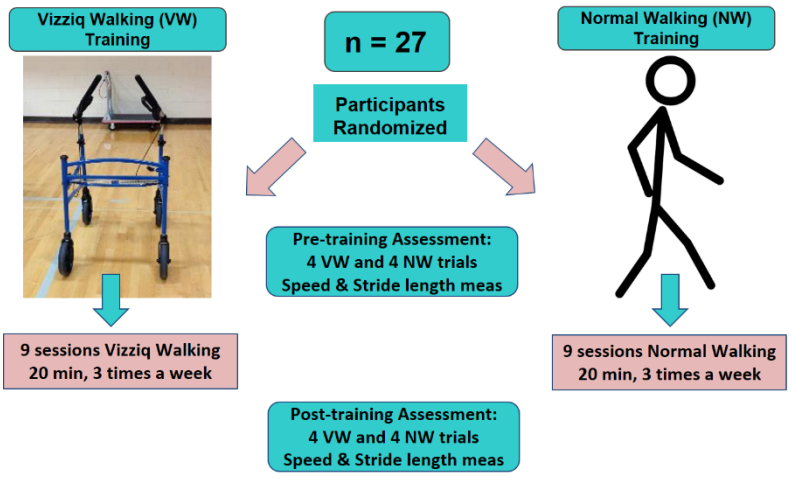
The Vizziq Neuromuscular Trainer (NT) is a novel 4-wheel pivoting gait training device designed to: a) encourage more symmetrical and faster walking by enhancing trunk and leg rotation with a spring-loaded pivoting mechanism in the frame, and b) promote proper posture by means of upright handlebars positioned within the frame of the device. This design is hypothesized to provide the user with properly-timed proprioceptive feedback that includes: a) haptic feedback (i.e. sense of touch) via the handles, as the device frame articulates in response to natural hip and shoulder rotation, and b) cyclical activation of the stretch receptors in the muscles and joints. Through this enhanced feedback and associated neurofacilitation, the Vizziq NT is thought to modulate the basic locomotor rhythm that is the basis of stable gait. Support for this hypothesis would be outcomes such as: increased pelvic rotation, longer stride length, faster walking speed, shorter double-support time, narrower step width, and greater gait cycle symmetry.

The goal of this project is to test whether the Vizziq Neuromuscular Trainer promotes natural walking movements, such as normal speed of walking and gait symmetry, in people 55 and older. If gait training with this device is effective at maintaining and /or improving dynamic balance and walking speed in older adults, the outcome would likely be reduced fall risk and greater mobility and independence in this population.

In the first stage of this project, we conducted a small, single-session (cross-sectional) study comparing gait variables in participants walking using the Vizziq NT and 2-wheel and 4-wheel conventional walkers. Participants were older (65yr+) adults who were not regular assistive device users. Specific gait variables measured were those associated with risk of falls, including self-selected speed, stride length, double-support time, and gait cycle symmetry. We found that participants walking with the Vizziq NT: a) moved 4% faster (p=0.02) when compared to using a 2-wheel walker, and 2) had 18% greater pelvic rotation (p=0.04) than when using a 4-wheel walker.

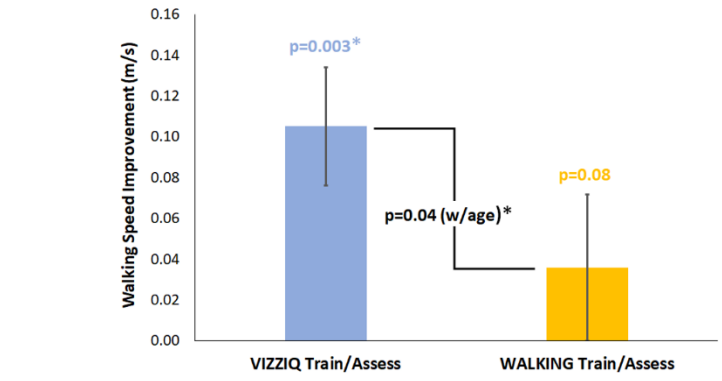
Based on these initial findings, we conducted a longitudinal training study comparing walking variables in older adults before and after a several week training period with the Vizziq NT. The goal of this study was to determine whether participants who trained (practiced walking) with the Vizziq NT would improve key aspects of their gait compared to another set of participants (control group) who walked an equivalent amount without the device.

Experimental Design: We randomly assigned 27 female participants (ages 55-88) to a control group who practiced normal walking (NW) or to a group who practiced walking with the Vizziq NT (VW). Under the supervision of a researcher, both groups walked according to their assigned practice mode at a self-selected pace three times per week for 20 minutes (sufficient repetitions to learn a novel motor task). Throughout the study, we assessed gait variables using a GWalk inertial sensor during pre-training and post-training assessments of gait variables in all participants walking with and without the device.

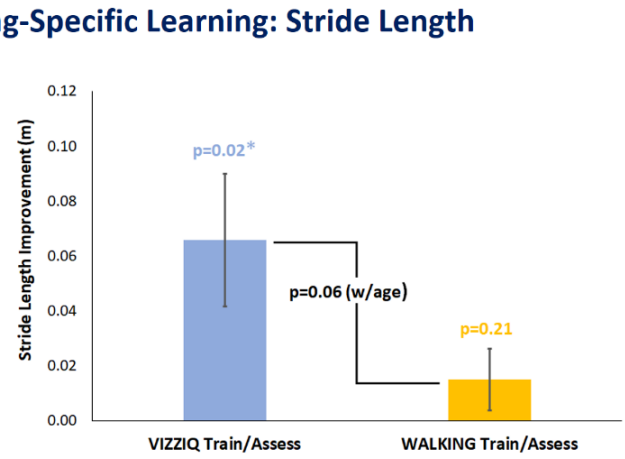


Results:

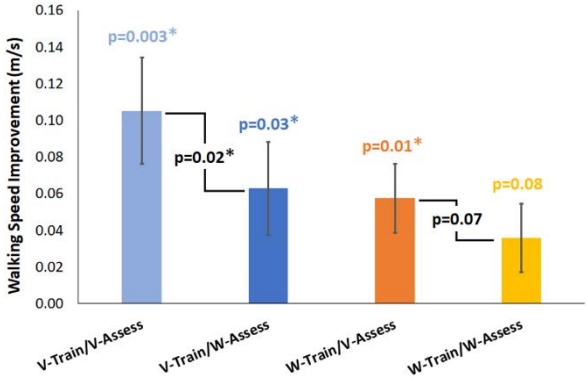
Training-Specific Learning—Walking Speed: Participants who trained with the Vizziq (**blue**) increased their walking speed while using the Vizziq by 0.11 m/s by the end of the study – a statistically significant improvement (p=0.003). This improvement in speed contrasts with the loss in speed that typically develops when using a conventional walker. The group who did normal walking (**yellow**) training had a 0.04 m/s increase in walking speed, a non-significant difference compared to pre-training speed (p=0.08). Comparing the training groups at the end of the experiment, when we accounted for age as a confounding factor, participants training with the Vizziq and assessed with it walked statistically significantly faster (p=0.04) than the walking trained group assessed while walking unassisted.



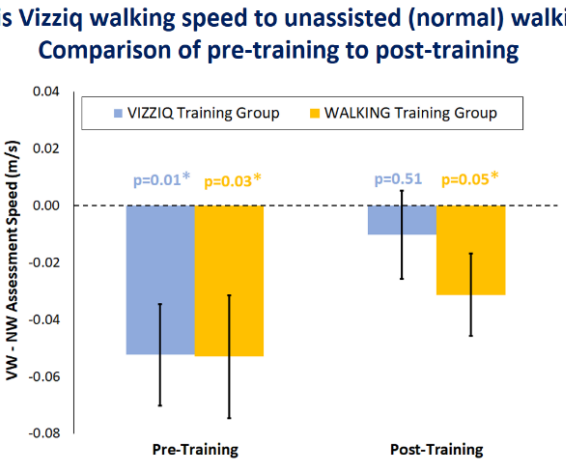
Training-Specific Learning—Stride Length: Participants who trained with the Vizziq (**blue**) increased their stride length while using the Vizziq by 0.07 m by the end of the study – a statistically significant improvement (p=0.02). The group who did normal walking (**yellow**) training did not significantly increase their stride length while walking (p=0.21). Comparing the training groups at the end of the experiment, when we accounted for age as a confounding factor, participants training with the Vizziq and assessed with it trended toward longer a longer stride length (p=0.06) than the walking trained group assessed while walking unassisted.



Cross-Training Learning--Speed: Here we see how well the learning under one training modality can cross over as a pre-to-post improvement in the other modality during the final assessment. As shown, the Vizziq-training group significantly improved speed, not only when assessed with the Vizziq (**blue**), but also during unassisted walking (**dark blue**) (p=0.03). This finding is consistent with our hypothesis that training with the Vizziq facilitates neural pathways through proprioceptive feedback to reinforce a faster locomotor pattern, one that can persist even when walking without the device. Interestingly, the group that trained using normal (unassisted) walking also improved their pre-to-post speed when assessed using the Vizziq (**orange**) (p=0.01). This shows that after only a few interactions with the Vizziq (at assessment sessions), the walking-trained group was able to use the Vizziq efficiently enough to increase their walking speed.



Vizziq Walking Speed versus Unassisted (Normal) Walking Speed: Both the Vizziq Training Group (**blue**) (p=0.01) and the Normal Waking Training Group (**yellow**) (p=0.03) walked more slowly with the Vizziq than in unassisted walking at their pre-training assessment; the difference was approximately 0.05 m/s for both groups. By the post-training assessment, at speeds faster than pre-training, participants in the Vizziq Training Group (**blue**) walked at essentially the same speed (p=0.51) either with or without the device. The Normal Walking Training Group (**yellow**), post-training, still walked slower while using the Vizziq than without it (p=0.05).



Conclusion:

Based on measured improvements in walking speed and stride length, our findings provide evidence that regular use of the Vizziq Neuromuscular Trainer is superior to regular walking practice as a means of improving walking patterns in older individuals; eliciting improvements that persist even when walking without the device. These results are consistent with our hypothesis that the pivoting articulated frame of the Vizziq NT enhances proprioceptive feedback and associated neurofacilitation that positively modulates the basic locomotor rhythm. We suggest that preventative gait training with the Vizziq NT could reduce fall risk and the need for conventional walkers in older adults.

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