

**Title:** Investigating an adaptive target biofeedback paradigm to reduce gait asymmetry in older adults post-stroke

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**Background:** Stroke is one of the most common causes of long-term disability in the United States and can present with debilitating motor impairment. Asymmetric walking patterns due to hemiparesis are energetically costly and impair walking performance. For this reason, gait asymmetry is an important target of clinical gait training and post stroke rehabilitation research. Visual gait biofeedback training is an effective, well-studied way to alter walking patterns in people with chronic stroke. However, there exists large methodological variability between studies with discrepancies in feedback target and feedback structure. The objective of this study was to determine the utility of a novel, adaptive target biofeedback paradigm to reduce step length asymmetry after stroke and explore its use as a standardized methodology.

**Methods:** Participants with chronic post stroke completed one day of visual gait biofeedback training. Sessions consisted of a baseline walking trail without biofeedback to determine the participant's habitual walking pattern. This was followed by four, five-minute walking trials with biofeedback where kinematic data was recorded through a 3D motion capture system. Lastly, a retention trial was performed without biofeedback. Step lengths were calculated by the distance between ankle markers along the anterior-posterior axis at each heel strike. The step length biofeedback target zones adapted during the course of the experiment based on the participant's performance. At the start of the experiment, the targets were large and easy to achieve. If the participant consistently walked (more than five of the last ten strides) with step lengths in the target zone, the targets would adapt, moving toward the predicted step length value. The final target was set as a function of each individual's predicted pre-morbid step length that was established based on height, body mass, age, leg length, and gait speed. If the participant was unable to hit the target zone, the target remained the same size. The primary outcome measures of this pilot study were 1) the difference between the actual step lengths and predicted step lengths (target error) and 2) the change in step length asymmetry between baseline and the final biofeedback trial.

**Results:** Five participants (3 male, 2 female) with chronic stroke (3 right-sided) ranging from 53 to 76 years of age were enrolled. At baseline, the mean target error was 0.038 +/- 0.031cm and 0.054 +/- 0.034cm on the paretic and non-paretic lower extremities, respectively. This increased to 0.052 +/- 0.044 on the paretic limb and decreased to 0.04 +/- 0.03 on the non-paretic limb during the last trial, with significant inter-participant variability. These biofeedback driven changes led to a decrease in the step length asymmetry in 3 out of the 5 participants. One participant did not change their step length asymmetry and one participant exaggerated their step length asymmetry while using the biofeedback.

**Conclusion:** This work provides preliminary evidence that it is feasible for people with chronic stroke to use real-time gait biofeedback with adaptive feedback targets to change their step length asymmetry within a single session of training. Further biofeedback training should be explored to determine the feasibility and efficacy of this paradigm as a standardized approach.