A Novel Task to Decrease Step Width Variability in Older Adults

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ABSTRACT
Walking is the most common fall-related activity among older adults [1]. Also, older adults experience greater step width variability when walking [2]. Importantly, increased step width variability during walking has been found to be a strong predictor of fall risk and incidence [3]. Therefore, an intervention for reducing increased step width variability may consequently reduce fall risk for older adults. In the present study we propose that lateral stepping training program improves walking in older adults by reducing the increased step width variability to normal values. Therefore, the purpose of the present study is to determine the effect of a six-week lateral stepping training program on step width variability.

MATERIAL/METHOD

Community-dwelling older adults aged over 65 underwent an initial screening, walking for three-minutes at their self-selected comfortable walking speed (baseline speed) on a treadmill. Two older adults (11 and 1m; age 69 and 81 yrs.; height 1.51 and 1.58 m; mass 66.8 kg and 63.04 kg, respectively) with abnormal levels of step width variability (> 0.029 m), and two older adults (11 and 1m; age 81 and 82 yrs.; height 1.54 and 1.78 m; mass 64.4 kg and 80.7 kg, respectively) with normal levels of step width variability (< 0.029 m) were identified and underwent our lateral stepping training three times a week for six weeks. Participants stepped laterally across a 10m section on an indoor track, changing direction at the ends thus alternating lead and lag legs. In addition, three minutes of lateral stepping was alternated with at least one minute of rest. Each session consisted of 30 minutes of lateral stepping. Following the six weeks of lateral stepping training, the participants’ step width variability was measured again (Fig.2).

RESULTS

The six-week lateral stepping intervention decreased step width variability to normal levels in the two older adults that were identified as having abnormal levels (A). Moreover, the new comfortable walking speed that the older adults chose after the six-week training was greater than the baseline walking speed (B). Walking speed also improved in the older adults with normal levels of step width variability (D). Their step width variability stayed within the normal levels (SD = standard deviation; Pre = Pre-intervention; Post = Post-intervention).

CONCLUSION
The lateral stepping training results in reduced step width variability during forward walking in older adults. Lateral stepping exercise program is simple, time and cost effective and can start from day one at home without the need for supervised training sessions. We proposed that community-dwelling older adults with step width variability > 0.029 m will benefit more from the lateral stepping gait intervention in the present study by reducing their increased step width variability to normal values.

REFERENCES

Fig.1: Step width variability (SD: standard deviation) during forward walking for young and older adults according to our literature review. The horizontal red line shows the upper threshold that differentiates older adults aged above 60 years with increased step width variability and higher fall risk from the older adults that have step width variability like the young adults.

Fig.2: Body is oriented orthogonal to typical forward walking during lateral stepping gait to alter the influence from passive mechanics of motion.

During the data collection on the treadmill, participants wore retroreflective markers on the top of the second metatarsal (MT) joint and posterior heel. Continuous motion of feet was tracked by a 17-camera high-speed motion capture system (Motion Analysis Corp.) at 100 Hz. The raw 3D marker trajectories were smoothed using the GCVSPL algorithm [4]. Foot position was calculated as the center point between a heel and MT marker (Visual 3D, C-Motion, Germantown, MD). Step width was determined as the medial-lateral distance between the locations of the sequential left and right mid-footsteps. Step width variability was calculated as the standard deviation of step width.

Fig. 2: The six-week lateral stepping intervention decreased step width variability to normal levels in the two older adults aged over 65 years that were identified as having abnormal levels (A). Moreover, the new comfortable walking speed that the older adults chose after the six-week training was greater than the baseline walking speed (B). Walking speed also improved in the older adults with normal levels of step width variability (D). Their step width variability remained within the normal levels (SD = standard deviation; Pre = Pre-intervention; Post = Post-intervention).

Step Width Variability

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