Background: Gait disturbances in general, and those leading to falls in particular, are a leading cause of morbidity and mortality among older adults. Within the framework of this research we study the physiological components leading to gait disturbances and falls in healthy elderly subjects and in patients with neurodegenerative diseases. In particular we focus on bilateral coordination of left-right stepping which is highly sensitive to changes with aging and with neurological alterations seen in PD. Research Hypothesis: Bilateral coordination of gait deteriorates with aging, is impaired in the presence of neurodegenerative disease and is sensitive to cognitive load and to affect. Further, we hypothesize that bilateral coordination of gait is sensitive to changes, and can, therefore, be used to evaluate interventions and plasticity processes. Aims: (1) To quantify the relation between bilateral coordination of gait and aging. (2) To evaluate the relationship between impaired bilateral coordination of gait and gait disturbances related to neurological disease associated with aging (e.g., Parkinson's disease, PD). (3) To evaluate the plasticity of the bilateral coordination of gait and the degree to which therapeutic interventions can improve this aspect of gait. Methods: We quantified the changes in the bilateral coordination of gait as a function of aging (20-90y). We used existing data of elderly subjects (>70y) and young adults (20-30y) and collected more data in the mid range. We studied how bilateral coordination of gait is impaired in PD and evaluate the effect of medications. We assessed the effect of interventions such as rhythmic auditory stimulation (RAS) on the level of bilateral coordination of gait.

Results: Data from 4 subgroups of young, elderly adults and patients with mild or advanced PD were analyzed. Gait speed was similar between young and old healthy subjects, but gait asymmetry (GA) and the PCI were increased in the elderly (i.e., more asymmetry and less coordinated gait). Effect of dual tasking deteriorated the accuracy and consistency of the anti phased stepping pattern in particular in elderly subjects suggesting sensitivity of this gait feature to ageing. In PD we found that among freezers, error in alternating hand tapping is increased as compared to non freezers. The figure shows the effect of aging and disease on bilateral coordination of gait. Cognitive load is in particular harmful among these patients to gait control. The results showed that impaired bilateral coordination of gait in the presence of cognitive load is provocative risk factor for falls in patient with PD. Relying on our findings from the first year of this study with respect to automated device for FOG detection we got funding from the Michael J. Fox Foundation in order to utilize this device for motor learning to improve bilateral coordination of gait and alleviate freezing in PD.

Discussion: Bilateral coordination of gait is a task which becomes harder with aging. The prospects of intervention for improving gait in patients with Parkinson's disease which is based on a wearable device that incorporating RAS and thus improving bilateral coordination of gait should be further studied. Conclusions: A. During aging, neuronal mechanisms that are related to bilateral coordination of gait, are in particular sensitive. B. Impaired bilateral coordination is not unique to gait among PD patients, but rather a general deficit of rhythmic limb movements.

Key words: Bilateral coordination, gait asymmetry, aging, Parkinson's disease
Publications associated with the project:


