Impairments in dynamic gait stability are related to the deficits in somatosensory and cerebellar involvement in people with Multiple Sclerosis

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Background and Purpose:
Dynamic stability of gait reflects ability of the system to flexibly adapt to perturbations during walking. For neurologically impaired individuals, changes in gait stability signal the presence of abnormal motor control strategies. In this study, we investigated local dynamic stability of gait in PwMS. Previous work from our lab has shown that PwMS have impaired local dynamic stability as compared to control individuals for a steady state walking. However, we do not know how deficits in somatosensory conduction and white matter tract integrity of the cerebellar peduncles affect the local dynamic stability. We hypothesized that deficits in the local dynamic stability will be related to 1) the postural response latency and 2) reduced white matter tract integrity of the middle and inferior cerebellar peduncles.

Methods:
Subjects (16 PwMS, EDSS: 2-4) underwent 20 discrete, backward translations of a support surface. Onset of postural response latency of agonist (medial-gastrocnemius) muscle was assessed. Local dynamic stability was measured during a steady state two-minute walk using the nonlinear measure (Lyapunov Exponent; LyE) for the acceleration time series of a body-worn inertial sensor on trunk. Radial diffusivity (RD), an indirect neural marker of myelination, of cerebellar peduncles was calculated for each participant. Lower RD is interpreted as being indicative of better white matter tract microstructure.
Results: We found that local dynamic stability was related to 1) the postural response latency ($r=0.6$, $p<.05$) and white matter tract integrity of both middle ($r=0.5$, $p<0.05$) and inferior ($r=0.52$, $p<0.05$) cerebellar peduncles.

Discussion:
Findings of this study suggest that the dynamic stability is impaired in PwMS and is related to the impaired somatosensory conduction and reduced integrity of the cerebellar white matter tract. This reduced stability can make patients with MS more susceptible to falls. Thus, improvements in postural response latency should be considered and/or targeted during balance and gait rehabilitation.