INTRODUCTION

Patients with Parkinson’s Disease (PD) develop postural instability associated with the progression of the disease. Postural instability contributes to falls in this population which is the second-most common reason a patient with PD is admitted to institutional care. Bradykinesia has been accepted as a partial contributor to the instability but cannot be fully responsible as it resolves with dopamine supplement pharmacotherapy. Stability of posture is a functional interplay between visual, proprioceptive/ musculoskeletal, and vestibular signals. PD patients rely heavily on visual input. The involvement of the vestibular system, however, is highly controversial but suspect as the vestibulospinal and vestibulocollic reflexes are known to stabilize the body and neck respectively. There have been studies that show vibration therapy to offer improvements to balance and dyskinesia in bilateral vestibular loss and PD patients.

OBJECTIVE: (1) To help clarify the role of vestibular dysfunction in PD postural instability and (2) offer a tangible form of therapy in patients affected with this disease using vibrotactile stimulation (VTS) applied to the trunk as a form of a sensory substitution feedback strategy. This therapy is targeted toward rehabilitating possible vestibular-mediated dysfunction.

BACKGROUND

Vestibular Dysfunction in PD patients? Controversial.

Data Supporting Vestibular Dysfunction in PD patients:

- Reichert WH, Doddle J, McDowell FH. Vestibular dysfunction in Parkinson disease. Neurology 1982;32:1133–8. When compared to controls, Parkinson’s patients had significant reductions or absence of vestibular responses measured by ENG and bithermal caloric testing. They concluded that vestibular dysfunction might contribute to the postural instability if PD.

- White OB, Saint-Cyr JA, Sharpe JA. Ocular motor deficits in Parkinson’s disease. I. The horizontal vestibulo-ocular reflex and its regulation. Brain 1983;106:555–70. When comparing vestibulo-ocular reflex (VOR) function in 14 parkinsonian patients compared with that of 10 age-matched controls, they concluded that there is “Unrecognized degeneration in brainstem VOR circuits” potentially attributing to their finding.

- Pollack, L, et al. Vestibuloocular reflexes in idiopathic Parkinson Disease Clinical Neurophysiology (2009) 29, 235–240. Examined the saccular function of 54 PD patients and controls using VEMP. They found that, compared to controls (p<0.05), 24/54 PD patients had either unilateral or bilateral vestibular dysfunction and, thus, concluded that PD patients often have absent vestibulocochlear function.

Data Against Vestibular Dysfunction in PD patients:

- Pastor MA, Day BL, Marsden CD. Vestibular induced postural responses in Parkinson’s disease. Brain 1993;116:1177–90. Measured GoS-induced postural sway in patients with mild PD, moderate PD, and controls. There were no significant differences between any of those groups in the speed or direction of the induced body sway response, latency to onset, latency to peak or peak amplitude of the initial horizontal ground reaction force response to the stimulus; concluded vestibular dysfunction does not explain the postural deficits of patients who are mildly or moderately affected by Parkinson’s disease.

- Bronstein, A.M. et al. 1996. Visually and posturally mediated tilt illusion in Parkinson’s disease and in labyrinthine defective subjects. Neurology 47: 651– 656. When investigating visual vertical in the setting of visual motion stimuli in patients with labyrinthine dysfunction (L2), PD patients, and controls, concluded that PD patients, regardless of whether they are posturally impaired or not, experience normal degrees of tilt of the visual vertical induced by visual-motion. Thus, data did not support a vestibular contribution to the postural disorder in PD.


- Postural instability partially contributes to falls in PD patients. Falls are the second most common reason a patient with PD is admitted to institutional care.
- PD patients are 2.2x higher risk for lifetime fractures than age match controls. The mortality with these falls and fractures is such that it can lead to rapid progression of the disease, reduced quality of life, and higher mortality rates in this group.

METHODS

1. Chair test (VOR, VVOR) measures nystagmus.
2. Optokinetic (OKC) test measures dizziness caused by viewing moving stimuli.
3. Fixation (VORHs) test measures nystagmus while the subject is being rotated, while looking at a dot of light that is rotating with them.

RESULTS

Posturography:

Pre-VTS and post-VTS posturography was statistically significant for improvement in 1 of the 11 PD patients, balance with eyes closed on a mobile platform (p = 0.01). One of the 10 controls also had significant improvement (p = 0.04) in this condition. 4/10 controls had a statistically significant decrease in performance for the aforementioned condition. Otherwise, no other significant data was found.

Conclusions

Postural instability possesses significant morbidity in PD. The role of the vestibular system has yet to be elucidated. VTS therapy has shown anecdotally to be an alternative method to improve balance in PD patients. The exact methods and mechanisms of this has yet to be understood. Further investigations are necessary.