

Rhythmic Auditory Stimulation and its Effects on Gait Asymmetries and Function in a Patient with Young-Onset Parkinson's Disease: A Case Report with 2-month Follow up

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Background:

Parkinson's Disease(PD) is a prevalent neurological disease that typically affects older adults causing postural and movement impairments.¹ It is defined by tremor, postural instability, and bradykinesia. Diagnosis typically occurs around age 60, but there are young-onset presentations of the disease.² While conventional physical therapy is shown to be effective in controlling symptoms, newer interventions such as rhythmic auditory stimulation(RAS) have shown to increase motor learning, improve balance, fall-risk, stride length, and gait speed.¹ Literature is scarce, however, on the effects of RAS on gait asymmetries. According to Plotnick et al³, marked gait asymmetry contributes to freezing gait, commonly seen in patients with PD. This case report works to determine the effects of RAS on gait asymmetries and function in an individual with young-onset PD over an 8-week intervention protocol.

Case Description:

The patient was a 46-year-old female, diagnosed with young-onset PD in March 2016. She noticed persistent slowness in her left hand that prompted her to seek professional consultation. Her doctor prescribed Sinemet and levodopa/carbidopa. Since diagnosis, she developed a noticeable tremor in her left hand while typing and grooming. Additionally, she noticed decreased balance on her left side during gait, sit to stand transitions, and when picking up objects off the floor. She has fallen twice between diagnosis and first evaluation for the study. Medications helped ease symptoms, but did not erase them. She described her general health as excellent and leads a very active lifestyle. Initial evaluation by a board-certified specialist in neurologic physical therapy included the following outcome measures: 6-Minute Walk Test(6 MWT), Timed Up and Go(TUG), Timed Up and Go Cognitive(TUGC), Activities- Specific Balance Confidence Scale(ABC Scale), Unified Parkinson's Disease Rating Scale(UPDRS), and Mini-Best Test.

Methodology:

An eight-week intervention protocol of daily RAS was administered. Protocol included 30 minutes of walking daily to a cadence predetermined by the researchers, paced by a metronome. Every two weeks, the participant came to the Movement Analysis Lab at Ithaca College to analyze walking cadence and for treatment—to increase cadence by 10% from her previous value. While walking on a Noraxon® instrumented treadmill paced to the metronome, researchers performed 2D motion analysis using I pads® to record right and left side kinematics for a total of 2 minutes in three, 10 minute intervals.

Kinovea® software was used to determine shoulder, hip, knee and ankle angular displacements in the sagittal plane. After 8 weeks of intervention, the participant was evaluated by the physical therapist and reanalyzed by 3D motion analysis. The participant then discontinued prescribed treatment.

Outcomes:

Anecdotally, the participant reported feeling “more at ease and symmetrical” post intervention. Percent change was calculated for the administered outcome measures pre to post intervention with the following results: 6MWT =3.3%, TUG=2.7%, TUGC=1.8%, UPDRS=22.7%, and Mini-Best Test=3.7%. There was a 2.5% decrease in the ABC scale. Values of each outcome measure are listed in table 1. Additionally, percent differences were calculated between left and right angular displacements at the shoulder, hip, knee and ankle joints. Changes in L/R difference from initial to final intervention are as follows: arm=7% increase; hip=1% decrease; knee=1% increase; ankle=12% decrease. Ground reaction forces(GRF) were analyzed to find L/R differences. The changes from initial to final intervention are as follows: peak heel-strike GRF=5% decrease; peak toe-off GRF=2% increase. Percent change in cadence, right and left step length, are as follows: cadence=17.5% increase; right step length 23.4% increase; and left step length 20.7% increase. Step width stayed similar=0.4% decrease. A decrease in L/R difference indicates increased symmetry. An increase in L/R difference indicates increased asymmetry.

Table 1: Pretest-Posttest Outcome Measure Reports

	Pre-Intervention	Post-Intervention
6 MWT	432.7398 m	446.8368 m
TUG	9.63 sec	9.37 sec
TUGC	9.88 sec	9.7 sec
ABC Scale	98.75%	96.25%
UPDRS	22/132	17/132
Mini-Best Test	27/28	28/28

Table 2: Pretest-Posttest Gait Analysis

	Week 1 (Baseline/ Pre-Intervention)	Week 8 (Post Intervention)
Cadence	93.0556 steps/min	109.378 steps/min
Step Length R	65.6633 cm	81.0712 cm
Step Length L	69.0491 cm	83.3617 cm
Step Width	9.76789 cm	9.73323 cm

The researchers are attributing increases in L/R difference to a change in medication during the intervention.

Discussion:

Decreased hip and ankle angular displacements, peak GRF (heel strike), increased cadence/step length during gait and outcome measure data suggest daily RAS is beneficial for patients with Young-Onset PD, though it had a negative impact on knee and arm angular displacements and peak GRF (toe-off). PD is a degenerative disease. To not improve is not negative for remaining constant and not deteriorating indicates stability of the disease at the given point. Further research is needed to assess the effects of RAS for the young-onset PD Population.

References:

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3. Plotnik M, Giladi N, Balash Y, et al. Is freezing of gait in Parkinson's disease related to asymmetric motor function? *Ann Neurol*. 2005May;57(5):656-63.