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Effect of auditory cues on gait among patients with Parkinson's disease in South India

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Nil

Effect of auditory cues on gait among patients with Parkinson's disease in South India

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Abstract

Introduction: In Parkinson's disease there is defective internal rhythm generation. There is some evidence that it can be overcome with external rhythmic cues. **Objective:** Evaluate the effect of auditory cues on gait among patients with Parkinson's disease. **Methodology:** Experimental – One group pretest post-test design was adopted. The study was conducted on 30 patients with Parkinson's disease attended the Department of Neurology, Medical College Hospital, Thiruvananthapuram. Samples were selected consecutively. Researcher collected data from the subjects using a semi structured interview schedule and Dynamic Gait Index Scale. The intervention was practice of gait listening to auditory cues by an electronic instrument metronome in which beats were set 20% faster than subject's preferred cadence. The effect of intervention was evaluated in the 4th week using Dynamic Gait Index Scale. **Results:** The study showed that Dynamic gait index mean score improved from 10.07 ± 0.944 to 13.37 ± 1.015 with mean difference 3.2 which is statistically significant ($p < 0.001$). Mean score of stride length increased from 57.23 ± 10.47 to 60.33 ± 10.152 with mean difference 3.1 which is statistically significant ($p < 0.001$). Mean score of cadence increased from 69.63 ± 5.991 to 74.4 ± 5.87 and mean difference was 4.767 which was also statistically significant ($p < 0.001$). This study shows that auditory cues with metronome beats set 20% faster than subjects preferred cadence would significantly improve gait among patients with Parkinson's disease. **Conclusion:** we concluded that auditory cues with metronome beats will significantly improve gait of patients with Parkinson's disease.

Key words: Auditory cues, gait, Parkinson's disease, metronome, stride length, cadence.

INTRODUCTION

Parkinson's disease (PD) is a neurodegenerative disease with a prevalence of 328.3 cases per 100,000 population in India (Bharucha, Bharucha, Bharucha, Bhise & Schoenberg, 1998). Since the prevalence increases with age, with aging population in India, the disease burden is increasing. Even though medical management improves some of the cardinal symptoms like tremor, rigidity and bradykinesia, the gait abnormality is not fully corrected.

There is evidence to suggest that there is defective internal rhythm generation in PD (Freeman, Cody & Schady, 1993). Even with external cueing using rhythmic auditory stimulation (RAS) rhythm of voluntary movements (e.g., finger tapping) were defective in PD (Freeman, Cody & Schady 1993). Still the effect of rhythmic auditory stimulation in

improving the gait of patients with PD has been shown. (Marchese, Diverio, Zucchi, Lentino & Abbruzzese, 2000; Fernandez del Olmo & Cudeiro, 2003; Espay & *et al.*, 2010). The temporal variability in gait was reduced by rhythmic auditory stimulation (RAS) as with normal controls. (del Olmo & Cudeiro, 2005; Hausdorff, Lowenthal, Herman, Gruendlinger, Peretz, & Giladi, 2007). Later it was found to be effective in Parkinson's patients with freezing of gait. (Rahman, Griffin Quinn, & Jahanshahi, 2008; Arias & Cudeiro, 2010). Turning is particularly difficult in patients with PD with increase in coefficient of variation (CV) of step duration compared to controls. RAS reduces the CV of step duration during turning (Willems *et al.*, 2007). The long term effectiveness of RAS after stopping it is conflicting with declined (Nieuwboer *et al.*, 2007) as well as retained effect (Rochester *et al.*, 2010) was reported.

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Continued RAS has a role in its use as part of physical rehabilitation. The improvement in gait seems to have a biological basis as shown by improvement in brain metabolic activity in the right cerebellum, right parietal and temporal lobes following rhythmic auditory stimulation. (del Olmo, Arias, Furio, Pozo, & Cudeiro, 2006). Alternate methods like rhythmic somatosensory cueing has also been found to be effective in PD (Van Wegen *et al.*, 2006). Treadmill training is synergistic to RAS (Frazzitta, Maestri, Uccellini, Bertotti & Abelli, 2009).

Thus, the authors intended to replicate the effect of RAS in South Indian population.

MATERIALS AND METHODS

Study was started after getting clearance from Institutional Ethics Committee. Patients with Parkinson's disease as per brain bank criteria (Hughes, Daniel, Kilford & Lees, 1992) with Modified Hoehn and Yahr scale score ≤ 3 attending outpatient Clinic (OPD) of Department of Neurology, Medical College Hospital, Thiruvananthapuram, were recruited consecutively for the study. The United Kingdom Parkinson's Disease Society Brain Bank Diagnostic Criteria for Parkinson's disease requires bradykinesia with one of the following rigidity, 4-6 Hz rest tremor, and postural instability. This criterion also includes exclusion criteria as well as supportive features. Hoehn and Yahr scale is a disability score for Parkinson's disease (Hoehn & Yahr, 1967). They are patients who have given consent and have been stabilized on medication for the last 4 weeks. Patients with impairment in vision or hearing, patients with dementia, psychosis, pre-existing mental sub normality, or fracture of lower limbs were excluded.

Apart from the socio-demographic data, clinical profile of the patients included frequency of freezing episodes per day, duration of disease, family history of Parkinson's disease, co-morbidities, habit of regular exercise, drugs taken, compliance to drugs, stride length in centimetres and cadence (number of steps per minute) of patients for assessment.

Dynamic Gait Index Scale (DGIS) is a standardized scale used to assess gait in terms of risk for fall (Shumway-Cook & Woollacott 1995). DGIS consisted of eight questions and the tasks included were walking with head turned both horizontally and

vertically, walking while stepping over and around obstacles, pivoting while walking and stair climbing. The maximum possible score was 24 and a score ≤ 21 has the risk for falls and lower the score indicates the high risk for fall.

Study samples were instructed to walk for 15 minutes twice a day with the metronome beat set 20% faster than the subject's preferred cadence. One care giver was instructed to monitor it. Metronome and pamphlets describing the use of metronome was provided to patients on the day of demonstration. Reinforcement via phone call every week was also done, at the end of second week they were asked to report to Neurology Outpatient Department for review. Researcher also evaluated number of steps per minute and stride length after 4th week of the intervention. Effect was evaluated by post-test using -Dynamic Gait Index Scale.

Data were analysed using descriptive and inferential statistical tests. The demographic data and clinical data were tabulated and percentages were calculated. The difference between pre-test and post-test score were analysed using Wilcoxon's signed rank test.

RESULTS

Thirty patients were recruited consecutively. The median age was 52.50 (IQR 43, 64.25). Majority of the patients (19, 63.3%) had only primary education and the rest had high school education (11, 36.7%). Most of the caregivers were spouses (22, 73.3%) followed by children (7, 23.3%).

Out of the 30 subjects under study, 56.7 percent were aged less than or equal to 55 years, 56.7 percent were females, 60.0 percent were living in urban area, 63.4 percent had only primary education, 73.4 percent were unemployed, only 10 percent had monthly income above Rs.10,000 per month, 90.0 percent were married and 73.4 percent had their spouses as caregivers.

Comorbidity was seen in 13(43.3%) subjects, of which the commonest was hypertension in 10 (33.3%) patients. Fourteen patients (46.7%) were in the habit of doing regular isotonic exercise. All 30 patients were on medication, 17 of whom were on tablet levodopa/carbidopa (11 of whom had additional pramipexole), ten patients were on pramipexole alone and three subjects were on trihexiphenyl. Drug compliance

was seen in 86.7 percent of subjects. Out of the four subjects who were not compliant, two had fear of side effects and other two lacked knowledge regarding the need for regular medications.

Table 1: Distribution of patients based on Socio-demographic data (n =30)

Socio-demographic data		Frequency	Percentage
Age group (years)	≤ 55	17	56.7
	>55	13	43.3
Gender	Male	13	43.3
	Female	17	56.7
Area of residence	Urban	18	60.0
	Rural	12	40.0
Education	Primary	19	63.4
	High school	11	36.6
Occupation	Unskilled	27	90.0
	Skilled	3	10.0
Monthly income	< 10,000Rs	27	90.0
	≥10,000Rs	3	10.0
Marital status	Married	27	90.0
	Unmarried	3	10.0
Care givers	Spouses	22	73.4
	Others	8	26.6

There were nine subjects (30.0%) with duration of illness < 2 years, 14 subjects (46.6%) with duration between 2 and 5 years, five subjects (16.6%) with duration between 5 and 10 years and 2 subjects (6.66%) with duration of > 10 years. Family history of PD was present in seven (23.3%) subjects.

Table 2: Distribution of patients based on Staging by Hoehn and Yahr Scale (n= 30)

Stage	Frequency	Percentage
1	1	3.3
1.5	2	6.7
2	9	30.0
2.5	10	33.3
3	8	26.7

Majority of patients (90.0%) had a Hoehn and Yahr score of more than 1.5. there was improvement in stride length, cadence and DGI scores after four weeks of intervention.

Table 3: Effect of auditory cues on gait in Parkinson's disease

	Pre-test score	Post-test score	Wilcoxon signed rank test	
			Z	p
Stride length (cm)	57.23(10.467)	60.33(10.152)	4.395	<0.001
Cadence	69.63(5.991)	74.4(5.87)	4.795	<0.001
DGI score	10.07(0.944)	13.27(1.015)	4.95	<0.001

The mean dynamic gait index score among subjects during pre-test and post-test has shown improved from 10.07 ± 0.944 to 13.27 ± 1.015 and the mean difference is 3.2 which is statistically significant ($p < 0.001$). Statistically significant difference was also observed between the pretest and post-test mean scores of stride length and cadence (steps/ minute). The mean score of stride length increased from 57.23 ± 10.467 to 60.33 ± 10.152 with mean difference 3.1 and mean score of cadence increased from 69.63 ± 5.991 to 74.4 ± 5.87 and mean difference is 4.8 ($p < 0.001$).

DISCUSSION

The aim of the study was to see if the gait improved with rhythmic auditory cues in patients with PD. This study has shown an improvement in gait along with increase in stride length as well as cadence. Findings are similar to the observation in other studies using the RAS (Thaut, McIntosh, Rice, Miller, Rathbun & Brault (1996); McIntosh, Brown, Rice & Thaut, 1997).

The motor symptoms in PD is proposed to be due to defect in the putamen-thalamus-supplementary motor area loop (Jahanshahi, Jenkins *et al.*, 1995). The motor symptoms in PD is proposed to be due to defect in the putamen-thalamus-supplementary motor area loop (Jahanshahi, Jenkins, Brown, Marsden, Passingham, & Brooks, 1995). The improvement is postulated to be due to rhythmic entrainment mechanism. This study was done using a metronome. Now metronome app is available in most of the smart phones and can be used by patients. Also use of suitable music is possible instead of metronome as an auditory cue.

The limitation of our study was that we did not have a control group. Our study has not seen if the effect of RAS is persisting after discontinuation of exercise using auditory cues. However, studies have reported the persistence of improvement in DGI scores four weeks after stopping training (Kadivar, Corcos, &

Hondzinski, 2011). In addition to pharmacological interventions, home rehabilitation programme which includes cueing is beneficial in PD patients (Nieuwboer, De Weerd, Dom, Truyen, Janssens, & Kamsma, 2001).

Present study shows that auditory cueing is beneficial in South Indian population where majority belong to low socio-economic and educational status. The study recommends training of nurses in auditory cues and establishment of gait training clinics in outpatient department.

CONCLUSION AND RECOMMENDATIONS

The study findings give evidence that auditory cues with metronome beats would significantly improve gait of patients with Parkinson's disease and suggests more studies to be taken up in this area to improve gait and motor skills of these patients. The study recommends to train nurses in auditory cues and other supportive therapies for establishing gait training clinics on outpatient basis which improves QOL of patients with Parkinson's disease.

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