Immersive virtual reality effects on balance and cognition in Parkinson's disease

^{1,2}Oliveira, AA; ²Jaen, M; ²Peixoto, D; Machado, A.

¹Graduate Course in Rehabilitation Sciences, ²Graduate Course in Psychology and Health

INTRODUCTION

Parkinson's disease is a neurodegenerative disorder that disrupts the patient's postural control and mobility. In addition to the typically characterized motor symptoms (bradykinesia, rigidity and resting tremor), it also manifests cognitive disturbances. The current therapeutic approach has been a combination of pharmacological and physiotherapy at a regular basis. Immersive virtual reality (IVR) can be added as a perceptual neurocognitive tool with technological rehabilitating value.

OBJECTIVE

The aim of this study was to evaluate the effects of a training protocol using IVR as a strategy to rehabilitate the balance, motor coordination, gait and cognition in Parkinson's disease.

METHOD

Twenty-three participants under the standard neurological attendance at the neurology hospital section were randomly set into three groups: Experimental group (n=11) exposed to an IVR environment in which the patients had to walk on a virtual "tight rope"; Lecture group (n=6) exposed to lecture sessions about falls avoidance and physical improvement; Control group (n=6) received the regular neurologist's attendance in which all participants also attended. In pre and post training assessment, we used Hoehn & Yahr scale (HYS), Berg Balance Scale (BBS), Timed Up and Go Test (TUG), 10 meter Walk test (10WT), Unified Parkinson's Disease Rating Scale III (UPDRS III) to assess balance and gait. Mini-Mental State Examination (MMSE), State-Trait Anxiety Inventory (STAI) and the Rivermead Behavioral Memory Test (RBMT) to assess the cognitive status. The intervention took 5 weeks, twice a week, 1 hour/session. No secondary symptoms were observed. The study was performed at the University's Laboratory of Virtual Reality

RESULTS

Cognitive and physical effects were assessed in two time points at the initial day and after the classes. **Cognitive effects:** There were no significant differences between the groups (Table 1).

Test	Experimental Group (N=11)				Lecture Group (N=6)				Control Group (N=6)			
	Pre Mean	Post Mean	std	Sig	Pre Mean	Post Mean	std	Sig	Pre Mean	Post Mean	std	Sig
MEEM	27,64	27,64	1,26	1,00	27,66	27,66	1,41	1,00	27,83	26,66	2,31	0,27
STAI-S	37,82	41,91	17,28	0,45	37,00	38,33	10,94	0,77	33,00	37,66	8,35	0,23
STAI-T	44,36	44,00	10,45	0,47	35,66	36,66	4,56	0,16	38,66	37,16	7,81	0,65
RBMT	98,00	96,18	20,36	0,77	93,66	91,16	22,61	0,79	93,66	91,16	20,29	0,94

Physical effects: there was a significant difference between the experimental group and the other training groups in the 10WT and the UPDRS III (Table 2).

Test	Experimental Group (N=11)				Lecture Group (N=6)				Control Group (N=6)			
	Pre Means	Post Means	std	Sig	Pre Means	Post Means	std	Sig	Pre Means	Post Means	std	Sig
BERG	54,27	54,27	2,28	1,00	51,66	52,50	3,71	0,60	50,00	53,00	3,03	0,60
TUG	8,81	9,14	1,60	0,50	9,68	9,83	1,20	0,78	10,80	11,80	1,45	0,15
10WT	15,06	12,61	1,42	0,07*	19,83	20,03	4,42	0,91	15,75	16,03	1,56	0,67
Cadence	115,82	113,00	5,09	0,90	115,16	120,66	12,07	0,31	110,16	109,50	5,60	0,78
Speed	1,25	1,35	0,21	0,16	1,04	1,24	0,25	0,11	1,09	1,12	0,15	0,58
UPDRS III	22,18	19,45	1,19	0,01*	22,00	20,33	2,06	0,10	20,33	21,16	2,13	0,38

Table 3: Age, Gender and Years in the condition.

	Experimental Group		Lecture Group		Control Group		Total	p
Age								
Mean-std	63,00±9,31		69,67±5,01		68,50±10,67		66,17±8,98	0,27
min-max	54 - 77		65 - 76		55 - 87		54 - 87	
EP	2,80		2,04		4,35		1,87	
Gender	n	%	n	%	n	%		
F	5	45,5%	1	16,7%	1	16,7%	7(30,4%)	0,32
M	6	54,5%	5	83,3%	5	83,3%	16(69,6%)	
Years in PD								
Median	5,00		3,00		5,50			0,36
min-max	02 - 18		02 - 15		02 - 20			

Fig. A: Sample of the tight rope IVR app (*Rope Crossing Adventure*®).
Fig. B: Patient performing the IVR protocol under a physical therapist supervision.

DISCUSSION

The results showed that PD patients submitted to a balance training in IVR might improve the motor feedback control. The results did not show cognitive changes which could be explained by the short period of time training. It is well reported that psychological effects are usually seen in longer treatments. However, the motor changes are insightful. Although it has been pointed in only two measurements, these are the golden standard for PD evaluation. Considering that Parkinson's disease is a complex condition, it is advisable to increase the sample size in future studies.

TUG test being performed with inertial movement sensor G-Walk® attached.