Movement Disorders, Vol. 26, No. 5, 2011

Acute Effects of Whole-Body Vibration at 3, 6, and 9 Hz on Balance and Gait in Patients with Parkinson's Disease

Marcelo Chouza, PhD,[1] Pablo Arias, PhD,[2] Susana Viñas, PhD,[1] and Javier Cudeiro, MD, PhD[3]

[1]Neuroscience and Motor Control Group (NEUROcom), Department of Physical Therapy, University of A Coruña, A Coruña, Spain; [2]Neuroscience and Motor Control Group (NEUROcom), Department of Physical Education and Sport Science, University of A Coruña, A Coruña, Spain; [3]Neuroscience and Motor Control Group (NEUROcom), Department of Medicine, University of A Coruña, A Coruña, Spain

Vibration as a stimulus to treat Parkinson's disease (PD) patients was first recommended by Charcot in 1892,[1] and although this approach was subsequently abandoned, recently, whole-body vibration (WBV) protocols have been suggested as a modern substitute.[2-5]

A small number of studies have assessed the effects of WBV on motor symptoms in PD, with apparently positive results, obtained in open-trial designs. In each case, however, only a fixed frequency of stimulation was used, and no placebo group was included.[2,3] It is therefore of fundamental interest to examine a range of "doses" (in this case, frequencies) in order to optimize potential therapeutic effects. Using an appropriate placebo-controlled experimental design, we have explored the use of different vibration frequencies, some of which had already been reported to have an effect after 1 session.[2,3]

Forty-eight patients with PD diagnosed as idiopathic participated in this study. Possible participants were excluded if any other disease or impairment potentially affected the validity of the results, and selected PD were naive to WBV protocols. Patients were randomly allocated to each of 4 groups: placebo, vibration at 3 Hz, vibration at 6 Hz, and vibration at 9 Hz (n = 12 each).

The protocol followed previous work reporting excellent results of single-session WBV[3] by means of a vibrating platform comprising 5 vibration sets of 1' each (interset rest period, 1'). The stepped platform (amplitude of 13 mm) thrusts the right and left legs upward alternately.[4,5] During stimulation, patients stood on the platform with their feet separated at a stable and comfortable position and with the knees slightly flexed. In the placebo group, patients adopted the same posture without vibration. Instead, they were required to stay still, trying to minimize hip oscillation; this controlled for a placebo effect.[5] Stimulation and evaluation were done during ON periods. The protocol conformed to the Declaration of Helsinki.

The effect of vibration on gait and balance was evaluated by the timed-up-and-go (TUG) and functional reach (FR) tests. Patients were evaluated just before (PRE), after (POST), and 48 hours after (POST-2) stimulation. Examiners were blind to protocol and group assignment.

- FR: Subjects had to displace, as far as they could, the movable stick of a Harpenden Anthropometer, pushing with their fists, without flexing the knees or lifting the heels. The FR distance was obtained from the difference between the starting and end positions of the stick. Each subject did so 3 times with each arm, with 30-second rests between trials. The variable analyzed was FR distance.
- TUG: Patients had to stand up from a chair, walk 3 m using their preferred pattern, turn, come back, and sit down again. The time taken was recorded, and this was the analyzed variable. Patients performed this task 3 times.

Differences between groups at PRE were assessed by a 1-way-ANOVA. A possible WBV effect was evaluated by a 3 x 4 ANOVA with repeated measures. The within-subjects factor was evaluation (PRE, POST, POST-2); the between subjects factor was group (3 Hz, 6 Hz, 9 Hz, placebo). Normality was checked by the 1-sample Kolmogorov-Smirnov test. Significance was set at $P < .05$.

Before stimulation, groups were comparable for FR distance ($F_{3,44} = 0.685$, $P = .566$) and TUG ($F_{3,44} = 1.052$, $P = .379$). Stimulation led FR to increase ($F_{1.590,69.968} = 4.255$, $P = .026$) and to reduce the time at

TUG ($F_{2,88} =$ 14.128, $P \leq .001$). However, the lack of significant interaction in evaluation x group showed that none of the vibration frequencies had an effect different from the placebo: $F_{4.771,69.968} = 0.717$, $P = .606$ for FR; $F_{6,88} = 1.332$, $P = .251$ for TUG (Table 1).

In summary, previous work has shown that a single session of WBV can appear to induce significant short-term improvement on postural stability in PD,[2,3] an effect subsequently confirmed by others using different protocols.[4] However, the role of placebo was either not investigated[2,3] or unsatisfactorily controlled.[4] We have shown here that a single session of WBV with 3 frequencies does not have acute effects on gait and balance of PD patients that are different than the effects of a placebo. However, the lack of significant improvements should not mean complete rejection of the use of WBV in the search for parkinsonian therapies: some reports suggest further analysis of the potential roles of the different vibrations protocols.[6] Future designs involving WBV should be devised in order to explore other parameters, such as application duration, number of sets, frequency, and the nature of vibration; however, in all cases, it is essential that the effect of the placebo be properly controlled for.

Acknowledgments: We are indebted to Dr. K. L. Grieve for his valuable comments and corrections on the manuscript.

Table 1. Differences between groups in the pretest (shaded) and effect of the protocol (unshaded)

	Functional reach (mm)	Timed up and go (s)
Placebo group	237.90 (±65.48)	16.39 (±7.28)
3-Hz group	260.99 (±57.78)	14.62 (±2.60)
6-Hz group	237.51 (±70.95)	13.38 (±3.25)
9-Hz group	264.79 (±48.20)	15.61 (±2.57)

	Pretest	Posttest 1	Posttest 2
Functional reach (mm)	250.30 (±60.59)	264.70 (±61.20)	255.42 (±65.97)
Timed up and go (s)	15.00 (±4.39)	14.15 (±3.79)	13.75 (±4.13)

The shaded part of the table shows the values of each group in the pretest. No significant differences were seen between groups in FR or TUG (see Results section). The unshaded part of the table shows the effect of the protocol on the analyzed variables. Results were pooled for the 4 groups, given the lack of significant interaction of evaluation x group. This demonstrates that the effect of the protocol equally affected all 4 groups, therefore suggesting no vibration frequency was superior to the placebo stimulation.

References

1. Charcot JM. La médicine vibratoire: application des vibrations rapides et continues au traitement de quelques maladies du système nerveux. Prog Méd. 1892;16:149‑151.
2. Turbanski S, Haas CT, Schmidtbleicher D, et al. Effects of random whole-body vibration on postural control in Parkinson's disease. Res Sports Med. 2005;13:243‑256.
3. Haas CT, Turbanski S, Kessler K, Schmidtbleicher D. The effects of random whole-body-vibration on motor symptoms in Parkinson's disease. NeuroRehabilitation. 2006;21:29‑36.
4. Ebersbach G, Edler D, Kaufhold O, Wissel J. Whole body vibration versus conventional physiotherapy to improve balance and gait in Parkinson's disease. Arch Phys Med Rehabil. 2008;89:399‑403.
5. Arias P, Chouza M, Vivas J, Cudeiro J. Effect of whole body vibration in Parkinson's disease: a controlled study. Mov Disord. 2009;24:891‑898.
6. Goetz CG. Jean-Martin Charcot and his vibratory chair for Parkinson disease. Neurology. 2009;73:475‑478.