

# Impact of sensorimotor training with whole body vibration platform on balance and functional mobility of an elderly individual after a stroke: case report

*Impacto do treinamento sensório-motor com plataforma vibratória no equilíbrio e na mobilidade funcional de um indivíduo idoso com sequela de acidente vascular encefálico: relato de caso*

*Efecto del entrenamiento sensorial-motor con plataforma vibratoria en el balance y en la movilidad funcional de una persona mayor con secuela de accidente cerebrovascular: un relato de caso*

Jéssica Maria Ribeiro Bacha<sup>1</sup>, Laura Rodrigues Cordeiro<sup>1</sup>, Teresa Cristina Alvisi<sup>2</sup>, Thatia Regina Bonfim<sup>3</sup>

**ABSTRACT** | The incidence of cerebrovascular accident (CVA) increases with aging and can result in sensory and motor changes, which limit functional capacity due to the reduction in balance and mobility. Different resources are being used by physical therapists in their practice to recover balance and mobility, such as sensorimotor training and training with a vibrating platform. The objective of this study was to investigate the effect of a sensorimotor training protocol with vibrating platform on the balance and functional mobility of an older adult with CVA sequela. An older adult, of the female sex, aged 72 years and with CVA sequela participated in this study. The assessment of balance was performed through the Berg Balance Scale (BBS) and the assessment of mobility through the Timed Up and Go Test (TUG). The dependent variables for monitoring were: score obtained through BBS and execution time of TUG. After the initial assessment, the older adult went through a sensorimotor training protocol with a vibration platform, comprised of 10 sessions of 45 minutes. With the final assessment, the results showed an increase in the scores of BBS (initial assessment = 41 points; final assessment = 51 points) and a

reduction in the execution time of TUG (initial assessment = 14 seconds; final assessment = 9 seconds) in the older adult with CVA sequela. Based on these results, we can conclude that the proposed training was effective for the improvement of balance and functional mobility of the older adult with CVA sequela.

**Keywords** | Cerebrovascular Accident; Older Adult; Postural Balance; Sensory Feedback; Physiotherapy Modalities.

**RESUMO** | A incidência de acidente vascular encefálico (AVE) aumenta com o envelhecimento e pode ter como consequência alterações sensitivas e motoras, as quais limitam a capacidade funcional, em função da redução do equilíbrio e da mobilidade. Diferentes recursos vêm sendo utilizados na prática fisioterapêutica para a recuperação do equilíbrio e da mobilidade, como treinamento sensório-motor e treinamento com plataforma vibratória. O objetivo deste estudo foi investigar o efeito de um protocolo de treinamento sensório-motor com plataforma vibratória no equilíbrio e na mobilidade funcional de um indivíduo idoso com

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<sup>1</sup>Physical therapist graduated from the Pontifícia Universidade Católica de Minas Gerais (PUC-MG) – Poços de Caldas (MG), Brazil.

<sup>2</sup>Physical therapist; master in Gerontology; assistant professor of the Department of Physiotherapy, Pontifícia Universidade Católica de Minas Gerais (PUC-MG) – Poços de Caldas (MG), Brazil.

<sup>3</sup>Physical therapist; PhD in Motricity Sciences; assistant professor of the Department of Physiotherapy, Pontifícia Universidade Católica de Minas Gerais (PUC-MG) – Poços de Caldas (MG), Brazil.

Mailing address: Thatia Regina Bonfim – Departamento de Fisioterapia, Pontifícia Universidade Católica de Minas Gerais (PUC-MG) – Avenida Padre Francis Cletus Cox, mailbox 1661, Jardim Country Club – Poços de Caldas (MG), Brazil – CEP: 37701-355 – Phone: (55 35) 3729-9222 – E-mail: thatiarb@pucpcaldas.br – Financing Source: Research Incentive Fund (FIP) of Pontifícia Universidade Católica de Minas Gerais (PUC-MG), Processes 2011/6605-S2 and 2013/8423-S2 – Conflict of interest: Nothing to declare – Presentation: Dez. 2015 – Accepted for publication: Feb. 2016 – Approved by the Research Ethics Committee of PUC-MG (CAAE – 0190.0.213.000-1).

sequela de AVE. Um indivíduo idoso, do gênero feminino, com 72 anos de idade e com sequela de AVE participou deste estudo. A avaliação do equilíbrio foi realizada por meio da Escala de Equilíbrio de Berg (EEB) e a avaliação da mobilidade por meio do teste Timed Up and Go (TUG). As variáveis dependentes para acompanhamento foram: pontuação obtida na EEB e tempo de execução do TUG. Após a avaliação inicial, a idosa realizou um protocolo de treinamento sensorio-motor com plataforma vibratória, composto por 10 sessões, de 45 minutos cada. Na avaliação final, os resultados indicaram um aumento da pontuação na EEB (avaliação inicial = 41 pontos e avaliação final = 51 pontos) e uma redução no tempo de execução do TUG (avaliação inicial = 14 segundos e avaliação final = 9 segundos) na idosa com sequela de AVE. Com base nesses resultados, é possível concluir que o treinamento proposto foi efetivo para a melhora do equilíbrio e da mobilidade funcional da idosa com sequela de AVE.

**Descritores** | Acidente Vascular Cerebral; Idoso; Equilíbrio Postural; Retroalimentação Sensorial; Modalidades de Fisioterapia.

**RESUMEN** | La incidencia del accidente cerebrovascular (ACV) aumenta con el envejecimiento, y su consecuencia puede ser las alteraciones sensoriales y motoras, que restringen la capacidad funcional, debido a la reducción del balance y de la movilidad. En la práctica fisioterapéutica para recuperarles

a los sujetos el balance y la movilidad, se están utilizando diversos recursos, tales como el entrenamiento sensorial-motor y el entrenamiento con plataforma vibratoria. Este estudio se propone a investigar el efecto de un protocolo de entrenamiento sensorial-motor con plataforma vibratoria en el balance y en la movilidad funcional de una persona mayor con secuela del ACV. Participó del estudio una persona mayor, mujer, con 72 años de edad y con secuela del ACV. Se realizó la evaluación del balance mediante la Escala de Equilibrio de Berg (EEB) y la evaluación de la movilidad a través del test Timed Up and Go (TUG). Las variables dependientes para análisis fueron: la puntuación obtenida en la EEB y el tiempo de ejecución del TUG. Tras la evaluación inicial, la participante realizó un protocolo de entrenamiento sensorial-motor con plataforma vibratoria, compuesto de 10 sesiones, de 45 minutos cada una. En la evaluación final, los resultados de la participante señalaron un aumento de la puntuación en la EEB (evaluación inicial = 41 puntos y evaluación final = 51 puntos) y una reducción en el tiempo de ejecución del TUG (evaluación inicial = 14 segundos y evaluación final = 9 segundos). Según estos resultados, se concluye que el entrenamiento propuesto produjo efecto en la mejora del balance y de la movilidad funcional de la participante con secuela del ACV.

**Palabras clave** | Accidente Cerebrovascular; Persona Mayor; Balance Postural; Retroalimentación Sensorial; Modalidades de Fisioterapia.

## INTRODUCTION

Currently, the theme aging has been subject of discussions and studies, due to the growth in the number of older adults in society<sup>1</sup>. The modifications arising from the ageing process associated with chronic disease and sedentary lifestyle are factors that increase the disability of older adults. The loss of mobility, decreased muscle strength and balance deficit are factors that contribute to addiction and loss of autonomy<sup>2,3</sup>. One of the pathologies that afflicts older adults is the cerebrovascular accident (CVA), a change of cerebral circulation that causes a transient or permanent deficit in the operation of one or more parts of the brain, which may happen by ischemic or hemorrhagic means, resulting in loss of the neurologic function<sup>4</sup>. Individuals who underwent CVA usually present functional disability, with loss of autonomy, physical aptitude and ability to perform activities

of daily living being the most affected physical dimensions<sup>5</sup>.

Various therapeutic modalities have been used in an attempt to minimize the CVA sequelae, including reduction of balance and functional mobility<sup>6</sup>. In this context, to propose measures that provide greater functional independence and improvement of physical conditions is essential to improve the quality of life of these older adults. One of these measures is functional training. In this sense, sensorimotor training has excelled as a training option for older adults, as it has fundamental importance in maintaining their functionality. Studies indicate the effectiveness of sensorimotor training in preventing falls of older patients, for allowing the improvement of the proprioceptive sensitivity, providing more accurate information on the position of anatomical segments and movement patterns, a decisive factor in gestural correction, dynamic stability and prevention of injuries<sup>7-11</sup>.

Another option that has been used recently is training in a vibrating platform, in which sinusoidal vibration in various frequencies and amplitudes is transmitted to the body, thus stimulating the muscle spindles. The activation of muscle spindles produces a tonic vibratory reflex that activates the alpha motoneurons. Consequently, a greater active population of motoneurons is responsible for greater strength and power production. The benefits of exposure to vibration in a controlled and frequent manner were reported in some studies, having as benefits the improvement in bone quality, neuromuscular function, and balance. Therefore, vibration training appears to be particularly attractive to individuals who present limitations of mobility and functionality<sup>12,13</sup>.

In this context, the objective of this study was to investigate the effect of a sensorimotor training protocol with vibrating platform on the balance and functional mobility of an older adult with CVA sequela.

## METHODOLOGY

### Study design and sample

This research is characterized as a case study, applied, experimental and longitudinal. It was conducted in the School Clinic of Physiotherapy, Pontifícia Universidade Católica de Minas Gerais (PUC-MG), in the city of Poços de Caldas, Minas Gerais, Brazil. The sample of the study was composed of one older adult, of the female sex, aged 72 years, with 1.65m of height and 64 kg of weight. This older adult presented history of two ischemic CVAs within 16 months, having as sequel left hemiparesis. We established as inclusion criteria: be over 65 years of age; walk independently without auxiliary devices; not present any associated pathology, except CVA. Exclusion criteria were: acute inflammatory signals of the musculoskeletal system and severe compromises of the spinal column. After receiving information on the procedures of this study, the participant signed an informed consent form, approved by the Research Ethics Committee of PUC-MG (CAAE 0190.0.213.000-1).

### Procedures

The older adult who participated in this study underwent two assessments:

- 1) Assessment of balance: By Berg Balance Scale (BSE), adapted to application in Brazil<sup>14</sup>, an instrument widely used in assessment studies involving older adults. It contains 14 items that simulate common activities of daily life. Each item has 5 score possibilities, ranging from 0 to 4, totaling a maximum of 56 points, with a cutoff point of 45 points for risk of falls.
- 2) Assessment of functional mobility: Through the Timed Up and Go (TUG) test, in which the time spent by the individual to rise from a chair, walk a distance of three meters, turn and walk back through the same route, ending the task sitting at the chair is measured in seconds<sup>15</sup>. The results of TUG are interpreted as follows: up to 10 seconds - older adult without changes in balance and with low risk of falls; between 11 and 20 seconds - older adult without significant change of balance, but showing some frailty and medium risk of falls; over 20 seconds and less than 30 - older adult in need of assistance; over 30 seconds - older adult with high risk of falls, dependent concerning the performance of daily life activities (DLAs) and with changed mobility<sup>16</sup>.

After the initial assessment procedures, the older adult performed 10 sensorimotor training sessions, in two weekly sessions with total duration of 45 minutes. Each session was composed of: 5 minutes of overall stretching; 5 minutes of warming-up exercises; 20 minutes of functional exercises; and 15 minute of exercises at the vibrating platform. The functional exercises were: 1) Exercises of sitting and getting up from a chair, holding or not a medicine ball; 2) Go up and down a step; 3) Plantar flexion in standing position; 4) Balance exercises using a proprioceptive disk; 5) Balance exercises using a circular board; 6) Walking circuit with hip flexion in anterior and posterior direction; 7) Lateral walking circuit. The exercises at the vibrating platform were performed as follows: position of light flexion of hips and knees; bipedal and unipedal support; with abduction movement of the lower limbs. The oscillation frequency of the vibrating platform was increased gradually from 10 to 20 Hz.

The dependent variables considered for the monitoring of the evolution of the case study were: 1) score obtained on BBS; and 2) time of execution of TUG. These variables were analyzed comparatively, having as comparison factor the initial and final assessments.

## RESULTS

In general, the results indicated an improvement of balance and functional mobility of the older adult

with CVA sequela, when comparing the initial and final assessments. Table 1 illustrates the score of BBS and the execution time of the participant in the initial and final assessments.

Table 1. Score obtained on BBS and execution of TUG of the older adult with CVA sequela

Participant	BBS - Initial (Score)	BBS - Final (Score)	TUG - Initial (Time)	TUG - Final (Time)
Older adult with CVA sequela	41	51	14	9

Source: Research data

## DISCUSSION

This study investigated the effect of a sensorimotor training protocol with vibrating platform on the balance and functional mobility of an older adult with CVA sequela. We observed an increase in the BBS score of the older adult with ischemic CVA sequela, indicating the effectiveness of the proposed protocol, and suggesting that the functional exercises and additional sensory information provided by the vibration interfered positively in the older woman with ischemic CVA functional balance sequela. Regarding functional mobility, this older adult presented reduction in the execution time of the Timed Up and Go test. At the moment, we do not have knowledge of any studies conducted with protocol similar to the one proposed here. However, there are similar studies that corroborate with this study, using isolatedly the training proposed here. As in the study by Ferrero et al.<sup>17</sup>, which investigated the effects of vibration in static and functional balance of patients with sequela of hemorrhagic and ischemic chronic CVA. After the implementation of the proposed training, the results indicated only an improved BBS score in patients with hemiparesis on the left side, but not in the right side. Using the vibrating platform as therapy, Van Nes et al.<sup>18</sup> evaluated a possible synergistic effect of the vibrating platform with the conventional balance rehabilitation in patients with ischemic cerebrovascular accident in subacute phase. The authors studied 53 subjects with moderate to severe disability, which were randomized for training on the platform or for therapeutic exercises with music for 6 weeks. The instruments included the Berg Balance Scale, stem control test, Rivermead Mobility Index, Barthel Index, Motricity and Somatosensory Index in the initial moment, six weeks after, and twelve weeks after. Both groups showed significant improvement when compared with

the initial BBS scores, but no difference was observed among the other parameters. Giriko et al.<sup>19</sup>, another study that used different therapeutic resources than this study, verified the effectiveness of physiotherapy in a groups regarding walking, body balance, risk of falling, and verification of correlation between the functional capacity of walking and balance in individuals with chronic hemiparesis. The results showed a progressive reduction, although non-significant, of the execution time of TUG, as well as a progressive increase, also non-significant, in BBS score. Thus, therapy was not effective in producing improvement in scores of tests, but contributed to maintain mobility.

Furthermore, studies involving training at the vibrating platform, in general, have been showing beneficial effects in healthy older adults, as observed in the study by Cheung et al., which investigated the effectiveness of the protocol on the improvement of balance. The authors compared older adults who received training at the vibrating platform (n=50) during 3 months, 3 times a week on the frequency of 20 Hz for 3 minutes, with the control group (n=25), which was not exposed to any intervention. We concluded that there was an improvement of the balance, as a result of the improvement in the movement speed ( $p<0.01$ ) and directional control ( $p<0.05$ )<sup>20</sup>. Using another therapeutic resource, Abreu et al.<sup>21</sup> compared the balance and walking of older women participating in a program of therapeutic exercise, with sedentary older women, through the Berg Balance Scale. They concluded that the older women who were practitioners of physical activity showed better performance against the sedentary women. In a recent work, Nascimento et al.<sup>22</sup> analyzed the effect of four weeks of proprioceptive training in measures of postural balance and observed that, after the intervention, participants showed a decrease of oscillations in Romberg and an increase in the total BBS score, demonstrating significant

improvement in dynamic and static balance condition. Similarly, Leal et al.<sup>23</sup> verified the effects of functional training on functional autonomy, balance and quality of life of older adults, dividing them into Functional Training Group (FTG) and Control Group (CG). After the intervention, the authors observed improvement in performance in dynamic and static balance tests of the FTG, with significant and satisfactory difference in relation to the CG.

Despite the positive results regarding balance and functional mobility demonstrated on the participant with CVA sequela, after a sensorimotor functional training protocol with vibrating platform, which are relevant to the area of physiotherapy and rehabilitation, it is important to report the limitation of this research, characterized as a case study. Therefore, we highlight the need of conducting studies to investigate the effect of sensorimotor training and with vibrating platforms in a larger sample, isolated and associated, concerning balance and functional mobility of individuals with CVA sequela, since we observed a lack of studies on this subject.

## CONCLUSION

We can conclude that the sensorimotor functional training with a vibrating platform was effective for the older woman with CVA sequela, since, after the implementation of the proposed protocol, we noted an improvement of balance and mobility, which can interfere positively in functional capacity.

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