

Influence of Posturographic Platform Biofeedback Training on the Dynamic Balance of Adult Stroke Patients

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The aim of the experiment was to analyze the influence of posturographic platform biofeedback training on the dynamic balance of patients who experienced ischemic stroke. The study included 21 patients treated at the Rehabilitation Center of the District Hospital in Białogard, in the Ward of Neurological Rehabilitation with the Stroke Division. The age of the patients (11 in the experimental and 10 in the control group) ranged between 55 and 65 years. The level of dynamic balance was determined with Timed Up and Go Test. The experimental group was subjected to the biofeedback training, practicing maintenance of body balance (forced sway training) on posturographic platform for 15 consecutive days. The perception of dynamic balance in the group subjected to biofeedback training improved to a markedly greater extent ($P < .05$) as compared with conventionally rehabilitated group. Participation in biofeedback training exerted stronger effect on the dynamic balance of patients who experienced the stroke of the left hemisphere with right-sided hemiparesis than in those with right hemisphere stroke and left-sided hemiparesis. The utilization of feedback mechanisms during training on a posturographic platform can be reflected by enhanced stimulation and further improvement of the control of performed motor tasks. **Key Words:** Stroke—biofeedback—body balance—adults—posturography.

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Introduction

Stroke constitutes an important cause of decreased functional capacity in humans.¹ Among numerous consequences of the stroke, marked decrease in the perception of body balance and ability to maintain correct spatial orientation are frequently mentioned. These balance disorders can be reflected by an increased risk of falling, which is particularly high in neurologic patients.²⁻⁴ Not only are such disorders very frequent but can also persist for a considerable time after the stroke episode.⁵

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Received July 9, 2013; revision received September 4, 2013; accepted October 14, 2013.

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1052-3057/\$ - see front matter

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<http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2013.10.029>

Noticeably, the balance disorders markedly affect the patient's daily living activities.

Despite preventive measures, falls are significantly more frequent in stroke patients than in healthy individuals.⁶ Nyberg and Gustafson⁷ analyzed the risk of falling among 161 patients subjected to geriatric rehabilitation after the stroke and revealed that 39% of the subjects experienced falling. Of note is the high variability of factors that play a direct role in falling of such patients. According to Tsur and Segal,⁸ most documented falls affect patients who suffer from decreased muscular tone (70%), paresis (54%), or unilateral hypoesthesia. Other factors that increase the risk of falling in stroke patients include sedatives or neuroleptics, hemianopia, loss of vision, and visual agnosia. Campbell and Matthews⁹ published a comprehensive review of experiments addressing the potential risk factors of falling during hospital rehabilitation of men and women after stroke. The authors concluded that the specific risk of falling, such as balance disorders, visuospatial hemineglect, and lack of caution, can be stronger predictors of falling than more general risk factors such as age or impaired sensual function.

Falls are particularly frequent among individuals with severe neurologic deficits, marked impairment, and neglect syndrome.¹⁰ However, the number of falls can be significantly reduced by properly conducted rehabilitation process; moreover, its effects can be observed quite quickly. Rogind et al¹¹ revealed that early implemented rehabilitation activity is reflected by improvement of posturographic parameters during each (1st, 2nd, 4th, and between the 8th and 52nd) week of exercise. The rate and degree of patient's improvement are modulated by an array of factors, such as the site and size of stroke, patient's age, general status, and implemented therapeutic and rehabilitation modalities. Yelnik et al¹² verified the role of this latter factor, comparing 2 rehabilitation strategies of improving balancing abilities of stroke patients. Their study included 28 patients who experienced the first episode of hemiparesis 3 to 15 months earlier. However, they did not confirm the superiority of multi-sensorial rehabilitation, as based on higher intensity of balance tasks and exercise during visual deprivation, over the neurodevelopmental theory-based therapy among patients treated at an outpatient setting.

Biofeedback methods are used in rehabilitation with increasing frequency.^{13,14} Biofeedback enables obtaining information on the present state of the body with an aid of various devices. Such information enables voluntary changes to the spatial orientation of the body. The most frequently used types of feedback include visual, acoustic, thermal, strength, electromyographic, and electrokinesiologic biofeedback.

Intiso et al¹⁵ emphasized the efficacy of this method during the rehabilitation of stroke patients. Nonetheless, each hemiparetic stroke patient may have unique combination of postural abnormalities,¹⁶ which may be reflected by highly variable effect of rehabilitation on the balance of such patients. A comparative study of the effectiveness of functional electrostimulation, biofeedback, and kinesiotherapy on various parameters of lower limb muscular strength, walking kinematics, and body balance of stroke patients revealed biofeedback as the most effective of all analyzed methods of treatment.¹⁷

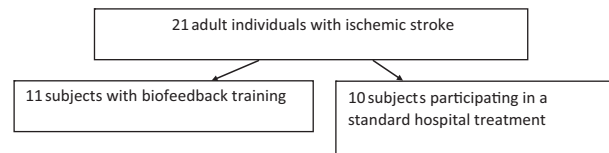
On the other hand, the results of available randomized trials did not confirm the efficacy of biofeedback in resuming the mobility of hemiparetic joints.¹⁸ Although the results of some preliminary clinical trials seem promising, the studied techniques are relatively new. Thus, the number of randomized trials necessary to ultimately confirm the usefulness of modern task-based feedback technologies in rehabilitation is limited.¹⁹

Glanz et al¹³ thought that the initial case reports and small uncontrolled series on biofeedback therapy in stroke included differences in the treatment, studied populations, outcome measures, random variation, and systematic variation (also known as bias). These constitute the potential sources of explanation for the disparate conclusions in clinical trials. As a result, stroke rehabilitation in particular

began to be widely discussed by health care professionals and intensively develops. Nevertheless, subsequent articles have delineated the lack of objective evidence for the efficacy of various neuromuscular rehabilitative techniques in stroke and the need for further research in the area. Therefore, there is a need for further studies analyzing the effects of biofeedback training on the fitness, including dynamic balance, of stroke patients. The aim of the experiment was to analyze the influence of posturographic platform biofeedback training on the dynamic balance of patients who experienced ischemic stroke.

Materials and Methods

In our study, stroke was defined according to the World Health Organization criteria as rapidly developed clinical signs of focal disturbance, lasting more than 24 hours, with no apparent cause other than vascular origin.



The study included patients treated at the Rehabilitation Center of the Hospital in Białogard, in the Ward of Neurological Rehabilitation with the Stroke Division. During the designing stage of the study, we strived to provide maximal homogeneity of examined group. Participants were in the subacute phase (functional rehabilitation) and did not possess cognitive or executive impairment or aphasia precluding contact; additionally, the subjects were capable of independent walking and did not have any other conditions associated with balancing disorders. The age of the patients ranged between 55 and 65 years. The group included women and men who were randomized to the experimental ($n = 11$) and control group ($n = 10$). All the patients experienced ischemic stroke with right- or left-sided hemiparesis, with no laryngologic or ophthalmologic problems.

Participation in the study was voluntary and every subject expressed the written consent to take part in the experiment, after receiving written information about the process of examination and participation in an exercise group. The study was approved by the Local Committee of Ethics in Research.

Pre- and Post-training Measurements

Control group was subjected to measurements solely at admission and discharge. The measurements of the experimental group were taken at the same time points, but the participants from this group practiced maintenance of body balance (forced sway training) on GOOD

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