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Original Research Article

EVALUATION OF STABILITY AND POSTURAL CONTROL IN PATIENTS WITH MULTIPLE SCLEROSIS PRE AND POST BALANCE PROGRAM ON BIODEX BALANCE SYSTEM

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ABSTRACT

The purpose of the study was to evaluate response of stability and postural control in patients suffering from multiple sclerosis. Thirty subjects, of both sexes ,their age ranged from 30 to 40 years shared in this study and were divided into two equal groups, the first group (GI) included normal subjects and the second group (GII) included patients suffering from multiple sclerosis. Assessment was done by Biodex balance system via the dynamic balance test which included anteroposterior, mediolatoral and overall stability index. This study was done in Biomechanics lab in Faculty of Physical Education at Kafrelsheikh University. Group II was trained for two months. The results revealed that there were slightly decrease in balance paremeters in the control group or normal subjects during assessment of balance in this study. In relation to the study group, there were no significant difference between the balance parameters post treatment than pre treatment ($p > 0.05$), this indicates that there was no improvement in balance in GII after receiving the balance training program. It could be concluded that performing balance training program did not improve balance in subjects suffering from multiple sclerosis.

KEY WORDS: Postural control, Balance , stability and Multiple sclerosis.

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INTRODUCTION

Multiple sclerosis (MS), also known as disseminated sclerosis is an inflammatory disease in which the insulating covers of nerve cells in the brain and spinal cord are damaged [1]. The name multiple sclerosis refers to scars (sclerae known as plaques or lesions) particularly in the white matter of the brain and spinal cord [2].

This damage disrupts the ability of parts of the nervous system to communicate resulting in wide range of signs and symptoms including physical, mental and sometimes psychiatric problems [3].

Multiple sclerosis takes several forms, with new symptoms either occurring in isolated attacks (relapsing forms) or building up over time (progressive forms) between attacks, symptoms may go away completely; however, permanent

neurological problems often occur, especially as the disease advances [4] .

The cause of MS is not clear; the underlying mechanism is thought to be either destruction by the immune system or failure of the myelin producing cells. Proposed causes for this include genetics and environmental factors such as infections [5]**.** MS is usually diagnosed based on the presenting signs and symptoms and the results of supporting medical tests .There is no known cure for multiple sclerosis. Treatments attempt to improve function after an attack and prevent new attacks [6]**.**

Symptoms of multiple sclerosis occur in two main patterns initially; either as episodes of sudden worsening that last a few days to months (called relapses, exacerbations, bouts, attacks, or flare-ups) followed by improvement (85% of cases) or as a gradual worsening over time without periods of recovery (10-15% of cases) [7].

Balance is controlled on the basis of afferent information from the somatosensory, visual and vestibular systems. All these systems are often affected in the presence of MS [8]**.** The somatosenory system is the biggest contributor of feedback for postural control. This sensory system is composed of several different muscle joint, and cutaneous mechanoreceptors [9,10]**.**

MATERIALS AND METHODS

Subjects: Thirty volunteer subjects (16 males and 14 females) shared in this study. The normal group (GI) consisted of fifteen subjects; they have no past history of any musculoskeletal problems, matched in age, sex, weight, height and socio-economic level. The study group (GII) consisted of fifteen patients suffering from multiple sclerosis. The age of both groups was ranged from 30 - 40 years. They were able to stand and walk independently. They were able to understand and follow verbal commands and instructions during both testing and training sessions. Patients who had fixed deformities of upper or lower limbs or had significant perceptual, cognitive, visual and auditory disorders were excluded.

Ethical approval was obtained in accordance with the ethical principles of the Declarations of Helsinki.

Instrumentation:

Biodex balance system: Is a balance screening and training tool Biodex medical system (Inc, Shirley New York, U.S.A) . It consists of a movable balance platform, which provides up to 20 degree of surface tilt in a 360 degree range. The stability levels available by the system range from a completely firm surface (stability level 8) to a very unstable surface (stability level 1) [11].

Procedures:

preparatory procedures:

1. The assessment and training procedure was explained to the patient.

2. Informal consent was filled and signed by all patients.

Balance assessment:

1. The session was started with the balance platform in the “locked” or static position.

2. The display must be positioned at the level of the patient’s eyes to ensure comfort and safety so support rail and biofeedback display were adjusted for each patient.

3. The patient was asked to stand in the center of the platform with grasping support handle, then progress to standing without grasping support handle. This ensured that new or unstable patients had an adequate understanding of the Balance System and protected the patient against sudden or unexpected movement of the platform.

4. Three trials performed prior to testing. For dynamic balance testing, the “default settings” were preselected with three trials per side. This should assist with the learning curve and better average of the data.

5. The degree of surface instability is controlled by the system’s microprocessor-based actuator.

The dynamic balance test parameters include

a- Anterior posterior (AP) stability index (SI): represent the patient’s ability to control their balance in front to back directions.

b- Mediolateral (ML) stability index: represent the patient’s ability to control their balance from side to side.

c- Overall (OA) stability index: represent the patient’s ability to control their balance in all

direction.

High values represent less stability in all indices of the system.

Balance training program :

The Biodex training program was performed in standing position. The subject was instructed to focus on the visual feedback screen directly in front of patient and attempt to maintain the cursor at the center of the screen while standing on the unstable platform (stability level six).**This choice of stability level six as training level was setteled after pilot study before starting the training program**. The treatment session was repeated three times weekly for two months [11]**.**

RESULTS

Assessment was carried out before and after treatment, and paired t test was used to analyse and compare the gained results within each group, and the independent t test to compare between both groups for stability (OA, AP and ML index) at eight and seven levels of stability during the dynamic balance test.

Table 1: Stability indices for the normal group at stability level eight and seven.

SI	Level eight	Level seven
	$\bar{X}$ ± SD	$\bar{X}$ ± SD
OA	3.35 ± 1.12	3.57 ± 1.17
AP	2.82 ± 1.11	2.96 ± 1.15
ML	2.14 ± 0.732	2.42 ± 0.714

SI: Stability Index, **OA:** Overall stability,
AP: Anteroposterior stability, **ML:** Mediolateral stability

Table 2: Stability indices for the study group at stability level eight.

SI	$\bar{X}$ ± SD		t value	P value	Level of significance
	Pre	Post			
OA	11.4 ± 1.44	11.3 ± 1.43	0.001	P>0.05	Not significant
AP	9.3 ± 1.25	9.2 ± 1.20	0.001	P>0.05	Not significant
ML	8.3 ± 1.14	8.1 ± 1.11	0.001	P>0.05	Not significant

Table 3: Stability indices for the study group at stability level seven.

SI	$\bar{X}$ ± SD		t value	P value	Level of significance
	Pre	Post			
OA	12.7± 1.39	12.2± 1.32	0.001	P>0.05	Not significant
AP	10.6 ± 1.2	10.3 ± 1.22	0.001	P>0.05	Not significant
ML	9.6 ± 1.1	9.2 ± 1.07	0.001	P>0.05	Not significant

DISCUSSION

Few literature exposed to the point of evaluation of postural control and balance in patients suffering from multiple sclerosis and study the effect of balance training program on those types of patients. So, from this point the need of our study has been derived and established.

No Significant difference was reported when comparing the pre and post treatment mean values of all measured balance variables of the study group indicating that there is no improvement in postural control and balance in patients suffering from multiple sclerosis.

The elevated stability indices of the dynamic balance test at both stability levels eight and seven in the pre treatment results of the study group could be attributed to muscles weakness. In addition to limited joint mobility and sensory problems in patients suffering from multiple sclerosis and this finding matched with the results of pilot study done by (Freeman and Allison) [12].

The significant disturbed standing balance seen in the present study which was reported by elevated stability indices values might result from impaired sensation from receptors in the planter aspect of the foot. This came in agreement with Karst et al. [13] who reported that, sensory problem can disrupt postural control by affecting the subject ability to adapt sensory inputs to changes in task and the environmental demands and also by preventing the development of accurate internal models of the body for the postural control.

The findings of the current study could be confirmed by the study of Thoumie et al. [14]who examined postural responses in patients with somatosensory deficits and showed significant delay in muscle response latencies in response to platform perturbations and in ability to modulate response amplitudes in relation to stimulus size .

Finlayson et al. [15] reported that deficits related to standing balance in the multiple sclerosis patients might be due to reduced sensation, distorted proprioception of the lower limb, decline in the muscle strength of the lower limb ,decline in the muscle endurance that may affect their ability to maintain balance in addition to limited joint mobility.

A person with sensory loss as multiple sclerosis does not receive normal sensory input from the

sensory receptors in the feet and ankles or from visual and vestibular systems. If there is significant sensory loss the person will be unable to adjust easily to changes in the support surface during tasks such as walking on grass uneven surfaces and even walking in shoes with soft soles [16,17,18].

Frzovic et al . [19] stated that people with MS whose balance control systems are affected, often adopt a slower gait speed, wider standing base of support, increased double stance time and reduction in ankle range and ankle muscle activation during walking.

The visual system including the retina, optic nerve, chiasm, post chiasmal pathways, the visual sensory cortices and their connections may be damaged by the MS disease process. A number of common ocular deficits experienced by people with MS include optic neuritis, visual field defects, and saccadic eye movement [8,20].

Limitations of the study: The sample size in the study was small due to limited inclusive criteria of selected patients.

CONCLUSION

It can be concluded that performing balance training program does not improve balance in subjects suffering from multiple sclerosis.

Conflicts of interest: None

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