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Effect of Task Oriented Approach on Balance in Ataxic Multiple Sclerosis Patients

MOSHERA H. DARWISH, Ph.D.*; NEVIN M. SHALABY, Ph.D.**; AHMED S. ALI, Ph.D.* and HABIBA Z. SOUBHY, M.Sc.*

The Department of Physical Therapy for Neuromuscular Disorders, Faculty of Physical Therapy and The Department of Neurology, Faculty of Medicine**, Cairo University, Egypt*

Abstract

Background: Multiple Sclerosis (MS) is a common, complex neurological disease. Balance Disorders (BDs) and ataxic symptoms are the most frequent and challenging symptoms in MS, lead to abnormal postural stability which have adversely effect on patients independence, participation and quality of life.

Aim of Study: To investigate the effect of task oriented training exercises on balance in ataxic MS patients.

Subjects and Methods: Thirty patients from both sexes diagnosed with remitting and Relapse Multiple Sclerosis (R.RMS) with ataxic symptoms and EDSS score ranged from 2 to 4.5, were recruited from multiple sclerosis specialized clinic in the Neurology Department, Faculty of Medicine, Cairo University and were randomly assigned into two equal groups.

Results: In control group there is significant improvement in Stability Index (SI), Anterior Posterior Stability Index (APSI) and non-significant improvement of Mediolateral Stability Index (MLSI), and berg balance scale. In the study group there is a significant improvement in all balance measures between pre and post treatment assessment. Study group results were highly significant than the control group ($p<0.05$) in all study measures.

Conclusion: Task oriented training approach in addition to conventional balance rehabilitation is effective for improving balance in ataxic MS patients. Therefore, task-oriented training may be considered as an essential part of the physical therapy program for balance rehabilitation in MS patients.

Key Words: *Multiple sclerosis – Ataxia – Balance – Task oriented training.*

Introduction

MULTIPLE Sclerosis (MS) is the most common disease of the CNS to cause permanent disability in young adults. It is chronic demyelinating disease of the Central Nervous System (CNS) of presume autoimmune etiology, characterized by localized areas of inflammation, demyelination, axonal loss and gliosis in the brain and spinal cord. Typically affecting patients between 20 and 40 years of age and characterized by heterogeneity in the symptoms, disease course, and outcomes **[1,2]**.

Symptoms of MS include diminished balance, coordination, muscle strength and sensory function. In early stages of the disease, functional recovery can be complete; however, residuals develop over time, and a chronic progressive phase evolves in a subgroup of patients **[3]**.

The incidence of ataxia in MS is high with about 80% of patients experiencing symptoms at some point during their disease **[4]**. Impaired balance is one of the most disabling MS symptoms. It seems to represent an early hallmark in Multiple Sclerosis, (MS) **[5]**, and affects about 75% of patients during the course of the disease **[6,7]** which leads to restrictions in everyday life and decreased participation in society **[8]**.

Multifocal central nervous system involvement, visual and somatosensory afferent feedback are commonly adversely affected in individuals with MS. Moreover, the high prevalence of MS-related involvement of the primary sensory integration brain structures (eg, brainstem, cerebellum) results in impaired central integration of these sensory systems along with the vestibular system. This is important because humans require efficient and effective Central Sensory Integration (CSI) of the visual, somatosensory, and vestibular sensory systems to maintain balance control **[9]**.

Correspondence to: Dr. Moshera H. Darwish, The Department of Physical Therapy for Neuromuscular Disorders, Faculty of Physical Therapy, Cairo University, Egypt

Subjects and Methods

Thirty patients with MS from both sexes represented the sample of the study. They were selected from multiple sclerosis specialized clinic in the Neurology Department, Faculty of Medicine, Cairo University. The study conducted from July 2018 till March 2019 with approval of the ethical committee (Approval NO: P.T.REC/012/001939).

Inclusion criteria:

Patients with relapsing remitting MS recruited according to McDonald's criteria 2010, their age ranged from 25 to 42 years, Expanded Disability Scale (EDSS) score ranging from two to 4.5 with ataxic symptoms, last attack occurred from at least two months, all of the patients were ambulant and can maintain independent static standing balance with eye open for five min without assistive device.

Exclusion criteria:

Patients with other neurological disease or orthopedic deformities which may affect their balance, patients with cardiovascular and pulmonary diseases that make exercise unsafe, patients with cognitive impairment or psychiatric disorders, pregnant patients and patients participated in other regular balance training program.

Study design and randomization:

Thirty patients with R.R MS with ataxic symptoms were assigned randomly into two groups control group (GA) and study group (GB) after consenting to participate and fulfilling the inclusion criteria. Sealed envelopes were prepared in advance and marked on the inside with A, B. Randomization was performed prior to the start of the pretest by a physical therapist who was not involved in the assessment or treatment of the subjects.

Control group (GA) treated by conventional rehabilitation for balance disorders consist of a combination of static postural control, weight shifting and perturbations exercises [10]. Study group (GB) treated by conventional rehabilitation for balance disorders in addition to task oriented training exercise.

Assessment:

I- The Expanded Disability Status Scale (EDSS).

II- Biodex stability system.

III- Berg balance scale.

Assessment procedures: All the patients were submitted to the following assessment steps:

1- The expanded disability status scale (EDSS): It was applied for each patient (by a neurologist) to assess physical disability before treatment period with specific attention on the clinical tests were used to evaluate the patient's ability to maintain position for 30 seconds, the ability to walk 7.62 meters and timed 25 foot walk test. Also matching in EDSS functional scores achieved between groups.

2- Biodex stability system:

- Patient was asked to stand on both feet without footwear on the BBS locked platform and maintain their arms by their sides and look straight ahead to the display screen that adjusted to each patient height.
- Patient's weight, height and age were entered to the device, then unlock the plate form to allow motion.
- Each patient was instructed to adjust the position of the feet until they found a position where they were able to maintain platform stability and can centered the cursor (visual feedback) on the screen grid.
- The cursor was in the center of the display target, patient was asked to maintain feet position till the platform was stabilized. Heels coordinates and feet angles from the platform were recorded.
- After introducing feet angles and heels coordinates into the biodex system the test began. It consisted of a 30s evaluation, on level eight (most stable). then the patient was instructed to focus on the visual feedback screen directly in front of him with both arms at the side of the body without grasping handrails and to maintain the cursor in the smallest concentric rings (balance zones) of the BBS.

3- Berg balance scale:

- Each patient was asked to maintain different positions of the scale and complete movement and tasks of varying difficulty began with sit to stand then stand to sit until completed the 14 items of the berg balance scale.
- The patient's ability to perform each task was evaluated and graded from 0 to 4, the scores of items were summed and collected to be analyzed.
- The assessment took approximately 10 to 15 minutes to complete.

B- *Treatment procedure:*

The intervention periods of both groups were identical, 6 consecutive weeks, two sessions per week, Duration of the session ranged from 50 to 60min according the ability of each patient with ten min of rest in between.

Control Group (GA): Received conventional rehabilitation for balance disorders consist mainly of a combination of static postural control, weight shifting and perturbations exercises and participants underwent 10min of stretching exercises, active lower limb joint mobilization at the beginning of the session.

Study group (GB): Received conventional rehabilitation in addition to task oriented training program. Frequency and duration of the session the same as the control group started with 20 to 25min of conventional rehabilitation then five min of rest followed by 30 minutes of task oriented training program with five min of rest in between.

Results

Table (1) represents the mean values of demographic data in study group and control group. The statistical analysis revealed that there was no significant differences (p>0.05) in demographic data (age, weight, height, BMI) among the two groups.

Table (1): The mean values of demographic data among control group, and study group.

Items	Age (Year) Mean ± SD	Weight (kg) Mean ± SD	Height (cm) Mean ± SD	BMI (kg/m^2) Mean ± SD
Control G	30.20±7.18	73.10±11.62	166.66±4.67	26.32±3.97
Study G	32.47±8.20	74.53±12.30	166.17±7.05	27.05±4.53
F-value	0.294	0.604	1.147	0.199
p-value	0.747	0.552	0.269	0.820

SD : Standard Deviation. F-value: Fisher value.
p-value: Probability value.

Table (2): The mean values of stability index pre and post treatment within control group and study group.

Item	Stability index	
	Control G (Mean ± SD)	Study G (Mean ± SD)
Pre-treatment	4.40±1.07	4.96±1.68
Post-treatment	3.31±1.14	2.03±0.86
Mean difference	1.09	2.93
Improvement %	24.77%	59.07%
F-value	7.312	35.827
p-value	0.012*	0.0001 *

SD : Standard Deviation. p-value: Probability value (p<0.05).
F-value: Fisher value.

Table (3): The mean values of anterior posterior stability index pre and post-treatment within control group and study group.

Item	Anterior posterior stability index	
	Control G (Mean ± SD)	Study G (Mean ± SD)
Pre-treatment	3.47±0.66	3.62±1.47
Post-treatment	2.79±1.12	1.49±0.77
Mean difference	0.63	2.13
Improvement %	19.60%	58.84%
F-value	4.123	24.520
p-value	0.035*	0.0001 *

SD : Standard Deviation. F-value: Fisher value.
p-value: Probability value (Significant p<0.05).

Table (4): The mean values of mediolateral stability index pre and post-treatment within control group and study group.

Item	Mediolateral stability index	
	Control G Mean ± SD	Study G Mean ± SD
Pre-treatment	3.67±1.13	3.84±1.30
Post-treatment	2.87±0.97	1.58±0.51
Mean difference	0.52	2.26
Improvement %	21.80%	58.85%
F-value	1.420	38.921
p-value	0.341	0.0001 *

SD : Standard Deviation.
F-value: Fisher value.
p-value: Probability value (Significant p<0.05).

Table (5): The mean values of Berg balance scale pre and post-treatment within control group and study group.

Item	Berg balance scale	
	Control G Mean ± SD	Study G Mean ± SD
Pre-treatment	42.00±3.41	39.00±5.19
Post-treatment	45.00±4.15	49.00±4.67
Mean difference	3.00	10.00
Improvement %	7.14%	25.64%
F-value	3.871	30.718
p-value	0.059	0.0001 *

SD : Standard Deviation.
F-value: Fisher value.
p-value: Probability value (Significant p<0.05).

Table (6): The mean difference of post-treatment measures between two groups.

Item	Post-stability index			
	Mean ± SD	MD	95% CI	p-value
Control G vs. Study G:				
Control G	3.31±1.14	1.28	0.34-2.21	0.004*
Study G	2.03±0.86			
Item	**Post anterior posterior stability index**			
	Mean ± SD	MD	95% CI	p-value
Control G vs. Study G:				
Control G	2.79±1.12	1.30	0.49-2.21	0.001 *
Study G	1.49±0.77			
Item	**Post mediolateral stability index**			
	Mean ± SD	MD	95% CI	p-value
Control G vs. Study G:				
Control G	2.87±0.97	1.29	0.46-2.12	0.001 *
Study G	1.58±0.51			
Item	**Post-Berg balance scale**			
	Mean ± SD	MD	95% CI	p-value
Control G vs. Study G:				
Control G	45.00±4.15	4.00	0.40-8.39	0.027*
Study G	49.00±4.67			

SD : Standard Deviation.
MD : Mean Difference.
CI : Confidence Interval.
p-value : Probability value Significant (p<0.05).

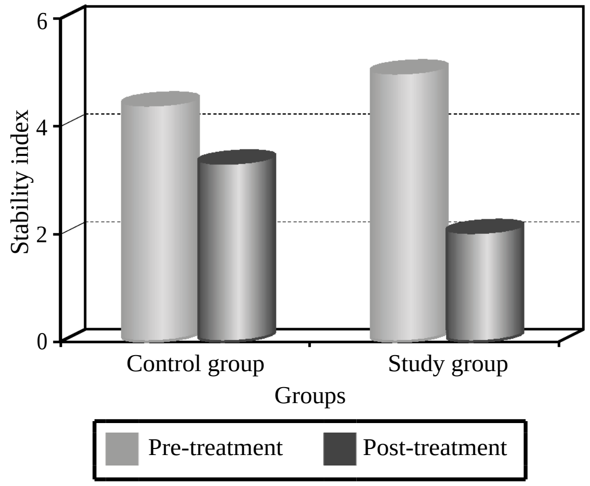

Fig. (1): The mean values of stability index pre and post-treatment within control group and study group.

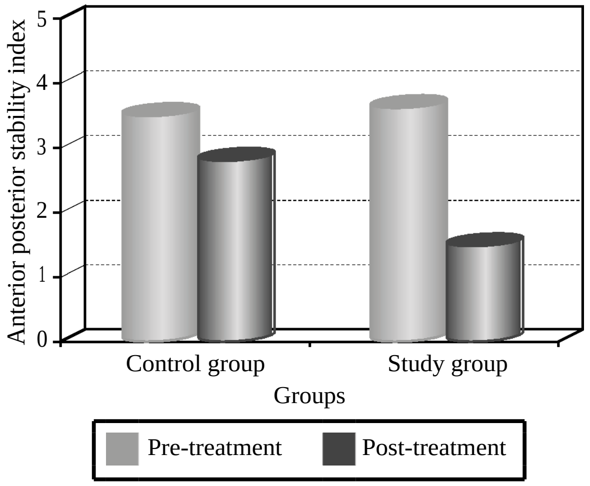

Fig. (2): Mean values of anterior posterior stability index pre and post-treatment within each group.

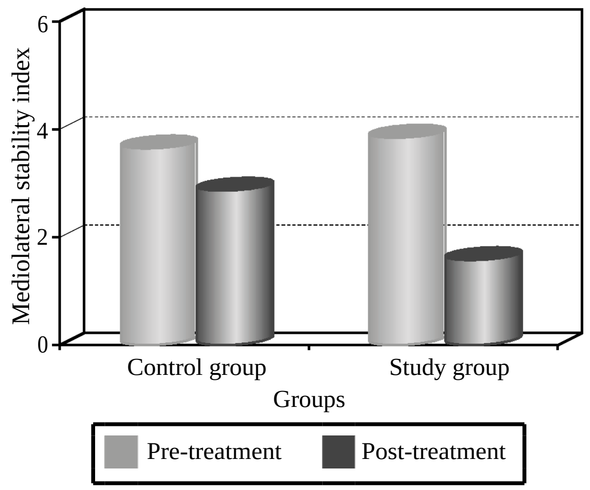

Fig. (3): Mean values of mediolateral stability index pre and post-treatment within control group and study group.

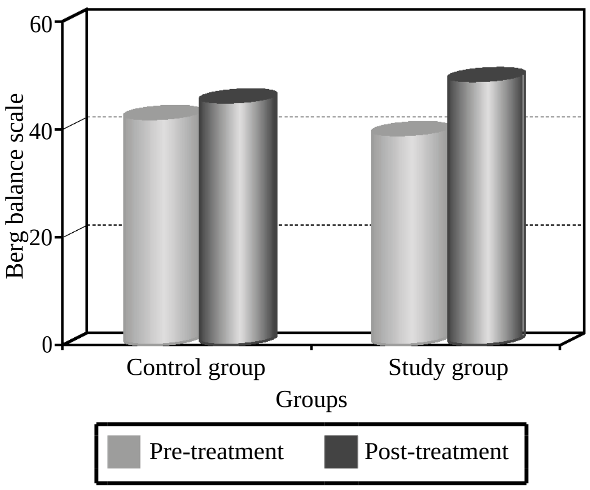

Fig. (4): Mean values of Berg balance scale pre and post-treatment within control group and study group.

Discussion

This study was conducted to investigate the effect of task oriented training approach on balance in ataxic MS patients. Thirty remitting and relapse MS patients from both sexes were assigned into two equal groups; control group (GA): Treated by conventional rehabilitation on balance disorders and the study group (GB): Treated by conventional rehabilitation on balance disorders in addition to task oriented training exercises. Biodex stabililty system was used as an objective, valid and reliable method for balance assessment in addition to Berg balance scale.

The present study proved that task oriented approach is an effective approach for balance rehabilitation in ataxic MS patients. Conventional balance training in addition to task oriented training resulted in highly significant improvements in postural control than balance training alone.

The results also agreed with Chisari et al., [11] and Cizelle et al., [12]. Task oriented approach may be a suitable approach for balance rehabilitation as it focuses on interactions between the sensori-motor system components of strength, endurance, range of motion, coordination, sensory awareness, postural control, and perceptual skills, and uses the concepts of degrees of freedom and control parameters [13]. It has been suggested that repetitive, and task-specific practice promote motor learning, plasticity and function restoration which lead to an enhancement of both functional and structural neural circuits [14] and this explanation also in line with Prosperini et al. That is mean that task oriented training-induced white matter plasticity and led to a functional restoration of myelin sheaths on de-myelinated axons [15].

The strength of this study was it employed an intervention that targeted multiple contexts of balance control, and progressively challenged patients by changing task and environmental demands. Limitations of this study are that the participants represent a selected group of stable, ambulant people with R.R MS (EDSS 2-4.5) so these results cannot be generalized to more severely impaired individuals. The study lacks power analysis for justifying the sample size and lacks post-treatment follow-up assessment.

The results of this study revealed highly significance difference of task oriented training approach group than the control group. Finally, according to the results of the current study task oriented training approach is an effective approach for improving balance in ataxic MS patients, promote a better result of balance rehabilitation and it may be considered as an essential part of the physical therapy program for balance rehabilitation in MS patients.

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تأثير أسلوب التدريب الموجه نحو المهام على التوازن في مرضى التصلب المتناثر الترنحي

مقدمة البحث: التصلب المتناثر (إم إس) هو مرض عصبي شائع ومعقد. تعد إضطرابات التوازن وأعراض الإرتجاجات أكثر الأعراض شيوعاً وتحدياً في مرض التصلب المتناثر، مما يؤدي إلى إستقرار وضعي غير طبيعي يؤثر سلباً على إستقلالية المرضى ومشاركتهم ونوعية حياتهم.

الهدف: التحقق في تأثير التمرينات الموجه نحو المهام على التوازن في مرضى التصلب العصبي المتعدد الترنحي.

هذه الدراسة تمت على ثلاثين مريضاً من كلا الجنسين تم تشخيصهم بخمول وإنتكاس مرض التصلب المتعدد وتم إختيارهم بشكل عشوائي من عيادة متخصصة لمرض التصلب العصبي المتعدد في قسم الأعراض العصبية، كلية الطب، جامعة القاهرة وجميعهم يعانون من أعراض ترنح ويتراوح مقياس عدم القدرة لديهم من ١٢ إلى ٥.٥.

أثبت التحليل الإحصائي أن إضافة التدريب الموجه نحو المهام إلى التدريب على التوازن التقليدي أكثر فاعلية لتحسين التوازن في مرضى التصلب. لذلك، ينبغي إعتبار التدريب الموجه نحو المهام كجزء أساسي من برنامج العلاج الطبيعي لإعادة التوازن في مرضى التصلب المتعدد.