Effect of Task Oriented Approach on Balance in Patients with Diabetic Neuropathy

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ABSTRACT

Background: Diabetesmellitus is a chronic metabolic disorder with a wide profile of complications. One of the complications is the diabetic peripheral neuropathy, which is associated with disorders in equilibrium and postural instability. **The Purpose:** The aim of study was to investigate the effect of task-oriented approach on balance in Diabetic Neuropathy patients. **Methodology:** Sixty diabetic patients with neuropathic complications were assigned into two equal groups (group I and II): Group (I) received task-oriented approach in addition to selected physical therapy program, while group (II) received selected physical therapy program only. Patients in both groups received three months of training, three times per week. Patients were assessed using Biodex stability system including postural stability test and clinical tests (Berg balance scale, and time up and go test). **Results:** The study findings revealed that postural stability is significantly improved in both groups with the best results for group I. **Conclusion:** Task-oriented approach could be considered a valuable and non-invasive treatment method for improving postural stability in patients with type II diabeticneuropathy.

Keywords: Diabetic peripheral neuropathy, Postural stability, Task-oriented approach.

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Introduction

Diabetes mellitus (DM) is a group of metabolic diseases, commonly referred as diabetes, in which there are high blood sugar levels over an extended period[1].

Diabetic microvascular injury affecting small blood vessels (vasa nervosa) that supply nerves are thought to be the result of nerve-damaging disorders associated with diabetes mellitus [2]

Several established risk factors for falls are more common in people with diabetes, decreased cognitive performance, including peripheral neuropathy, poor vision and decreased physical performance [3].

Additionally, hypoglycemic episodes may contribute to fall risk. Furthermore, falls are the main cause of fractures, and fractures are more common in those with diabetes [4].

Postural stability is the ability to maintain or control the center of mass in relation to the base of support to maintain static postures and to complete desired movements [5].

The amount of cognitive processing needed for postural control depends both on the capability of the patient's postural control system and on the complexity of the postural task. The control of posture involves many different underlying physiological systems that can be affected by pathology or sub-clinical constraints [6].

During regular exercise training, in the task-oriented approach, movement occurs as an interaction between many systems in the brain and is organized around a goal and constrained by the environment [7].

Task-oriented is a behavioural approach in which the member focuses on the tasks that need to be performed in order to meet main goals or achieve a certain standard performance [8]. It could facilitate brain plasticity. Cortical reorganization during motor learning is evoked by repeatedly performed skilled movements with task specificity and high functional content [9]. Task-oriented training can improve functional mobility, walking speed and endurance [10].

The aim of the study was to determine the effect of task-oriented approach on balance in diabetic neuropathy patients and to compare between task-oriented training and regular physiotherapy programs for improving postural stability in those patients.

Subjects, Instrumentations and Methods

Subjects:

Sixty diabetic neuropathy patients were selected from the Outpatient Clinic of Faculty of Physical Therapy, Modern University for Technology and Kasr Al- Aini Hospitals, Cairo, from September to November 2017.

They were randomly assigned into two equally matched groups, group I (study) that received task-oriented approach in addition to selected physical therapy program, for 12 sessions every other day for three month, group II (control) that received the selected physical therapy program.

Inclusion criteria:

The patients had type II diabetes mellitus diagnosed with peripheralneuropathy. Patients age ranged from 40-60years. They were medically stable and ambulant. The body mass index ranged from 20-30 Kg/m^2. The patients were examined and had deep sensory hypoesthesia and grade 3-4 according to manual muscle test in both lower limp muscles.

Exclusion criteria:

Patients with musculoskeletaldeformity or with psychiatric disorders orseizures or with visual impairment or tremors influencebalance or with foot ulcers or with cognitive impairment.

Methods

Evaluation:

Biodex Balance System(made in the United States of America), the software was designed to for assessment and treatment of balance and mobility skills of patients, whether their impairments and functional limitations result from orthopaedic, neurologic, vestibular or geriatric conditions.[11]

Measures of Biodex balance system:

Stability Index (SI) represents displacement from a level platform position. Patient having difficulty maintaining a level platform position may represent poor neuromuscular control and indicate high SI. This can be observed in both the unilateral stance and bilateral evaluations. [12].

The Anterior/Posterior Stability Index represents platform displacement in a sagittal plane. Poor neuro-muscular control of the quadriceps and/or hamstringmuscles in addition to the Anterior/Posterior compartment muscles of the lowerleg is an indication for high score in this direction [13].

The Mediolateral Stability Index representing platform displacement in the frontal plane. Bilateral or unilateral poor neuromuscular control of the inversion or eversion muscles of the lowerleg are indication for high score in this direction [14]

Berg BalanceScale:

Berg Balance Scale (BBS) was developed to measure balance among older people with impairment in balance function by assessing the performance of functional tasks. It is a valid way used for evaluation of the effectiveness of interventions and for quantitative descriptions of function in research and clinical practice [15].

Timed Up and Go Test (TUG):

It is a simple test to assess a

person's mobility and requires both static and dynamic balance [16].

Treatment:

Task-oriented training program [17]

Rocker board training

The subject was asked to control anteroposterior then mediolateral rolling movement of the rocking board, first placing both feet then one foot, first with eyes opened then with eyes closed, from sitting then standing position.

Wobble board training

The subject was asked to try to stop the multidirectional rolling wobble board movement, first with eyes opened then with eyes closed, from sitting then standing position, repeat 10 times.

Sit to stand

The patient was instructed to lean forward then press on heel then stand up. Both hands should be on the thigh and push against it to stand. This progress to be performed with opened eyes then with closed eyes firstly on a firm surface then on foam surface with repetitions 10 times.

Walk five steps forward

From standing position, the patient was asked to walk five steps forward firstly on a firm surface, then on foam surface and repeat 10 times.

Upstairs and downstairs three steps

The patient was asked to perform upstairs five steps and downstairs with hand supported then without hand supported, repeat 10 times.

Selected physical therapy program: [For both groups (I & II)]

Pain management:

Transcutaneous Electric Nerve Stimulation [TENS] (80– 150 Hz) was used. Electrodes were placed on the skin on the location of pain for 30 minutes.

Range of motion exercises

Range of motion exercises was performed for the foot. The patient was asked to sit in a chair, lift the affected foot and circle in a clockwise, then a counterclockwise motion. Repeat this cycling five and ten times in each direction.

Strengthing exercises:

Graduate active exercise was used through strengthing of ankle dorsiflexors, planterflexor, invertors and evertors. Proprioceptive neuromuscular facilitation was also applied to strength distal muscles in the form of repeated contraction for dorsiflexors of ankle joint for ten minutes.

Sensory re-education:

Tactile stimulation for both superficial and deep sensation was applied.

Gait Training

Walking within parallel bar with hand supported then without hand support was participated for ten minutes. Obstacles also were used with hand support then without hand support.

Data analysis

Data were presented as means and standard deviations. Post hoc test were used to compare within and between groups, with a p-value < 0.05 was considered statistically significant. Data was analyzed and presented using the SPSS version 16 and Microsoft Office Excel 2007 respectively.

RESULTS

Overall stability index

Table (1) and figure (1) represented the mean values of pre- and post-overall SI within and between groups. In group I, the mean ±SD values of pre- and post overall SI was 4.16 ±0.39 and 2.45 ±0.42 respectively, with improvement percentage 41.11%. In group II, the mean ±SD values of pre and post overall SI were 3.99 ±0.41 and 3.09 ±0.51 respectively, with improvement percentage 24.81%. The results revealed that there was a significant reduction of the overall SI in group I (P=0.0001) and group II (P=0.002) post-treatment compared with pre-treatment. No significant difference was found in the mean values of pre overall SI (P=0.463), while, there was significant difference in the mean values of post-overall SI between groups I and II (P=0.0001).

Table (1): Comparison between SI mean values of pre and post in groups I and II.

Items	Group I	Group II	Mean difference	P-value
	Mean ±SD	Mean ±SD		
Pre-treatment	4.16 ±0.39	3.99 ±0.41	0.17	0.463
Post-treatment	2.45 ±0.42	3.09 ±0.51	-0.64	0.0001*
Mean difference	1.71	0.90		
Improvement %	41.11%	24.81%		
P-value	0.0001*	0.002*		

*Significant level

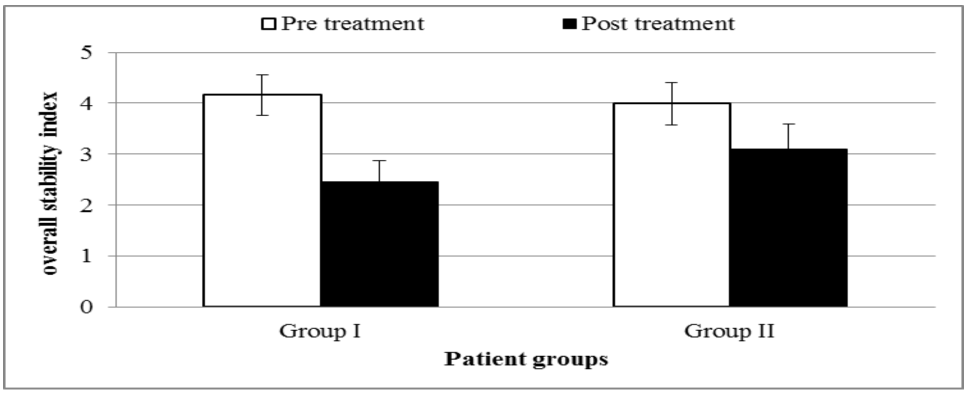

Figure (1): Mean values of pre and post overall SI in groups I and II.

Anterior-posterior (AP) stability index

Table (2) and figure (2) represented the mean values of pre and post AP SI within and between groups. In a group I, the mean ±SD values of pre and post AP SI were 3.49 ±0.11 and 1.98 ±0.49 respectively, with improvement percentage 43.27%. In group II, the mean ±SD values of pre- and post AP SI were 2.87 ±0.43 and 2.44 ±0.1 respectively, with improvement percentage 14.98%. The results revealed that there was a significant reduction of AP SI in group I (P=0.0001) and group II (P=0.006) post-treatment compared with that pretreatment. No significant difference was found in the mean values of pre AP SI (P=0.284), while, there was significant differences in the mean values of post-AP SI between groups I and II (P=0.0001).

Table (2): Compare between SI mean values of pre and post in groups I and II.

Items	Group I	Group II	Mean difference	P-value
	Mean ±SD	Mean ±SD		
Pre-treatment	3.49 ±0.11	2.87 ±0.43	0.62	0.284
Post-treatment	1.98 ±0.49	2.44 ±0.1	-0.46	0.0001*
Mean difference	1.51	0.43		
Improvement %	43.27%	14.98%		
P-value	0.0001*	0.006*		

*Significant level

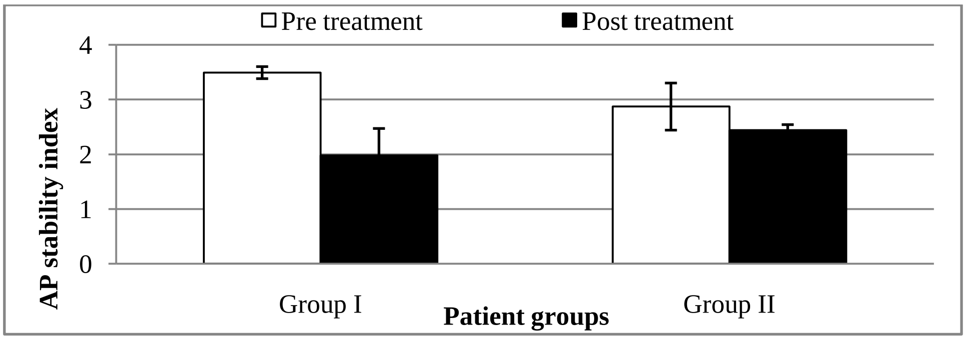

Figure (2): Mean values of pre- and post-AP stability index in groups I and II.

Medial-lateral (ML) stability index

Table (3) and figure (3) represented the mean values of pre and post ML SI within and between groups. In a group I, the mean ±SD values of pre and post ML SI were 3.72 ±0.58 and 1.52 ±0.29 respectively, with improvement percentage 59.14%. In group II, the mean ±SD values of pre and post ML SI were 3.35 ±0.35 and 2.48 ±0.24 respectively, with improvement percentage 25.97%. The results revealed that there was a significant reduction of ML SI in group I (P=0.0001) and group II (P=0.006) post-treatment compared with that pretreatment. No significant difference was found in the mean values of pre-ML SI (P=0.839), while, there was significant differences in the mean values of post-ML SI between groups I and II (P=0.0001).

Table (3): Compare between SI mean values of pre and post in groups I and II.

Items	Group I	Group II	Mean differenc e	P-value
	Mean ±SD	Mean ±SD		
Pre-treatment	3.72 ±0.58	3.35 ±0.35	0.37	0.839
Post-treatment	1.52 ±0.29	2.48 ±0.24	-0.96	0.0001*
Mean difference	2.20	0.87		
Improvement %	59.14%	25.97%		
P-value	0.0001*	0.0001*		

*Significant level

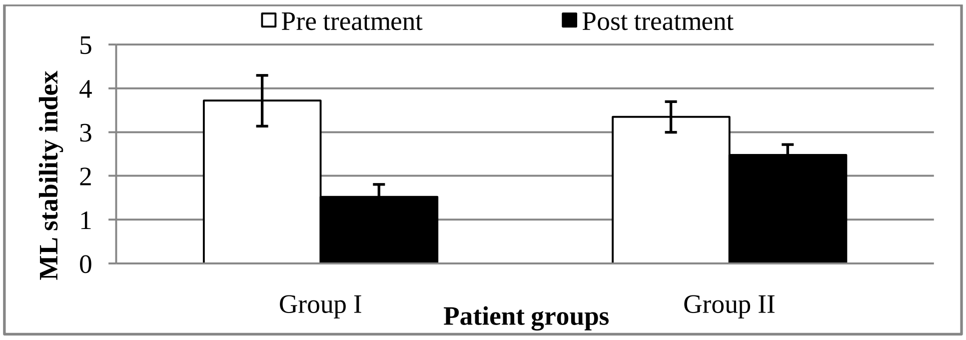

Figure (3): Mean values of pre- and post-ML stability index in groups I and II.

Berg balancescale (BBS)

Table (4) and figure (4) represented the mean values of pre and post treatment BBS scores within and between groups. In a group, I, the mean ±SD values of pre and post BBS was 41.04 ±3.98 and 48.26 ±4.42 respectively, with improvement percentage 17.59%. In group II, the mean ±SD values of pre and post BBS were 41.38 ±4.53 and 45.71 ±4.09 respectively, with improvement percentage 10.46%. The results revealed that there was a significant increase of BBS within group I (P=0.002) and group II (P=0.028) post-treatment compared with that pretreatment. No significant difference was found in the mean values of a pre BBS (P=0.740), while, there was significant differences in the mean values of post BBS between groups I and II (P=0.031).

Table (4): Compare between BBS mean values of pre and post in groups I and II.

Items	Group I	Group II	Mean difference	P-value
	Mean ±SD	Mean ±SD		
Pre-treatment	41.04 ±3.98	41.38 ±4.53	-0.34	0.740
Post-treatment	48.26 ±4.42	45.71 ±4.09	2.55	0.031*
Mean difference	-7.22	-4.33		
Improvement %	17.59%	10.46%		
P-value	0.002*	0.028*		

*Significant level

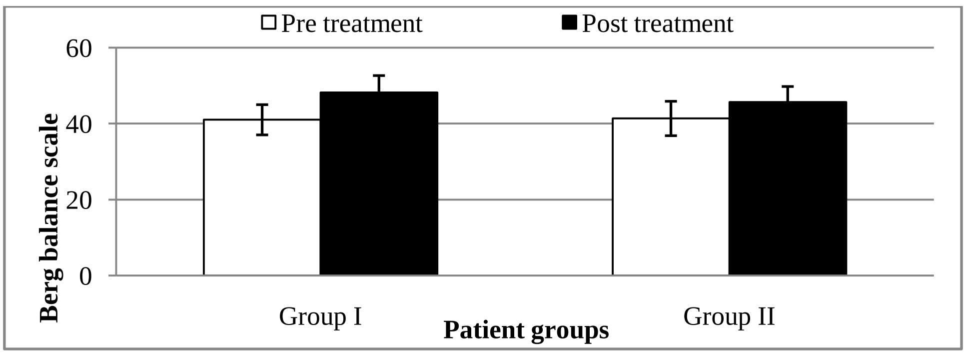

Figure (4): Mean values of pre- and post-Berg balance scale in groups I and II.

Time up and go test (TUG)

Table (5) and figure (5) represented the mean values of pre and post TUG within and between groups. In group I, the mean ±SD values of pre- and post-TUG were 27.21 ±2.70 and 14.34 ±1.43 respectively, with improvement percentage 47.30%. In group II, the mean ±SD values of pre and post TUG were 28.30 ±1.45 and 20.40 ±1.17 respectively, with improvement percentage 27.92%. The results revealed that there was a significant increase of TUG within group I (P=0.0001) and group II (P= 0.0001) posttreatment compared with that pretreatment. No significant difference was found in the mean values of pre TUG, while (P=0.099), there was significant differences in the mean values of TUGbetween groups I and II (P=0.0001).

Table (5): Compare between TUG in mean values of pre and post groups I and II.

Items	Group I	Group II	Mean difference	P-value
	Mean ±SD	Mean ±SD		
Pre-treatment	27.21 ±2.70	28.30 ±1.45	-1.09	0.099
Post-treatment	14.34 ±1.43	20.40 ±1.17	-6.06	0.0001*
Mean difference	12.87	7.90		
Improvement %	47.30%	27.92%		
P-value	0.0001*	0.0001*		

*Significant level

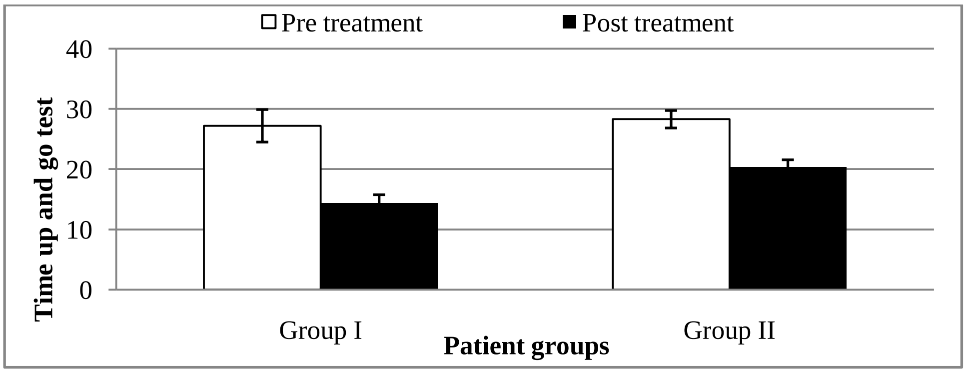

Figure (5): Mean values of pre- and post-time up and go test in groups I and II.

Correlations

Table (6) and figure (6 and 7) represented the correlation between post overall SI with the post BBS and post TUG in the study group. It was revealed that there was a significant negative correlation between the overall SI and post BBS after treatment (r=-0.73; P=0.037). No significant correlation was found between post-overall SI and post TUG (r=0.41; P=0.067).

Table (6): Correlation between post-overall SI withpost- BBS scores and post TUG in thestudy group.

Items	Correlation coefficient (r)	P-value
Post-Berg balance scale	-0.73	0.037*
Post-time up and go	0.41	0.067

*Significant level

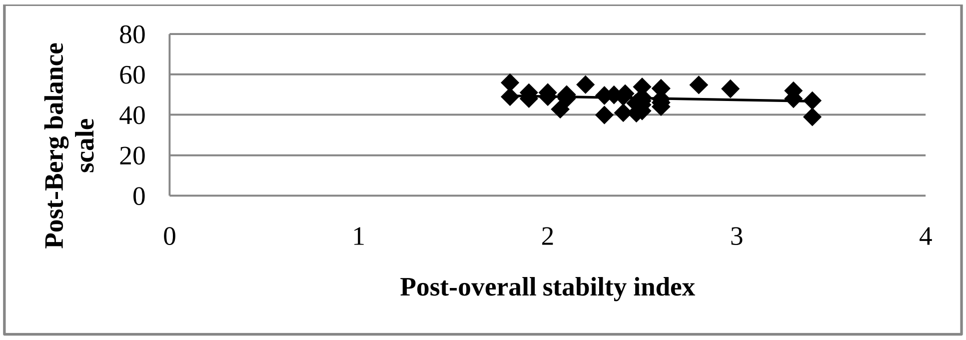

Figure (6): Correlation between postoverall SI and post BBS scores in thestudy group.

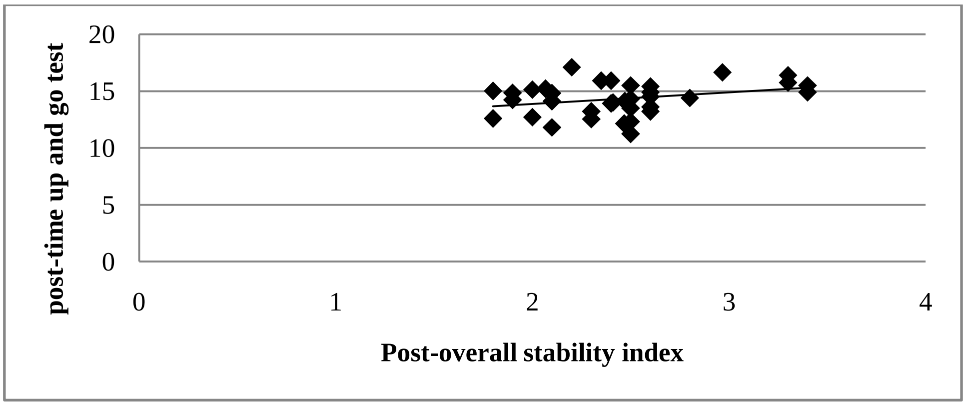

Figure (7): Correlation between postoverall SI and post TUG scores in thestudy group.

DISCUSION

The outcomes of current study proved that there was clinical improvement of postural stability in both groups post-treatment with superiority of group (I) which was treated with task-oriented approach combined with selected physical therapy program. This may be attributed to neural re-organization, in addition, motor cortical system excitatory mechanisms can be significantly modulated by sensory flow. Afferent input from the same body region, where the muscle 'target' of the cortical motor output is located, provokes an initial decrement of excitability. This effect may have importance in favouring synaptic efficiency mechanisms **(18)**.

The results of the present work were supported by **Ghazal et al** [19]who proved that the impairment of balance commonly affects the diabetic population. Diabetic patients are more liable to develop increased risk of fall. A better result in improving the decreasing fall risk and balance is obtained by the task-oriented approach. The appropriate and proper task-oriented training must be included as part of diabetic management to prevent further consequences and enhancing the quality oflife.

Also the results of a current study were in agreement with **Kalra**[20]who declared that movements performed in the presence of a functional task target are smoother and faster than movements performed in the absence of such objects during seated tasks.

Salsabili et al [21]agreed with the results of the present study. They suggested that task-oriented motor gait training for diabetic neuropathy patients, not only enhanced performance during walking, but also improved and modified foot mechanics during walking. Changes in the enhanced muscle abilities and provided sensorimotor information can be regarded as reliable contributions for gait responses and walking balance in diabetic neuropathy patients. Furthermore **Ching-Yi et al** [22]reported thattask-oriented training improved daily function, motor control strategies, sensory recovery and motor performance more than the traditional treatment. Also, task-oriented training could provide proper visual input and substitutes for absent or reduced proprioceptive input from the affected part of the body **(23)**.

Additionally**, Hoffman and Koceja**[24]agreed with our findings and concluded that a task-oriented training assisted by sensory manipulation is more effective at improving the standing balance of patients with diabetic neuropathy than physical therapy exercise program.

The present study findings were in accordance with **Akbari et al** [25]who proved that diabetic patients who experience peripheral neuropathy and consequent balance problems could achieve better balance and stability through progressive balance training (through motor tasks) with emphasis on the anterior-posterior neuromuscular elements of stability. Similarly, **Bahrpeyma et al** [26]showed that training using reactive and sensory movement strategies with external visual feedback improves standing postural stability in patients with diabeticneuropathy.

In the same line, **Dettmann et al** [27] demonstrated that the functional use of a task object can influence the performance of both the postural control and reaching activity. This comes in agreement with **Ikai et al** [28]who showed improvement in static balance by using task-oriented training where there was a significant improvement in anteroposterior and mediolateral velocity (mm/s) with eyes closed and eyes open.

Moreover Laufer et al [29] supported the results of current study**.** Theypostulated that there was a significant difference between the effect of task-oriented training and conventional physical therapy exercises on balance disturbance in diabetic neuropathy patients. Also **Visser et al** [30]revealed that there were significantly worse in parameters of the limit of stability (LOS) test in diabetic neuropathy patients. Moreover, significant improvement of some parameters of LOS test after balance training and task-oriented training in diabetic neuropathy patients was found, which comes in agreement with our statistical results. The findings of Liston **and Brouwer**[31]camein agreement with our findings. They demonstrated that stance symmetry improved in diabetic neuropathy patients after visual feedback training program in specific tasks. **Pastor et al.** [32]revealed that balance training program could positively influence postural stability in combination with task-oriented training, improve the level of confidence perceived during daily life balance activities and reduce the frequency of falls in patients withdiabetic neuropathy.

CONCLUSION

Task-oriented training could be considered a valuable treatment method for improving postural stability in patients with diabetic neuropathy.

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