EFFECT OF OTAGO EXERCISES ON BALANCE IN DIABETIC NEUROPATHY

Dr. Pratik Gamre[1], Dr Amruta Doijad[2], Dr. Risha Kamble[3]

1. MPTh Neurosciences, D Y Patil College of Physiotherapy Kolhapur, D Y Patil Deemed University
2. Professor and HOD,(Department of Neuroscience Physiotherapy) D. Y. Patil College of Physiotherapy, Kolhapur D. Y. Patil Education Society (Deemed to be University), Kolhapur
3. Associate Professor(Department of Musculoskeletal) MIT College of Physiotherapy, Latur

ABSTRACT

Background: Peripheral neuropathies are most commonly caused by diabetes. There is currently no known cure for diabetic neuropathies, and there aren't many published studies on how exercise can lessen the condition's symptoms or occurrence. **Methods:** This study assessed the effects of Otago exercises on balance in diabetic neuropathy patients. 54 diabetic neuropathy patients were chosen, randomly assigned, and split into two groups.The experimental group which consisted of 27 patients practiced Otago exercises. The control group consisted of 27 patients which practiced conventional exercises for balance. Exercises were done 2 times per week for 8 weeks. Outcome measures taken were Berg Balance Scale and Time up and go Test which were taken pre exercise and post exercise after 8 weeks. **Results:** 54 patients with diabetic neuropathy were divided into 2 groups randomly in Experimental group which were given Otago exercises and Control group which were given conventional exercises for balance. 27 patients were divided into each group. Pre values of Berg Balance scale and Time up and Go test and after 8 weeks post values were taken. Compared to the control group, the experimental group displayed notable changes. **Conclusion:** Patients with diabetic neuropathy who performed Otago exercises for eight weeks saw a significant improvement in both their dynamic and static balance as well as a reduction in their fear of falling. **Keywords-**Diabetes, neuropathy, conventional, exercise, Otago.

INTRODUCTION

Diabetes mellitus, is a clutter that creates when the body is incapable to use glucose, a shape of sugar, as it ought to. Glucose is the essential vitality source for the body's cells. Hormone mindful for controlling blood glucose levels is Affront. The pancreas produces affront. Beta cells are the cells that make affront. These cells are scattered all through the pancreatic cluster known as the Islets of Langerhans[8].

Since diabetes can have fatal consequences if left untreated, early detection can help prevent serious consequences from the condition. One common consequence of Type 2 Diabetes Mellitus (T2DM) that significantly affects a patient's health is diabetic neuropathy (DN). Diabetic peripheral neuropathy (DPN), the most prevalent adverse impact of type 2 diabetes,

causes tingling, numbness, muscle weakness, polyuria, and hyperglycaemia in the extremities. DPN results in neuromuscular system dysfunction, fatigue, and a decrease in exercise tolerance. Additionally, peripheral neuropathy is a typical diabetic problem. Patients with diabetes will experience balance problems as a result of peripheral neuronal damage. [5]

The two main indicators of diabetic neuropathy are the length of diabetes and haemoglobin A1c (HbA1c) values, which measure glycated haemoglobin as a proxy for average daily glucose levels. Diabetic neuropathy prevalence is also influenced by the duration of the condition.[5] The conduction of afferent and efferent fibres is compromised in DPN. Consequently, DPN patients experience diminished muscle strength, weakened postural control, and loss of tactile sensibility in comparison to healthy persons. Peripheral neuropathy is frequently caused by microvascular anomalies that cause damage to the nerves. By interfering with regular cellular communication and starting signalling cascades, chronic hyperglycaemia damages microvascular circulation.

Elderly patients with diabetic peripheral neuropathy are at a higher risk of falling; these patients frequently have balance issues. DPN patients frequently have impaired foot sensation, which makes it harder for them to maintain adequate balance while performing daily tasks. Impaired proprioception may be the cause of poor balance. Even when their eyes are open, people with diabetic neuropathy have balance issues that make them susceptible to falls.

Peripheral neuropathy can cause severe aches or cramps, paraesthesia, numbness or insensitivity to warmth or pain, and high sensitivity to touch. Diabetic neuropathy causes many physical problems, such as poorer balance and coordination when walking or standing, and an increased chance of falling. In the later stages of DPN, poor gait is one of the problems that arises. Because of their aberrant gait and loss of postural control, patients with DPN are 15 times more likely to fall than healthy people. Falls affect the quality of life for the sufferer.[4]

Lower limb weakness and impaired balance are controllable risk factors that the Otago Exercise Programme (OEP) attempts to address in order to prevent falls. Although the OEP's effectiveness in preventing falls in the elderly is well-established, its underlying treatment processes are less so. The goal of the Otago Exercise Program (OEP) is to keep older people from falling. This at-home workout regimen includes customized strength and balance training routines as well as a walking plan.. The OEP is intended to help adults over 80 who have a history of falls avoid falling. It consists of a set of exercises designed to improve balance and

develop the leg muscles. According to the majority of research, the OEP is a fall prevention technique that improves balance function.[7].

In general balance has improved as a result of the OEP's incorporation of activities that train many domains of balance, including proactive (Knee bends and sit-to-stand exercises), dynamic (Toe walking and sideways walking), and static (heel-toe and one leg standing) balancing tasks. In balance exercises, this exemplifies the idea of specificity: the more a certain motor function is focused in an exercise, the more the advantages of the exercise translate to real-world related activities [7]. Reports indicate that 35% of older persons saw fewer falls and injuries as a result of this program, with the biggest benefits observed in those over 80.

The visual, somatosensory and vestibular systems—the three main sensory systems involved in balance—decline with age and diabetes. The Otago exercise program was not utilized for diabetic neuropathy balance training. The goal of the current study was to assess how Otago exercises affected the balance of people with diabetic neuropathy.

MATERIALS AND METHODOLOGY

The study was conducted at D. Y Patil College of Physiotherapy for a period of 1 year. 54 participants fulfilling the inclusion and exclusion criteria were selected for the study.

Inclusion criteria.

Participants aged above 60-70 years, belonging to both the genders, willing to participate, having Controlled Type 2 diabetes mellitus duration since 10-15 years.

Exclusion Criteria

Participants having Cardiovascular disease, Unstable proliferative retinopathy, end stage renal disease, Uncontrolled hypertension, previously participated in balance/resistance training.

The study's subjects were described before it began., regarding the procedure and written Informed consent was taken prior to the study.

Two groups of participants were formed. Groups A and B were the experimental and control groups, respectively.. Equal number of samples were divided into 2 groups randomly i.e 27 in group A and 27 in group B. Group A (Experimental group) participants were given Otago

exercises and Group B(Control group) participants were given conventional balance exercises. Exercises were asked to be performed twice a week for 8 weeks.

The Time Up and Go (TUG) test and the Berg Balance Scale were administered prior to and following the eighth week of the intervention. A data collection sheet was used to collect the data, and statistical analysis was performed.

Otago exercises	
First 4 weeks	**Repetitions**
1. Knee bend: with support	-5x3
2. Heel toe standing- with support	-5x3
3. Heel toe walking- with support	-5x3
4. Heel Toe walking backward-with support	-5x3
5. Stair climbing-with support	-5x3

Conventional exercises	
First 4 weeks	**Repetitions**
Balance exercises	
1. Sit to stand: 2 hand support	-10x3
2. Walking - Forward	-10x3
3. Heel walking with support	-10x3
4. One leg standing with support	-10x3
5. Toe walking with support	-10x3

Otago Exercises	
Second 4 weeks	**Repetitions**
1.Knee bend: without support	-10x5
2. Heel toe standing- without support	-10x5
3. Heel toe walking-without support	-10x5
4.Heel toe walking backward-without support	-10x5
5.Stair climbing-without support	-10x5

Second 4 weeks	**Repetitions**
Balance exercises	
1. Sit to stand: 2 hand support	-10x3
2. Walking - Forward	-10x3
3. Heel walking with support	-10x3
4. One leg standing with support	-10x3
5. Toe walking with support	-10x3

Group A Experimental group				
Variable	**Time Point**	**Mean**	**S.D**	**P-Value**
Berg Balance Scale	Pre	45.30	3.35	6.48E-14*
	Post	47.81	3.43	
Time Up and Go Test	Pre	22.30	2.30	2.76E-218*
	Post	19.30	2.27	

RESULT

Table 1: Pre-Post comparison in Group A (Paired t test used)

(*indicates P-value(<0.0001) is significant)

The mean BBS score improved from 45.30(SD= 3.35) to 47.81(SD=3.43), with a significant p-value of 6.48E-14.

The mean TUGT Score improved from 22.30(SD- 2.30) to 19.30(SD= 2.27), with a significant p- value of 2.76E-218.

Indicates P value (<0.0001) is significant

Both results indicate significant changes in Balance.

Table 2: Pre-Post comparison in Group B (Paired-t test used)

Group B control group				
Variable	**Time Point**	**Mean**	**S.D.**	**P-Value**
Berg Balance Scale	Pre	44.11	3.02	5.78E-14*
	Post	46.00	3.21	
Time Up and Go Test	Pre	22.19	2.73	2.63E-14*
	Post	20.48	2.75	

(*indicates P-value(<0.0001) is significant)

The mean BBS score improved from 44.11(SD= 3.02) to 46.00(SD=3.21), with a significant p-value of 5.78E-14.

The mean TUGT Score improved from 22.19(SD- 2.73) to 20.48(SD= 2.75), with a significant p- value of 2.63E-14.

Indicates P value (<0.0001) is significant

Both results indicate significant changes in Balance

Table 3: Group-wise Comparison (by using Unpaired t-test)

Variable	Group	Mean	S.D.	P-Value
Berg Balance Scale	A (Experimental Group)	47.81	3.43	0.0250*
	B (Control Group)	46.00	3.21	
Time Up and Go Test	A (Experimental Group)	19.30	2.27	0.0450*
	B (Control Group)	20.48	2.75	

(*indicates P-value(<0.05) is significant)

The mean BBS score for group A 47.81(SD= 3.43) compared to group B 46.00(SD=3.21), with a significant p-value of 0.0250.

The mean TUGT Score for group A 19.30(SD=2.27) compared to group B 20.48(SD= 2.75), with a significant p- value of 0.0450.

Indicates P- value <0.05 is significant

Both results indicate significant changes in Balance.

Also, Mean age of group A and group B was done. For group A the mean was 63.04(SD- 3.55). For group B the mean was 62.59(SD- 2.58).

Gender distribution in group A was done. There were 33.33% females and 66.67% males in group A. There were 33.33% females and 66.67% males in group B.

Discussion

The study's objective was to evaluate the effects of Otago exercise on diabetic neuropathy patients' balance. Based on outcome measures, the results of the Berg balancing scale and the Time up and go test were evaluated. The results demonstrated that patients with diabetic neuropathy had considerably better dynamic and static balance after performing Otago exercises. Progressive balance training that targets the anterior-posterior neuromuscular components of stability can help diabetics with peripheral neuropathy and the ensuing balance problems improve their stability and balance, suggested Mohammad Akbari et al.. [12]

Rana Almarzouki Et al. concluded that It has been demonstrated that the Otago Exercise Program helps middle-aged people become more balanced. Additionally, the YBT seems to be a safe and effective tool for assessing dynamic balance in middle-aged, healthy persons..[6]

Saeide Solati Dasht Arzhane concluded that Three months of OEP significantly improved the participants static, dynamic, and postural balance and reduced fear of falling.[10]

Stretching, muscle-strengthening, and balance exercises were all part of the treatments. After eight weeks of training, the experimental group A, which had received Otago exercises, showed a substantial improvement in dynamic balance when compared to group B, who got traditional balance exercises. P -value for berg balance score was 0.0250 and for TUGT was 0.0450 which indicates P-value (<0.05) is significant for experimental group compared to conventional group.

The findings of the study support our hypothesis. According to the results, the experimental group's Time Up and Go scores and Berg Balance scale scores considerably improved when compared to the conventional group, which was not given the Otago exercises. However, the traditional group's results on the Time Up and Go and Berg Balance tests both increased.

The experimental group exceeded the control group in terms of the difference between their scores.. BBS score improved from 44.11 to 46.00 and TUGT Score showed improvements from 22.19 to 20.48. When compared between the groups, Group A (Experimental group) BBS

score was 47.81 and group B (control group) BBS score was 46.00. TUGT score for Group A was 19.30 and for Group B was 20.48.

The experimental group's improved balance can be linked to the impact of the exercise regimen that was recommended for this study. The recommended eight-week exercise regimen of two sessions per week may have improved the balance of diabetic neuropathy patients.

Improving balance in diabetic neuropathy patients was the main goal of the prior research in an effort to stop them from falling in the future. Exercises like heel-toe standing and squats have been shown to enhance the balance feedback loop's function and increase the plasticity of the central nervous system (CNS) in persons 60 years of age and older. [28] Furthermore, through neuromuscular adaptations, such exercises may enhance muscular strength.[27]

Joint position sense, a component of proprioception in the knee and ankle joints of the lower limbs, is diminished with age. This workout regimen addressed both joints. Even though proprioception and kinesthesia help maintain posture, balance, and motions with the eyes open and closed, it is necessary to assess and exercise these abilities with the eyes closed. Closed-eye proprioceptive exercises strengthen the data transmitted and interpreted by the central nervous system. Older folks may have different ways of processing and receiving this information on a sensory and perceptual level. When physical therapists carefully focus attention on body postures and movements while performing exercises with closed eyes, they can stimulate these functions.[29]

The nervous compatibilities that result from exercise promote balance by applying more efficient neural units, reorganizing the somatosensory cortex, increasing the power and efficiency of synaptic connections, increasing nervous system activity, decreasing neural inhibitory reflexes, facilitating the input transfer of the senses and reducing the impedance of neural pathways to impulse transmission..[10]

The outcome of the study revealed significant improvements in balance of diabetic neuropathy patients after 8 weeks of Otago exercise programme. Though the experimental group with Otago exercises showed improvement, there were also improvements in the control group which used conventional balance exercises.

CONCLUSION

According to the study mentioned above, people with diabetic neuropathy who perform Otago exercises for eight weeks see a significant improvement in both their dynamic and static balance as well as a reduction in their fear of falling.

REFERENCES

1. Dwivedi M, Pandey AR. Diabetes mellitus and its treatment: an overview. J Adv Pharmacol. 2020;1(1):48-58.
2. Korkusuz S, Seçkinoğulları B, Yürük ZÖ, Uluğ N, Kibar S. Balance and gait in individuals with diabetic peripheral neuropathy. Neurological research. 2024 Jan 2;46(1):14-22.
3. Feldman, E.L., Callaghan, B.C., Pop-Busui, R. *et al.* Diabetic neuropathy. *Nat Rev Dis* Primers **5**, 41 (2019).
4. Chiu HL, Yeh TT, Lo YT, Liang PJ, Lee SC. The effects of the Otago Exercise Programme on actual and perceived balance in older adults: A meta-analysis. PLoS one. 2021 Aug 6;16(8):e0255780.
5. Akbari M, Jafari H, Moshashaee A, Forugh B. Do diabetic neuropathy patients benefit from balance training? Journal of Rehabilitation Research & Development. 2012 Mar 1;49(2).
6. Almarzouki R, Bains G, Lohman E, Bradley B, Nelson T, Alqabbani S, Alonazi A, Daher N. Improved balance in middle-aged adults after 8 weeks of a modified version of Otago Exercise Program: A randomized controlled trial. Plos one. 2020 Jul 15;15(7):e0235734.
7. Arzhane SS, Hazrati M, Ashraf A. The Effect of Otago Exercise Program Training on Balance and Fear of Falling in Elderly Individuals.
8. Hafström A, Malmström E-M, Terdèn J, Fransson P-A, Magnusson M. Improved Balance Confidence and Stability for Elderly After 6 Weeks of a Multimodal Self-Administered Balance-Enhancing Exercise Program: A Randomized Single Arm

Crossover Study. Gerontology and Geriatric Medicine. 2016;2. doi:10.1177/2333721416644149

9. Cadore, E.L., Izquierdo, M., Pinto, S.S. *et al.* Neuromuscular adaptations to concurrent training in the elderly: effects of intrasession exercise sequence. *AGE* 35, 891–903 (2013)
10. Espejo-Antúnez L, Pérez-Mármol JM, de los Ángeles Cardero-Durán M, Toledo-Marhuenda JV, Albornoz-Cabello M. The effect of proprioceptive exercises on balance and physical function in institutionalized older adults: a randomized controlled trial. Archives of physical medicine and rehabilitation. 2020 Oct 1;101(10):1780-8.