

Effectiveness of Frenkel Exercise on Balance among Patients with Type 2 Diabetic Neuropathy in Medical Ward

Helen Vinitha A^{1*}, Karpagam K¹, KalaBarathi S¹, Vishnu Priya V²

¹Saveetha College of Nursing, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India

²Department of Biochemistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India

Corresponding Author*

Helen Vinitha A

Saveetha College of Nursing, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai,

India

E-mail: vinielisha@gmail.com

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Abstract

Background: Diabetic patients have many complications; type 2 diabetic outpatients do suffer diabetic neuropathy most commonly, followed by hypertension (223%), neuropathy (184%), nephropathy (160%), diabetic retinopathy (125%) and neuropathy with imbalance (21.5%). Frenkel's exercises are used to treat the balance impairment in type 2 diabetic neuropathy patients. The aim of this study is to determine the effect of Frenkel Exercise on balance among type 2 Diabetic Neuropathy patients. The quasi experimental design was adopted in this study. The MNSI was used to select 60 samples in total. The samples that matched the inclusion criteria were also chosen utilizing the convenience sampling technique. Then separated the group into experimental (n=30) and control (n=30). The patients' demographic data was collected, and their balance was tested using the OLSST as a pre-test. The experimental group was given the Frenkel Exercise once a day for 5 days, up to 55 minutes. The exercise was provided for a period of three weeks. Only Regular therapy was given to the control group. After 3 weeks, samples were examined using the OLSST as a post-test. Descriptive and inferential statistics were used to analyses the data. There is a significant difference in the frequency and distribution of pre and post-test balance between experimental and control groups at $p < 0.001$. According to this study, Frenkel exercise can help people with type 2 diabetic neuropathy improve their balance.

Keywords: Frenkel Exercise; Type 2 Diabetic Neuropathy; Michigan Neuropathy Screening Test; One Leg Stance Test

Introduction

Diabetes has become one of the most serious worldwide health issues of the twenty-first century. Between 2000 and 2030, the number of persons with diabetes is expected to treble, reaching a pandemic level of 366 million people. Diabetic polyneuropathy (DPN) is the most prevalent diabetic consequence, with a lifetime frequency of roughly 50%. Due to foot ulceration and amputation, gait instability, and fall-related injury, DPN is a primary cause of disability. Neuropathic pain affects 20 to 30 percent of DPN patients, causing them to lose their balance [1]. Over the previous 50 years, diabetes prevalence rates have risen rapidly in parallel with obesity, with an estimated 285 million people living with the disease in 2018, up from around 30 million in 2000. [American diabetes association]. It's also been connected to an elevated

risk of dementia and cognitive decline as a result of diseases like Alzheimer's and Vascular Dementia. Exercises that boost the supply of blood, oxygen, and glucose to mitochondria, such as those that improve strength and balance, as well as aerobic exercise, may allow mitochondria to create energy more efficiently. Increased mitochondrial energy production and peripheral nerve blood flow may lead to less neuropathic symptoms, improved strength and balance, and a higher quality of life. Complications are common among type 2 diabetes outpatients, according to the study, with diabetic foot being the most common, followed by hypertension (223%), neuropathy (184%), nephropathy (160%), and diabetic retinopathy (125%). (21.5 percent). Diabetic foot ulcers, diabetic ketoacidosis, hypoglycemia, diabetic cardiomyopathy, and diabetic coma are all examples of diabetic complications [2]. In diabetic individuals, there is neurological degeneration, which leads to balance problems. Diabetic neuropathy is linked to a higher risk of falling in the elderly, and those with diabetes-related diabetic neuropathy frequently report balance problems [3]. Retinopathy, diabetic neuropathy, and peripheral neuropathy are all diabetes complications that have been linked to gait instability and falls. The type of nerve injury and which nerves are impacted determine the symptoms. The spatiotemporal coordination of information obtained from the vestibular, visual, and somatosensory systems is required for proper postural regulation. Damage to one or more of these systems increases the likelihood of older persons falling. Diabetic neuropathy can lead to nerve fibre demyelination and axonal degeneration, slower nerve conduction velocity, and delayed reflex reaction time, all of which can lead to a loss of balance [4]. Aly et al., said in comparison to nondisabled people, diabetic neuropathy patients demonstrated lower stability measurements in all balance indices. They also showed that using visual inputs can help these patients improve their balance. Emam et al., said diabetes patients with neuropathy showed significantly inferior balance capability than diabetic patients without neuropathy, according to the study. Exercise therapy, which includes balance exercises, improves cutaneous blood flow by increasing oxygen pressure in diabetic patients' lower limbs, skin, and chests. Group exercise therapy can help elderly persons improve their balance and minimize their chance of falling. Any changes in tension and pressure on the soles of the feet during standing tasks can stimulate mechanoreceptors in the brain, resulting in improved balance in diabetic neuropathy patients [3]. Frenkel's exercises are a type of treatment for improves the level of balance to diabetic neuropathy patients. Heinrich Frenkel's exercise, as previously stated, is a balance and proprioception exercise created for diabetic ataxia sufferers. Frenkel's exercises began with a little assistance and progressed until the patients no longer required assistance. Patients who lacked adequate muscle strength or were unable to complete the exercise were not included. Frenkel's exercise was expected to improve lower limb feeling and function in diabetic neuropathy patients with impaired sensory function because it retrains proprioception and balance with a focus on the lower limbs [5]. Neuropathy eventually leads to a loss of balance, which is the most common cause of falls in these people. However, there are insufficient data to compare various procedures for improving balance in diabetic individuals. The goal of this study was to assess the effects of two therapeutic activities on clinical balance parameters in diabetic peripheral neuropathy patients with type II diabetes [6]. In patients, the efficacy of balance exercises (Frenkel) with and without aerobic activities. Frenkel's workouts began with a little assistance and progressed until the patients no longer required assistance. When compared to Aerobic Exercises, balance exercises (Frenkel) show significant gains in diabetic neuropathy patients [7]. In diabetic peripheral neuropathy, somatic sensory impairment has emerged as the most serious issue. Exercises to improve balance and somatosensory responses include balancing and somatosensory stimulation. However, there isn't enough information available to measure the somatosensory response after practicing balance exercises and somatosensory stimulation. The goal

of this study is to see how balance exercise and somatosensory stimulation affect somatosensory responsiveness in diabetic peripheral neuropathy patients [8]. Although exercise is suggested for diabetics, little is known regarding exercise in diabetic peripheral neuropathy patients (DPN). This was a preliminary research with only one group. It took place in an academic medical Centre. Interviews were conducted with people aged 40 to 70 who had been diagnosed with type 2 diabetes and had symptoms of neuropathy and were interested in participating in the study [9].

Materials and Methods

After obtaining ethical clearance from the Institutional Ethical Committee (IEC) and a formal permission from the Medical Superintendent and Departmental Head of Medicine at Saveetha Medical College and Hospitals (SMCH) SIMATS, the main study was conducted [10]. A quasi experimental design was used to assess the level of balance among type 2 diabetic neuropathy patients. A total 60 samples were selected by using Michigan neuropathy screening instrument. Along with that the samples that have met the inclusion criteria were selected by using convenience sampling technique. The purpose of the study was explained to the samples by investigator. Providing a patient information sheet in their own regional language and after clarifying the doubts, a written informed consent was obtained from each sample. The ethical principles were followed and adhered to protect the rights of the samples, the safety was taken into consideration till the completion of the study and confidentiality was ensured throughout the study. Then the researcher has divided the group into Experimental group (n=30) and control group (n=30). Both the groups were selected from Medical Ward. Then demographic variables were collected from patients. The investigator was assessed the diabetic neuropathy by using Michigan neuropathy screening instruments [11]. And the demographic data were collected from samples, the demographic characteristics including Age in years, gender, Marital status, Dietary pattern, BMI, duration of type 2 diabetes mellitus, occurrence of diabetic neuropathy previously, duration of diabetic neuropathy, treatment under taken for diabetic neuropathy previously, any of the exercises practiced for diabetic neuropathy. Followed by that, the level of balance was assessed by one leg stance test. The MNSI consists of appearance of feet, ulceration, ankle reflexes, and vibration perception. In one leg stance test consists of poor, fair, average, good, excellent, amazing and unbelievable. All tools were tested for content validity by research experts. A previous study also tested the reliability of the tools. Before the primary data with 6 type 2 diabetic neuropathy patients. These diabetic neuropathy patients were not included in the main study. It took around 6 days to accomplish. The data were collected quickly with the interpretation of participant outcomes. In pretest the level of balance was assessed by One Leg Stance Test. Then experimental group received the Frenkel Exercise for period of 5 days up-to 55 minutes once in a day. Frenkel Exercise session contained 5 min warm-up 45 min exercise training and 5 min of cool down activities including stretching of the muscles involved in balance exercise [12]. The exercises were given for 3 weeks. The control group was received only Regular treatment. During post-test assessment, samples were assessed by using One Leg Stance Test after 3 weeks. Data were analyzed by using descriptive and inferential statistics.

Ethical Statement

Ethical approval in this study was obtained from the research unit committee at the Saveetha College of nursing, Saveetha institute of medical and technical science Thandalam Chennai, with Approval Number-059/04/2021/IRB-HS/SIMATS on April 9th 2021. Prior to the study, each participant has signed informed consent. The investigators explained the nature of the study objectives and a clear explanation. The ethical principles were followed

and adhered to protect the rights of the samples, the safety was taken into consideration till the completion of the study and confidentiality was maintained throughout the study. In addition, the data collected could only be accessed by the investigators only. All participants also had the right to withdraw from the study at any time without penalty.

Result

In the pre-test mean score of one leg stance test in the experimental group was 6.30±1.18 test and the post-test mean score was and the post-test mean score was 11.03±1.81. The mean difference score was 4.73. The calculated paired 't' test value of 11.481 was found to be statistically significant at P <0.001. In the pretest mean score of one leg stance test in the control group was 6.43±1.45 and the posttest mean score was 8.67±2.11. The mean difference score was 2.23. The calculated paired 't' test value of 6.357 was found to be statistically significant at p<0.001.

Statistical analysis

SPSS program version 20 was used for statistical analysis. The variables were presented in the form of frequency and percentages, standard deviation, and mean. The chi-square test and paired 't' test were used to test a significant difference between the study groups' outcome criteria. P-value was set at <0.001 for statistically significant criteria.

All data collected for this purpose was entered into an excel sheet, tabulated, and statistically analyzed. Several statistical measures were used including mean, standard deviation, chi square and paired 't' test.

Section A: Frequency and percentage distribution of pre-test level of one leg stance test among patients with type 2 diabetic neuropathy between the experimental and control group. (Table 1)

The table 1 shows that in the experimental group, 19(63.3%) were aged above 50 years, 16(53.3%) were female, 30(100%) were married, 20(66.7%) were non-vegetarian, 10(33.3%) had a BMI of 27 – 30, 19(63.3%) had type 2 diabetes mellitus of 10 – 15 years, 25(83.3%) had no diabetic neuropathy previously, 25(83.3%) had had diabetic neuropathy for more than 8 hours, 27(90%) had not taken any treatment for diabetic neuropathy previously and 30(100%) had not practiced any exercises. In the control group, 14(46.7%) were aged above 50 years, 18(60%) were male, 24(80%) were married, 23(76.7%) were non-vegetarian, 9(30%) had a BMI of 27 – 30, 12(40%) had type 2 diabetes mellitus of 10 – 15 years, 25(83.3%) had no diabetic neuropathy previously, 24(80%) had had diabetic neuropathy for more than 8 hours, 25(83.3%) had not taken any treatment for diabetic neuropathy previously and 30(100%) had not practiced any exercises.

Section B: Comparison of pre-test and post-test level of one leg stance test among patients with type 2 diabetes mellitus in the experimental group. (Table 2) (Figure 1)

The table 2 depicts that in the pre-test mean score of one leg stance test in the experimental group was 6.30±1.18 test and the post-test mean score was and the post-test mean score was 11.03±1.81. The mean difference score was 4.73. The calculated paired 't' test value of 11.481 was found to be statistically significant at P <0.001.

Section C: Comparison of pre-test and post-test level of one leg stance test among patients with type 2 diabetes mellitus in the control group. (Table 3)

The table 3 depicts that in the pretest mean score of one leg stance test in the control group was 6.43±1.45 and the posttest mean score was 8.67±2.11. The

Table 1: Frequency and percentage distribution of pre-test level of one leg stance test among patients with type 2 diabetic neuropathy between the experimental and control group.

One Leg Stance Test	Pretest		Post Test		Chi-Square Test Value
	No.	%	No.	%	
Poor (<8)	26	86.7	0	0	X ² =46.560 P=0.0001 S***
Fair (8 – 12)	4	13.3	21	70.0	
Good (12 – 16)	0	0	9	30.0	
Excellent (>16)	-	-	-	-	
***p<0.001, S – Significant					
N= 60(30+30)					

Table 2: Comparison of pre-test and post-test level of one leg stance test among patients with type 2 diabetes mellitus in the experimental group.

One Leg Stance Test	Mean	S. D	Mean Difference Score	Paired 't' test Value
Pretest	6.30	1.18	4.73	t=11.481 p=0.0001, S***
Post Test	11.03	1.81		
***p<0.001, S – Significant		N = 30		

Table 3: Comparison of pre-test and post-test level of one leg stance test among patients with type 2 diabetes mellitus in the control group.

One Leg Stance Test	Mean	S. D	Mean Difference Score	Paired 't' test Value
Pretest	6.43	1.45	2.23	t=6.357 p=0.0001, S***
Post Test	8.67	2.11		
*** p < 0.0001, Significant		N= 30		

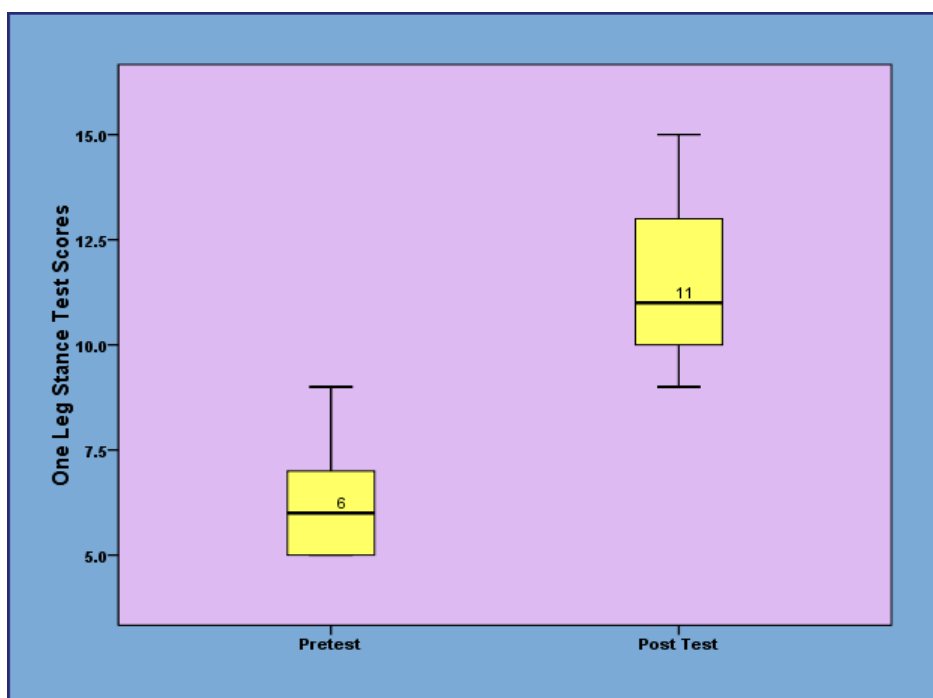


Figure 1:

mean difference score was 2.23. The calculated paired 't' test value of 6.357 was found to be statistically significant at p<0.001.

The present study supported by Nida Kiani et al. The finding of the study was balance exercises (Frenkel) shows marked improvements in balance of diabetic neuropathic patients as compared to Aerobic Exercises [7].

Section D: Association of post-test level of one leg stance among patients with type 2 diabetic neuropathy with their selected demographic variables in the experimental group. (Table 4)

The table 4 shows that the demographic variable BMI ($\chi^2=11.270, p=0.010$) had shown statistically significant association with post- test level of balance among patients with type2 diabetic neuropathy in the experimental group at p<0.05 level. The other demographic variables had not shown statistically significant association with post-test level of trunk control among patients with type 2 diabetic neuropathy in the experimental group.

The current study supported by Zahra Rojhani Shirazi et al. therapeutic exercise programs significantly improved balance in single leg stance [6], star excursion test, and Berg balances cale test (P 0.05) compared to the control group. Besides, this was more significant in the Frenkel training group (P 0.05).

Discussion

The main focus of the study was to determine the effects of Frenkel exercise among patients with type2 Diabetic neuropathy. A total of 60 samples were

selected by convenience sampling technique, out of them 30 samples were considered as experimental group and 30 samples were considered as control group.

The table 2 depicts that in the pre-test mean score of one leg stance test in the experimental group was 6.30±1.18 test and the post-test mean score was 11.03±1.81. The mean difference score was 4.73. The calculated paired 't' test value of 11.481 was found to be statistically significant at P <0.001.

This study was supported by Zahra Rojhani Shirazi to compare the effects of two therapeutic exercises on clinical balance measures in patients with type II diabetic peripheral neuropathy [6]. The result of this study was both types of therapeutic exercise programs significantly improved balance in single leg stance. But the level of balance was more significant in the Frenkel training group (P 0.05). The conclusion of this study was it can improve balance in diabetic neuropathy, Frenkel training is preferred compared to Swiss ball exercise. This study was supported by Shamshiya, C P Effectiveness of Experimental Group (Balance exercise with medical treatment) While comparing the pre-test and post-test values of experimental group using Paired' test, it states that there was significant difference between the pre-test and post-test values of experimental group [13]. When comparing the mean values of both, the post-test mean value which is greater than the pre-test. Hence it confirms that there was a significant improvement in post-test experimental group than pre-test experimental group. The study concludes that balance exercise seemed to be beneficial in improving balance and thereby reducing the frequency of fall in patients with diabetic neuropathy [14, 15].

Table 4: Association of post-test level of one leg stance among patients with type 2 diabetic neuropathy with their selected demographic variables in the experimental group.

Demographic Variables	Fair (8 – 12)		Good (12 – 16)		Chi-Square Test Value
	No.	%	No.	%	
Age					$X^2=0.393$ d.f=3 p=0.942 N. S
35 – 40 years	3	10.0	2	6.7	
41 – 45 years	2	6.7	1	3.3	
46 – 50 years	2	6.7	1	3.3	
Above 50 years	14	46.7	5	16.7	
Gender					$X^2=0.408$ d.f=1 p=0.523 N. S
Male	9	30.0	5	16.7	
Female	12	40.0	4	13.3	
Demographic Variables	Fair (8 – 12)		Good (12 – 16)		Chi-Square Test Value
	No.	%	No.	%	
Marital status					-
Married	21	70.0	9	30.0	
Unmarried	-	-	-	-	
Dietary pattern					$X^2=0.714$ d.f=1 p=0.398 N. S
Vegetarian	8	26.7	2	6.7	
Non-vegetarian	13	43.3	7	23.3	
BMI					$X^2=11.270$ d.f=3 p=0.010 S*
18 – 21	1	3.3	5	16.7	
21 – 24	6	20.0	0	0	
24 – 27	6	20.0	2	6.7	
27 – 30	8	26.7	2	6.7	
Duration of type 2 diabetes Mellitus					$X^2=3.567$ d.f=3 p=0.312 N. S
Below 10 years	3	10.0	2	6.7	
10 – 15 years	14	46.7	5	16.7	
15 – 16 years	1	3.3	2	6.7	$X^2=0.286$ d.f=1 p=0.593 N. S
More than 16 years	3	10.0	0	0	
Have you had diabetic neuropathy previously?					$X^2=0.286$ d.f=1 p=0.593 N. S
Yes	3	10.0	2	6.7	
No	18	60.0	7	23.3	
If yes, how long are you having diabetic neuropathy?					$X^2=0.444$ d.f=2 p=0.801 N. S
Less than 1 year	1	3.3	1	3.3	
2 – 5 years	2	6.7	1	3.3	
5 – 8 years	-	-	-	-	
More than 8 hours	18	60.0	7	23.3	
Have you taken any treatment for diabetic neuropathy previously?					$X^2=0.018$ d.f=1 p=0.894 N. S
Yes	2	6.7	1	3.3	
No	19	63.3	8	26.7	
Have you practiced any of the exercises mentioned below previously for improving your diabetic neuropathy?					-
Swiss ball exercises	-	-	-	-	
Burger Allen exercises	-	-	-	-	
Frenkel exercises	-	-	-	-	
None of the above	21	70.0	9	30.0	

**p<0.01, S – Significant, N.S – Not Significant

N=30

Conclusion

This study indicates that the level of balance can be improved by Frenkel exercise among patients with type 2 diabetic neuropathy in medical ward. It helps to diminish complications and minimize the length of hospital stay.

Limitation of the study

- The study will be limited to a period of one month.
- The study findings are limited to only diabetic neuropathy patient with age group of above 35 years.

Author's Contribution

All authors contributed equally to the manuscript.

Conflict of Interest

The authors declare no conflict of interest.

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