Original Study

Effect of Proprioception Exercise versus Focused Regimen Exercise on Balance and Quality of Life in Subjects with Diabetic Neuropathy

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Abstract

Background: Diabetic peripheral neuropathy is a polyneuropathy that can cause damage to the peripheral nerve fibers, sensorimotor and autonomic nervous system. Neuropathy causes somatosensory dysfunction of the lower extremities, such as decreased ankle position and vibration sensations. The sensation of the skin on the feet and the proprioceptive sense are two important factors in standing balance, postural control and coordination. As this condition progresses, this can lead to increased postural sway, gait disturbance, abnormal neuromuscular control and increased reaction time leading to falls in balance impaired patients.

Objective: To determine the effect of proprioception exercise versus focused regimen exercise on balance and quality of life in subjects with diabetic neuropathy.

Methods: 20 Subjects with diabetic neuropathy of both genders, in the age group of 40 – 60 years were conveniently assigned into 2 groups. Group A (n = 10) received Proprioception exercise and Group B (n = 10) received Focused regimen exercise, 3 sessions a week for 8 weeks. Balance and quality of life were evaluated with Berg Balance Scale and SF – 36 Survey questionnaire.

Results: The difference in the post-test mean scores of group A and group B in Berg Balance Scale was 32 and 28.3 and SF – 36 Survey questionnaire was 61.4 and 56.6 respectively. The result showed a significant improvement in Group A than in Group B at $p < 0.0001$.

Conclusion: Therefore, the study concludes that the Proprioception exercise training is better management to improve balance and quality of life in subjects with diabetic neuropathy.

Keywords: Diabetic Peripheral Neuropathy, Proprioception exercise, Focused regimen exercise, Quality of life, Balance, Berg Balance Scale.

Introduction

Farida Chentli, Said Azzoug & Souad Mahgoun argued that, Diabetes Mellitus, a chronic metabolic condition is characterized by excessive levels of glycated hemoglobin and hyperglycemia, either with or without glycosuria.[1]

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Michael J. Fowler argued that, the harmful effects of hyperglycemia are generally classified into macrovascular complications (Coronary artery disease, Peripheral arterial disease and stroke) and microvascular complications (Diabetic nephropathy, neuropathy and retinopathy).[2]

Pavana,Nair Anjali Premranjan & Amrita Ghoshargued that, Diabetic peripheral neuropathy is a polyneuropathy that can cause damage to the peripheral nerve fibers, sensorimotor and autonomic nervous system.[3]

Eva L. Feldman, Brian C. Callaghan, Rodica Pop-Busui et al. argued that, Diabetic neuropathy is a very common illness that has a significant impact on patients by raising the risk of falls, causing discomfort, and lowering the quality of life.[4]

Gabriella Deli, Edit Bosnyak, Gabriella Puschet al. argued that, Diabetic peripheral neuropathy is a common complication and affects an estimated 30-50% of diabetic patients.[5]

Manoj Abraham M, Ennapadam S Krishnamoorthy & Vivek Misra Bargued that, Distal symmetric polyneuropathy is the most common, accounting for about 75% of Diabetic neuropathy.[6]

Brian C Callaghan, Hsinlin T Cheng, Catherine L Stables et al. argued that, Distal symmetric polyneuropathy patient has one or more of the following symptoms – numbness, tingling, pain or weakness.[7]

Zahra Rojhani-Shirazi, Fatemeh Barzintaj & Mohamad Reza Salimifard argued that, Neuropathy causes somatosensory dysfunction of the lower extremities, such as decreased ankle position and vibration sensations. The sensation of the skin on the feet and the proprioceptive sensation are two important factors in standing balance, postural control and coordination. Therefore, loss of sensation leads to loss of balance. Where, balance is a necessary element of daily life.[8]

Irshad Ahmad, Ejaz Hussain, Deepika Singla et al. argued that, Balance is the ability to maintain or return the body's center of gravity within the limits of stability that are determined by the base of support. Balance training is considered to be an important tool for preventing falls.[9]

Luis Espejo-Antúnez, José Manuel Pérez-Mármol, M. de losÁngeles et al. argued that, Proprioception is the perception of joint and body movements and the position of body segments in space. Kinesthetic sensation is the sensation of movement of limbs. Proprioceptive and kinesthetic sensations are involved in maintaining position, balance and movement when the eyes are opened and closed.[10]

Pavana,Nair Anjali Premranjan & Amrita Ghosh argued that, Proprioception exercise mainly focus on the sense of joint position that helps to maintain joint stability and posture that helps to improve somatosensory system.[3]

Abeer El-Wishy; PTD and EnasElsayed; PTD argued that, Proprioceptive training augments increased proprioceptive firing from the cutaneous receptors from the feet and also from mechanoreceptors of the muscle during co-contraction produced by the swaying movement. Thus, it improves balance and quality of life in diabetic neuropathy subjects.[11]

Quality of life is a major issue in diabetic neuropathy.

James K. Richardson, David Sandman& Steve Vela argued that,the focused regimen exercise was designed to increase rapidly available ankle strength which in turn improves balance among older persons with mild to moderate peripheral neuropathy.[12]

The aim of the study is to find out the effect of proprioception exercise versus focused regimen exercise on balance and quality of life in subjects with diabetic neuropathy.

Materials and Methodology

Study Design:

Pre and Post Experimental study design.

Study Setting:

Department of Physiotherapy, K.G. Hospital, Coimbatore, Tamil Nadu, India.

Study Duration:

6 months.

Materials Required:

- Michigan Diabetic Neuropathy Scoring Sheet.

- 36 – item short form survey (SF 36) questionnaire.
- Reflex Hammer.
- Tuning Fork.
- 10g Monofilament.
- Hot and Cold test tubes.
- Berg Balance Scale Scoring Sheet.
- Stop Watch.
- One standard chair with arm rest.
- Foot Stool.
- Pen / Pencil.

Sample Size:

20 Diabetic neuropathy subjects were divided into 2 groups – Group A [10 subjects] and Group B [10 subjects].

Sampling Technique - Convenient Sampling.

Inclusion Criteria:

- Age group between 40 – 60 years.
- Ability to walk household distances without assistance or without an assistive device.
- Patients diagnosed with Diabetic peripheral neuropathy ≥ 1 year and Type 2 Diabetes ≥ 10 years.
- Patients with mild to moderate neuropathy in Michigan Diabetic Neuropathy Score.
- Patients with Berg Balance Score of low and medium risk.
- Patients with diabetes having symptoms of neuropathy such as numbness and tingling sensation of extremities, loss of sensations and abnormal sensation.
- Gender – both males and females are included.

Exclusion Criteria:

- Central nervous system dysfunction [Hemiparesis, Cerebellar Ataxia, Myelopathy etc..]
- Neuropathies due to non – diabetic cause.
- Patients with severe diabetes with foot ulcers or foot deformities.
- Patients with any kind of lower limb amputation.
- Lower extremity arthritis or pain that limits standing or weight bearing.
- Symptomatic Postural hypotension.
- Vestibular dysfunction.
- Patients who are visually impaired as it may affect walking.
- Patients with systemic illness.
- Severe cardiopulmonary insufficiency.
- Psychiatric illness.

Outcome Measures:

- Berg Balance Scale.
- 36 – item short form survey.

Procedure:

A total of 20 Diabetic Peripheral Neuropathy subjects were taken after getting a written consent from each and conveniently divided into 2 groups, group A and group B with 10 subjects in each group. On day 1 pre-test score were recorded after that, treatment session for 8 weeks, 3 times per week, 1 hour per session was provided and post-test score were recorded.

GROUP-A [PROPRIOCEPTION EXERCISE] = 10 Subjects.

- **Proprioception Exercise:**

Exercises included One leg balance, Forward leg swings with knee extension, Backward leg swings with knee flexion, Toe walking, Heel walking, Cross body leg swing right side, Cross body leg swing left side, Partial squat, Blind advanced one leg balance, Side lunge.[3]

- **Duration:**

Each exercise was done for 5 minutes with 1 minute rest in between for a 1-hour treatment session.

GROUP-B [FOCUSED REGIMEN EXERCISE] = 10 Subjects.

- **Focused Regimen Exercise:**

Exercises included Warm up (Open chain active ankle range of motion exercises), Bipedal toe raises, Bipedal heel raises, Bipedal inversion, Bipedal eversion, Unipedal toe raises, Unipedal heel raises, Unipedal inversion, Unipedal eversion, Wall slides (Knee flexion maximum of about 45°).[12]

- **Duration:**

Each exercise was done for 5 minutes with 1 minute rest in between for a 1-hour treatment session.

At the end of 8 weeks, balance is measured with Berg Balance Scale and quality of life is measured with 36-item short form survey and compared with the respective pre intervention scores to know the effect of exercises.

Patient consent: After getting a written consent from each subject.

Data Analysis and Results

Student 't' test was used for statistical analysis. Unpaired 't' test has been used to find significance of the study parameters between groups. While paired 't' test has been used to find significance of the study within the groups.

This study results shows that there is statistically significant improvement in Berg Balance Score and 36-item short form survey questionnaire score between pre and post – test mean values in group A and group B. Group A shows an improvement than that of group B in the post – test mean values of Berg Balance Score and 36-item short form survey questionnaire score.

Table 1: Age distribution of subjects.

The table 1 shows that majority of study subjects, such that 70% in 41 – 50 years followed by 30% in 51 – 60 years in both group A and group B respectively.

Age (years)	Proprioception Exercises (Group A)		Focused Regimen Exercises (Group B)	
	Number	Percent	Number	Percent
41 – 50 years	7	70	7	70
51 – 60 years	3	30	3	30
Total	10	100	10	100

Table 2: Gender distribution of subjects.

The table 2 shows that 60% males and 40% females are present in both group A and group B respectively.

Gender	Proprioception Exercises (Group A)		Focused Regimen Exercises (Group B)	
	Number	Percent	Number	Percent
Males	6	60	6	60
Females	4	40	4	40
Total	10	100	10	100

Table 3: Paired 't' test values of Berg Balance Score in group A and group B.

The table 3 shows the analysis of Berg Balance Score in group A and group B. Using paired 't' test with 9 degrees of freedom and 5% level of significance the calculated 't' value is 25.66 in group A and 12.33 in group B, which were greater than the tabulated 't' value 2.262. The results shows that there is a marked difference between pre and post-test values in group A and group B.

Berg Balance Score	Pre-test Mean	Post-test Mean	Mean Difference	Pre-test Standard Deviation	Post-test Standard Deviation	't' values
Group A	24.3	32	7.7	2.83	3.46	25.66
Group B	24.6	28.3	3.7	2.63	2.79	12.33

Table 4: Unpaired 't' test values of Berg Balance Score in group A and group B.

The table 4 shows the analysis of Berg Balance Score in group A and group B. Using unpaired 't' test with 18 degrees of freedom and 5% as a level of significance the calculated 't' value is 2.63, which was greater than the tabulated 't' value 2.101. The result shows that there is a marked difference between post-test values of group A and group B.

Berg Balance Score	Mean	Mean Difference	Standard Deviation	't' value
Group A	32	3.7	3.46	2.63
Group B	28.3		2.79	

Table 5: Paired 't' test values of 36-item short form survey questionnaire score in group A and group B.

The table 5 shows the analysis of 36-item short form survey questionnaire Score in group A and group B. Using paired 't' test with 9 degrees of freedom and 5% level of significance the calculated 't' value is 16.86 in group A and 23.82 in group B, which were greater than the tabulated 't' value 2.262. The results shows that there is a marked difference between pre and post-test values in group A and group B.

36-item short form survey questionnaire score	Pre-test Mean	Post-test Mean	Mean Difference	Pre-test Standard Deviation	Post-test Standard Deviation	't' values
Group A	44.2	61.4	17.2	2.39	3.31	16.86
Group B	44.4	56.6	12.2	2.8	2.22	23.82

Table 6: Unpaired 't' test values of 36-item short form survey questionnaire score in group A and group B.

The table 6 shows the analysis of 36-item short form survey questionnaire Score in group A and group B. Using unpaired 't' test with 18 degrees of freedom and 5% level of significance the calculated 't' value is 3.81, which was greater than the tabulated 't' value 2.101. The results shows that there is a marked difference between post-test values of group A and group B.

36-item short form survey questionnaire score	Mean	Mean Difference	Standard Deviation	't' value
Group A	61.4	4.8	3.31	3.81
Group B	56.6		2.22	

Discussion

The aim of the study was to examine the effect of proprioception exercise versus focused regimen exerciseon balance and quality of life in subjects with diabetic neuropathy. A total of 20 diabetic neuropathy subjects in the age group of 40-60 years participated in the study. The participants who satisfied the selection criteria were conveniently assigned into 2 groups. Measurements were taken at baseline using Berg Balance Scale and 36-item short form survey questionnaire for both groups, Group A received Proprioception exercise and Group B received Focused regimen exercise for 8 weeks. At the end of 8 weeks the participants again underwent the evaluations using the outcome measures mentioned above.

Pavana, Nair Anjali Premranjan& Amrita Ghosh argued that, Proprioception exercise mainly focus on the sense of joint position that helps to maintain joint stability and posture that helps to improve somatosensory system which is affected in subjects with diabetic neuropathy.[3]

Abeer El-Wishy; PTD and EnasElsayed; PTD argued that, Lack of accurate proprioceptive information from the lower extremities in diabetic neuropathy subjects has resulted in postural

instability during static and dynamic situations, especially when the body is exposed to unexpected postural perturbations. Proprioceptive training augments increased proprioceptive firing from the cutaneous receptors from the feet and also from mechanoreceptors of the muscle during co-contraction produced by the swaying movement. Thus, it improves balance and quality of life in diabetic neuropathy subjects.[11]

Mahdieh Ravand, Mehri Ghasemi, Abbas Rahimi et al. argued that, Ankle reflexes are induced by lower limb proprioception, which also aids in triggering other automatic postural reactions to the necessary postural strategy. Compromise in the lower limb proprioception in turn lowers the effectiveness of balance responses. So that proprioceptive training improves balance and proprioception sense of lower limb.[13]

James K. Richardson, David Sandman & Steve Velaargued that, the focused regimen exercise was designed to increase rapidly available ankle strength which in turn improves balance among older persons with mild to moderate peripheral neuropathy.[12]

This shows the superiority of proprioception exercise given to group A over the focused regimen exercise given to group B.

Conclusion

This study was focused on analysing the effect of proprioception exercise versus focused regimen exercise on balance and quality of life in subjects with diabetic neuropathy.

Based on statistical analysis at 5% level of significance, the 'p' value is less than 0.0001 and calculated value is greater than tabulated value, thereby showing significant improvement in balance and quality of life on group A compared with group B. There is a significant difference between proprioception exercise and focused regimen exercise in improving balance thereby reducing the fall risk and improving quality of life in subjects with diabetic neuropathy.

Therefore, the study concludes that the proprioception exercise is better management to improve balance and quality of life in subjects with diabetic neuropathy.

Limitations:

The period of time allotted for the study was found to be insufficient for the inclusion of greater number of subjects. There was lack of long term follow up of the patients to find out the carry over effects of the interventions. Individual variation in age range, gender difference and handedness has not taken into account.

Recommendations:

Large sample size can be used to demonstrate the effect of intervention. Long term follow up should be made to find out which exercise is so effective. Similar study can be done by comparing various other types of balance exercises. Can use other outcome measures to assess balance and quality of life in subjects with diabetic neuropathy.

Ethical Concern: The study was approved by the college ethics committee, K.G. College of Physiotherapy, Coimbatore.

Conflict of Interest: There was no personal or institutional conflict of interest for this study.

Source of Funding: Self

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