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Effectiveness of Balance and Strength Training in Reducing the Fallrisk in Subjects with Diabetic Neuropathy

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Abstract:
Diabetes is being recognized as an important risk factor for fall, among patients age 60 yrs and over. Evidence suggests that exercise programme can be effective in improving gait and balance in general fall risk population, as well as reducing falls and fall related injuries. It is an experimental study with 2 groups pre test and post test study design. 30 diabetic subjects were selected and divided into two groups of 15 diabetic subjects each based on selection criteria using convenience sampling. Group A is an experimental group consist of 15 patients given strength training and balance training programme. Group B is the control group consists of 15 patients given General mobility exercise to all joints along with regular walking programme. Treatment duration for both the group was six weeks. Balance and fall risk was the outcome measure and were measured by berg balance scale, Timed Up and Go test and Functional reach test. Pre test and Post test values were measured and analysed by students' test. The result showed that there is a significant difference between Balance with Strength training and general mobility exercise by walking in reducing the fall risk in subjects with Diabetic Peripheral Neuropathy. This concludes that the Balance and Strength training will reduce the fall risk in subjects with Diabetic Peripheral Neuropathy.

Key words: *Diabetic Peripheral Neuropathy, Balance training, Strength training*

1. Introduction

Diabetes mellitus is defined as an endocrine disorder resulting from either a deficiency in production and release of insulin in the blood stream (Type I) or resistance to insulin in the body (Type II). (Thompson and Godwin 1995). Recently published findings revealing that in 2011, the country with the largest numbers of people with diabetes is India (40.9 million).

The Diabetic neuropathies can be classified into 3 different categories: 1) focal neuropathies, 2) diffuse neuropathies, and 3) autonomic neuropathies. (Vinik, et al., 2000). The proposed study addresses one of the diffuse neuropathies, distal symmetric polyneuropathy, which is the "most common and widely recognized form of diabetic neuropathy"(Vinik, et al., 2000). Diabetic Peripheral Neuropathy is defined as "the presence of symptoms and/or signs of peripheral nerve dysfunction in people with diabetes after the exclusion of other causes". (Boulton et al., 2005)

Clinically, Diabetic Peripheral Neuropathy presents as abnormalities in sensory and sometimes motor function in the lower legs and the hands. Generally, sensory abnormalities in the lower leg present earlier in the progression of Diabetic Peripheral Neuropathy than motor abnormalities and the hands are usually involved only in more severe cases of Diabetic Peripheral Neuropathy.(Vinik & LeRoith, 2008).

Falls have been studied extensively in older persons and it is estimated that 30% of people over the age of 65 fall every year.(Tinetti, Speechley, & Ginter, 1988). Diabetic peripheral neuropathy influences sensory and depending on severity, motor nerve function in the distal lower extremities. (Cavanaugh and colleagues1992).

Balance training provides stability and prevent falls. (Maures MS, Burcham, 2002)

Evidence suggests that exercise programme can be effective in improving gait and balance in general fall risk population, as well as reducing falls and fall related injuries. Exercise interventions have been designed to reduce fall risk and promote successful ageing. (Patricia Ann Quigley,2005)

The major benefits of resistance training in individuals with diabetes are improved blood cholesterol profiles, increased heart function, decreased blood pressure, improved insulin sensitivity and blood glucose control, improved muscular strength, power and endurance, increased bone strength. (Souk up et al.) Resistance training for patients with diabetic neuropathy has the potential to improve muscle strength, endurance and flexibility which reduces the risk of fall.(Lord SR, Mckay HA, 2010)

2. Methodology

A two group pre test and post test experimental study design was adopted in this study. Study was conducted at Physiotherapy Outpatient department, K.G Hospital, Coimbatore. Subjects with history of diabetes mellitus (Type I and Type II) with moderate & severe symptoms of distal sensory neuropathy (Michigan diabetic neuropathic score), age group varies from 50-65 years and both sexes were included. Patients with Cardiovascular disease, uncontrolled hypertension, Peripheral neuropathy, Lower extremity musculoskeletal deformities, and Vestibular deficits were excluded.

A total of 30 diabetic subjects were selected and divided into two groups of 15 diabetic subjects each based on selection criteria using convenience sampling.

Group A received Strength training and Balance training, and Group B received general Mobility exercise with walking regularly. Treatment Duration is for six weeks. Balance and fall risk was the outcome measure and measured by Berg balance scale, Timed Up and Go test, Functional reach test. Pre test and Post test values were measured and analyzed using student't' test.

2.1. Strength Training

- To determine resistance -1 repetition Max can be done.(stable)
- No of sets and repetitions-1-2 sets of exercise with 10-12 repetitions.
- Rest time between sets-30 to 60 seconds .Up to 2 minutes
- Frequency of strength training- At least 2 days per week.

2.1.1. Types of Strength Training

- Arm curl
- Military press
- Bench press
- Knee extension
- Back extension
- Bend knee sit ups
    - 2 set of 10 repetitions for upper limb muscles
    - 2 sets of 20 repetitions for lower limb muscles
    - Five times per week for 4-6 week at workloads corresponding to 40 to 50% of their 1 repetition maximum.

2.2. Exercise for Balance Training

- Warm up (ankle ROM) exercises
- Bilateral toe raise and heel raise
- Bilateral inversion and eversion
- To practice ankle strategy
- Narrow base standing
- Tandem walking
- Standing on Rocker Board

3. Results and Analysis

Table 1 and Figure 1 shows the post test Berg Balance Scale values of Group A and Group B.

S.NO	GROUPS	MEAN	STANDARD DEVIATION	't' VALUE
1.	GROUP A	37.13	± 5.95	2.376
2.	GROUP B	31.80	± 6.34	

Table 1

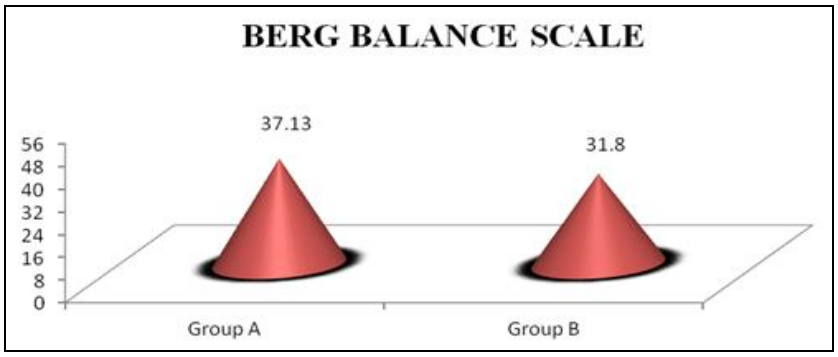

Figure 1

Table 2 and Figure 2 shows the post test Timed up and Go test values of Group A and Group B.

S.NO	GROUPS	MEAN	STANDARD DEVIATION	't' VALUE
1.	GROUP A	16.13	± 5.38	2.1087
2.	GROUP B	20.33	± 5.52	

Table 2

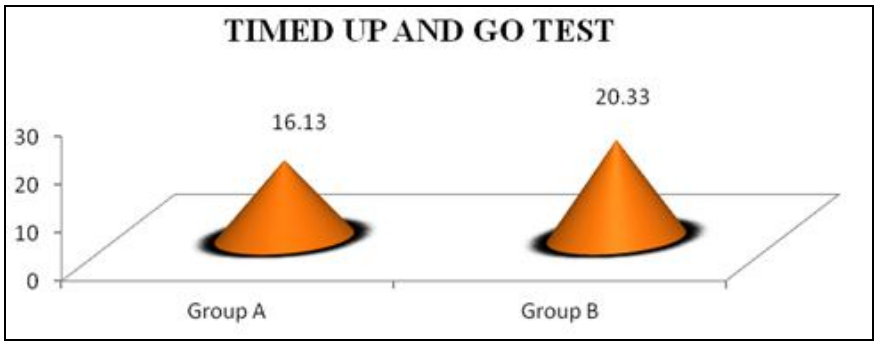

Figure 2

Table 3 and Figure 3 shows the post test Functional Reach Test values of Group A and Group B.

S.NO	GROUPS	MEAN	STANDARD DEVIATION	't' VALUE
1.	GROUP A	17.58	± 0.40	2.967
2.	GROUP B	17.00	± 0.63	

Table 3

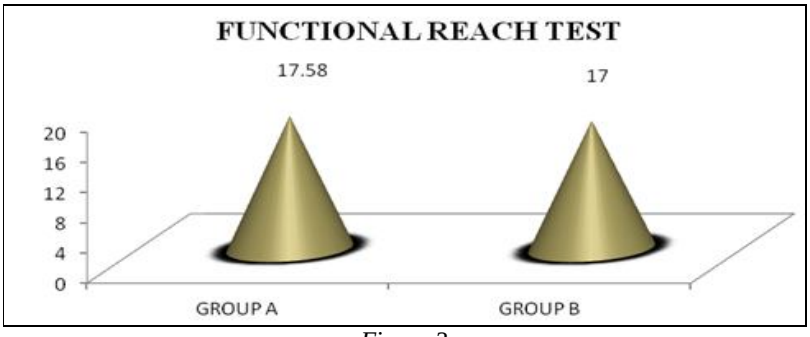

Figure 3

4. Discussion

This is an experimental study to find out the effectiveness of balance and strength training in reducing fall risk as evidenced by the outcome measures -Berg Balance Scale, Timed Up and Go test and Functional Reach Test in subjects with Diabetic Peripheral Neuropathy. Results obtained from statistical analysis between pre test and post test values of Group A which is the Experimental group at 5% level of significance showed improvement in BBS, TUGT and FRT following balance and strength training.

Analysis of pre test means of Group A and Group B of BBS, TUGT and FRT revealed that there is no significant difference between the two groups indicating that they are unmatched group of subjects undergoing different exercise program but were selected from same population.

Analysis of results also shows that there is an increase of about 32.6% in Group A when compared with Group B has only 16.91% increase in BBS. Analysis of TUGT shows that there is an increase of 34.43 % in Group A and 18.02% in Group B. There is also an increase of 11.97% in Group A and 8.48% in Group B in FRT. This shows the superiority of Balance and Strength training given to Group A over general mobility exercise and walking given to Group B.

According Uccicoli et al the major risk factors for falling are increasing age, previous falls history, increased postural sway and presence of diabetes. Aging results in slower cognitive processes, slower postural reactions and decreased muscle strength. Decrement is more pronounced in diabetes especially with mild to moderate neuropathy and associated with increased fall risk (Steve Morrison et al)

Diabetic Peripheral Neuropathy results in a remarkable functional imbalance which may expose these patients to danger of falling during activities of daily living and becomes more severe as the severity of neuropathy increases. (Jabasson et al)

Balance training seems to be beneficial in improving functional balance in diabetic subjects with Distal Sensory Neuropthy (Ajimsha et al). The researchers also reported that the rate of blood glucose entry into the working muscles increased after training. Moderate intensity high volume training improved insulin sensitivity by 48%(Ishir)

It has been shown that management of sensory problems causing balance difficulty focuses on facilitation of demand system and encouragement of remaining system. For example in the absence of reduction in proprioceptive system and the other systems like visual and vestibular system can be promoted by narrow base standing, tandem walking, standing on rocker boards, walking on rough terrains and stairs. (Taly)

Improvement in reaction time and reduction in fall risk could be attributed to improvement in proprioception due to increased physical activity, increased Hamstrings and Quadriceps strength. In addition learning effect could also be added. Hence it can be concluded that Balance and Strength training can reduce fall risk in Diabetic subjects with Peripheral Neuropathy.

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