

**EFFECTIVENESS OF PROPRIOCEPTIVE TRAINING AND AEROBIC EXERCISE ON
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ABSTRACT

Background: Peripheral neuropathy is a common complication of diabetes mellitus, peripheral neural damage and nerve conduction velocity is reduced in diabetic patient. It may cause balance impairment physical activities are prevention and management of diabetes mellitus. Physiotherapy intervention, such as aerobic exercise, resisted exercise and proprioceptive exercise may reduce the complication of diabetes mellitus. **Objective of the study:** To compare the effectiveness of the proprioceptive exercise training and aerobic exercise training on balance in Diabetic Peripheral Neuropathy (DPN). **Material and Method:** Thirty patients were recruited and equally divided into 2 groups - Group A (Proprioceptive exercises) and Group B (Aerobic exercise). Population with DPN defined as a minimum score of 7 or >7 on the Michigan Neuropathy Screening Instrument (MNSI). The subjects in both groups were examined for balance abilities through Berg Balance Scale (BBS) and Time Up and Go test (TUG) for before and after intervention. The intervention was given thrice weekly for 6 weeks. Group A received proprioceptive exercise for 30 minutes and Group B received aerobic exercise for 30 minutes. **Results:** significant ($P < 0.0001$) increase in BBS score and significant decrease in TUG score were found after intervention in both groups. Group A (Proprioceptive exercise) was score higher mean value than Group B (Aerobic exercise). **Conclusion:** Proprioceptive exercise training was more effective than aerobic exercise on balance in Diabetic Peripheral Neuropathy (DPN).

KEYWORDS: Balance, Diabetic Peripheral Neuropathy, Michigan Neuropathy Screening Instrument, proprioceptive exercise, aerobic exercise, Berg Balance Scale, Time Up and Go test.

INTRODUCTION

Diabetes is a group of metabolic disease characterised by Hyperglycemia resulting from defect in insulin secretion, action (or) both.^[1] The diabetic peripheral neuropathy patient have 68% poor glycemic control and 50% have a good glycemic control. Neuropathy is a complication of diabetes. Most common neuropathy is symmetric poly neuropathy. This leads to loss of vibration, proprioception & thermal sensation, also cause muscle atrophy, loss of sensation, musculoskeletal impairment and autonomic dysfunction in later stages.^[2]

Diabetes is affect almost 246 million people in worldwide and it is expected to affect 380 million peoples in 2025. India is the second most popular country in diabetes population.^[3] The study shows that the males are developed neuropathy earlier than the females. Long standing case of type1 and type2 diabetes, 60% people have diabetic neuropathy.^[2] It cause pain, numbness, tingling and impaired sensation of the leg,

feet and hand. And also leads to reduce movement in the limbs, balance impairment in the daily activities.^[2]

Peripheral neuropathy may leads to sensory and motor deficit, which results balance and mobility dysfunction and improper gait pattern^[4] (fig:1). The diabetic patients have postural instability in larger centre of pressure displacement and instability standing with eyes closed position. In this patient had walking and balance difficulty for individual activities in daily living. The study shows diabetes people are 15 time more likely fall when walking.^[5]

The reflex response and nerve conduction velocity is decrease in the diabetes population. The problem is start when the conduction of somato sensory information from periphery to central nervous system is affected. So, proprioception and kinesthetic information to central nervous system is impaired compare to without neuropathy patients. It will increase the risk of fall and balance problems.^[6]

It can also develop retinopathy and poor glycemic control.^[7] Chronic hyperglycemic of diabetes is leads to failure of different organs like eyes, kidney, nerves, heart and blood vessels.^[2] Poor balance can attribute the movement dysfunction biomechanical disorder and disorientation.^[11]

Peripheral neuropathy patient have loss of plantar cutaneous sensation tend to move with slower preferred walking speed(PWS). Afferent and efferent function of the lower extremities are responsible for balance.^[8]

Sensitivity is decrease in the sole of foot and information from mechano receptors is reduced. So, balance declines in the elderly person and diabetic patients.^[7] The exercise mechanism on neuropathic pain is not understood, there is evidence indicating that regular exercise practice may

improve the dysfunction caused by diabetes and neuropathic pain.^[9]

Recent study states aerobic exercise alone (or) combination of resistance exercise is effective for type-2 diabetes.^[9] Many studies shown positive effect of variable exercise protocol for treating the symptoms of diabetic peripheral neuropathy.^[2] Proprioceptive training along with conventional physiotherapy exercise is improve the balance.^[11]

The current study is design how diabetic peripheral neuropathy is affected balance control and to explore the effect of proprioceptive training & aerobic exercise training on balance impairment in diabetic peripheral neuropathy.



Fig 1: peripheral nerve damage.

AIM OF THE STUDY

The study aims to analyse the efficacy of proprioceptive training and aerobic exercise training to improve balance among Diabetic Peripheral Neuropathy(DPN) population.

OBJECTIVE OF THE STUDY

- To improve the balance
- To improve the activities of daily living

NEED OF THE STUDY

The purpose of the study is to report the effectiveness of proprioceptive training given individually in improving the balance and also to know the effectiveness of aerobic exercise were by improving the balance in treadmill.

BACKGROUND OF THE STUDY

Peripheral neural damage and nerve conduction velocity is reduce in these diabetes patient. It may cause balance impairment. Physical activities are prevention and management of diabetes mellitus. Physiotherapy intervention, such as aerobic exercise, resisted exercise,

proprioceptive exercise may reduce the complication of diabetes mellitus.^[6]

Chang Ho Song et al(2011): stated that peripheral neuropathy is the common complication of diabetes. There is no definitive treatment for diabetic neuropathy has been reported, limited studies have been published on the role of exercise reducing the symptoms or incidence of diabetic neuropathy.

METHODOLOGY

STUDY DESIGN

Experimental study

STUDY TYPE

Comparative study

SAMPLING METHOD

Convenient sampling

SAMPLE SIZE

30 Samples

STUDY DURATION

6weeks

STUDY SETTING

Saathvik physiotherapy clinic, shollinganallur

SELECTION CRITERIA**INCLUSION CRITERIA**

- History of more than 5 years of diabetes
- Presense of peripheral neuropathy symptoms
- Age group 40 to 60
- Minimum score of 7 in the MNSI

EXCLUSION CRITERIA

- Subjects with Amputation
- History of foot surgeries
- Foot ulcer
- Subjects with Fracture condition in lower extremities.
- Musculoskeletal problem
- Subjects with Unstable heart disease
- Subjects with Hypertension

OUTCOME MEASURES

- Berg Balance Scale (BBS)

The berg balance scale(BBS) was originally developed for the assessment of postural control and is widely use the many fields of rehabilitation. The 14 items in this

scale assess static sitting and standing balance, as well as anticipatory balance during activities commonly performed in daily function, including transfers, turning and retrieving objects from the floor. The scoring is done on a 5- point scale that consider whether the patient can perform the task safely and independently. Normal performances are grade from 0 to 4 points.scores on individual items are summed for a total score,with a maximum of 56 points.^[17]

- Time Up and Go test (TUG)

Time up and go test was valid outcome tool to measure static or dynamic balance. A person sits in a chair with arm rest. On “go”, they stand, walk 3m at a comfortable and safe pace,turn around, walk back to the chair and sit down. Timing begins at “go” and stops when the person is seated. A score is more than or equal to 12 seconds has shown to indicate high risk of falls.^[17]

TOOLS USED

- Tuning fork
- Knee hammer
- Monofilament
- Stop watch
- Step stool
- Scale
- Back and arm rest chair
- Inch tap

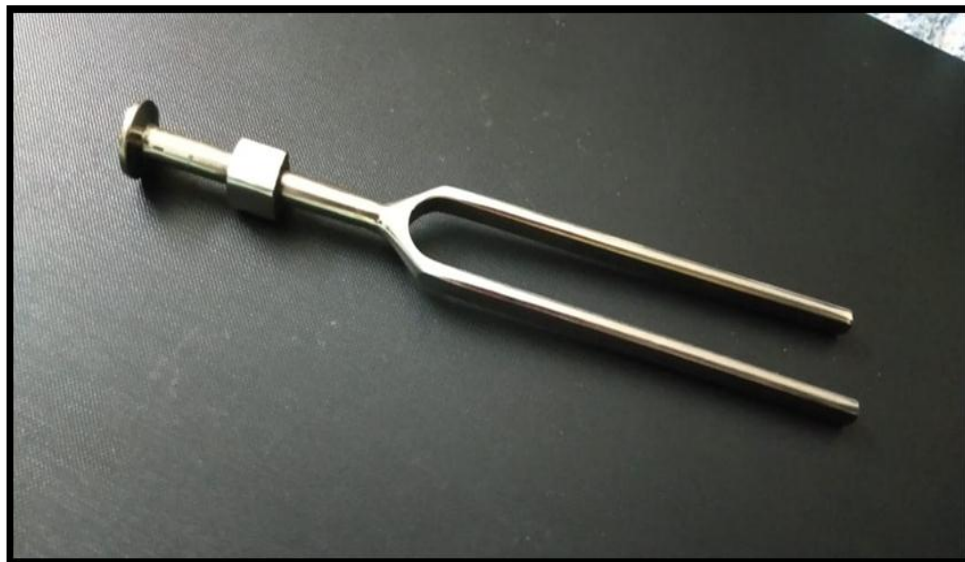


Fig 2: Tuning fork.



Fig 3: Knee hammer.



Fig 4: Monofilament.



Fig 5: Stopwatch.



Fig 6: Step stool.

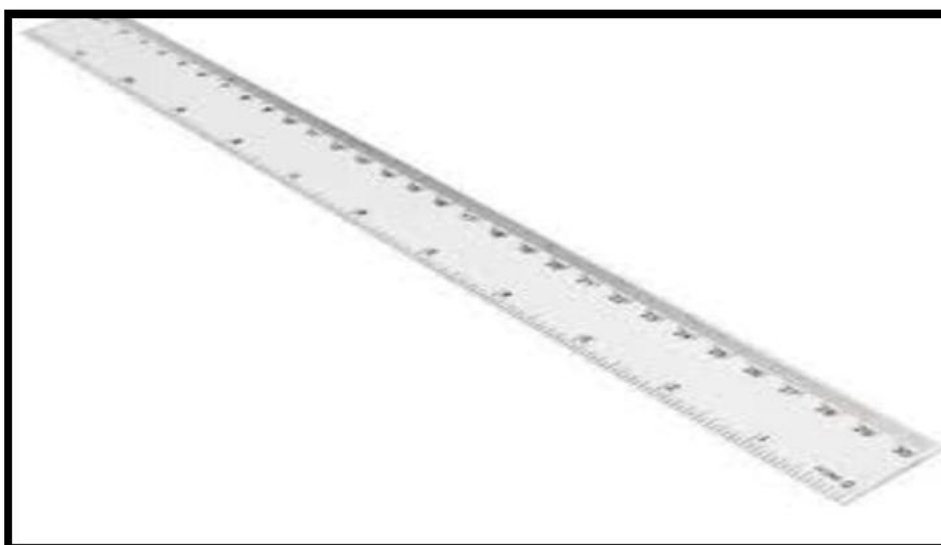


Fig 7: Scale.

PROCEDURE

The samples were selected on the inclusion and exclusion criteria. Informed consent form was obtained from the subjects. The study consist of 30 subjects both males and females with decline in balance activities and independence activity of daily living with the age group between 40-60 years will be assigned into 2 groups. Therapist will give instruction to the patient about exercise protocol. The subjects were divided into 2 groups.(Group A and Group B). The subjects participating in this study will informed that they have to do the exercise regularly.

GROUP (A) PROPRIOCEPTIVE TRAINING

In this group proprioceptive exercise was trained for 15 patients. The exercise involve forward leg swings, wide stance, standing with foot together, heel walking, toe walking, one leg stance with slight knee flexion, one leg stance with increasing knee flexion, feet sliding exercise.

The exercise has perform for 6 weeks, 3 days per week. Each treatment session consist of 30 minutes, 1 minute rest for each and every exercise.

Forward leg swing: The patient were stand and the foot flat on the ground slightly extended the one leg hold for 10 seconds and back to normal. Perform alternatively in both legs for 6 to 7 times(fig:8).

Wide stance: The patient were widely stand on the wobble board for 2 minutes. After that they were asked to swing anteriorly and posterirly for 2 minutes.(fig:10).

Heel walking: The patient were walk on there heel for 3 minutes(fig:9)

Toe walking: The patient were walk on there toe for 3 minutes (fig:11).

One leg stance: Initially the patient stance one leg in slight knee flexion 30 seconds alternatively in both legs for 5 times (fig:12). After the patient is stance one leg in increased knee flexion 30 seconds alternatively in both legs for 5 times (fig:13).

Feet & heel sliding exercise: The patient were sit on the chair with foot rest on the floor. To put the sand paper in the ground and the patient place the foot on the sand paper. After that to slide the foot alternatively for 2 minutes (fig:14) and also slide the heel for 2 minutes(fig:15).

GROUP-A (PROPRIOCEPTIVE TRAINING)



Fig 8 : Forward leg swing exercise.



Fig 9: heel walking.



Fig 10: wide leg stance.



Fig 11: toe walking.



Fig 12: partial one leg stance.



Fig 13: one leg stance.



Fig 14: foot sliding.



Fig15: heel sliding.

GROUP (B) AEROBIC EXERCISE

In group B the 15 patients were trained for aerobic exercise. The exercise involve warm up by stretching exercise for 5 minutes(biceps &triceps stretching, hamstring stretching, quadriceps stretching, calf stretching). Treadmill walk for 10 minutes in low (or) moderate intensity. Stationary bicycle cycling for 10 minutes and cool down by normal slow walking for 5 minute(fig:16).

GROUP-B (AEROBIC EXERCISE)

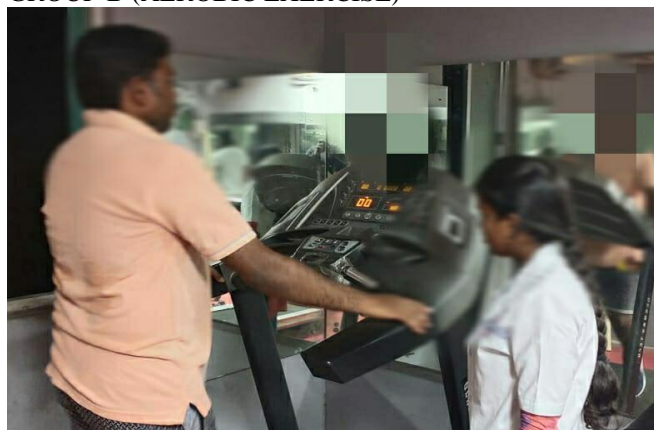


Fig16: Treadmill walking.

STATISTICAL ANALYSIS

The IBM SPSS® software platform offers advanced statistical analysis, a vast library of machine-learning algorithms, text analysis, open-source extensibility, integration with big data and seamless deployment into applications. Its ease of use, flexibility and scalability make IBM SPSS accessible to users with all skill levels and outfits projects of all sizes and complexity to help you and your organization find new opportunities, improve efficiency and minimize risk.

A comprehensive set of statistical tools

Work inside a single, integrated interface to run descriptive statistics, regression, advanced statistics and many more. Create publication ready charts, tables, and decision trees in one tool.

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Use a simple drag and drop interface to access a wide range of capabilities and work across multiple data sources. Plus, flexible deployment options make purchasing and managing your software easy.

This function gives a paired Student t test, confidence intervals for the difference between a pair of means and, optionally, limits of agreement for a pair of samples (Armitage and Berry, 1994; Altman, 1991).

The paired t test provides an hypothesis test of the difference between population means for a pair of random samples whose differences are approximately normally distributed. Please note that a pair of samples, each of which are not from normal a distribution, often yields differences that are normally distributed.

The test statistic is calculated as

- where \bar{d} is the mean difference, s^2 is the sample variance, n is the sample size and t is a Student t quantile with $n-1$ degrees of freedom.

Power is calculated as the power achieved with the given sample size and variance for detecting the observed mean difference with a two-sided type I error probability of $(100-CI)\%$ (Dupont, 1990).

DATA ANALYSIS

Berg Balance Scale (BBS)

Table 1 shows statistical report of group A and B.

BBS	MEAN		SD		t- value	p-value
	Pre	Post	Pre	Post		
GROUP A	33	43.13	5.52	5.33	26.93	<0.0001
GROUP B	32.87	37.80	3.87	3.45	15.62	<0.0001

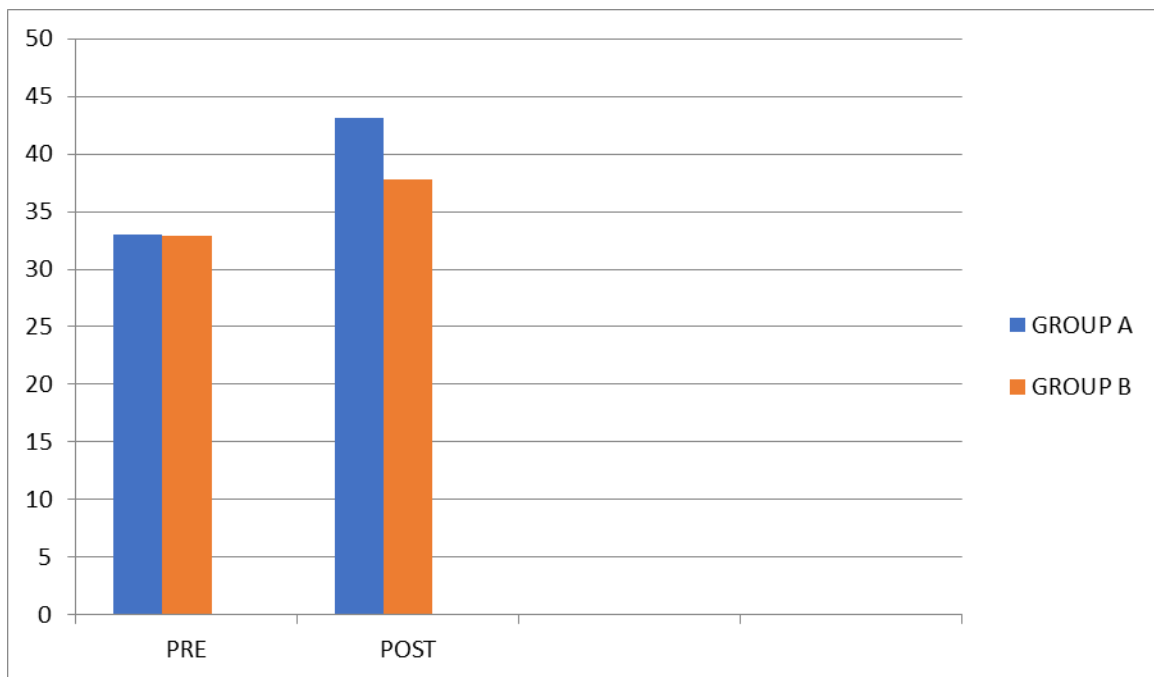


Fig 2: shows statistical report of group A and B.

Time Up and Go test(TUG)

Table 2: shows statistical report of group A and B.

TUG	MEAN		SD		t-value	p-value
	Pre	Post	Pre	Post		
GROUP A	17.60	11.27	2.06	2.15	33.89	<0.0001
GOUP B	18.13	15.07	1.73	1.3	11	<0.0001

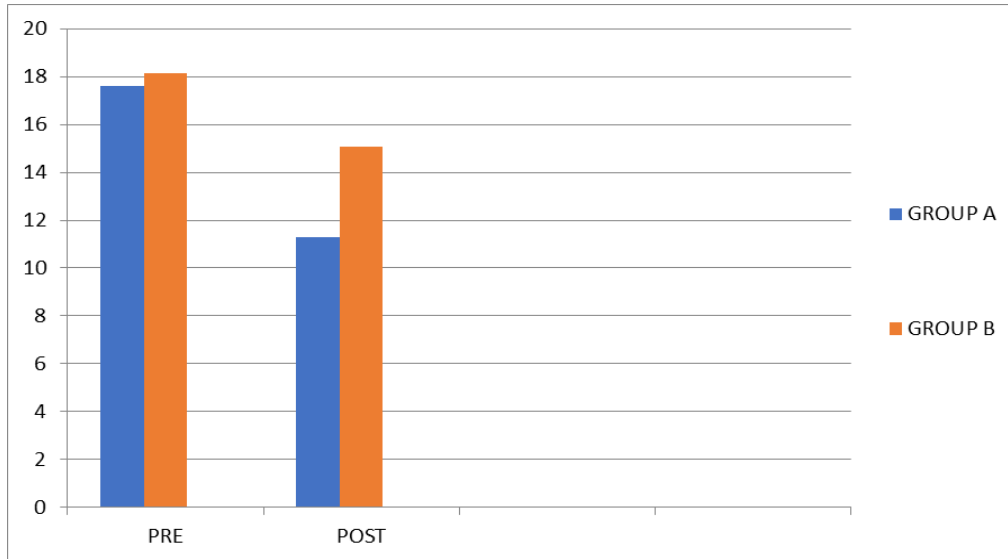


Fig 2: shows statistical report of group A and B.

Table 3: shows statistical report of post values of Group A & Group B

OUTCOME MEASURE	GROUP	MEAN	SD	t-value	p-value
BBS	Post test (A)	42.79	5.35	2.3908	<0.03
	Post test (B)	37.79	3.58		
TUG	Post test(A)	11.27	2.15	5.8569	<0.0001
	Post test (B)	15.07	1.53		

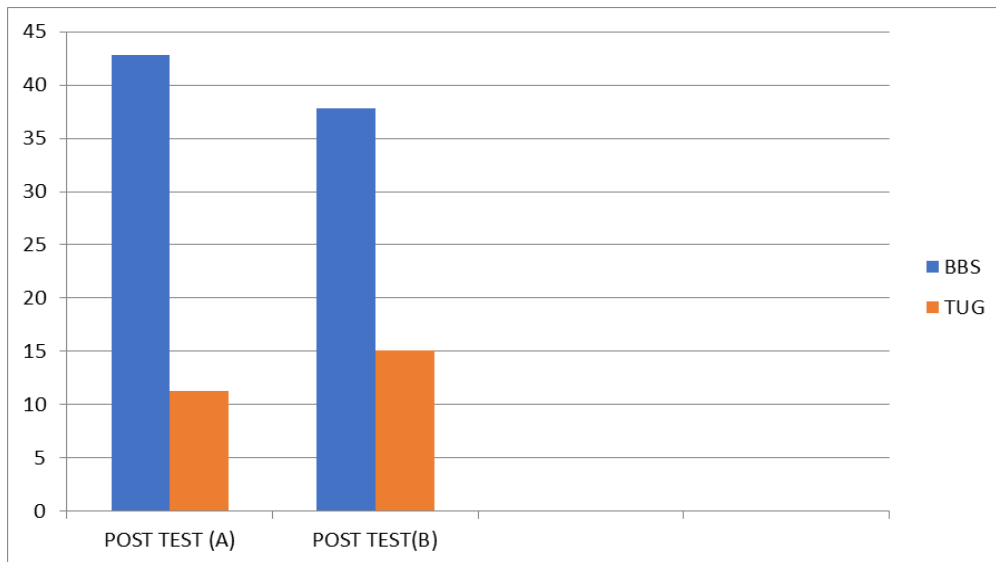


Fig 3: shows statistical report of post test values of Group A & Group B.

RESULTS

Table 1 shows pre and post values of BBS score. Group A mean pre(33), post(43.1) and Group B mean pre (32.8), post(37.5), p- value is (<0.0001).

Table 2 shows pre and post values of TUG score. Group A mean pre(17.67), post (11.27) and Group B mean pre (18.13), post (15.07), p-value is (<0.0001).

Table 3 shows post mean values of BBS and TUG scores. Group A & B post mean value of BBS (42.79) &(37.79) and TUG(11.27)& (15.07), p-value is(<0.0001)

DISCUSSION

The study designed to examine whether proprioceptive exercise training was more effective than the aerobic exercise in improving balance among diabetic peripheral neuropathy population of after 6 weeks exercise program., functional balance was improved by the proprioceptive exercise group than the aerobic exercise group and significantly improved in the proprioceptive exercise group.

Though many drug therapy are available for the management of diabetic peripheral neuropathy. Still the physiotherapy management is uncertain (Callaghan et.al 2012). So, I intend to do this study. Abee El-Wishy et.al [2012] has stated that the proprioceptive exercise training along with conventional physiotherapy was significantly more effective in improving balance in diabetic peripheral neuropathy. Proprioceptive training improve the proprioception firing from the cutaneous receptors from the feet and also mechanoreceptor of the muscle during co-contraction produced by the swaying movement.^[1] Similarly there were drastic improvement in the proprioception sensation stated by K. Kamatchi.^[6]

Snehl dixit reported aerobic exercise along with drug therapy yields greater benefit than drug therapy.^[3] Nida kiani stated that balance was improved those who received aerobic exercise along with traditional physiotherapy.^[2] Stefano balducci stated long term aerobic exercise training can modify the natural history of diabetic peripheral neuropathy.^[9]

Hoda Salsabili proposed dynamic stability training improves the balance control in type 2 diabetic neuropathy patients.^[16] Chang Ho Song reported 8 weeks of balance exercise program will improve the static balance, dynamic balance, and trunk proprioception.^[18]

MNSI is the test, it was first proposed in 1994. Therefore, MNSI is the simple non-invasive procedure to assess the diabetic peripheral neuropathy. The cut point to define positive test for the questionnaire (>7).^[13] Referring these article the MNSI questionnaire were used in this study to conform the neuropathy and the result is positive.

Balance Scale was most relevant outcome tool for peripheral neuropathy. It shows more sensitive to identify the balance impairment than the Tinetti Balance Scale in patient with peripheral neuropathy. Dixon et.al showed BBS was appropriate tool to assess risk of falls in the peripheral neuropathy population.^[14] BBS is a valid tool used for intervention effectiveness and function in clinical practice and research. The scale consist of 14 questions based upon simple balance task.(transfer, positions, postural changes and simple object retrieval). To perform each task the score was given from 0 (unable) to 1 (independent) and the final result was the sum of all 14 scores.^[17]

Time up and go test is the valid outcome tool to assess balance. It is a good inter and intra-rater reliability tool for measure static and dynamic balance. A score is more than or equal to 12 was indicating high risk of fall.^[17]

In this study we have compared proprioceptive exercise and aerobic exercise in diabetic peripheral neuropathy population on balance impairment age group between 40 to 60, participated in both proprioceptive and aerobic exercise group. Group A& B, both are improved

functional balance on Berg Balance Scale(BBS) and Time Up and Go test(TUG).

Hence the study concluded that proprioceptive exercise training have more significant difference than the aerobic exercise.

CONCLUSION

The study concluded that the proprioceptive exercise can significantly improve the balance and reduce the balance indices although both the group shows improvement in balance among diabetic peripheral neuropathy (DPN) population. As per the statistical report group A and group B to improve the balance and reduce the balance indices. However group A, who received proprioceptive exercise had a better improvement in balance compared with group B treated with aerobic exercise. This study proved the effectiveness of proprioceptive exercise treatment was improve the balance and reduce the balance indices when compared to aerobic exercise.

LIMITATION

- Small sample size
- Short duration of the study
- The study performed with in 40 to 60 age group

RECOMMENDATION

- To improve sample size
- Long duration of the study was given excellent result
- The study perform various age groups

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