



## Routine Physiotherapy; Reduce the Complications of Diabetic Peripheral Neuropathy

**Megha Tandon\***

Senior Physiotherapist Consultant, Priyush Neuro Superspeciality Hospital, India

\*Corresponding Author: Megha Tandon, Senior Physiotherapist Consultant, Priyush Neuro Superspeciality Hospital, India.

**Received:** June 09, 2023

**Published:** August 20, 2023

© All rights are reserved by **Megha Tandon**.

### Abstract

Peripheral neuropathy is the term for damage to nerves of the peripheral nervous system, which may be caused either by diseases. Neuropathy may be associated with varying combination of weakness, autonomic changes and sensory changes. Loss of muscles bulk or fasciculation, a particular fine twitching of muscles may be seen. Damage to peripheral nerve may impair sensation, movement, gland or organ function depending on which nerve are affected. Peripheral neuropathy may be acute (with sudden onset, rapid progress) or chronic (symptoms begin subtly and progress slowly) and may be reversible or permanent. Approximately 2% - 7% of the US population and 24% over age 60 years are estimated to have neuropathy.

**Keywords:** Routine Physiotherapy; Diabetic; Peripheral Neuropathy

### Abbreviations

VAS: Visual Analogue Scale; MMT: Manual Muscles Testing; ROM: Range of Motion; BBS: Berg Balance Scale; TENS: Transcutaneous Electrical Nerve Stimulation

### Introduction

Disability due to peripheral neuropathy can be severe, as the patient suffer from symptoms daily. DM result from the failure of our body to generate and/or respond to insulin, the principal hormones regulating uptake of glucose from the blood stream, leading to abnormally high blood glucose level termed hyperglycaemia. Sensory neuron absorbed glucose as a direct function of extracellular glucose concentration instead of insulin-mediated glucose uptake and are particularly susceptible to the cumulative metabolic insults imposed by chronic hyperglycaemia. The damage leads to secondary micro vascular complications that contribute to the progression of diabetic neuropathy. A distal symmetric sensorimotor polyneuropathy is the most frequent manifestation of DPN. Patient with this form of DPN are predisposed to foot ulceration and increased risk of amputation, ulcerative complications from DPN account for approximately 87% of non traumatic lower extremity amputations. As a consequences longstanding hyperglycemia downstream metabolic cascade leads to peripheral nerve injury through and increased flux of the polyol pathway advanced glycation and product formation excessive release of cytokinase, activation of protein kinase C and exaggerated oxidative stress and

in this complication process inhibitions of single metabolic factors. In other neuropathic pain arise as a direct consequencw of a lesion and disease affecting the somatosensory system without any noxious stimuli.

Anatomical characteristics of the peripheral nervous system are covered by perineurium, where only a few transperineurial arterioles penetrate into the endoneurium. The vascular supply in peripheral nerve is sparse and blood flow is likely to be compromised and lack autoregulation. This system makes peripheral nerve vulnerable to ischemia. Endoneurial microvessels are tightly connected with endothelial cells on their inner surface, but when destroyed they are leaky and affect the endoneurial tissue components. Leaky vessels are mainly located in the ganglion with fenestrated vessels and nerve terminals on the distal side are directly exposed to environments not covered by perineurium and are susceptible to traumatic injury. Innervation of epineurial microvessels is involved in diabetes, resulting in impaired blood supply in diabetic nerves. Endoneurial microvessels show thickened and multi-layered basement membranes cell debris of pericytes as well as disrupted endothelial cells, and thus constitute salient structural changes in diabetic nerves.

Peripheral neuropathy is nerve damage caused by the chronically high blood sugar and diabetes. Its leads to numbness, loss of sensation and sometimes pain in your feet, legs or hand...High level

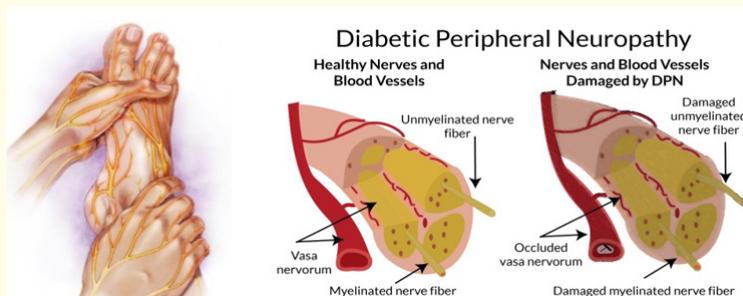


Figure 1: Healthy nerves and Blood vessels or Nerve and blood vessels damaged by DPN.

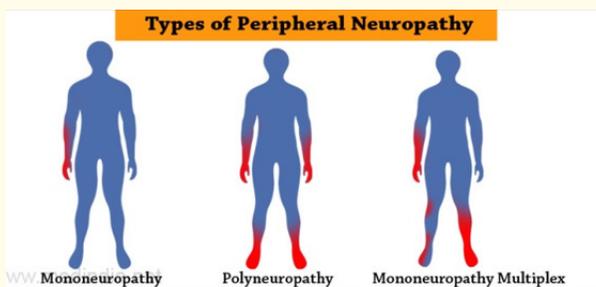


Figure 2: Different type of peripheral neuropathy.



Figure 3: Images of Diabetic peripheral neuropathy in lower limb.

of triglycerides, a key blood fat which is measured during a cholesterol check, are also associated with the development of nerve damage.

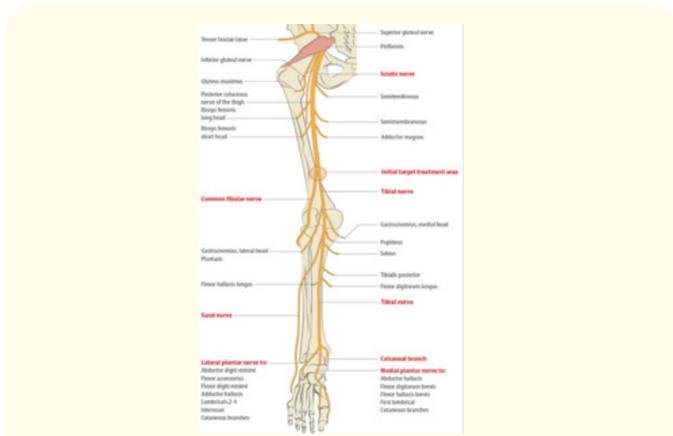
A combination of other causal factors included

- High blood pressure
- Smoking
- Alcohol use
- Having chronic liver or kidney diseases
- Vitamin B deficiency

Certain medications, including some anticancer drugs, also associated with bringing on neuropathy.

The pathophysiology of diabetic peripheral neuropathy is multifactorial and is thought to result from vascular disease occluding

the vasa nervorum; endothelial dysfunction; deficiency of myoinositolaltering myelin synthesis and diminishing sodium potassium adenine triphosphatase (ATPase) activity; chronic hyperosmolarity, causing edema of nerve trunk; and effects of increased sorbitol and fructose. In addition to this traumatic medical event, DPN is also a major contributing factor to the development of joint deformities limb threatening ischemia as well as other various neurological dysfunctions a number of biochemical events have been identified as important mediators linking hyperglycemic stress to the development of DPN; increased oxidative stress formation of advanced glycation end-products [AGEs], overflux of glucose through polyol and hexosamine pathways abnormal activity of mitogen-activated protein kinases ( MAPKs) and nuclear factor -kb (NK-kB), neuro inflammation as well as impaired neurotropic support.



**Figure 4:** Nerves are affected by Diabetic peripheral neuropathy.

**Risk factor**

**Hereditary Neuropathy**-Having a family member, and especially a parents, who’s been diagnosed with a hereditary neuropathy is the most significant risk factor. Such as diabetes and obesity, may increase your risk for certain hereditary neuropathy.

**Age**-About 8% of adult over 65 years of age report some degree of neuropathy. Risk factor for neuropathy included diabetes, metabolic syndrome and heavy alcohol use.

**Other factors**-If your sugar levels are poorly controlled. Alcohol abuse. Vitamin deficiency particularly B vitamins. Infections such as Lyme disease, shingles, Epstein-bar virus, hepatitis B and C, and HIV.



**Figure 5:** Complications of Diabetic peripheral neuropathy.

**Diagnose**

Diabetic neuropathy by performing a physical exam and carefully reviewing your symptoms and medical history.

The doctors will check your

- Overall muscles strength and tone
- Tendon reflexes
- Sensitivity to touch and vibration
- Filament test
- Nerve conducting test
- Autonomic testing

**Aims and Objective**

**OBJECTIVES**

- To find out the effectiveness of exercise therapy with the electrotherapy, technique on pain, strength and damage nerve case of patients with lower limb.
- To find out the effectiveness of strengthening, aerobic, balance training and TENS modality on pain, weakness in lower limb.

**Need of the study**

There are sample numbers of patient, who are gone through the diabetic peripheral neuropathy, But due to lack of physiotherapy they won’t be able to achieve the functional goals. The routine physiotherapy is very useful to get the functional target with the medication of diabetic peripheral neuropathy.

- The purpose of the study is get to know about the result based on the combination of exercise therapy and electrotherapy with the diabetic medications.
- We are going to observe the early result of the exercise in (strengthening, aerobic activity, balance training with TENS)

**Aim of the study**

The aim of this study to find out the efficacy of exercise therapy with electrotherapy versus only medications (NSAIDS), acetaminophen, capsaicias.

**Review of Literature**

A literature survey was done in google advanced search, keywords used were (routine physiotherapy reduce the complication of diabetic neuropathy). Over 27000 articles were found. Some of few relevant to our work are listed below.

- Denial umpire 2013-2015 When the concept of combination of exercise and electrotherapy originated by the one of the author and he was suggestion of his research follow have investigated his aerobic, resistant exercise and TENS with low frequency, effects on the release of endothelial progenitor cell and vascular functions in diabetic mellitus. In wide variety of experimental method on 4<sup>th</sup> man with type I diabetic mellitus. And 5 non diabetic mellitus control were randomly assigned to 40 min AE Aerobic exercise and RE resistance exercise sessions. his study has cross over design and intervention were one week apart, at the end of the conclusion point increase vascular reactivity in both group after both exercise session, EPCs Endothelial progenitor cell were only influenced by exercise in control.

- Jillian Michael by Bronwyn Ellison Exercise you choose will depend on the extent of peripheral neuropathy, Some people with mild cases of diseases may be carry on fairly normal exercise routine. The national library of medicine states that physical therapy supervised by professional may help to increases mobility and reduce symptoms.
- NHS trust 2016 According to NHS trust, Said losing the ability to feel can increased the risk of the injury in your foot. Injury may become infected or develop into an ulcer which can take long term to heal. In this conditions exercise is good for this condition, loss of feeling in the foot can mean that is possible to break a bone or dislocate a joint with little or no pain even from a minor injury and changes foot shape can put increased pressure on part of the foot, this can lead to serious complication called diabetic charcoat foot, Where they foot can become inflamed and permanently deformed. The pain can range from mild to severe cramping, tingling, burning or shoot pain which are often worse in night.
- International diabetes federation 1950 According to international diabetes federation, overtime a healthy lifestyle may not be enough to keep under control blood sugar, if treatment with a single medication is not sufficient, combination therapy may be prescribed. Regular physical exercise is essential to help control blood glucose level and most effective when they combined with exercise (Aerobic and resistant exercise).
- Pain research and treatment 2014 About one third of all diabetic patient suffer from peripheral diabetes neuropathy, its huge effects of person daily life both physical and mentally and origin of the pain could be a central nervous system. We can improved the conditions of using TENS modality, help to pain management.
- American diabetes association 2015 ADA recommended two type of physical exercise are the most important for manage diabetes, Aerobic and strengthening exercise. These exercise improved the functions of the muscles and provide the flexibility of the body as well as improved the all functional movements.
- Global Scenario Majority of the western studies highlighted the effective role of exercise in diabetes mellitus. Both insulin and exercise increase glucose uptake into skelrtal muscles via the glucose transportor from an intracellular to the cell surface.
- The journal of clinical endocrinology and metabolism, 1st may 2016- According to the oxford academic physiotherapy also help to the glucose maintain in the body and prevent to some major complications. as well as restore the functions.
- World health organization 2016 According to the WHO physiotherapy may perform to main role to help reducing the major nerve blocage and improve the blood circulation. This is very important to routine physiotherapy.

- International journal of physiotherapy and research 2019 The effects of impaired balance and fall risk on quality of life in paatients with diabetes peripheral neuropathy.This is based under the balance training and postural corrections.

### Methodology

#### Research design

Experimental design of the study.

#### Sample size

A sample of 30 patients with the mean age of 30-50 years those fulfil the inclusion and exclusion criteria were referred to the outpatient physiotherapy department of Mahatma Gandhi Hospital Jaipur, with diagnosis of diabetic peripheral neuropathy after obtaining informed consent were recruited for the study.

#### Sampling method

Simple Random Sampling Method.

### Hypothesis

#### Alternative hypothesis (H1)

Routine physiotherapy is reduce the complications of diabetic peripheral neuropathy will be more effective on pain, strengthening, balancing and functional disability, and in comparison based on only diabetes medications.

#### Null hypothesis (H0)

There will be no significant differences on pain relief, strengthening, balancing and functional disability in diabetes peripheral neuropathy, and no comparison based.

### Inclusion criteria

- Age group 30-50 years
- Both male and female
- Uncontrolled blood sugar
- Genetically cause
- Numbness
- Tingling
- Loss of sensation and impaired motor functions
- Radiating pain
- Muscles atrophy
- Mentally orientation
- Restricted movements

### Exclusion criteria

- Thyroids
- Unstable angina
- Cardiovascular diseases
- Tennis elbow
- Cancer

### Material used

- Pillow
- Towel
- Treatment couch
- Goniometer
- Weight cuff 1kg
- Quadripod sticks
- Bolster
- Cycling
- Stop watch
- Tissue paper
- TENS machine

### Outcomes measure

- Pain
- Strengthening
- Flexibility
- Functional disability
- Restore balance
- Restore sensation
- Maintain glucose levels

### Description of outcomes measure

- Intensity of pain will be measured by using VAS scale
- Muscles strengthening will be measured by using MMT (Manual muscles testing).
- Balance will be measured by the BBS (Berg balance scale).

### Variables

- **Independent variable:** Routine physiotherapy of reduce the complications of diabetes peripheral neuropathy.
- **Dependent variable:** Pain, strengthening, balancing, aerobic and functional disability.

### Procedure

- Subject who met the inclusion criteria were selected.
- The subjects were divided into two groups A and B.
- For the purpose of this study, 30 patients sufferings from diabetes peripheral neuropathy were enrolled.
- Sample Size 30 participant- Group A: 15 and Group B: 15
  - **Group A:** Patients treatment based on exercise therapy and electrotherapy in diabetes peripheral neuropathy.
  - **Group B:** Patients treatment based on only diabetes medications.

All the participants with diabetic peripheral neuropathy who report to Mahatma Gandhi Hospital, Jaipur and Medical Research Centre during the study period were included. Their suitability as per the inclusion and exclusion criteria was made before enrolment. A written informed consent after explaining the advantages and disadvantage of the study was taken from them. Before the treatment session the pain, strengthening, balancing, aerobic and functional disability of the patients in group A were assessed with the help of Visual Analogue Scale(VAS) scale, Berg Balance Scale(BBS) and Manual Muscles Testing(MMT) respectively. Data will be collected 2 times i.e. on first day before starting of the treatment, after completion of one week, and after completion of 2 weeks.

According to the both group but only Groups A will receive treatment for 2 weeks. Each session will be on of 30 minutes. The treatment protocol will be as mentioned below

- **Group A:** Will receive hot fermentation, strengthening exercises, aerobic exercise, balance training and TENS machine. Before exercise you should check patient sugar level, and manual muscles testing.

### Treatment

This lack of understanding regarding its aetiology has led to a large number of treatments, including physiotherapy, being advocated. As up to 60% of all patients seen in primary care with diabetic peripheral neuropathy are referred to physiotherapy, the aim of this review is to examine the evidence of effectiveness of frequently used physiotherapy exercise therapy and electrotherapy in the management of diabetic peripheral neuropathy. For the purpose of this review, exercise therapy and electrotherapy were classified.

Specific exercise program should include

- Flexibility (progressive stretching and self stretches).
- Muscles Strengthening (using a variety of modes as appropriate eg. Isometric, graded weight progression, open and close chain).
- Aerobic activity (aiming for 30 minutes)
- Balance (for falls prevention and stability)
- Gait (can improve gait pattern or walking in patient with diabetic neuropathy).
- Resistant strengthening exercise lower blood glucose level.

### Aerobic exercise

Move large muscles and cause you to breath deeply. This increase blood flow and release endorphins that act as the body's natural painkiller. Aerobic exercise

- Take a brisk walk (inside on a treadmill)
- Stationary bicycle indoors
- Aerobic exercise should be at least at moderate intensity, approx. to 40-60% of Vo2 max.
- Hot fermentation 10 minute
- Strengthening exercise.

**Seated dorsiflexion**

While seating on the front half of a chair place both feet flat on the floor; Gradually pull the toes and ankle up as high as you can. Slowly let them down. To make this exercise more challenging position your feet closer to your body. (Repeat: 10 times, 3 repetition)

- **Chair squat:** Using a firm chair with armrests, position your feet in a split stance with one foot at the base of the chair and the other foot placed comfortably in front and slightly out to the sides. Slowly transfer your weight forward until your legs are supporting your body weight. Slowly press up with your legs to standing. To lower yourself, slowly reach for the chair with your hips. Touch the chair with your hips and press back up for your next repetition.
- (Repeat 10 times, 2 repetition).
- **Wall push up:** Stand facing a wall. Experiment with the distance to determine the right difficulty for you. For intensity, closer is less so, farther is more so. Place your palms flat against the wall. Bend your elbows to lower your chest toward the wall, keeping your body straight in a strong plank position. Slowly straighten your arm to return to the starting position

Some examples of aerobic exercise are

- Brisk Walking
- Swimming
- Bicycling

**Stretching exercise**

Stretching increase your flexibility and warm up your body for other physical activity. Routine stretching can also reduce the risk of developing an injury while excrsing. Common techniques are calf stretches and seated hamstring stretches.

**Balance training**

- **Hip flexion:** Hold table or chair with one hand, then one fingertip, then no hands; then do exercise with eye closed, if steady. Stand straight: holding onto table or chair for balance. Slowly bend one knee towards chest, without bending waist or hips. Hold position 10 seconds. Slowly lower leg all the way down. Repeat with other leg. It is a postural sway from pelvis and trunk. It is seen

when the sway is large, fast and nearing the limits of stability. (2 repetition) same applicable on hip extension.

- **Ankle strategy:** Describe postural sway control from ankle musculature level, this strategy act when the sway is small, slow and near midline.
- **Suspensary strategy:** It describe lowering of COG by flexing both the knee, commonly seen in windsufing.
- Peripheral neuropathy can leave your muscles and joints feeling stiff and sometimes weak. Balance training can build your strength and reduce feelings of tightness. Improved balance also prevent falls.

**Side leg raise**

- Using a chair or counter, steady your balance with one hand.
- Stand straight with feet slightly apart.
- Slowly lift one leg to the side and hold for 5-10 seconds.
- Lower your leg at the same pace.
- Repeat with the other leg.

**Calf raise**

- Using a chair or counter, steady your balance.
- Lift the heels of both feet off the ground so you are standing on your toes.
- Slowly lower yourself down.
- Repeat for 10 repetitions



**Figure 6:** Assessment.



**Figure 7 and 8:** Performing strengthening exercises.



Figure 9: Electrodes placements of DPN and TENS machine.

**Transcutaneous electrical nerve stimulation (tens) therapy**

The skin surface to be treated should be inspected; inflammatory skin conditions should be avoided, and the nature of the treatment explained to the patient. The patients should be in a comfortable position so that the area to be treated is accessible and supported. The couplant should be applied to the skin surface. The treatment head is placed on the skin before the output is turned on. Electrodes need to be placed on areas of skin with good sensation. TENS applied on the distal aspect of the thigh and proximal aspect of the leg or through a stocking electrodes covering the painful leg reduced the pain.

SETTING/MODE-Burst or SMP

TREATMENT TIME-30-60 Minutes, 3-4 times per day

ELECTRODES PLACEMENT-Channel 1 => Place one electrodes midline on the posterior calf, two-thirds of the way down to the Achilles tendon insertion. This will stimulate the sural and lateral cutaneous nerve of the calf. Place of the other electrodes in the depression between the medial malleolus and the Achilles tendon.

There will be 2 sittings per weeks. After completion of one week and after completion of 2 week again pain, strengthening, balance and functional disability measurement will be taken.

**Data Analysis**

- **Data collection:** Data will be collected 2 times i.e. on first day before starting of the treatment, after completion of one week, and after completion of 2 weeks.
- **Data management and analysis:** Data obtained on first day, on the completion of one week and on the completion of 2 weeks will be interpreted and analysed by using appropriate statistical method.
- **Ethical clearance:** Ethical clearance has been obtained from the ethical committee of our institutions to carry out the investigations and interventions on patients necessary for this study.

**Results**

**Demographical data**

A total of 30 participants volunteered for this study participant in the study (GROUP A-15, GROUP B-15). The mean age in the group A and group B were  $42.40 \pm 7.18$  and  $41.07 \pm 7.58$  respectively. Table given the details of means and standard deviation of this data.

| Age Group     | Group A          |        | Group B          |        |
|---------------|------------------|--------|------------------|--------|
|               | No.              | %      | No.              | %      |
| 30-40         | 5                | 33.33  | 7                | 46.67  |
| 41-50         | 10               | 66.67  | 8                | 53.33  |
| Total         | 15               | 100.00 | 15               | 100.00 |
| Mean $\pm$ SD | $42.40 \pm 7.18$ |        | $41.07 \pm 7.58$ |        |
| P value       | 0.624 (NS)       |        |                  |        |

Table 1: Age Distribution.

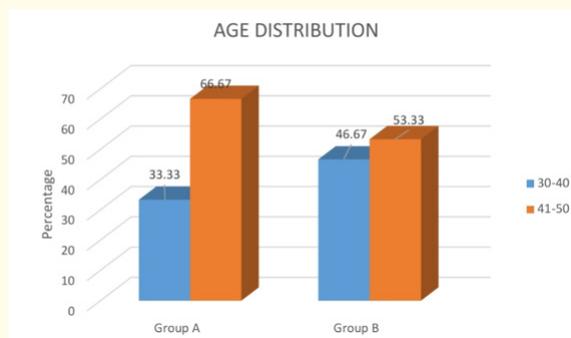
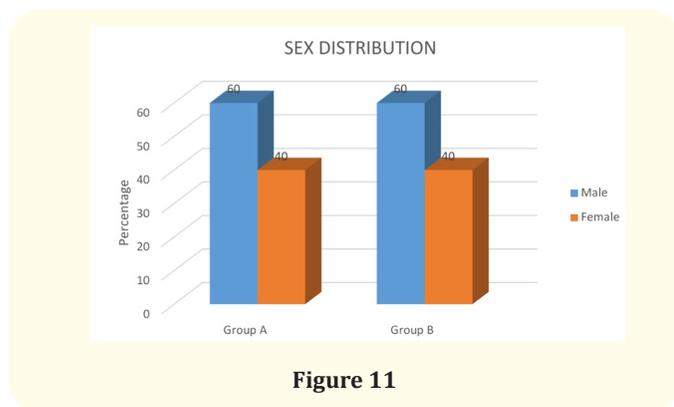


Figure 10

| Gender | Group A |        | Group B |        |
|--------|---------|--------|---------|--------|
|        | No.     | %      | No.     | %      |
| Male   | 9       | 60.00  | 9       | 60.00  |
| Female | 6       | 40.00  | 6       | 40.00  |
| Total  | 15      | 100.00 | 15      | 100.00 |

**Table 2:** Distribution of patients by Gender.



**Figure 11**

**Within the group comparison of pain**

**Group A**

The mean value for pain measured using the VAS scale (Visual analogue scale) of participants in the group A during the various stages of the study came out to be according pre and post, pre is 5.93 ± 1.03 for day 0, for after treatment post is 2.00 ± 0.00 for 2 weeks.

|         | Pre-Test |        | Post Test |        |
|---------|----------|--------|-----------|--------|
|         | No.      | %      | No.       | %      |
| Score 2 | 0        | 0      | 15        | 100.00 |
| Score 5 | 8        | 53.33  | 0         | 0.0    |
| Score 7 | 7        | 46.67  | 0         | 0.0    |
| Total   | 15       | 100.00 | 15        | 100.00 |

|           | Number of cases | Mean | SD   | P value                 |
|-----------|-----------------|------|------|-------------------------|
| Pre-Test  | 15              | 5.93 | 1.03 | P < 0.001 (Significant) |
| Post Test | 15              | 2.00 | 0.00 |                         |

**Table 3:** Comparison of Visual Analogue Scale (VAS) (Pre and Post Score).

**Group B**

The mean value for pain measured using VAS scale (Visual analogue scale) of participants in the group B during the various stages of the study came out to be 5.93 ± 1.49 based on the only medications.

|                       | Group A |      | Group B |      | p value   |
|-----------------------|---------|------|---------|------|-----------|
|                       | Mean    | SD   | Mean    | SD   |           |
| Visual Analogue Scale | 5.93    | 1.03 | 5.93    | 1.49 | 1.00 (NS) |

**Table 4:** Comparison of Visual Analogue Scale (VAS) Group A and Group B.

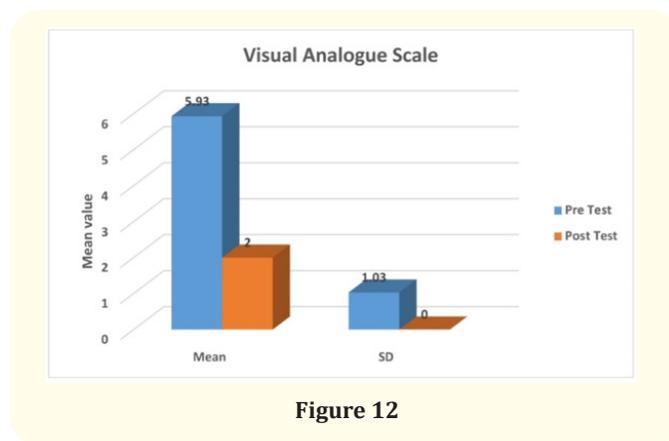
**Within the comparison of berg balance scale (BBS)**

The mean value for BBS measured by during a series of pre-determined tasks of participants in the Group A, during various stages of the study came out to be pre and post manner, Pre is 0.53 ± 3.00 for day and post is 0.52 ± 0.00 for 2 weeks.

|         | Pre Test |        | Post Test |        |
|---------|----------|--------|-----------|--------|
|         | No.      | %      | No.       | %      |
| Score 0 | 7        | 46.67  | 0         | 0.0    |
| Score 1 | 8        | 53.33  | 0         | 0.0    |
| Score 3 | 0        | 0      | 15        | 100.00 |
| Total   | 15       | 100.00 | 15        | 100.00 |

|           | Number of cases | Mean | SD   | P value                 |
|-----------|-----------------|------|------|-------------------------|
| Pre Test  | 15              | 0.53 | 3.00 | p < 0.001 (Significant) |
| Post Test | 15              | 0.52 | 0.00 |                         |

**Table 5**



**Figure 12**

**Within the group comparison of manual muscles test (MMT)**

|         | Pre-Test |        | Post Test |        |
|---------|----------|--------|-----------|--------|
|         | No.      | %      | No.       | %      |
| Score 1 | 7        | 46.67  | 0         | 0.00   |
| Score 2 | 5        | 33.33  | 7         | 46.67  |
| Score 3 | 3        | 20.00  | 5         | 33.33  |
| Score 4 | -        | -      | 3         | 20.00  |
| Total   | 15       | 100.00 | 15        | 100.00 |

|           | Number of cases | Mean | SD   | P value                 |
|-----------|-----------------|------|------|-------------------------|
| Pre Test  | 15              | 1.73 | 0.80 | p < 0.001 (Significant) |
| Post Test | 15              | 2.73 | 0.80 |                         |

|                        | Group A |      | Group B |      | p value    |
|------------------------|---------|------|---------|------|------------|
|                        | Mean    | SD   | Mean    | SD   |            |
| Manual Muscles Testing | 1.73    | 0.80 | 2.20    | 0.77 | 0.115 (NS) |

Table 6

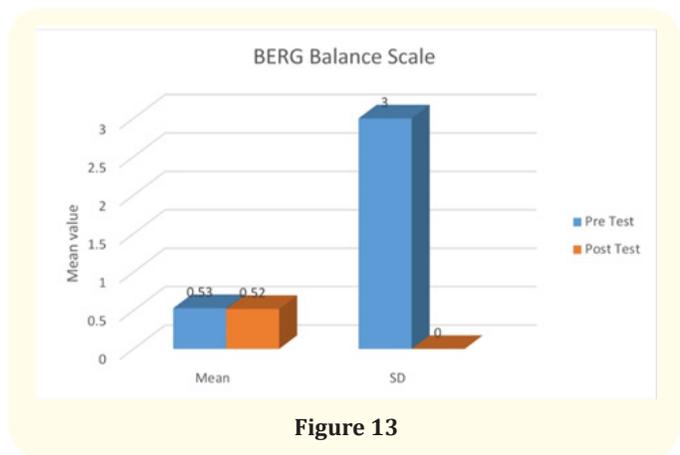


Figure 13

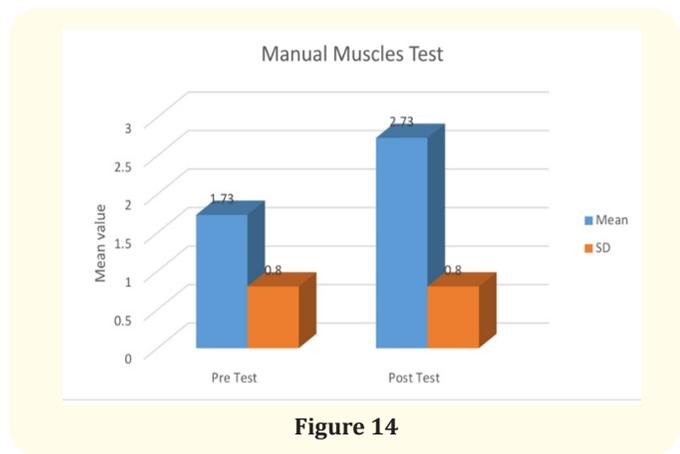


Figure 14

**Discussion**

It is found from the analysis that 2 weeks of interventions consisting simultaneous application of transcutaneous electrical nerve stimulation along with exercise therapy (strengthening exercise, aerobic exercise, balance training) for the subjects in Group A shown statistically significant greater percentage of improvement in pain, range of motion and severity of the radicular symptoms than Group B who received based only diabetic medications [1-30].

In Group A subjects the improvements could be because of simultaneous application of TENS (Transcutaneous electrical nerve stimulation) along with exercise therapy (strengthening exercise, aerobic exercise, balance training). In this present study based on the before the start treatment give hot fermentation for 10 minutes, then start the exercise therapy. While patient seated dorsiflexion and pull the toes and ankle up as high as you can. After this patient while perform the chair squat strengthening exercise and then wall push up. And then after all this patient while perform the balancing training with the help of the therapist (Ankle strategy, suspensory strategy). And after balance training patient while perform the aerobic exercise for flexibility. This treatment based on the exercise therapy but we can perform the combination of electrotherapy TENS machine. TENS machine setting/mode is burst or SMP, and treatment time is 30 minutes, electrodes placements is channel 1 one electrodes place on midline on the posterior calf two-third of the way down to the Achilles tendon insertion and other electrodes in the depression between the medial malleolus and Achilles tendon.

In Group B is generally based on the only medication.

**Conclusion**

By the virtue of study, we can conclude that exercise therapy with the combination of the TENS machine is very effective in treating patient with diabetic peripheral neuropathy. As the result, have shown that clinically, there is a significant difference in the subject’s outcomes treated by the combination comparing along the based on the medication treatment.

The study thus conclude by accepting experimental hypothesis and rejecting the null hypothesis i.e. that exercise therapy with TENS machine is more effective on treating patient with diabetic peripheral neuropathy as compared with the medications.

**Limitation of the Study**

- Study is a short duration.
- Small sample size.
- Follow-up taken is inadequate

**Recommendation**

- This study can be performed on a large sample size.
- It can be performed on homogenous population.
- The duration of the study can be longer.
- The follow- up period after the treatment can be enhanced.

**Annexure 1**

Consent form

Ethical informed consent form

**Study title “the routine physiotherapy reduces the complications of diabetic peripheral neuropathy”.**

Date of birth/age (year): sex

- I have been explained in details about the various questions/ test that will be asked/performed is to assess my functional capacity and health status etc. I have also been explained that all the test are non- invasive and without any side effect.
- I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal right being affected.
- I understand that the data obtained through the study may be used for research paper publication and I also understand that my identify will not be revealed at any cost. I agree to give my consent for taking part in the above study and have no objection against it.
- understand that the investigator of its study and others working on the investigator’s behalf, the institutional ethics committee will not need my permission to look at my health record both in respect to current study and any future research study that may be conducted in relation to it.

Subject’s Name: Signature:

Investigator’s Name: Megha Tandon Investigator signature:

Witness’s Name: Witness’s Signature

**Annexure 2**

Data collection form

assessment form

Name: Age/Gender:

Dominance:

Address:

Phone no.: OPD reg.no:

Education: Occupation:

Evaluation Date:

Chief complain:

H/O Pain and symptoms

- Onset : Sudden/Gradual:

If Sudden specify MOI

- Type: Aching/dull/tingling/burning/other:
- Duration: <3 month/ >3 month:
- Frequency: Constant/intermittent:
- Symptom: Non radiating/ Radiating:
- Aggravating Factor:
- Reliving Factor:
- Diurnal variation:
- Pain Level:

Special Test

| Outcome measures                | Before treatment | After completion of 1 <sup>st</sup> week | After completion of 2 <sup>nd</sup> week |
|---------------------------------|------------------|--|--|
| Pain on VAS Scale               |                  |  |  |
| Muscles strengthening MMT Scale |                  |  |  |
| Balance Scale BBS               |                  |  |  |

**Annexure 3**

Master chart

GROUP A - Treatment based on Exercise therapy with TENS machine

| S.NO | Age | Sex | Manual muscles testing (MMT) |                    | Berg balance scale (BBS) |            | Visual analogue scale (VAS) |            |
|------|-----|-----|------------------------------|--------------------|--------------------------|------------|-----------------------------|------------|
|      |     |     | Pre-testing scale            | Post testing scale | Pre-scale                | Post scale | Pre-scale                   | Post scale |
| 1    | 49  | F   | 2                            | 3                  | 1                        | 3          | 5                           | 2          |
| 2    | 35  | F   | 1                            | 2                  | 0                        | 3          | 7                           | 2          |
| 3    | 50  | F   | 1                            | 2                  | 0                        | 3          | 7                           | 2          |
| 4    | 45  | M   | 3                            | 4                  | 1                        | 3          | 5                           | 2          |
| 5    | 42  | M   | 1                            | 2                  | 0                        | 3          | 7                           | 2          |
| 6    | 35  | M   | 3                            | 4                  | 1                        | 3          | 5                           | 2          |
| 7    | 30  | M   | 2                            | 3                  | 1                        | 3          | 5                           | 2          |
| 8    | 42  | F   | 1                            | 2                  | 0                        | 3          | 7                           | 2          |
| 9    | 50  | F   | 1                            | 2                  | 0                        | 3          | 7                           | 2          |
| 10   | 45  | F   | 3                            | 4                  | 1                        | 3          | 5                           | 2          |
| 11   | 32  | F   | 2                            | 3                  | 1                        | 3          | 5                           | 2          |
| 12   | 50  | M   | 2                            | 3                  | 1                        | 3          | 5                           | 2          |
| 13   | 49  | M   | 1                            | 2                  | 0                        | 3          | 7                           | 2          |
| 14   | 35  | F   | 1                            | 2                  | 0                        | 3          | 7                           | 2          |
| 15   | 47  | F   | 2                            | 3                  | 1                        | 3          | 5                           | 2          |

**Annexure 4**

Master Chart

GROUP B-Treatment based on only medications.

| S.NO. | Age | Sex | Manual muscles testing (MMT) | Visual analogue scale (VAS) |
|-------|-----|-----|------------------------------|-----------------------------|
| 1     | 41  | M   | 2                            | 6                           |
| 2     | 34  | M   | 2                            | 5                           |
| 3     | 50  | M   | 1                            | 6                           |
| 4     | 35  | F   | 2                            | 4                           |
| 5     | 45  | F   | 3                            | 8                           |
| 6     | 34  | M   | 3                            | 7                           |
| 7     | 40  | F   | 2                            | 7                           |
| 8     | 30  | F   | 1                            | 6                           |
| 9     | 45  | M   | 2                            | 8                           |
| 10    | 50  | M   | 2                            | 8                           |
| 11    | 30  | F   | 3                            | 5                           |
| 12    | 35  | M   | 1                            | 5                           |
| 13    | 50  | F   | 3                            | 5                           |
| 14    | 50  | M   | 3                            | 6                           |
| 15    | 47  | M   | 3                            | 3                           |

**Bibliography**

- By Jennifer Robinson.
- By Sharon Liao. "Peripheral neuropathy and diabetes". High blood sugar damage the nerve fiber (2021).
- By Daniel Bubnis. Developed exercise program (2016).
- By Dr. Tony Lauretta PT.
- By Danial umpire. "In Diabetology and metabolic syndrome (2015).
- Jillian Michael by Bronwyn Ellison getfit.
- Strotmeyer ES., et al. "Sensory and motor peripheral nerve function and lower\_extremity quadriceps strength: the health, aging and body composition study". *Journal of the American Geriatrics Society* 57.11 (2010): 2004-2010.
- Pirart J. "Diabetes mellitus and its degenerative complications: a prospective study of 4400 patients observed". *Diabetes Care* 1.3 (1978): 168-188.
- Diabetes control and complications trial research group: the effects of intensive treatment of diabetes on the development and progression of long\_term complications in insulin". *Med* (1993).
- Jin DM., et al. "Effects of transcutaneous electrical nerve stimulations on symptomatic diabetic peripheral neuropathy: a meta-analysis of randomized controlled trial". *Diabetes Research and Clinical Practice* 89.1(2010): 10-15.
- Basbaum AI and Field HL. "Endogenous pain control mechanism: review and hypothesis". *ANN Neurology* 45.5 (1978): 451-462.
- Snyder MJ., et al. "Treating painful diabetic peripheral neuropathy". *American Family Physician* 94.3 (2016): 227-234.
- Groover AL., et al. "Exercise-mediated improvement in painfull neuropathy associated with prediabetes in mice". *Pain* 154.12 (2013): 2658-2667.
- Kennedy WR., et al. "Quantitation od epidermal nerve in diabetes neuropathy". *Neurology* 47.4 (1996): 1042-1048.
- Akbari M., et al. "Do diabetic neuropathy patients benefit from balance training". *Journal of Rehabilitation Research and Development* 49.2 (2012): 333-338.
- Lee K., et al. "Whole body vibration training improves balance, muscles strength and glycosylated haemoglobin in elderly patient with diabetes". *The Tohoku Journal of Experimental Medicine* 231.4 (2013): 305-314.
- Simoneau GG., et al. "Postural instability in atient with diabetic sensory neuropathy". *Diabetes Care* 17.12 (1994): 1411-1421.
- Noonam V and Dean E. "Submaxial exercise testing".
- Zakaria HM., et al. "The role of physical therapy intervention in the management of diabetes neuropathies". *Bulletin of Faculty of Pharmacy, Cairo University* 13.2 (2008).
- Youtube video: The Diabetes foot exam.
- Kumar D and Marshall HJ. "Diabetic neuropathy: Amelioration of pain with transcutaneous electrostimulation". *Diabetes Care* 20.11 (1997): 1702-1705.
- Dworkin RH., et al. "Advances in neuropathic pain: Diagnose, mechanism and treatment recommendation". *Archives of Neurology* 60.11 (2003): 1524-1534.

23. Forst T, *et al.* "Impact of low frequency transcutaneous electrical nerve stimulation on symptomatic diabetic neuropathy". *Diabetes, Nutrition and Metabolism* 17.3 (2004): 163-168.
24. Akyuz G and Ozkok O. "Evidencebased rehabilitation in chronic pain syndrome". *Agriculture* 24.3 (2012): 97-103.
25. Jacob M and jorning. "Electrical stimulation improve micro-vascular blood flow in limb (1988).
26. Lirigia J., *et al.* "Economic burden of diabetes mellitus in the WHO African region". *BMC International Health on Human Rights* 9 (2009): 6.
27. Ucccioli L., *et al.* "Body sway in diabetes neuropathy". *Diabetes Care* 18.3 (1995): 339-344.
28. World health organization. About diabetes (2014).
29. World health organization. Diabetes fact sheet (2013).
30. World health organization. Diabetes programme (2014).