

# Effect of Sensorimotor Exercise Training to Improve Balance and Gait in Diabetic Peripheral Neuropathy - A Case Study

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**Abstract:** *Peripheral neuropathy is one of the common complications in patients with diabetes Mellitus (DM) which leads to disrupting the peripheral nervous system resulting in reduce sensory inputs and motor outputs. Patients with diabetic peripheral neuropathy have weakness in lower limb and sensory loss due to disruption of small myelinated and unmyelinated nerve fibers. Sensory motor training (SMT) will facilitate sensory inputs, correcting muscle imbalance, and ensuring correct program at the level of central nervous system. Hence the purpose of the study to combine the effect of sensorimotor exercise training to improve balance and gait in diabetic peripheral neuropathy in patient with type II DM. The case report study of 68 year old female patient diagnosed with diabetic Peripheral neuropathy manifested by type II diabetes mellitus on medication. Intervention of patient received Sensory motor exercise training for 5 days a week for 4 weeks and outcome measures used were Berg balance scale (BBS), Time up and go test (TUG), Diabetic Neuropathy Examination (DNE) score for diabetic neuropathy which were taken on day one and after 4 weeks of intervention and results shown improved on the outcome measures which concluded that Sensory - motor exercise training have shown efficacy on improving balance, gait and sensation.*

**Keywords:** Diabetes Mellitus (DM), Sensory Motor Training (SMT), Proprioceptive, Balance, Gait.

## 1. Introduction

Diabetic peripheral neuropathy (DPN) is a common complication of long - term diabetes mellitus (DM) and is a progressive and irreversible disease. DPN occurs in 40% - 59% of the total DM population, in general the estimated prevalence of DPN is 15.3 - 72.3/100, 000 person - years, and in developing countries the prevalence of DPN is around 25 - 50%.<sup>1</sup>

Symptoms of DPN include paresthesias, hyperesthesia, and dysesthesias, and some patients experience neuropathic symptoms (such as burning and tingling) while others may have no signs or symptoms. Many disorders of the lower extremities and feet such as deformity, decreased range of motion, impaired balance coordination, and muscle weakness can be caused by DM.<sup>1</sup> People with diabetes tend to have impaired balance and increased risk of falling. Type 2 diabetes is associated with obesity, physical inactivity, unhealthy diet, genetics, and aging. People who have type 2 diabetes are at risk for several long - term complications including heart disease, stroke, kidney failure, retinopathy, peripheral artery disease, amputations, erectile dysfunction, depression, anxiety, vision loss, and nerve damage.<sup>1</sup>

Diabetic neuropathy is a complication of diabetes mellitus and occurs when a person's bloodsugar level is abnormally high - overtime. As a result of high blood sugar, the body produces excess amounts of sorbitol, sugar alcohol that damages the small fibers of the nerve. Damage to these fibers causes them to lose their ability to transmit nerve impulses.<sup>2</sup>

Diabetic neuropathy occurs when nerve cells lose their

normal function. As a result, people who experience this problem may feel pain, discomfort, and reduced sensitivity in certain parts of their body. These changes can affect the way that people walk, stand, sit, and perform daily activities. People suffering from diabetic neuropathy may also benefit from using compression garments. Compression socks are tightfitting socks that wrap around the affected limb (s). They help to decrease swelling and promote circulation. In addition, they may provide some relief from pain and numbness.<sup>2,3</sup>

The maintenance of functional balance relies on the central integration of afferent information from visual, vestibular and somatosensory systems. In people with diabetes and neuropathy, the loss of cutaneous sensory receptors in the plantar surface of the foot and LEMS seem to be associated with altered awareness of lower limb positioning and functional restriction at the ankle, leading to reduced postural stability. When people with diabetes and neuropathy detect postural instability, they tend to adopt a more rigid posture involving muscle co - contraction to aid stability. sub - type, diabetic peripheral neuropathy, can lead to significant complications.<sup>3</sup>

Symptoms vary depending on the location of the damaged nerves. Most commonly, people experience numbness, burning, or tingling in their feet or hands. Other possible symptoms include weakness in the legs or arms, problems walking, difficulty speaking, dizziness, blurred vision, headaches, stomachaches, fatigue, and mood changes.<sup>1</sup>

Physical therapy can improve the overall quality of life of DPN patients, and can relieve symptoms of diabetic neuropathy. It can also improve muscle strength, joint mobility, balance, coordination and physical function, when

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done regularly can reduce neuropathic pain and can help control blood sugar levels.<sup>1,2</sup>

Sensori - motor training is considered to be a global approach for balance training. It emphasizes the sensori - motor system function as one unit, and works on enhancing sensory inputs and proper recruitment patterns of various muscles in maintaining joint stability, regulating the movement through central nervous system (CNS) 24. Any imbalance in the muscles responsible for postural control leads to movement impairments and ultimately changes the motor programming in CNS<sup>1,2,3</sup>.

To correct these impairments, sensori - motor exercises first facilitate sensory inputs (proprioceptive and somatosensory structures), then corrects muscle imbalance and finally facilitates correct motor programming<sup>24</sup>. Along with improvement in balance and spatiotemporal parameters of gait, balance exercises as a part of sensori - motor training have also been shown to improve trunk proprioception in DPN patients. However, there is a lack of studies about the effect of these exercises on the nerve function and muscular activity of lower limb muscles.<sup>1,2,3</sup>

**2. Case Study**

A 68 Years old women working in hospital was suffering with an impaired glucose tolerance since 15 years.

Hypertension, which is her only other medical issue, is managed with a low dose of an angiotensin - converting enzyme inhibitor of (ACE) and diabetes mellitus with Metformin + Vildagliptin 50/500mg. She has had stress electrocardiograms every two years with normal results and has no dyslipidemia. On normal laboratory tests, her glucose intolerance was found. She received diabetes education, learned how to check her blood sugar at home, and followed a diet and exercise regimen recommended by our diabetes educator. She began to experience Sensation loss in her feet around 1 year ago. She acknowledged that she hadn't felt as good as usual and that walking was getting harder. She denied feeling breathless or having chest pain. Her physical examination revealed that she has weakness in both the limbs and diminished Vibratory sensation. Her Superficial and deep tendon reflexes normal in both upper limbs. But Altered (1+) in both lower limbs, indicating possible neuropathy. Almost invariably, postprandial glucose levels were greater than 150 mg/dl. Studies in the lab indicated normal chemical compositions other than fasting blood glucose 146 mg/dl. Her HbA1c was 7.2%, up from 6.1% six months prior (normal range: 4.0-6.0%). Prostate specific antigen (PSA) testing, a complete blood count, a lipid panel, a liver screening, and a kidney profile were all normal.

**Warm up:**

Lower Limb Range of motion (5 min each X 10 reps x 1set)

**Table 1: Intervention (Sensory - Motor Training)**

Sr. No	Texture	Time	Frequency	Procedure	
				Balance	Gait
1)	Stones	5 min each activity	10 reps x 1set	1) Standing with narrow base of support with eyes open and eyes close.	1) Walking. 2) Sideway walking. 3) Tandem walking. 4) cross walking. 5) Obstacle walking.
2)	Green Mat			2) Standing with wide base of support with eyes open and eyes close.	
3)	Sand paper			3) Tandem Standing with eyes open and eyes close.	
4)	Grass			4) One leg standing with eyes open eyes close.	
5)	Soil			5) Slide the cones as per therapist command on drawn figure.	
6)	Foam				

**Cool Down:** Lower Limb Stretching (10 sec hold X 10 reps x 1set X 5 min each)



**Figure A**



Figure B



Figure C



Figure D



Figure E



Figure F



Figure G

**Sensorimotor training Path**

**Outcome Measures**

- 1) Berg Balance Scale: Is used to objectively determine a patient's ability to safely balance during a series of predetermined tasks.
- 2) Time up and go test: is a simple test used to assess a person's functional mobility and requires both static and dynamic balance.
- 3) Diabetic Neuropathy Examination (DNE) score: total score 16, higher the score indicated impairment and lower the score indicates improvement seen in outcome measure<sup>[14]</sup>.

**Outcome measures**

Outcome Measures	Pre - Test	Post - Test
Berg Balance Scale	23/56 (Moderate risk of fall)	42/56 (Low risk of fall)
Time up and go test	Less than 30 seconds (Cannot walk outside alone require walking aid)	More than 10 sec (walking normal can walk without aid)
Diabetic Neuropathy Examination	5/16 (Severely disturbed)	3/16 (Moderate, positive for PNP)

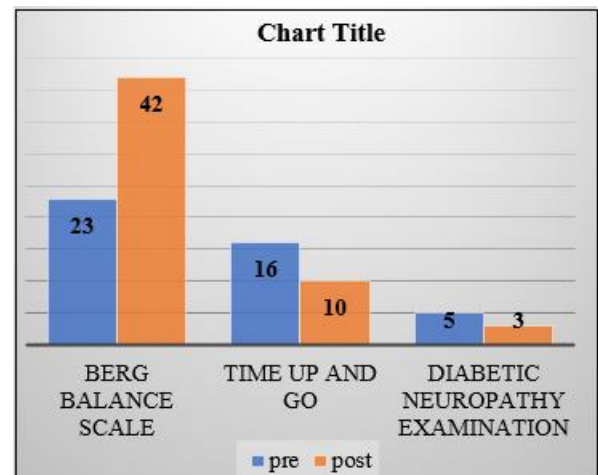


Table 1: Pre and post assessment

**3. Result**

As per the table no.1 the value of BBS increased from 23 to 42 and TUG was reduced by 20 sec and DNE Score was 3. As significant improvement was observed.

#### 4. Discussion

The current case study report on the effects of Sensory Motor exercise training to improve balance and gait in diabetic peripheral neuropathy patients with 4 weeks of intervention with pre and post outcomes i. e. Berg balance scale, time up and go test and diabetic neuropathy examination have shown improved after intervention. Sensorimotor system functions as one unit and that changes within one section of the system are reflected by adaptations elsewhere in the system. The possible mechanism of improvement on sensory motor training, new coordinated movement pattern is programmed in the subcortical region, becoming more “automatic” and requiring less conscious thought processing, thus becoming much quicker. At this point, “feed - forward” mechanisms become important. Feed - forward mechanisms occur unconsciously and are important in preparing the body for movement by contracting stabilizing muscles prior to initiating the movement. This automatic level of processing was essential to protect joints for dynamic functional stability throughout the body. SMT is to increase proprioceptive input in order to stimulate subcortical pathways and facilitate automatic coordinated movement pattern [6, 9, 14]. In this study we assessed the patient on Berg balance scale, time up and go test which showed improvement in static and dynamic balance, enhanced proprioception, reduced postural sway and increased stability and in gait increased stride length, reduced gait variability and improved walking speed in patient. whereas Diabetic Neuropathy Examination (DNE) showed improvement in muscle strength of quadriceps femoris, tibialis anterior and improved sensitivity to touch and pin prick.

#### 5. Conclusion

In present case study, according to result it can be concluded that effect of sensori - motor exercise training was seen considerable improvement in balance, gait and sensation. It was observed that sensori - motor exercise protocol has helped in improving the patient with diabetic peripheral neuropathy.

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