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RESEARCH PAPER

Effect of Weightbearing versus Non-Weightbearing Sensory Integration Therapy in Patient with Diabetic Peripheral Sensory Neuropathy in Diabetic Foot

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Received: 25th Aug, 2026 | Revised: 1st Sep, 2026 | Accepted: 5th Sep, 2026 | Available Online: 11th Sep, 2026

ABSTRACT

BACKGROUND: Diabetes neuropathy is a common condition characterised by signs and symptoms of peripheral nerve damage in diabetic patients. The overall prevalence of peripheral neuropathy among the study participants was observed to be 13.2% and diabetes is more prevalent in India (4.3%) than in the West (1-2%). (3)

AIMS OF THE STUDY - To study effect of weightbearing versus non-weightbearing sensory integration therapy in patient with diabetic peripheral sensory neuropathy in diabetic foot.

PROCEDURE- Ethical clearance was obtained from Institution Ethical Committee. Total 64 participants were included in this study according to the inclusive criteria; participants were allocated by randomization method into two groups. GROUP A included 32 participants sensory integration in weight bearing with sensory mat.
(sensory integration in weight bearing with sensory mat) and GROUP B included 32 participants (sensory integration in non-weight bearing with sensory stroking) for 4 days in week.

OUTCOME MEASURES- vibration perception threshold test (Biothesiometer)

RESULT-The study included participants diagnosed with Diabetic peripheral neuropathy. Gender distribution analysis showed that males are accounted for 56.30% of the total, while females comprised 43.80%. The Vibration Perception Threshold (VPT) tes**t** was used as the
primary outcome measure to evaluate sensory function and the severity of neuropathy. At the pre-test stage, both groups had similar VPT values, indicating comparable levels of sensory impairment, with most participants showing higher thresholds suggestive of severe neuropathy. After the intervention, post-test results showed a decrease in VPT values in both groups, reflecting improvement in sensory function. The reduction was more pronounced in the weightbearing group, indicating better sensory recovery compared to the non–weight-bearing group. Although both treatment approaches were beneficial, weight-bearing sensory integration therapy demonstrated greater effectiveness in reducing VPT values and improving sensory function in patients with diabetic peripheral sensory neuropathy.

CONCLUSION- Both weight-bearing and non–weight-bearing sensory integration therapies were effective in improving neuropathy severity and sensory function in patients with diabetic peripheral sensory neuropathy. However, weight-bearing sensory integration therapy showed comparatively greater benefits, with enhanced improvement in sensory function among patients with diabetic neuropathy.

KEYWORD'S –Diabetic peripheral neuropathy, Diabetes mellitus, Sensory Integration, Weight bearing exercises, non- weight-bearing exercises, Vibration perception threshold test,

How to cite this article: Miss. Maithilee Kishor Sonsurkar1 Dr. Akanksha Bhat2* Dr. Romita Shah3 Dr. Soniya Lohana4. Effect of Weightbearing versus Non-Weightbearing Sensory Integration Therapy in Patient with Diabetic Peripheral Sensory Neuropathy in Diabetic Foot. Int J Drug Deliv Technol. 2026;16(82s):1130-1139. DOI: 10.25258/ijddt.16.82s.124.

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by defects in insulin secretion, insulin action, or both, resulting in persistent hyperglycaemia and disturbances in carbohydrate, fat, and protein metabolism. Prolonged hyperglycaemia causes tissue and vascular damage, leading to complications such as diabetic retinopathy, nephropathy, neuropathy, cardiovascular diseases, and diabetic foot ulceration. (19)

There are several forms of diabetes mellitus, but type 1 and type 2 are the major varieties. Type 1 diabetes occurs in individuals with little or no endogenous insulin secretion and therefore requires insulin therapy for survival. Type 1a diabetes, which accounts for nearly 90% of cases in Europe, results from autoimmune destruction of pancreatic β-cells, whereas type 1b diabetes is idiopathic and lacks evidence of autoimmunity. Type 2 diabetes, the most common form, is characterized by insulin resistance and abnormalities in insulin secretion.

Both forms present with symptoms such as polyuria, polydipsia, polyphagia, fatigue, blurred vision, cramps, constipation, candidiasis, and weight loss, although symptoms appear more rapidly in type 1 diabetes. Type 2 diabetes often develops gradually and is frequently detected incidentally or after complications occur. It is commonly associated with obesity, hypertension, hyperlipidaemia, and increased risk of atherosclerosis. (19)

Neuropathy refers to disorders affecting peripheral, cranial, or autonomic nerves, with diabetes being the most common cause. (1) The prevalence of neuropathy exceeds 2% in the general population and rises to nearly 15% in individuals above 40 years of age. (5) In North America, diabetes is the leading cause of neuropathy. Elevated blood glucose, triglycerides, body mass index, smoking, and hypertension are important risk factors. Distal symmetric polyneuropathy (DSPN) is the most common form of diabetic neuropathy. Symptoms depend on the type of sensory fiber involved. Small fiber involvement commonly produces burning pain, dysesthesias, and shooting pain, whereas large fiber involvement causes tingling, numbness, and loss of protective sensation. (20)

Diabetic neuropathy is a common condition characterized by signs and symptoms of peripheral nerve damage in diabetic patients. Diabetes prevalence is higher in India (4.3%) compared to Western countries (1–2%). (3) Diabetes may affect the peripheral nervous system in different ways, producing focal neuropathies or generalized polyneuropathies involving sensory, autonomic, and motor nerves. The incidence of neuropathy increases with duration of diabetes and may occur in IDDM, NIDDM, and secondary diabetes. (3)

The pathology of diabetic neuropathy involves multiple mechanisms. One theory suggests excessive accumulation of sugar alcohols (polyols) within Schwann cells and axons. Another emphasizes nerve ischemia, hypoxia, and oxidative stress. Additional mechanisms include nonspecific glycosylation of structural nerve proteins such as neurofilaments and deficiencies of neurotrophins or growth factors. Limited evidence also suggests autoimmune damage to nerves and ganglia. (4)

Clinical features vary according to nerve fiber involvement. Large fiber neuropathy slows nerve conduction and impairs quality of life and daily activities, while small fiber neuropathy causes burning pain, discomfort, and impaired temperature and pain sensations, often associated with autonomic neuropathy. Advanced stages may produce sensory ataxia. (3)

Diabetic Peripheral Neuropathy (DPN) affects nearly 50% of diabetic individuals and is characterized by pain, paraesthesia, and sensory loss. About one-third of patients experience painful symptoms such as burning, tingling, electric shock-like sensations, or stabbing pain. DPN commonly begins in the toes and gradually progresses proximally in a “glove and stocking” distribution. Motor weakness is uncommon in early stages but may appear later in the disease course. Symptoms often worsen at night and disturb sleep. DPN is associated with significant morbidity including depression, ulceration, lower limb amputations, and increased susceptibility to foot fractures. (21)

Peripheral neuropathy refers to damage to nerves outside the brain and spinal cord and includes symmetric polyneuropathy, mononeuropathy, multiple mononeuropathy, and radiculopathy. It commonly causes pain, weakness, and numbness, particularly in the hands and feet, and may also affect circulation, digestion, and urination. Diabetes, immune-mediated disorders, and toxins such as alcohol are major causes. Symptoms generally begin with intermittent numbness and pain, progressing gradually to persistent pain and eventually loss of sensation. (6)

Peripheral neuropathies are classified as sensory, motor, or mixed neuropathies. Sensory neuropathies produce paraesthesia, increased pain, and reduced sensation to touch, vibration, heat, and cold. Motor neuropathies cause muscle weakness, cramping, wasting, and shrinking. Autonomic neuropathies are associated with heat intolerance, sweating abnormalities, high blood pressure, and swallowing difficulties. (6)

Individuals with diabetes mellitus and peripheral neuropathy have approximately three times greater risk of reduced mobility compared with individuals without these conditions. Common mobility limitations include inability to walk a quarter mile or climb stairs without stopping. Studies have demonstrated significant functional limitations, especially in weight-bearing activities such as walking. Although moderate physical activity benefits patients with diabetes mellitus, concerns regarding insensitive feet and plantar ulceration have historically discouraged weight-bearing exercise in individuals with diabetic peripheral neuropathy. High plantar pressure combined with sensory neuropathy and foot deformities is a major cause of diabetic plantar ulcers. However, avoiding weight-bearing activities may reduce skin tolerance and increase risk of breakdown. Recent evidence indicates that controlled physical activity may safely improve mobility without increasing skin damage. The Feet First randomized controlled trial demonstrated a 14% increase in daily step count without increased skin breakdown. Therefore, supervised weight-bearing and non–weight-bearing exercise programs may improve functional outcomes in individuals with diabetic peripheral neuropathy. (18)

Sensory Integration theory was developed in the 1960s by occupational therapist and psychologist A. Jean Ayres. During treatment of children with cerebral palsy, Ayres observed that some children had difficulty performing motor activities due to impaired sensory processing rather than motor weakness alone. Initially focusing on visual perception, she later investigated the roles of tactile, vestibular, proprioceptive, and kinaesthetic systems in movement, learning, behaviour, and emotional well-being. (7)

Ayres' research demonstrated dysfunctions in tactile, vestibular, proprioceptive, and ocular systems that affected motor planning, language, behaviour, cognition, and emotional development. According to sensory integration theory, tactile, proprioceptive, and vestibular systems contribute to muscle tone, reflex activity, and emotional well-being. In infants, sensory input triggers reflexes such as rooting, grasping, and postural reactions. These sensory systems also support emotional bonding, as infants respond positively to rocking and swaddling. (7)

As children develop, visual and auditory systems integrate with tactile, vestibular, and proprioceptive systems to support coordination and interaction with the environment. For example, eye-hand coordination requires integration of visual, vestibular, and proprioceptive input to maintain posture and guide movement toward objects. Tactile and proprioceptive feedback further help children understand object size, shape, and texture. Sensory integration therapy therefore aims to improve motor, cognitive, behavioural, and socio-emotional development by enhancing sensory processing and integration. (7)

MATERIALS AND METHODOLOGY

An Interventional Study conducted on Patients diagnosed with Diabetic neuropathy at D. Y. Patil Medical College Hospital and Research Institute, Kolhapur using Randomised Clinical trial. The study was conducted for a duration of 6 months.

Materials- Sensory Mat, Sensory textures: Cotton, Velcro, Sand paper, Silk, Fur, Net, Grass

Sensory kit, Parallel bar, Vibration perception threshold test (biothesiometer), Stop watch

Data collection sheet, Consent Form

Inclusion criteria- Diabetic peripheral neuropathy, Gender: Male and Female, Insulin dependent diabetes mellitus, Non -insulin dependent diabetes mellitus, Secondary diabetes mellitus, Type 2 diabetes mellitus.

Exclusion criteria.

Diabetic peripheral neuropathy, Gender: Male and Female, Insulin dependent diabetes mellitus,

Non -insulin dependent diabetes mellitus, Secondary diabetes mellitus, Type 2 diabetes mellitus,

Diabetic neuropathy patient with wound, Diabetic ulcer, Severe foot deformity, BMI more than grade 3 or 4.

PROCEDURE

Ethical clearance will be obtained from the institution ethical committee. According to inclusive and exclusive criteria Participants will be screened. The procedure will be explained to the subject Prior written consent form from the participants will be obtained. Pre assessment value will be recorded before study is started.

The participants will be divided into two group 32 in each group. Participants were educated about the condition and procedure of the exercise will be explained in detail. Group A will receive sensory integration in weight bearing with sensory mat for 4 days in a week and Group B will receive sensory integration in non-weight bearing with stroking for 4 days in a week. Pre and post assessment with vibration perception threshold test was done for each participant of each group.

GROUP A: Will be receiving sensory integration in weight bearing with sensory mat. Setup:

parallel bar (adjusted to patient height)

Sensory mat with different textures

Stop watch

Patient position: General standing posture of patient in parallel bar.

Therapist position: Therapist stand behind the patient and assist during step initiation

Procedure: Warm up (5min)

Ankle movements (circular, pump)

Toe curls and spreads

Stretching (tibialis anterior, quadriceps, hamstring)

The patient should be positioned in parallel bar with their head facing forward, their shoulder relaxed and at equal level, hands lightly gripping the parallel bar, their feet should be kept within the shoulder line, knees are slightly flexed and equal weight distributed across both the legs And ask patient to walk for 15minutes on sensory mat with varying textures while maintaining their gait pattern.

Cool down(5min)

Breathing exercises

Relaxation

Group B: Will be receiving sensory integration in non-weight bearing with sensory stroking

Setup:

Various textures (cotton, fur net, Velcro, sandpaper, grass, silk, coir)

Patient position: supine (lying down) with legs extended and sitting.

Therapist position: Therapist stand or sit beside the patient

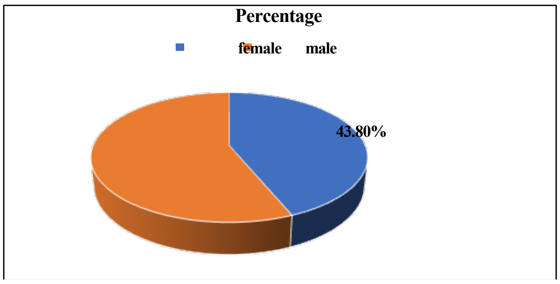
Procedure: The patient is positioned comfortably in a non -weight bearing posture, in supine with their limbs relaxed and accessible for stimulation. The patient and therapist are seated or standing next to each other. To provide sensory input, a variety of textured materials are used, such as cotton, Velcro, sand paper, silk, fur, net. A stroking technique is used to apply each texture with light to moderate pressure, moving from distal to proximal parts in a single direction. In each session, the therapist completes 3sets of 30repetations per texture over the targeted area, with the 30-60 seconds rest period in

RESULT

The comparative study of weight-bearing and non-weight-bearing sensory integration therapy revealed that vibration perception threshold improved more significantly in the weight-bearing group than in the non-weight-bearing group. However, both interventions demonstrated improvement in sensory function following the intervention period. These findings suggest that while weight-bearing sensory integration therapy is more effective in improving vibration perception threshold, both interventions provide beneficial effects in enhancing sensory function in patients with diabetic peripheral sensory neuropathy.

A. GENDER DISTRIBUTION

Table 1 presents the gender distribution of the total participants. Among the 64 participants, 36 were male and 28 were female.



Pie chart no:.1 Gender distribution

B. AGE WISE DISTRIBUTION

Table 2 presents the age-wise distribution of

C. Pre-Assessment Comparison of Diabetic Neuropathy Severity Between Group A and Group B

The Below graph and table illustrates the pre-assessment distribution of severity levels between Group A (weight-bearing sensory integration therapy) and Group B (non–weight-bearing sensory integration therapy) in patients with diabetic peripheral sensory neuropathy. At baseline, the **mild category** shows a slightly higher percentage in Group B (34.40%) compared to Group A (31.30%), indicating that more participants in the non–weight-bearing group had less severe symptoms initially. In the **moderate category**, Group A has a higher proportion (28.10%) than Group B (21.90%), suggesting a greater number of moderately affected individuals in the weight-bearing group. The **severe category** is equal in both groups (40.60%), demonstrating that a large and comparable proportion of participants in each group had severe neuropathy before intervention. In the **normal category**, Group A has no participants (0.00%),

Graph 1 illustrates the percentage distribution, showing that males are accounted for 56.30% of the total, while females comprised 43.80%.

GENDER DISTRIBUTION		
GENDER	**Frequency**	**Percentage**
female	28	43.80%
male	36	56.30%
Total	**64**	**100%**

Table No.1 Gender distribution

participants in **Group A** (**sensory integration in weight bearing with sensory mat.**) and **Group B** (**sensory integration in non-weight bearing with sensory stroking.**). The mean age of maximum and minimum participants mean age of 63.66 years (S.D 8.14).

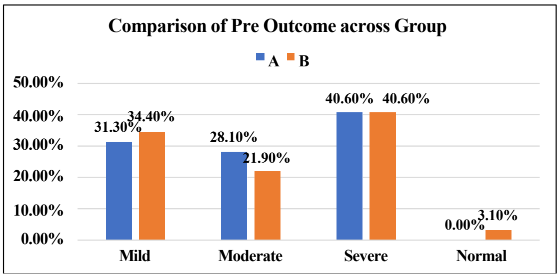
	Minimum	**Maximum**	**Mean**	**Std. Deviation**
AGE	52.00	80.00	63.66	8.14

Table No. 2 Age Distribution

while Group B has a small percentage (3.10%), indicating minimal baseline difference. Overall, both groups are fairly comparable before treatment, especially in the severe category, which supports the validity of comparing post-intervention outcomes to assess the effectiveness of weight-bearing versus non–weight-bearing sensory integration therapy.

Pre Outcome	**A**		**B**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Mild	10	31.30%	11	34.40%
Moderate	9	28.10%	7	21.90%
Severe	13	40.60%	13	40.60%
Normal	0	0.00%	1	3.10%
Total	**32**	**100%**	**32**	**100%**

Table No. 3 Pre-Assessment Comparison of Diabetic Neuropathy Severity Between Group A and Group B



Graph No.1 Pre-Assessment Comparison of Diabetic Neuropathy Severity Between Group A and Group B

D. Post Assessment Comparison of Diabetic Neuropathy Severity Between Group A and Group B In 2nd Week

The below graph and table illustrate the **post–2-week outcome comparison** of neuropathy severity

(31.30%), indicating that more participants in the non–weight-bearing group remained in the severe stage. Overall, the graph suggests that Group A experienced a more favourable shift from severe to mild and normal categories compared to Group B after two weeks, highlighting the greater effectiveness of weight-bearing sensory integration therapy in improving neuropathy severity in patients with diabetic foot.

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E. Post Assessment Comparison of Diabetic Neuropathy Severity Between Group A and Group B In 4th Week

The graph and table represents the post–4-week outcome comparison of neuropathy severity between Group A (weight-bearing sensory integration therapy) and Group B (non–weight-bearing sensory integration therapy) in patients with diabetic peripheral sensory neuropathy. After four weeks of intervention, the **mild category** shows a higher proportion in Group A (28.10%) compared to Group B (21.90%), indicating a greater shift toward milder symptoms in the weight-bearing group. In the **moderate category**, Group A (25.00%) is also higher than Group B (15.60%), suggesting better improvement in symptom severity among participants receiving weight-bearing therapy. Notably, in the **normal category**, Group A demonstrates a higher percentage (31.30%) compared to Group B (28.10%), reflecting a greater number of participants achieving normal sensory status after the intervention. Conversely, the **severe category** is considerably higher in Group B (34.40%) than in Group A (15.60%), indicating that

between Group A (weight-bearing sensory integration therapy) and Group B (non–weight-bearing sensory integration therapy) in patients with diabetic peripheral sensory neuropathy. After two weeks of intervention, in the **mild category**, Group A shows a higher proportion (34.40%) compared to Group B (31.30%), indicating a greater shift of participants toward milder symptoms in the weight-bearing group. In the **moderate category**, Group A (25.00%) also exceeds Group B (21.90%), suggesting relatively better improvement in symptom severity. In the **normal category**, Group A demonstrates a higher percentage (9.40%) than Group B (6.30%), reflecting a greater number of participants achieving normal sensory status following weight-bearing therapy. Conversely, in the **severe category**, Group B has a higher proportion (40.60%) compared to Group A

Post 2 Week Outcome	**A**		**B**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Mild	11	34.40%	10	31.30%
Moderate	8	25.00%	7	21.90%
Normal	3	9.40%	2	6.30%
Severe	10	31.30%	13	40.60%
Total	**32**	**100%**	**32**	**100%**

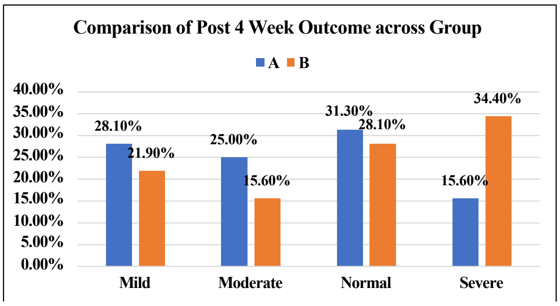
Table No. 4 Post-Assessment Comparison of Diabetic Neuropathy Severity Between Group A and Group B in 2nd week

Graph No.2 Post-Assessment Comparison of Diabetic Neuropathy Severity Between Group A and Group B in 2nd week

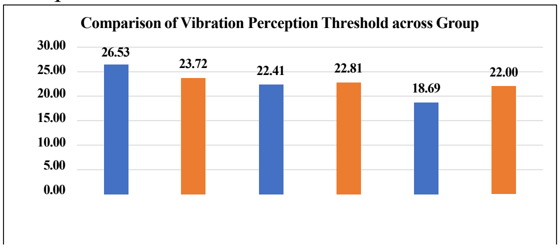
more participants in the non–weight-bearing group remained in the severe stage. Overall, the findings show a more pronounced improvement in Group A, with a clear shift from severe to mild and normal categories, highlighting the superior effectiveness of weight-bearing sensory integration therapy over non–weight-bearing therapy in reducing neuropathy severity in patients with diabetic foot over a four-week period.

Post 4 Week Outcome	**A**		**B**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Mild	9	28.10%	7	21.90%
Moderate	8	25.00%	5	15.60%
Normal	10	31.30%	9	28.10%
Severe	5	15.60%	11	34.40%
Total	**32**	**100%**	**32**	**100%**

Table No. 5 Post-Assessment Comparison of Diabetic Neuropathy Severity Between Group A and Group B in 4th week



Graph No. 3 Post-Assessment Comparison of Diabetic Neuropathy Severity Between Group A and Group B in 4th week



F. Comparison of Vibration Perception Threshold across Group (Right)

The below graph illustrates the comparison of vibration perception threshold (VPT) values between two groups—Group A (weight-bearing sensory integration therapy) and Group B (non–weight-bearing sensory integration therapy)—across three time points: pre-intervention, post 2 weeks, and post 4 weeks. At baseline (Pre Rx), Group A demonstrated a higher VPT value (26.53) compared to Group B (23.72), indicating relatively poorer vibration sensation in Group A at the start of the study. Following 2 weeks of intervention, both groups showed improvement, reflected by a reduction in VPT values; Group A decreased to 22.41, while Group B slightly reduced to 22.81. Notably, Group A exhibited a greater reduction compared to Group B, suggesting a more pronounced early response to weight-bearing therapy. By the end of 4 weeks, this trend became more evident, with Group A showing a substantial decrease in VPT to 18.69, whereas Group B reached 22.00. The larger decline in VPT values in Group A indicates a greater improvement in vibration perception, which reflects enhanced sensory function. Overall, the graph suggests that weight-bearing sensory integration therapy is more effective than non–weight-bearing therapy in improving vibration perception threshold in patients with diabetic peripheral neuropathy in the diabetic foot, with progressive improvements observed over time.

	Group	Mean	Std. Deviation	p-value
Pre Rt	A	26.53	8.13	0.138
	B	23.72	6.76	
Post 2 Week Rt	A	22.41	7.47	0.822
	B	22.81	6.89	
Post 4 Week Rt	A	18.69	6.72	0.063
	B	22.00	7.25	

Table No. 6 Comparison of Vibration Perception Threshold across Group (Right)

A **B** **Pre Rt**	**A** **B** **Post 2 Week Rt**	**A** **B** **Post 4 Week Rt**

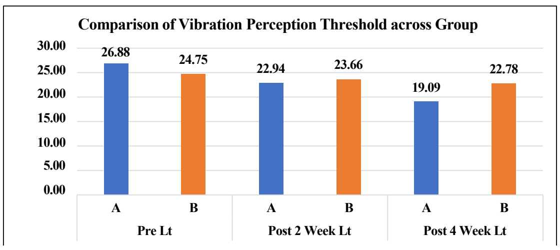
Graph No. 4 Comparison of Vibration Perception Threshold across Group(right)

E. Comparison of Vibration Perception Threshold across Group (Left)

The below graph presents the comparison of vibration perception threshold (VPT) for the left side between Group A (weight-bearing sensory integration therapy) and Group B (non–weight-bearing therapy) at three time points: pre-treatment, post 2 weeks, and post 4 weeks. At baseline (Pre Lt), Group A had a higher VPT value (26.88) compared to Group B (24.75), indicating relatively poorer vibration sensation in Group A. After 2 weeks of intervention, both groups showed improvement, with VPT decreasing to 22.94 in Group A and 23.66 in Group B, demonstrating a slightly greater improvement in the weight-bearing group. By 4 weeks, this difference became more pronounced, as Group A showed a further reduction in VPT to 19.09, while Group B decreased to 22.78. The greater decline in VPT values in Group A indicates better recovery of sensory function. Overall, the graph suggests that although both interventions are effective, weight-bearing sensory integration therapy leads to more significant improvement in vibration perception in patients with diabetic peripheral neuropathy affecting the diabetic foot over time.

	Group	Mean	Std. Deviation	p-value
Pre Lt	A	26.88	7.49	0.239
	B	24.75	6.81	
Post 2 Week Lt	A	22.94	7.04	0.678
	B	23.66	6.75	
Post 4 Week Lt	A	19.09	6.74	0.038*
	B	22.78	7.14	

Table No. 7 Comparison of Vibration Perception Threshold across Group (Left)



Graph No. 5 Comparison of Vibration Perception Threshold across Group (Left)

DISCUSSION

This study aims to compare the effectiveness of weight-bearing and non–weight-bearing sensory integration therapy on improving vibration perception threshold in patients with diabetic peripheral sensory neuropathy of the diabetic foot.

A total 64 subjects were recruited in the study divided into two groups 32 in each group. Group A will be receiving sensory integration in weight bearing with sensory mat and Group B will receive Will be receiving sensory integration in non-weight bearing with sensory stroking.

Evidence from previous studies indicates Diabetic peripheral neuropathy (DPN) is a common complication of diabetes mellitus, affecting nearly 50% of individuals with long-standing disease. The International Diabetes Federation reports that the increasing global prevalence of diabetes has led to a parallel rise in neuropathic complications. In India, the prevalence of DPN ranges from 20–30%, influenced by factors such as duration of diabetes and poor glycaemic control.

Additionally, previous research suggests that Diabetic peripheral neuropathy (DPN) shows slight variation between genders, with several studies reporting a higher prevalence in males, possibly due to greater exposure to risk factors such as smoking and poor glycaemic control. However, some studies indicate similar prevalence in both genders, with differences mainly in symptom presentation.

The study by R Sundareswaran 2022 highlights the importance of early assessment of diabetic peripheral neuropathy using Biothesiometry. The findings suggest that vibration perception threshold (VPT) is an effective and reliable tool for detecting sensory impairment and identifying patients at risk of developing diabetic foot complications. Increased VPT values were associated with greater severity of neuropathy. [8]

Another study conducted by Sankari Mansa Devi H, Vishnu Prasad R (2015) Diabetes mellitus leads to chronic hyperglycaemia, which causes microvascular damage and nerve dysfunction, resulting in diabetic peripheral neuropathy. The study highlights that sensory loss and reduced proprioception in the lower limbs increase the risk of balance impairment and foot complications. These findings support the need for early therapeutic interventions. Exercise plays an important role in improving circulation and neuromuscular function. Weight-bearing activities may enhance sensory input and functional ability, while non-weight-bearing exercises provide a safer alternative in severe cases. Thus, both approaches are beneficial, and their comparison is important for optimizing rehabilitation outcomes in diabetic neuropathy.

The study by Mueller (2015) demonstrated that both weight-bearing and non-weight-bearing exercise programs are effective in improving functional outcomes in individuals with diabetic peripheral neuropathy. However, weight-bearing exercises showed greater improvements in walking ability, balance, and overall physical function. This may be due to increased proprioceptive input and functional loading of the lower limbs during weight-bearing activities. Non-weight-bearing exercises, while beneficial in improving muscle strength and cardiovascular fitness, provide less sensory stimulation compared to weight-bearing activities. However, they remain a safer option for patients with severe neuropathy or high risk of foot complications. These findings support the present study, suggesting that weight-bearing sensory integration therapy may lead to superior functional improvements, while non-weight-bearing therapy serves as an effective alternative. Therefore, selecting an appropriate intervention should be based on patient condition and risk factors to achieve optimal rehabilitation outcomes.

The study by Suraj B. Kanase (2023) emphasizes the impact of diabetic peripheral neuropathy on sensory and motor functions, particularly affecting balance and functional mobility. It highlights that impaired sensation and reduced proprioception in the lower limbs increase the risk of instability and foot complications. The study supports the role of therapeutic interventions in improving sensory integration and functional performance. Exercise-based rehabilitation was found to enhance circulation, muscle strength, and neuromuscular coordination. These findings justify the use of both weight-bearing and non-weight-bearing sensory integration therapies, as they contribute to improving overall functional outcomes in patients with diabetic neuropathy.

In Previous literature by Michael J. Mueller and Lori J. Tuttle (2015) highlights the effectiveness of structured exercise programs in individuals with diabetic peripheral neuropathy. The findings indicate that both weight-bearing and non-weight-bearing exercises improve functional capacity, muscle strength, and overall mobility. However, greater improvements were observed with weight-bearing exercises, likely due to enhanced proprioceptive input and functional loading of the lower extremities. Non-weight-bearing exercises, although beneficial for improving strength and cardiovascular fitness, provide comparatively less sensory stimulation. They are particularly useful for patients with higher risk of foot injury or severe neuropathy. The study supports the importance of incorporating exercise therapy in rehabilitation and suggests that weight-bearing interventions may offer superior functional benefits, while non-weight-bearing exercises serve as a safe and effective alternative based on patient condition.

The result shows the comparison of vibration perception threshold (VPT) of the left side between Group A and Group B at pre-intervention, 2 weeks, and 4 weeks. At baseline, Group A had a higher VPT (26.88) compared to Group B (24.75), indicating greater sensory impairment initially.

After 2 weeks of intervention, both groups showed improvement, with VPT values decreasing to 22.94 in Group A and 23.66 in Group B. This reduction suggests that both weight-bearing and non-weight-bearing sensory integration therapies were effective in improving vibration perception.

At 4 weeks, further improvement was observed in both groups; however, Group A showed a greater reduction (19.09) compared to Group B (22.78). This indicates that Group A demonstrated more significant improvement over time.

The greater improvement in Group A may be attributed to the effects of weight-bearing activities, which enhance proprioceptive input, stimulate plantar mechanoreceptors, and improve neuromuscular coordination. Although Group B also showed improvement, the comparatively lesser change suggests that non-weight-bearing exercises provide limited sensory stimulation. Overall, the findings indicate that both interventions are beneficial, but weight-bearing sensory integration therapy appears to be more effective in improving vibration perception in patients with diabetic peripheral neuropathy.

The graph illustrates the comparison of vibration perception threshold (VPT) of the right side between Group A and Group B at pre-intervention, 2 weeks, and 4 weeks. At baseline, Group A had a higher VPT (26.53) compared to Group B (23.72), indicating greater sensory impairment on the right side initially.

After 2 weeks of intervention, both groups showed improvement, with VPT values decreasing to 22.41 in Group A and 22.81 in Group B. This reduction reflects the positive effect of both interventions on sensory function.

At 4 weeks, further improvement was observed, with Group A showing a greater reduction in VPT (18.69) compared to Group B (22.00). This indicates that Group A experienced more significant improvement on the right side over time.

The greater reduction in Group A suggests that weight-bearing sensory integration therapy is more effective in improving vibration perception on the right side, likely due to enhanced proprioceptive input and functional loading. Although Group B also improved, the comparatively smaller change indicates that non-weight-bearing therapy provides limited sensory stimulation.

Overall, both interventions are beneficial, but weight-bearing therapy appears to be more effective in improving right-side sensory function in patients with diabetic peripheral neuropathy.

The result of both graphs show the changes in vibration perception threshold (VPT) on both the left and right sides at three time points: pre-intervention, 2 weeks, and 4 weeks, for Group A and Group B. At baseline, Group A had higher VPT values on both sides compared to Group B, which indicates that participants in Group A had more severe sensory loss at the beginning of the study. This difference highlights the initial variation in sensory impairment between the two groups.

After the intervention, both groups showed a gradual reduction in VPT values at 2 weeks and further improvement at 4 weeks. This decrease in VPT suggests an improvement in vibration sensation and overall sensory function in both groups. The continuous improvement over time

indicates that both weight-bearing and non-weight-bearing sensory integration therapies are effective in managing sensory deficits associated with diabetic peripheral neuropathy.

However, when comparing the two groups, Group A showed a greater reduction in VPT values on both the left and right sides at each follow-up. By the end of 4 weeks, the difference between the groups became more noticeable, with Group A demonstrating a larger improvement in vibration perception. This indicates that the intervention used in Group A was more effective in restoring sensory function.

The better results seen in Group A may be due to the nature of weight-bearing activities. These activities involve direct contact of the feet with the ground, which increases sensory input from the plantar surface. This helps in stimulating sensory receptors, improving awareness of joint position, and enhancing coordination of movements. Regular loading of the lower limbs during weight-bearing exercises may also help improve circulation and nerve function, which can contribute to better sensory recovery.

On the other hand, Group B, which performed non-weight-bearing exercises, also showed improvement in VPT values, but the changes were smaller. These exercises are useful in improving muscle strength and are safer for patients who have a higher risk of foot injury or severe neuropathy. However, since they do not involve direct loading of the feet, the level of sensory stimulation is comparatively less, which may explain the slower improvement in sensory function.

Another important observation is that improvement was seen on both the left and right sides in a similar pattern. This shows that the effects of the interventions were consistent and not limited to one side of the body. It also supports the reliability of the treatment approach used in the study.

Overall, the findings suggest that both weight-bearing and non-weight-bearing sensory integration therapies are helpful in improving vibration perception in patients with diabetic peripheral neuropathy. However, weight-bearing therapy appears to be more effective in producing greater and faster improvement in sensory function. Therefore, it can be considered a better approach for enhancing sensory recovery, while non-weight-bearing therapy can be used as a supportive or alternative option based on the patient's condition and safety.

CONCLUSION

The findings showed a significant improvement in vibration perception threshold post-intervention in both groups, indicating enhanced sensory function. However, when comparing both the interventions, the weight-bearing sensory integration therapy demonstrated greater effectiveness in improving vibration perception threshold values, suggesting its superiority in enhancing sensory re-education and neural adaptation in individuals with diabetic peripheral sensory neuropathy.

Both interventions were effective in improving sensory function; however, weight-bearing sensory integration therapy proved to be more beneficial in improving vibration perception threshold. These findings highlight the importance of sensory integration therapy in rehabilitation and suggest that weight-bearing sensory integration therapy is a preferred approach for improving sensory outcomes in patients with diabetic peripheral sensory neuropathy.

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