CASE REPORT

Vibration Perception Threshold Changes Following Integrated Care for Diabetic Peripheral Neuropathy: A Case Report.

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ABSTRACT

Diabetic peripheral neuropathy (DPN) is a common microvascular complication of diabetes mellitus characterized by sensory loss, pain, and foot ulceration. This case report evaluates longitudinal changes in vibration perception threshold (VPT) and glycaemic parameters in a 65-year-old man with long-standing type 2 diabetes mellitus presenting with bilateral lower extremity pain and plantar burning sensations. At baseline, HbA1c was 9.8%, and biothesiometry measured VPT values of 32.48 V (right) and 30.12 V (left), classified as severe impairment, alongside preserved 10-gram monofilament responses. The patient received a one-month programme of dietary glycaemic management, supervised warm water foot immersion, and plantar acupressure. At one month, VPT decreased to 24.35 V and 23.33 V in the right and left feet, respectively, and remained in the moderate range at subsequent assessments. HbA1c was 8.2% at final follow-up. These findings suggest a temporal correlation between the integrated protocol and objective improvements in neuropathy metrics.

Key words: Diabetic Neuropathies, Sensory Thresholds, Vibration.

Diabetic peripheral neuropathy (DPN) is a common microvascular complication of diabetes mellitus manifesting symmetrically as distal sensory loss, burning paresthesia, and sharp neuropathic pain that severely diminishes patient quality of life [1]. Left unmanaged, the progressive loss of protective tactile and vibratory sensation significantly increases the risk of diabetic foot ulceration, soft tissue infection, and lower extremity amputation [2]. Management of DPN includes optimisation of glycaemic and cardiovascular risk factors, regular foot surveillance, patient education, and neuropathic pharmacotherapy, though these provide only partial symptomatic relief and fail to reverse the structural nerve damage. Consequently, various complementary and integrative modalities such as specialized foot baths, structured hydrotherapy, and traditional acupoint stimulation are increasingly explored as adjunctive therapies to ameliorate ischemic and neuropathic symptoms [3] and help to improve sensory and motor nerve conduction velocity [4]. This case report documents the changes in the biothesiometry-derived vibration perception threshold, microvascular perfusion parameters, and glycemic shifts in a patient with long-standing type 2 diabetes with DPN undergoing a structured integrated care programme over a 4.5-month observation.

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CASE PRESENTATION

Patient information

A 65-year-old man with long-standing type 2 diabetes mellitus (>10 years) presented on 1 April 2025 with persistent lower - extremity pain and a bilateral burning sensation on the soles of both feet lasting for the preceding six months. He had discontinued an Ayurvedic formulation two years prior, and he had not taken any standard allopathic antidiabetic medications. He was managing his condition solely via dietary modifications and had received no prior targeted therapy for neuropathic pain. Renal evaluation showed a serum creatinine of 0.92 mg/dL, eGFR of 62.68 mL/min, and urinary albumin excretion of 10.2 mg/L. The patient provided written informed consent for publication of this case report, including all pre- and post-intervention imaging reports.

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Baseline vital signs and systemic examination are summarised in Table 1.

Table 1. Baseline demographics, vitals, and systemic examination

Parameter	Finding
Age/gender	65 years/Male
Height/weight/BMI	172cm/75 kg/25.3 kg/m2
Blood pressure	130/80 mm Hg
Heart rate	78 bpm
Respiratory rate/temperature	16 cycles/min/98.4˚F
Cardiovascular system	S1, S2 heard; no murmurs
Respiratory system	Clear, bilateral vesicular breath sounds heard
Abdomen	Soft, non-tender, no organomegaly
Central nervous system	Motor function intact; deep tendon reflexes sluggish bilaterally

Diagnostic assessment

The clinical diagnosis of DPN was made based on the patient's chronic hyperglycemic history, symmetrical distal burning pain, and quantitative biothesiometry testing. The Vibrometer Dx device reference criteria categorize VPT values below 15 V as normal, 15 to 25 V as mild-to-moderate sensory impairment, and values exceeding 25 V as severe sensory impairment. Baseline assessment included an HbA1c of 9.8%; digital biothesiometry revealed severe impairment, with bilateral averages of 32.48 V (right) and 30.12 V (left) (Figure 1).

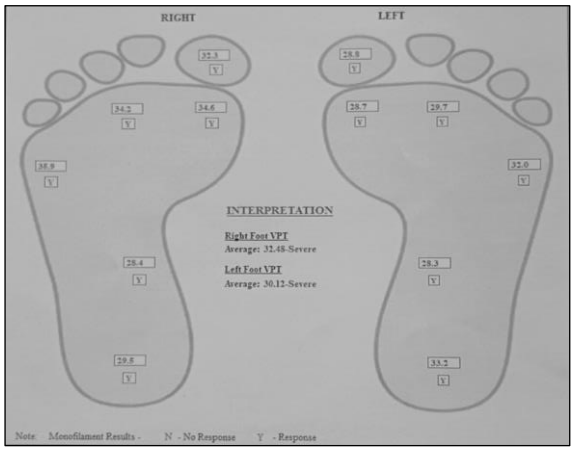


Figure 1. Vibration perception threshold (VPT) and 10-G monofilament test at baseline (01 April 2025)

Baseline biothesiometry report demonstrating severe bilateral vibration sensory loss, with an average VPT of 32.48 V in the right foot and 30.12 V in the left foot response of the 10-g Semmes-Weinstein monofilament is intact across all plantar sites bilaterally ('Y') Protective touch perception remained intact, as responses to the 10-g Semmes-Weinstein monofilament were preserved across all tested sites. Baseline photoplethysmography (PPG) demonstrated adequate peripheral microvascular perfusion with normal triphasic waveform. Great toe peak-to-peak pulse amplitudes were 5.0 m V/V on the right (HR:81 BPM) and 5.1 mV/V on the left (HR:74 BPM), with pedal digit amplitudes ranging between 7.4 and 12.7 m V/V bilaterally (Figure 2).

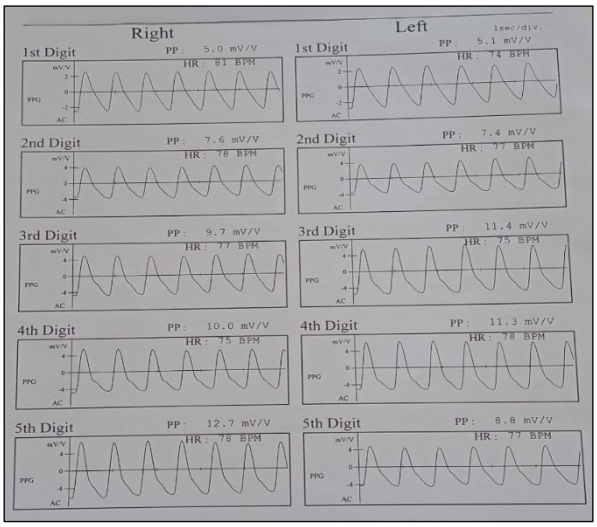


Figure 2. PPG Toe perfusion tracing at baseline (01 April 2025)

Baseline PPG tracing across digits 1-5 bilaterally showing well-defined, triphasic pulsatile waveform.

THERAPEUTIC INTERVENTION

The intervention lasted 1 month and included assessments at 1, 3, and 4.5 months after baseline, consisting of dietary glycaemic management, warm-water foot immersion, and plantar/regional acupressure. Dietary management was self-administered at home for 1 month. Recommendations included low-glycaemic index foods, high-fibre foods, complex carbohydrates and lean protein, portion control and avoidance of foods causing excessive postprandial glycaemic elevation. The patient was instructed to maintain these habits throughout the study period. Warm-water foot immersion was administered in- hospital under supervision, three times weekly for 1 month. Each session consisted of 10 minutes of immersion at 35˚C to minimize thermal injury risk. Feet were dried carefully post-immersion, particularly interdigital spaces, to maintain skin integrity (Table 2).

Acupressure was subsequently administered by an experienced acupuncturist. Interventions were performed bilaterally at Zusanli (ST 36), Taixi (KI3), Sanyinjiao (SP6), Taichong (LR3), and Baxie/Ba Feng (EX-LE10). ST 36, KI3, and SP6 received firm or gentle-to-firm pressure for 1-2 minutes per side; LR3 received direct pressure for 1-2 minutes per foot, and interdigital Baxie/Bas Feng points were stimulated for 30 seconds per web space (Table 3).

Table 2. Integrated care protocol

Intervention	Procedure
Warm water foot immersion	Immerse both feet in warm water at 35˚C for 10 mins.
Dietary management	Low-glycaemic index meals, high-fibre complex carbohydrates and lean proteins.
Foot care	Dry between toes after immersion.

Table 3. Acupressure protocol

ACUPOINT	LOCATION	APPLICATION
Zusanli (ST 36)	3 CUN below the patella, lateral to the tibial crest.	Firm circular thumb pressure,1-2 min/leg
Taixi (KI3)	Depression between the medial malleolus and Achilles tendon	Firm steady pressure,1-2 min/leg
Sanyinjiao (SP6)	3 CUN above the medial malleolus, posterior to the tibia	Gentle to firm pressure,1-2 min/leg
Taichong (LR3)	Dorsum of foot, between the first and second toes	Direct pressure,1-2 min/foot
Ba Feng (EX-LE10)	Interdigital web spaces of the feet	Pressure 30 sec per web space

FOLLOW-UP AND OUTCOMES

Following the 1-month active intervention, follow-up evaluations were conducted at 1, 3, and 4,5 months (final follow-up on August 15, 2025). Digital biothesiometry demonstrated an objective decrease in VPT values into the moderate impairment range (24.35 V right 23.33 V left at 1 month (Figure 3); 24.73 V right, 23.57 V left at 3 months (Figure 5); and 24.67 V right, 22.72 V left at final follow-up) (Figure 7). Glycemic control improved, with HbA1c dropping by 1.6% from 9.8% to 8.2%. Renal laboratory parameters showed an increase in eGFR from 62.68 to 85.34 mL/min and a decrease in serum creatinine from 0.92 to 0.84 mg/d L, while urinary albumin excretion exhibited an upward shift from 10.2 to 21.9 mg/L, representing a biomarker change that requires continued clinical monitoring. Protective touch perception via 10-g monofilament testing remained preserved bilaterally throughout the monitoring period. Clinical timeline data are structured in Table 4.

Biothesiometry report following the 1-month integrated intervention showing a reduction in VPT to an average of 24.35 V in the right foot and 23.33 V in the left foot. Device classified improved from severe to moderate sensory loss.10-g monofilament perception remains fully preserved bilaterally ('Y') (Figure 3).

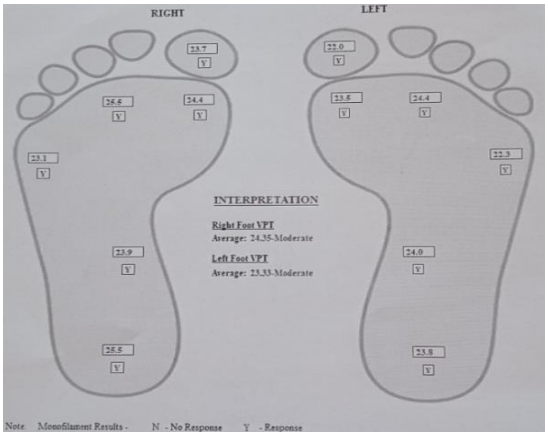


Figure 3. Post-intervention assessment: VPT and 10-G monofilament test at 1 month (01 May 202

Table 4. Clinical and laboratory timeline

Clinical Phase	HbA1c	Right VPT (V)	Left VPT (V)	10-g Monofilament	Right 1st digit PPG	Left 1st digit PPG	Renal Parameters (eGFR / Cr / Urine Alb)
Baseline 01 Apr 2025	9.8%	32.48 (Severe)	30.12 (Severe)	Response present	5.0 mV/V	5.1 mV/V	62.68 mL/min / 0.92 mg/dL / 10.2 mg/L
1-Month Assessment 01 May 2025 *(Post-Intervention)*	Not reported	24.35 (moderate)	23.33 (moderate)	Response present	3.7 mV/V	3.7 mV/V	Not reported
3-Month Assessment 09 Jul 2025	Not reported	24.73 (moderate)	23.57 (moderate)	Response present	3.3 mV/V	3.8 mV/V	Not reported
Final Follow-Up 15 Aug 2025	8.2%	24.67 (moderate)	22.72 (moderate)	Response present	1.8 mV/V	1.8 mV/V	85.34 mL/min / 0.84 mg/dL / 21.9 mg/L

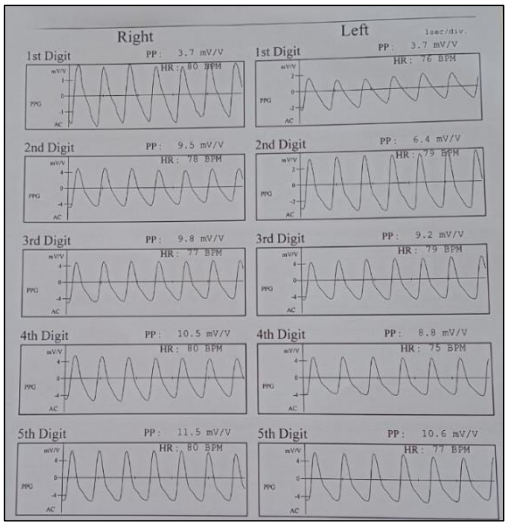


Figure 4. PPG toe perfusion tracing at 1-month assessment (01 May 2025)

Follow -up PPG tracing showing preserved pulsatile contours across all digits. Great toe (1st digit) peak-to-peak pulse amplitude is 3.7 m V/V bilaterally (Right HR: 80 BPM; Left HR: 76BPM)



Figure 5. VPT and 10-g monofilament test at 3- month assessment (09 July 2025)

Intermediate follow-up biothesiometry report demonstrating sustained improvement in vibration perception, with an average VPT of 24.73 V in the right foot and 23.57 V in the left foot. Device interpretation remains categorised as moderate sensory loss, with preserved 10-g monofilament responses bilaterally (Figure 5).

PPG tracing at 3 months confirming intact microvascular perfusion. Great toe (1st digit) peak-to-peak pulse amplitude measures 3.3 m V/V on the right (HR:72 BPM) and 3.8 m V/V on the left (HR:76 BPM), with normal pulsatile contours maintained across pedal digits 2-5.

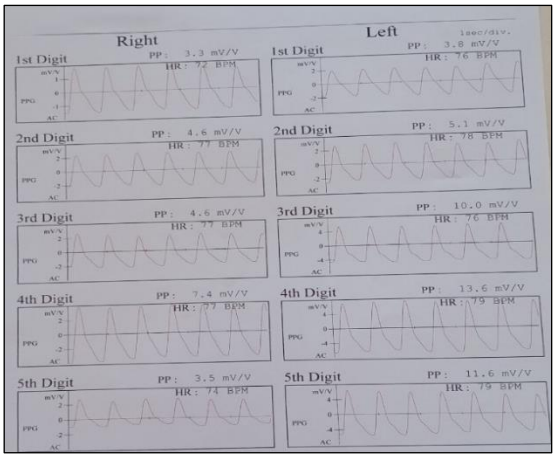


Figure 6. PPG toe perfusion tracings at 3-month assessment (09 July 2025)

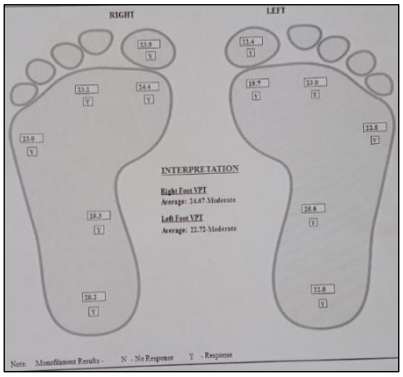


Figure 7. VPT and 10-g monofilament test at final follow - up (15 August 2025)

Final biothesiometry report at approximately 4.5 months after baseline, with an average VPT of 24.67 V in the right foot and 22.72 V in the left foot. Device classification remains stable at moderate sensory loss, with persistent 10-g monofilament perception ('Y') (Figure 7).

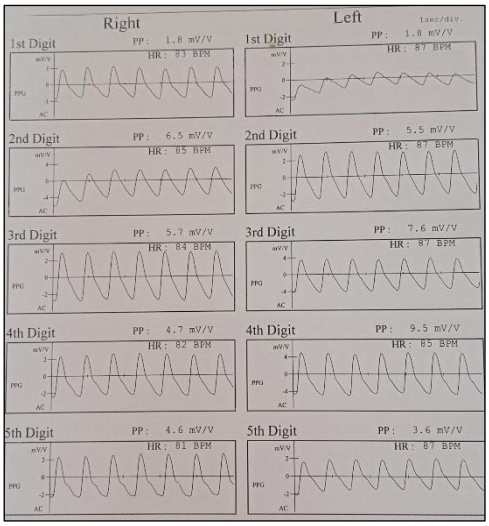


Figure 8. PPG toe perfusion tracing at final follow-up (15 August 2025)

Final PPG tracing at 4.5 months confirming stable peripheral microvascular flow without evidence of ischemia or severe waveform dampening. Great toe (1st digit) peak-to-peak pulse amplitude is 1.8 m V/V bilaterally (Right HR:83 BPM; Left HR:87 BPM)

DISCUSSION

This case showed reduction in device-reported VPT after a one-month programme combining dietary glycaemic advice, supervised warm-water foot immersion and plantar acupressure, with the lower VPT values persisting through approximately 4.5 months in a patient with DPN. HbA1c lowered at the final assessment, while monofilament responses remained preserved.

These findings align with emerging clinical trials evaluating complementary therapies for diabetic neuropathy. Previous systematic reviews report that acupuncture and acupoint massage modalities can alleviate neuropathic pain symptoms and improve nerve conduction velocity parameters, characterised by low methodological certainty across trials [5]. Similarly, localized warm-water hydrotherapy protocols have demonstrated short-term efficacy in improving local circulation and reducing neuropathic discomfort [3]. Randomised trials support reductions in pain or symptom severity through acupuncture, acupressure, auricular acupressure, reflexology, and foot baths, and glycemic control has a modest effect on DPN progression [6]. Randomised trials of warm salt water foot baths evaluated symptom outcomes [7]. Evidence for direct glucose-lowering effects from acupuncture or foot baths remains mixed across the literature [8], while previous studies varied widely in session length and frequency [9], many focused primarily on subjective pain scales.

Although this case report acts as reliable evidence since the study has used instrument-based biothesiometry, microvascular PPG, and renal markers, it has many limitations, including its single-patient scope, lack of a parallel control group, and potential confounding variables from lifestyle shifts. Further randomised controlled trials incorporating long-term blinding and comprehensive nerve conduction studies are required to validate these integrative clinical protocols.

CONCLUSION

This case report demonstrates a temporal association between a 1-month integrated intervention of dietary glycaemic management, warm water foot immersion, and targeted acupressure, and sustained objective improvements in vibration perception threshold over 4.5 months for a patient with DPN.

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