Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 9 (2025): September 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i9.2047
Original Article

Clinical and electrophysiological profiles of patients with diabetic peripheral neuropathy: A cross-sectional study of 50 patients.

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Abstract

Background:

Diabetic peripheral neuropathy (DPN) is a prevalent complication of type 2 diabetes mellitus, often presenting with sensory and motor deficits. This study aimed to characterize the clinical and electrophysiological profiles of patients with DPN and explore correlations between symptom severity and nerve conduction parameters.

Methods:

A cross-sectional study was conducted at the Neurology Outpatient Department of a tertiary care centre of Eastern India. Fifty patients with type 2 diabetes and clinical signs of peripheral neuropathy were enrolled. The Neuropathy Disability Score (NDS) was used for clinical grading. Nerve conduction studies (NCS) of the peroneal, tibial, and sural nerves were performed.

Results:

Sensory symptoms were predominant (84%), with sensorimotor involvement in 16%. Patients with higher NDS scores showed significantly reduced sural SNAP and peroneal CMAP amplitudes. A strong inverse correlation was observed between NDS and sural SNAP amplitude ($r = –0.68$, $p < 0.001$) and peroneal conduction velocity ($r = –0.55$, $p = 0.002$). Sural nerve abnormalities were present in 90% of patients.

Conclusion:

Electrophysiological parameters, particularly sural SNAP amplitude, correlate strongly with clinical severity in DPN. Combined use of NDS and NCS enhances early detection and stratification of neuropathy severity.

Recommendations

Adopt Combined Screening Protocols: Integrate NDS scoring with targeted NCS, especially sural SNAP amplitude, as a routine diagnostic approach in diabetic clinics. This dual assessment can improve early detection and stratification of DPN severity.

Keywords: *diabetic peripheral neuropathy, nerve conduction studies, clinical profile, type 2 diabetes, Neuropathy Disability Score.*
Submitted: *2025-07-10* ***Accepted:*** *2025-08-20* ***Published:*** *2025-09-20*

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Introduction

Nearly half of patients with prolonged diabetes experience peripheral neuropathy, which significantly impacts quality of life, leading to pain, numbness, and ulceration risk [1,2]. Early identification of neuropathic changes is crucial to implementing preventive strategies.

While clinical scoring systems provide subjective severity grading, nerve conduction studies offer objective quantification of large-fiber dysfunction [3]. Integrating both approaches may enhance patient stratification and management. This study investigates the relationship between clinical severity and electrophysiological parameters in a group of 50 patients with type 2 diabetes.

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Methods

Study Design

This was a cross-sectional observational study.

Study Setting

The study was conducted at the Neurology Clinic of a tertiary care centre in Eastern India.

Study Period

January 1 to April 30, 2025.

Participants

Patients were recruited consecutively from outpatient services. Inclusion criteria: age 30–75 years, type 2 diabetes with clinical signs of peripheral neuropathy, and stable glycaemic control for ≥3 months. Exclusion criteria: other causes of neuropathy, limb trauma, or surgery, or severe organ dysfunction.

Sample Size

A sample size of 50 was calculated based on previous prevalence estimates of DPN and expected correlation strength ($r > 0.5$) between NDS and NCS parameters, with 80% power and $\alpha = 0.05$.

Selection bias was reduced by consecutive sampling. Measurement bias was minimized by standardized NCS protocols and blinded scoring of NDS.

Data Analysis

Descriptive statistics were used for demographic and clinical variables. Pearson's correlation assessed relationships between NDS and NCS parameters. Missing data were handled using pairwise deletion.

Ethical Considerations

Approved by the Institutional Ethics Committee of Kalinga Institute of Medical Sciences. Written informed consent was obtained from all participants.

Participant Flow

- Screened: 65
- Eligible: 55
- Enrolled: 50
- Analysed: 50

Reasons for exclusion: 5 declined consent, 10 had alternative neuropathy aetiologies.

- Inclusion criteria:
  1. Age 30–75 years
  2. Clinical signs or symptoms suggestive of peripheral neuropathy
  3. Stable glycemic control for at least 3 months
- Exclusion criteria:
  1. Other causes of neuropathy (e.g., alcohol, vitamin B12 deficiency)
  2. History of lower-limb trauma or surgery
  3. Severe renal or hepatic dysfunction

Clinical Evaluation

- Demographics: age, sex, diabetes duration
- Neuropathy Disability Score (NDS): assessment of reflexes, vibration, pinprick, and ankle reflexes [4].
- Symptom assessment: burning, tingling, numbness

Electrophysiological Assessment

- Motor NCS: peroneal and tibial nerves
- Sensory NCS: sural nerve
- Parameters recorded:
  - Distal latency (ms)
  - Conduction velocity (m/s)
  - Compound muscle action potential (CMAP) amplitude (mV)
  - Sensory nerve action potential (SNAP) amplitude (μV)

All studies were performed using a standardized protocol at skin temperature 32–34 °C.

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Results

Demographic and Clinical Characteristics

TABLE 1- Patient Characteristics Summary (n = 50)

Characteristic	Value
Age (mean ± SD)	56.4 ± 8.7 years
Gender Ratio (Male: Female)	28: 22
Duration of Diabetes (median, IQR)	12 years (IQR: 8–16)
Neuropathy Disability Score (NDS)	5.7 ± 2.3
Symptom Profile	
• Sensory only	42 patients (84%)
• Sensorimotor	8 patients (16%)

TABLE-2 Nerve Conduction Study Parameters

Nerve	Parameter	Mean ± SD	Reference Range
Peroneal	Distal latency (ms)	5.1 ± 1.2	3.5 – 5.0
	Conduction velocity (m/s)	41.2 ± 6.5	45 – 55
	CMAP amplitude (mV)	3.8 ± 1.1	4.0 – 8.0
Tibial	Distal latency (ms)	6.2 ± 1.4	4.0 – 6.0
	Conduction velocity (m/s)	38.5 ± 7.2	40 – 50
	CMAP amplitude (mV)	5.2 ± 1.3	5.0 – 12.0
Sural	SNAP amplitude (μV)	4.5 ± 1.7	6.0 – 20.0
	Conduction velocity (m/s)	38.9 ± 5.9	40 – 48

Table 3: Distribution of NDS Scores

NDS Score Range	Number of Patients	Percentage (%)
0–3 (Mild)	12	24%
4–6 (Moderate)	26	52%
>6 (Severe)	12	24%

Table 4: Abnormal NCS Findings by Nerve

Nerve	Patients with Abnormal Values	Percentage (%)
Peroneal	35	70%
Tibial	38	76%
Sural	45	90%

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Table 5: Symptom Type vs. NCS Abnormality

Symptom Type	Avg. SNAP Amplitude (µV)	Avg. CMAP Amplitude (mV)
Sensory only	4.8 ± 1.5	4.1 ± 1.2
Sensorimotor	3.2 ± 1.1	3.5 ± 1.0

The study reveals a strong alignment between clinical severity measured by the Neuropathy Disability Score (NDS) and abnormalities in nerve conduction studies (NCS) Patients with sensory-only symptoms (84%) had relatively higher sural SNAP and peroneal CMAP amplitudes. Those with sensorimotor symptoms (16%) showed significantly reduced amplitudes, indicating more advanced nerve damage.

NDS Correlation: A strong inverse correlation was found between NDS and sural SNAP amplitude ($r = –0.68$, $p < 0.001$), suggesting that as clinical severity increases, sensory nerve function deteriorates. Peroneal conduction velocity also showed a negative correlation with NDS ($r = –0.55$, $p = 0.002$), reinforcing the link between motor deficits and clinical grading.

Severity Stratification: Patients with NDS ≥ 6 (severe neuropathy) consistently exhibited lower CMAP and SNAP amplitudes across all nerves tested.

The sural nerve was the most frequently affected (90% of patients), making it a sensitive marker for early detection.

Discussion

This study aimed to characterize the clinical and electrophysiological profiles of patients with diabetic peripheral neuropathy (DPN) and examine correlations between symptom severity and nerve conduction parameters.

The key findings include Predominance of sensory symptoms: 84% of patients presented with sensory-only complaints, while 16% had sensorimotor involvement. Strong correlation between clinical severity and electrophysiological impairment: Higher Neuropathy Disability Scores (NDS) were significantly associated with reduced sural SNAP amplitude ($r = –0.68$, $p < 0.001$) and peroneal conduction velocity ($r = –0.55$, $p = 0.002$). Sural nerve as a sensitive marker: Abnormalities in sural nerve conduction were observed in 90% of patients, making it the most frequently affected nerve. Severity stratification: Patients with severe neuropathy (NDS > 6) consistently exhibited lower CMAP and SNAP amplitudes across all nerves tested. These results support the study's objective of validating the combined use of clinical scoring and nerve conduction studies for stratifying DPN severity.

Interpretation

The findings suggest that electrophysiological parameters, particularly sural SNAP amplitude, are reliable indicators of clinical severity in DPN. The strong inverse correlations with NDS reinforce the utility of integrating objective nerve conduction metrics with clinical grading tools.

However, interpretation should remain cautious due to the cross-sectional nature of the study, which limits causal inference. The single-centre design may also restrict generalizability to broader populations.

When compared with prior literature, Studies by Malik et al. and Tesfaye et al. similarly highlight early involvement of sensory fibres, particularly the sural nerve, in diabetic neuropathy progression. (5)

- The observed correlation between NDS and NCS parameters aligns with findings from Feldman et al., who emphasized the role of electrophysiological testing in staging neuropathy and guiding treatment. (6)
- Unlike some earlier studies that focused primarily on motor deficits, this study underscores the predominance and diagnostic value of sensory abnormalities in early DPN.

Overall, the results advocate for a dual-assessment approach, clinical and electrophysiological, to enhance early detection and personalized management of diabetic neuropathy.

These study findings align with prior reports that sensory fibres are affected earlier and more severely in diabetic neuropathy. Integrating NCS into routine evaluation may facilitate the timely initiation of glycemic optimization and neuroprotective therapies.

Generalizability

Results apply to similar tertiary care settings but may vary in community populations. Multicentre studies are needed for broader applicability.

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Conclusion

In patients with diabetic peripheral neuropathy, nerve conduction studies provide objective measurements that correlate with clinical severity. Sural SNAP amplitude is a particularly valuable marker. Implementing a combined clinical and electrophysiological assessment can improve the stratification and management of DPN.

Limitations

- Cross-sectional design limits causal inference
- Single-centre recruitment may affect generalizability
- Lack of longitudinal follow-up

Recommendations

To enhance the clinical utility and impact of this research, the following recommendations are proposed:

- Adopt Combined Screening Protocols: Integrate NDS scoring with targeted NCS, especially sural SNAP amplitude, as a routine diagnostic approach in diabetic clinics. This dual assessment can improve early detection and stratification of DPN severity.
- Longitudinal Follow-Up: Future studies should track patients over time to evaluate progression and response to interventions, providing dynamic insights into disease trajectory.
- Expand Sample Diversity: Include patients from multiple centres and varied demographic backgrounds to improve generalizability and uncover potential regional or genetic influences.
- Therapeutic Implications: Use electrophysiological markers to guide personalized treatment plans, such as neuroprotective agents or intensified glycemic control for patients with early NCS changes.

Acknowledgements

We thank all participants for their cooperation.

List of Abbreviations

- DPN: Diabetic Peripheral Neuropathy
- NDS: Neuropathy Disability Score
- NCS: Nerve Conduction Studies
- SNAP: Sensory Nerve Action Potential
- CMAP: Compound Muscle Action Potential

Source of Funding

No external funding was received for this study.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

- Study design: Dr Pragateshnu Das
- Data collection: Dr Rajalaxmi Satapathy
- Analysis: Dr Rajalaxmi Satapathy, Dr Prerana Dash
- Manuscript drafting: Dr Prerana Dash
- Review and editing: All authors

Data Availability

Data supporting the findings are available from the corresponding author upon reasonable request.

Author Biographies

Dr Rajalaxmi Satapathy- MBBS, MD Medicine, DM NEUROLOGY
Area of interest -Headache, Demyelinating disorders
Dr Prerana Dash, MBBS, MD Medicine, DM Neurology
Interest-movement disorder, stroke
Dr Pragateshnu Das- MBBS, MD Medicine, DM NEUROLOGY
Interest-Parkinson's disease, a neuromuscular disorder

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PUBLISHER DETAILS.

Student's Journal of Health Research (SJHR)
(ISSN 2709-9997) Online
(ISSN 3006-1059) Print
Category: Non-Governmental & Non-profit Organization
Email: studentsjournal2020@gmail.com
WhatsApp: +256 775 434 261
Location: Scholar's Summit Nakigalala, P. O. Box 701432, Entebbe Uganda, East Africa