

## Assessment and Treatment of Balance and Falls in Diabetic Peripheral Neuropathy: An Evidence-Informed Update

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### Abstract

**Background:** Balance is an integrated function of visual, vestibular and somatosensory systems in the human body which helps the body and its parts to be energy efficient in their static and dynamic postures both at rest and during activity. **Purpose:** The objective of this review was to provide an overview of evidence for balance dysfunction and balance interventions for people with Diabetic peripheral neuropathy (DPN). **Methods:** Three studies on assessment and nine intervention studies support the presence of balance dysfunction in DPN and treatments that improved balance respectively. **Results and Conclusion:** There was thus limited evidence existed for presence of balance impairments such as shifts in center of pressure, reduced unipedal stance time or reduced Berg balance test scores and few treatments such as pain-relieving modalities and exercises had been shown to improve balance among people with DPN. More studies are required in the future to derive evidence-informed recommendations for practice.

**Keywords:** Balance; Equilibrium; Falls; Metabolic neuropathy; Rehabilitation.

### Introduction

Balance is an integrated function of visual, vestibular and somatosensory systems in the human body which helps the body and its parts to be energy efficient in their static and dynamic postures both at rest and during activity.[1] Impairments in balance result from a complex interaction of dysfunctions resulting from affector-sensory and effector-motor systems that manifest as imbalance leading to falls and vertigo.[2] Falls are highly prevalent in elderly population, and fear of falling is a single most important risk factor for disability and participation restriction in basic and instrumental activities of daily living.[3]

Amongst many other neurological disorders that affect balance, Diabetic peripheral neuropathy (DPN) affects bilateral lower limbs by not only causing neuropathic pain but also sensory and motor deficits that might impair balance function.[4] The objective of this review was to provide an overview of evidence for balance dysfunction and balance interventions for people with DPN.

### Methodology

#### *Search method and Strategy*

The following search terms were entered into PubMed-(balance [Title] OR falls [Title]) AND (diabetes [Title] OR diabetic [Title]) AND (neuropathy [Title] OR neuropathic [Title]) NOT autonomic[Title/Abstract] with search filters activated for articles with abstracts and published in English language. The search was performed by two testers independently and mutual consensus method was adopted periodically. Two main themes were selected under assessment and treatment.

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*Main findings**Balance dysfunction in DPN*

Three studies evaluated balance dysfunction in individuals with PDPN:

Ghanavati *et al*[5] in their case-control study evaluated functional balance in patients with DPN and normal older adults which showed a significant decline in the overall score of Berg Balance Scale (BBS) in DPN patients versus the healthy control group.

Kanade *et al*[6] investigated standing balance in 23 patients with diabetic neuropathy alone (controls) who were compared with 23 patients with diabetic foot ulceration, 16 patients with partial foot amputation and 22 patients with trans-tibial amputation and found that the 4 groups demonstrated significant decline in balance from neuropathy alone to foot ulceration, to partial foot amputation and trans-tibial amputation based on total excursion of centre of pressure and centre of pressure excursion in antero-posterior direction. Each of three study groups demonstrated decreased balance (diabetic neuropathy vs. foot ulceration, diabetic neuropathy vs. partial foot amputation and diabetic neuropathy vs. trans-tibial amputation).

Turcot *et al*[7] investigated quiet standing balance using an accelerometric-based method in 24 diabetic patients (12 with and 12 without peripheral neuropathy) and compared with 12 control subjects. The diabetic patients with peripheral neuropathy showed a higher-range and root mean square values compared with those of control subjects and diabetic patients without peripheral neuropathy which indicated that diabetic patients with peripheral neuropathy had greater postural instability with higher acceleration values than those of control group and diabetic patients without peripheral neuropathy.

*Balance interventions in DPN*

Nine studies evaluated the efficacy of interventions on balance in DPN:

Ahn and Song[8] studied the effects of Tai

Chi Exercise (1 hour per session, twice a week for 12 weeks) and found significant improvements in glucose control, neuropathy scores, balance, and quality of life in 59 DPN patients

Akbari *et al*[9] compared 10 DPN patients with 10 healthy controls on their response to balance training (progressive Biodex stability and rocker and wobble-board training for 10 sessions) and found that the overall stability index and anterior-posterior stability index were significantly decreased after treatment in the case group compared to control group which suggested that balance training can improve stability indices in diabetic patients with neuropathy.

Salsabili *et al*[10] evaluated the effects of 3-weeks balance training using the results of Biodex stability scores and force platform medial-lateral sway measurements which improved significantly with higher open-eyes and postural sway in the medial-lateral direction that indicated enhanced stability.

Ites *et al*[11] found 6 articles, including 1 randomized controlled trial in their systematic review that were on 4 physical therapy interventions including monochromatic infrared energy therapy, vibrating insoles, lower extremity strengthening exercises, and use of a cane. Delphi recommendations were fair for lower extremity strengthening exercises for clinical use in treating balance dysfunction in patients with DPN.

Kruse *et al*[12] studied the effects of a lower-extremity exercise and walking intervention on balance, lower-extremity strength (force-generating capacity), and fall incidence in 79 DPN patients who were randomly assigned to either a control group (n=38) or an intervention group (n=41). The 12 months post-intervention unipedal stance time improved in the treated group compared to the control group.

Hijmans *et al*[13] investigated the effects on standing balance of random 60 second vibrations applied to the plantar side of the feet by vibrating insoles in 17 subjects with neuropathy and 15 nondisabled subjects. The

subjects stood on a force platform In four different conditions (eyes open or closed and with or without an attention-demanding task [ATD]). The study found that Vibrating insoles improved standing balance in subjects with neuropathy only when attention was distracted.

Powell *et al*[14] in their retrospective cohort study of 252 patients with documented symptomatic reversal after Monochromatic near-infrared phototherapy (MIRE) had reduced incidence of falls (78) and fear of falling (79) within 1 month post-treatment.

Cimbiz and Cakir[15] found balance impairments such as static and dynamic unipedal stance, and functional reach test scores in dominant leg of 30 DPN patients compared to a non-diabetic control group.

Leonard *et al*[16] found that 90% of DPN subjects reported substantial balance impairment prior to MIRE therapy and after treatment, this was decreased to 17%.

## Discussion

This review paper aimed to provide an overview of evidence for balance dysfunction and balance interventions for people with DPN and found some evidence for presence of balance deficits for which treatments ranging from therapeutic exercise training to pain relieving modalities were reported to be useful in a small number of studies.

The studies found were too heterogeneous to draw any definitive conclusions and thereby we cannot arrive at any recommendations for practice. The lack of meta-analysis is justified in this context, and future studies should be conducted as large-scale pragmatic multi-center randomized clinical trials on balance interventions for people with DPN.

It is imperative that evaluation and intervention of balance should be considered for patients with DPN when subjective reports of imbalance were present with or without a previous history of falls.

## Conclusion

There was limited evidence for presence of balance impairments and few treatments had been shown to improve balance among people with DPN. More studies are required in the future to derive evidence-informed recommendations for practice.

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