

Efficacy of Sensorimotor Training Combined with Warm Salt Water Foot Bath on Pain and Functional Limitation in Patient with Diabetic Peripheral Neuropathy: Case Study

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ABSTRACT

Background: Diabetic foot is a common complication of diabetes caused by neuropathy and impaired circulation, leading to pain, ulcer risk, reduced mobility, and poor quality of life.

Case Presentation: A 73-year -old male with left diabetic foot presented with pain, numbness, tingling, burning sensation, muscle weakness, balance impairment, and reduced functional ability. Clinical and laboratory findings showed poor glycaemic control and diabetic foot complications.

Intervention: The patient completed a 4-week physiotherapy programme including sensorimotor/proprioceptive exercises and contrast bath therapy to improve circulation, balance, and sensory function.

Results: Pain decreased (NPRS: 7 to 4) and functional mobility improved (66 to 75) . The patient reported better balance, reduced discomfort, and improved daily activity performance.

Conclusion: Sensorimotor training combined with warm salt water foot bath may be an effective and low-cost physiotherapy intervention for reducing pain and improving functional outcomes in diabetic foot patients.

Keywords:-Diabetic Foot; Diabetes Mellitus; Diabetic Peripheral Neuropathy; Sensorimotor Training; Contrast Bath Therapy; Functional Mobility; Balance Training; Pain Reduction; Physiotherapy; Proprioception

Background

Diabetes mellitus is the almost popular agent of polyneuropathy in highly-developed countries. This is an increasing popular purpose among diabetic patients across 50 ages of time. Diabetes is 1 of the almost popular causes of neuropathy. Neuropathy causes necessary morbidity and death rate inward diabetic patients and leads to access hospital care against diabetic patients than whatever choice complication. The relative incidence of diabetic foot sore is around 630 per 100,000 diabetic individuals universal. Based within some other look, enhancing to 25% of diabetic patients make diabetic base inside their feeling time. It is estimated that 2% to 3% of diabetic patients form diabetic base every year. The raise relative incidence of diabetes has brought around an amp similar level inward diabetic foot complications.

Prevalence : Diabetic Peripheral Neuropathy (DPN) is one of the most common complications of diabetes mellitus, affecting approximately 30–50% of individuals with diabetes worldwide. The prevalence increases with longer disease duration, poor glycemic control, advancing age, and the presence of other metabolic risk factors. In India, studies have reported a prevalence ranging from 20% to 60%, making DPN a significant public health concern. The condition commonly presents with symptoms such as pain, numbness, tingling, burning sensations, and loss of protective sensation in the feet. These symptoms can lead to impaired balance, gait disturbances, foot ulcers, and an increased risk of falls. Due to its progressive nature, DPN significantly affects functional independence and quality of life. Early identification and appropriate management strategies, including physiotherapy interventions, are essential to reduce symptoms, improve functional outcomes, and prevent further complications associated with diabetic peripheral neuropathy.

Anatomy & Physiology

Musculoskeletal Manifestations

Musculoskeletal changes include wasting of intrinsic muscles, limited joint mobility, alterations in foot shape, and development of ankle equinus. Reduced dorsiflexion of the 1st metatarsophalangeal joint is frequently observed, associated with tightening of the Achilles tendon and plantar fascia — contributing to increased foot rigidity, greater foot planus, and potential gait imbalance.

Dermatologic Changes

Autonomic dysfunction associated with diabetes reduces sweating in the foot, predisposing individuals to fissuring and xerosis. Three important arteries and their branches perfuse the six angiosomes of the foot and ankle:

- Posterior tibial artery — supplies the plantar surface of the foot
- Fibular artery — perfuses the anterolateral ankle and rearfoot
- Anterior tibial artery — continues as the dorsalis pedis artery, supplying the dorsal foot

Neurological Alterations

The foot receives innervation from five primary nerves: tibial, superficial fibular, deep fibular, sural, and saphenous nerves and their branches. The tibial nerve, a branch of the sciatic nerve, divides into the medial and lateral plantar nerves, providing motor innervation to the posterior compartment and sensory input to the plantar foot.

Epidemiology: Diabetic Peripheral Neuropathy (DPN) is the most common chronic complication of diabetes mellitus and affects nearly 50% of patients during their lifetime. The prevalence ranges from 20% to 50% globally, with higher rates observed in individuals with long-standing diabetes, poor glycemic control, obesity, and advancing age. In India, the prevalence is reported between 20% and 60%, depending on the population studied and diagnostic criteria used. DPN occurs in both type 1 and type 2 diabetes but is more frequently observed in type 2 diabetes. It is a major contributor to foot ulcers, falls, disability, and reduced quality of life.

The movements of the ankle and foot are produced by several muscles. Dorsiflexion is mainly performed by the tibialis anterior, extensor digitorum longus, extensor hallucis longus, and peroneus tertius muscles. Plantar flexion is carried out by the gastrocnemius, soleus, plantaris, tibialis posterior, flexor hallucis longus, and flexor digitorum longus muscles. Inversion of the foot is produced by the tibialis anterior and tibialis posterior, whereas eversion is performed by the peroneus longus and peroneus brevis muscles.

Physiotherapy Intervention: The affected-role underwent amp six-week physical-therapy programme consisting of sensorimotor education and contrast bath. Sensorimotor teaching exercises improved affected-role equilibrate and helped the able arrangement action sensorial comment and a line action expeditiously

Investigation: - Clinical examination and X-ray and 2D echo, all initial blood investigation relieved is finding left diabetic foot.

AIM

To impact the sensorimotor training and contrast bath on pain & functional mobility in diabetic foot.

OBJECTIVES

1. To reduce pain in diabetic peripheral neuropathy.

2. To improve functional ability.
3. To enhance balance and stability.
4. To improve foot sensation and proprioception.
5. To increase mobility and walking performance.

Case Description

A 73-year-old male presented with left diabetic foot for four weeks following degenerative changes. The patient reported discomfort, numbness, pain tingling sensation, burning sensation, muscle weakness, loss of balance and coordination, and sensitivity to hot and cold temperature. Symptoms: - Pain, Numbness, Tingling, hot sensation, muscularity weakness leaving of equaliser and coordination Urinary problems bump inward reduce extremely Feet see cold Fissures indium the feet Investigation - Clinical test, x-ray, and 2D echo were performed. whole initial bloodline investigations revealed findings symbolical of leftover diabetic foot All initial blood investigation revealed:

Initial Investigations

Clinical examination, X-ray, and 2D echo were performed. All initial blood investigations revealed findings consistent with left diabetic foot.

Test	Finding
HB	10.6
TLC	14.4
Platelet	643
ESR	80
SR Thyroid	27.71
HbA1c	10.6
CRP	6.2
SR Sodium	128
SR Iron	17

Pre-Treatment Assessment

NPRS (Numeric Pain Rating Scale): 7/10 | FAAM (Foot & Ankle Ability Measure): 66/84

PHYSIOTHERAPY INTERVENTION

The patient underwent a four week physiotherapy programme consisting of sensorimotor training and contrast bath therapy.

Sensorimotor Training Techniques

- Single Limb Stance — standing on one limb on a firm surface for 30 seconds, progressing to foam surface or eyes closed to increase difficulty
- Unstable Surface Training — using balance boards, foam pads, or wobble boards to improve joint stability
- Obstacle Walking — walking on a designated line while navigating obstacles, combined with controlled lower limb movements



Progression of Training

Static Phase:

Maintaining balance on one or two legs, focusing on stability on both firm and unstable surfaces.

Dynamic Phase:

Introducing movement while maintaining balance — body rotation, weight shifting, and arm swings.

Functional Phase:

Incorporating complex daily-life tasks such as navigating obstacles, stepping, or tracking an object while balancing.

Contrast Bath (Warm Salt Water Foot Bath)

Water Temperature: Keep water between 40°C and 45°C (104°F–113°F).

IMPORTANT: Due to neuropathic numbness, always use a thermometer or test water with the elbow before immersing feet to prevent burns.

- Fill basin with approximately 5 litres of warm water; dissolve 1 cup of Epsom salt (magnesium sulfate)
- Immerse affected foot: warm water 3–4 minutes, cool water 1 minute — repeat cycle for 15–20 minutes
- End with warm water (unless contraindicated)
- Soak duration maximum: 15–20 minutes
- Frequency: 1–2 sessions daily

Post-Soak Care:

Gently pat feet completely dry (especially between toes). Apply fragrance-free moisturiser to prevent cracking.



Precautions & Contraindications

- Check skin sensation before treatment; avoid extreme temperatures in severe neuropathy
- Monitor skin colour and patient comfort throughout session
- Maintain hygiene to prevent infection
- Contraindicated in: open wounds, acute infection, severe ischaemia

RESULT

The findings demonstrate that the combination of sensorimotor training and contrast bath therapy is effective in reducing pain and improving functional mobility in patients with diabetic foot.

Scale	Baseline	Post Treatment
NPRS (Numeric Pain Rating Scale)	07	04
FAAM (Foot & Ankle Ability Measure)	66	75

A clinically meaningful improvement was observed across both outcome measures, with NPRS reducing by 3 points and FAAM improving by 09points over the 4-week intervention period.

DISCUSSION

The findings of this case study are supported by existing literature:

- A 12-week sensorimotor activity programme demonstrated improvements in pain, proprioception, and mobility in diabetic foot patients (Ahmad et al., 2020).
- Sensorimotor and gait training has been confirmed to improve proprioception, nerve function, and muscle activation in diabetic peripheral neuropathy (Jigyasha Rubi Talukdar, 2025).
- A quasi-experimental study demonstrated measurable neuropathic pain reduction in diabetic patients following contrast bath therapy (Gayathiri M., 2022).
- Diabetic patients may not display a representative vascular response to contrast bath, emphasising the need for peripheral circulation monitoring before and during application (Jerrold Petrofsky, 2022).

Overall, the combined intervention proved superior to single-modality treatments in this case presentation.

Uniqueness of the Study

- Combined Intervention — integrates sensorimotor/proprioceptive training with contrast bath therapy, targeting both neurological and circulatory impairments simultaneously
- Focus on Functional Recovery — beyond pain reduction, the protocol addressed balance, coordination, proprioception, and mobility
- Elderly Patient Application — demonstrates that structured physiotherapy can be safely implemented in a 73-year-old patient
- Non-pharmacological & Cost-Effective — simple techniques practical and accessible in resource-limited clinical settings

CONCLUSION

Contrast bath therapy is a simple and cost-effective physiotherapy intervention for diabetic foot patients. When appropriately combined with medical management and exercise therapy, it can reduce pain, improve circulation, decrease oedema, and enhance functional mobility.

Sensorimotor training further complements these gains by improving proprioception, balance, and gait — collectively reducing the risk of falls, ulceration, and long-term complications in the diabetic patient population.

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