

Clinical Outcomes of Integrative Naturopathy, Yoga, and Herbal Interventions in Diabetic Foot Ulcer: A Case Report

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Abstract: Background: Diabetic foot ulcer (DFU) is a significant complication of type 2 diabetes mellitus, characterized by delayed wound healing, risk of infection, and increased morbidity. Integrative approaches may support wound healing and glycemic control.

Case Presentation: A 58-year-old male with an 8-year history of type 2 diabetes presented with a non-healing ulcer over the posterolateral aspect of the left ankle, associated with pain, mild swelling, and difficulty in walking. The ulcer was classified as Wagner Grade II. Baseline investigations revealed elevated blood glucose levels.

Intervention: The patient underwent a 70-day integrative treatment protocol delivered in phases, including pranayama practices, hydrotherapy, dietary modifications, and herbal interventions. Topical applications included Aloe vera, neem, and turmeric, while internal herbal preparations comprised fenugreek, bitter gourd, and cinnamon.

Results: A marked reduction in ulcer size was observed, decreasing from $15 \times 7 \times 2$ cm at baseline to $5 \times 3 \times 0.2$ cm by day 70, along with the development of healthy granulation tissue and epithelialization. Glycemic parameters improved, with fasting blood glucose reducing from 165 mg/dL to 118 mg/dL and postprandial glucose from 238 mg/dL to 170 mg/dL.

Conclusion: This case suggests that integrative therapy may support wound healing and glycemic control in diabetic foot ulcer. Further controlled studies are needed to establish efficacy.

Keywords: Diabetic foot ulcer; Naturopathy; Yoga; Herbal medicine; Integrative medicine.

1. INTRODUCTION

Diabetes mellitus, particularly type 2 diabetes mellitus (T2DM), has emerged as a major global health concern, with a rapidly increasing prevalence in low- and middle-income countries such as India. Chronic hyperglycemia associated with T2DM contributes to long-term damage of various organ systems, leading to complications such as neuropathy, retinopathy, nephropathy, and cardiovascular diseases. Among these, diabetic foot ulcer (DFU) represents one of the most severe and disabling complications, significantly affecting quality of life and imposing a substantial economic burden on healthcare systems. It is defined as a full-thickness wound below the ankle in individuals with diabetes, commonly resulting from a combination of peripheral neuropathy, peripheral arterial disease, and impaired immune response(1).

The pathophysiology of diabetic foot ulcer is multifactorial, involving reduced tissue perfusion, loss of protective sensation, repetitive trauma, and chronic inflammation. These factors collectively impair the normal wound healing process, leading to delayed epithelialization and increased susceptibility to infection. Studies indicate that individuals with diabetes have a significantly higher lifetime risk of developing foot ulcers, and recurrence rates remain high even after initial healing(2). If not managed effectively, DFU may progress to severe infection, gangrene, and ultimately lower limb amputation, contributing to increased morbidity and mortality.

Conventional management of DFU includes glycemic control, debridement, infection management, pressure offloading, and advanced wound care techniques(3). While these approaches are essential, healing outcomes are often suboptimal, particularly in chronic or non-healing ulcers. This has led to growing interest in complementary and integrative approaches that may enhance the wound healing process and improve metabolic regulation.

Naturopathy and yoga are increasingly recognized as supportive therapies in the management of chronic metabolic disorders. Yogic practices, including pranayama and meditation, have been shown to improve autonomic balance, reduce stress, and contribute to better glycemic control in patients with T2DM(4). Improved autonomic regulation may indirectly support wound healing by enhancing circulation and reducing inflammatory responses. Hydrotherapy, a key modality in naturopathy, has been reported to improve peripheral circulation and promote tissue oxygenation, which are essential for effective wound repair(5).

Herbal medicine also plays a significant role in integrative wound management. Several plant-based agents have demonstrated antimicrobial, anti-inflammatory, and tissue-regenerative properties. Aloe vera has been widely studied for its ability to stimulate fibroblast proliferation, collagen synthesis, and angiogenesis, thereby accelerating wound healing(6). Similarly, *Curcuma longa* (turmeric) contains curcumin, which exhibits potent anti-inflammatory and antioxidant effects, supporting tissue repair processes(7). *Azadirachta indica* (neem) possesses well-documented antimicrobial properties that help prevent wound infection(8). In addition to topical applications, certain herbal agents such as fenugreek, bitter melon, and cinnamon have been reported to improve glycemic control, which is a critical factor in the management of diabetic wounds(9).

Despite the growing body of evidence supporting individual components of integrative therapy, there is limited clinical documentation on the combined effect of naturopathy, yoga, and herbal interventions in the management of diabetic foot ulcers. Case-based evidence can provide valuable insights into the feasibility and potential effectiveness of such integrative approaches in real-world clinical settings.

Therefore, the present case study aims to evaluate the clinical outcomes of a structured integrative treatment protocol incorporating naturopathy, yoga, and herbal medicine in the management of a diabetic foot ulcer.

Case Presentation

A 58-year-old male presented to the outpatient department of G.T.N. Prakruthi Chikitsalaya, Dindigul, Tamil Nadu, India, with a complaint of a non-healing ulcer over the posterolateral aspect of the left ankle, persisting for approximately 4–6 weeks. The patient reported associated pain, mild swelling around the affected area, and difficulty in walking. He had a known history of type 2 diabetes mellitus for the past 8 years and was on irregular medication, with suboptimal glycemic control.

There was no history of preceding trauma. The patient reported a gradual increase in the size of the wound, accompanied by intermittent serous discharge. No systemic symptoms such as fever or chills were noted. His lifestyle had been predominantly sedentary following retirement, and his dietary habits were irregular.

On general examination, the patient was moderately built and nourished. Vital signs were stable, with blood pressure recorded at 140/86 mmHg and a pulse rate of 76 beats per minute. He was afebrile. Anthropometric measurements revealed a height of 165 cm and a weight of 76 kg, corresponding to a body mass index (BMI) of 28 kg/m², indicating overweight status.

Local examination of the affected limb revealed an ulcer located on the posterolateral aspect of the left ankle extending towards the heel region. The ulcer measured approximately 15 cm in length, 7 cm in width, and 2 cm in depth at baseline. The margins were irregular, and the base was covered with slough and necrotic tissue, with minimal evidence of healthy granulation tissue. Moderate serous discharge was present. The surrounding skin showed mild edema, and sensation was slightly reduced, suggestive of peripheral neuropathy.

Based on clinical evaluation, the ulcer was classified as Wagner Grade II, indicating a deep ulcer extending into subcutaneous tissue without evidence of abscess or osteomyelitis. Further assessment using the PEDIS classification revealed mildly reduced perfusion, involvement limited to subcutaneous tissue, mild infection, and partial sensory impairment.

Baseline laboratory investigations indicated poor glycemic control, with fasting blood glucose of 165 mg/dL, postprandial blood glucose of 238 mg/dL, and glycated hemoglobin (HbA1c) of 8.1%.

Considering the chronicity of the wound and inadequate glycemic control, an integrative treatment approach incorporating naturopathy, yoga, and herbal interventions was planned and implemented over a period of 70 days. The patient was closely monitored throughout the treatment period, with regular assessment of wound healing parameters and glycemic status.

Intervention

The intervention was implemented in a phased manner over a period of 70 days, integrating naturopathy, yoga, dietary modification, and herbal therapies. The structured approach aimed to sequentially promote detoxification, improve metabolic control, enhance tissue repair, and support wound regeneration. All interventions were administered under clinical supervision, and the patient was regularly monitored for compliance and clinical response.

Phase 1 (Days 1–15): Detoxification Phase

The initial phase focused on systemic detoxification and initiation of glycemic regulation. The patient was advised to perform daily pranayama practices, including hand stretch breathing (5 minutes), Nadi Shuddhi (5 minutes), and Om chanting (5 minutes), to promote relaxation and improve oxygenation.

A herbal decoction prepared from fenugreek seeds (1 teaspoon) and cinnamon bark (½ teaspoon), boiled in 200 mL of water, was administered once daily in the morning. Local wound care consisted of cleansing with neem leaf decoction, followed by topical application of fresh Aloe vera gel as a dressing.

Phase 2 (Days 16–35): Metabolic Regulation Phase

This phase emphasized optimization of metabolic function and glycemic control. Pranayama practices were continued with increased duration: Nadi Shuddhi (10 minutes), Bhramari (5 minutes), Om chanting (5 minutes), and hand stretch breathing (5 minutes), performed daily. A herbal formulation comprising fresh bitter melon juice (30 mL) and amla juice (20 mL), diluted in 100 mL of water, was administered once daily. Dietary modifications were introduced, focusing on the inclusion of millets, vegetables, legumes, and low glycemic index fruits. Hydrotherapy in the form of a neutral hip bath was administered for 20 minutes daily to enhance peripheral circulation.

Phase 3 (Days 36–55): Tissue Repair Phase

The third phase aimed to promote tissue regeneration and wound contraction. The established pranayama regimen was continued without modification. Internal herbal supplementation included Aloe vera juice (20 mL) combined with amla juice (10 mL) in 100 mL of warm water, administered once daily. Local wound care involved the application of a herbal paste prepared from turmeric powder and Aloe vera gel to support granulation tissue formation and reduce inflammation. Hydrotherapy with a neutral hip bath (20 minutes daily) was continued.

Phase 4 (Days 56–70): Regeneration Phase

The final phase focused on epithelialization and consolidation of healing. The patient continued the established pranayama practices.

A herbal decoction prepared from fenugreek seeds (1 teaspoon), cumin seeds (1 teaspoon), and cinnamon bark (1 teaspoon), boiled in 200 mL of water, was administered once daily to support glycemic regulation and ongoing tissue repair.

Local wound care was continued based on clinical assessment until the end of the intervention period.

The integrative treatment protocol was administered over 70 days in a phased manner. The details of the intervention are summarized in Table 1.

Table 1. Phased Integrative Intervention Protocol.

Phase & Duration	Components	Intervention Details
Phase 1 (Days 1–15) Detoxification Phase	Pranayama	Hand stretch breathing (5 min), Nadi Shuddhi (5 min), Om chanting (5 min) daily
	Herbal Decoction	Fenugreek seeds (1 tsp) + Cinnamon bark (½ tsp) boiled in 200 mL water, once daily
	Local Wound Care	Cleansing with neem decoction followed by topical application of fresh Aloe vera gel

Phase 2 (Days 16–35) Metabolic Regulation Phase	Pranayama	Nadi Shuddhi (10 min), Bhramari (5 min), Om chanting (5 min), Hand stretch breathing (5 min)
	Herbal Preparation	Bitter gourd juice (30 mL) + Amla juice (20 mL) diluted in 100 mL water, once daily
	Dietary Modification	Millets, vegetables, legumes, and low glycemic index fruits
	Hydrotherapy	Neutral hip bath for 20 minutes daily
Phase 3 (Days 36–55) Tissue Repair Phase	Pranayama	Continued as in Phase 2
	Internal Herbal Therapy	Aloe vera juice (20 mL) + Amla juice (10 mL) in 100 mL warm water, once daily
	Topical Application	Paste of turmeric powder and Aloe vera gel applied over the ulcer
	Hydrotherapy	Neutral hip bath for 20 minutes daily
Phase 4 (Days 56–70) Regeneration Phase	Pranayama	Continued as in previous phases
	Herbal Decoction	Fenugreek seeds (1 tsp) + Cumin seeds (1 tsp) + Cinnamon bark (1 tsp) boiled in 200 mL water, once daily
	Local Wound Care	Continued as per clinical assessment

Outcome Measures

Clinical outcomes were assessed based on wound healing progression and glycemic parameters over the 70-day intervention period. Wound healing was evaluated through serial measurements of ulcer dimensions and observation of tissue characteristics, while metabolic control was assessed using fasting and postprandial blood glucose levels.

2. RESULTS

A progressive improvement in wound healing was observed throughout the intervention period, with reduction in ulcer size and improvement in wound characteristics, including decreased slough, reduction in discharge, and development of healthy granulation tissue followed by epithelialization.

At baseline, the ulcer measured approximately $15 \times 7 \times 2$ cm with a necrotic base and moderate discharge. By day 20, a reduction in inflammation and discharge was noted. By day 40, healthy granulation tissue was evident, indicating progression to the proliferative phase of healing. Continued improvement was observed by day 50, with marked wound contraction. By day 70, the ulcer size had reduced to approximately $5 \times 3 \times 0.2$ cm, with evidence of epithelialization.

Glycemic parameters also showed improvement over the study period. Fasting blood glucose decreased from 165 mg/dL at baseline to 118 mg/dL on day 70, while postprandial blood glucose reduced from 238 mg/dL to 170 mg/dL.

No adverse events or complications were reported during the intervention period, and the patient demonstrated good compliance with the prescribed treatment protocol.

Table 2. Wound Healing Progression.

Day	Ulcer Size (cm)	Clinical Observation
Day 1	$15 \times 7 \times 2$	Necrotic base with slough and moderate discharge
Day 20	$14 \times 6 \times 1.5$	Reduction in inflammation and discharge
Day 40	$12 \times 5 \times 1$	Presence of healthy granulation tissue
Day 50	$8 \times 4 \times 0.5$	Progressive wound contraction
Day 70	$5 \times 3 \times 0.2$	Epithelialization and near-complete healing

Photographic documentation of the ulcer demonstrates progressive reduction in wound size, slough clearance, and epithelialization over the 70-day intervention period (Figures 1–5).



Figure 1. Diabetic foot ulcer at baseline (Day 1).



Figure 2: Reduction in necrotic tissue (Day 20)



Figure 3. Granulation tissue formation (Day 40).



Figure 4. Wound contraction (Day 50).



Figure 5. Near-complete epithelialization (Day 70).

Table 3. Glycemic Parameters.

Parameter	Baseline	Day 70
Fasting Blood Glucose	165 mg/dL	118 mg/dL
Postprandial Blood Glucose	238 mg/dL	170 mg/dL

3. DISCUSSION

Diabetic foot ulcer (DFU) is a multifactorial complication of type 2 diabetes mellitus characterized by delayed wound healing due to peripheral neuropathy, microvascular dysfunction, and chronic inflammation. Persistent hyperglycemia plays a central role in disrupting the normal wound healing cascade by promoting the formation of advanced glycation end products (AGEs), increasing oxidative stress, and impairing cytokine signaling. These changes prolong the inflammatory phase, reduce fibroblast proliferation, impair angiogenesis, and alter collagen synthesis, ultimately leading to chronic, non-healing wounds(1,2). In the present case, the progressive reduction in wound size and improvement in tissue characteristics over 70 days suggest a favorable modulation of these pathological processes through integrative intervention.

Mechanisms of Herbal Interventions in Wound Healing

The topical and systemic use of herbal agents may have contributed to the observed clinical improvement. Aloe vera is known to enhance wound healing through stimulation of fibroblast proliferation, increased collagen deposition, and promotion of angiogenesis. Its anti-inflammatory effects help in reducing local cytokine activity, thereby facilitating the transition from the inflammatory to the proliferative phase of healing(10,11). Turmeric, through its active compound curcumin, exerts antioxidant and anti-inflammatory effects by inhibiting nuclear factor-kappa B (NF- κ B) signaling pathways and scavenging reactive oxygen species, which are elevated in diabetic wounds(7,12). Additionally, curcumin enhances tissue remodeling by promoting fibroblast migration and collagen synthesis. Neem contributes through its antimicrobial properties, helping to reduce wound bioburden and prevent secondary infection, which is a major barrier to healing in DFU(8,13).

Role of Glycemic Control in Tissue Repair

Systemic herbal interventions such as fenugreek, bitter melon, and cinnamon may have supported improved glycemic control, which is critical for wound healing. Cinnamon has been shown to enhance insulin sensitivity and glucose uptake, thereby reducing blood glucose levels(9). Improved glycemic regulation reduces oxidative stress, minimizes AGE formation, and restores normal cellular function, all of which are essential for effective tissue repair. Hyperglycemia is known to impair leukocyte function and increase susceptibility to infection; therefore, its correction plays a vital role in wound healing outcomes(1).

Influence of Yoga on Neuroendocrine and Metabolic Regulation

Yogic practices, particularly pranayama, may have contributed to the healing process through modulation of the autonomic nervous system and stress response. Slow and controlled breathing techniques enhance parasympathetic activity and reduce sympathetic overactivity, leading to decreased cortisol levels and improved metabolic balance. Chronic stress is known to delay wound healing by altering immune and inflammatory responses; thus, stress reduction through yoga may indirectly facilitate tissue repair. Evidence suggests that yoga-based interventions can significantly improve glycemic control and metabolic parameters in individuals with type 2 diabetes(4,14).

Contribution of Hydrotherapy in Enhancing Circulation

Hydrotherapy, administered as a neutral hip bath, may have supported wound healing by improving peripheral circulation and tissue perfusion. Enhanced blood flow increases oxygen and nutrient delivery to the wound site, which is essential for fibroblast activity, collagen synthesis, and angiogenesis. In diabetic patients, microvascular impairment often limits tissue perfusion; therefore, interventions that enhance circulation are beneficial in promoting wound healing(5).

Integrated Mechanistic Perspective

The integrative approach adopted in this case may act through multiple interconnected mechanisms that collectively support wound healing. The combined anti-inflammatory, antioxidant, and antimicrobial actions of herbal therapies help reduce local inflammation, control microbial load, and create a favorable environment for tissue repair(3,15). At the systemic level, the use of herbal formulations contributes to improved glycemic control, which is a critical determinant in diabetic wound healing, as persistent hyperglycemia is known to impair cellular repair mechanisms and increase oxidative stress(9). Yogic practices, particularly pranayama, may further enhance healing by modulating autonomic balance and reducing stress-induced hormonal responses, thereby supporting metabolic regulation and immune function(16). In addition, hydrotherapy may improve peripheral circulation and tissue perfusion, facilitating oxygen and nutrient delivery essential for fibroblast activity, collagen synthesis, and angiogenesis(17). The interaction of these local and systemic effects likely promotes progression through the physiological stages of wound healing, including inflammation, proliferation, and remodeling. Furthermore, the structured phase-wise implementation of the intervention aligns with these stages, potentially enhancing the efficiency and sustainability of the healing process.

This case study demonstrates several strengths, including a structured and phase-wise intervention protocol, systematic monitoring of wound healing parameters, and improvement in objective glycemic indices. The inclusion of photographic documentation provides visual evidence supporting the clinical findings. However, certain limitations must be acknowledged. As a single case report, the findings cannot be generalized to a broader population. The absence of a control group limits causal inference, and the combined use of multiple therapies makes it difficult to isolate the individual

contribution of each component. Additionally, variability in herbal preparations and lack of standardized dosing may affect reproducibility.

The findings of this case suggest that integrative approaches combining naturopathy, yoga, and herbal therapies may offer supportive benefits in the management of diabetic foot ulcers. However, further well-designed randomized controlled trials with larger sample sizes and standardized protocols are required to establish efficacy and reproducibility.

4. CONCLUSION

This case suggests that an integrative approach combining naturopathy, yoga, and herbal therapies may contribute to improved wound healing and glycemic control in a patient with a diabetic foot ulcer. The observed reduction in ulcer size, progression of granulation tissue, and eventual epithelialization over 70 days suggest that a multi-targeted intervention addressing local wound care, metabolic regulation, and neurophysiological balance can support the physiological healing process. The phase-wise implementation of therapy appears to align with the stages of wound healing, potentially enhancing treatment effectiveness. However, as this is a single case report, the findings cannot be generalized. Further well-designed randomized controlled trials with larger sample sizes and standardized protocols are required to validate the efficacy and reproducibility of such integrative interventions in the management of diabetic foot ulcers.

Patient Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Ethical Approval

This case report did not require institutional ethical committee approval as per institutional guidelines.

Conflict of Interest

The authors declare no conflict of interest.

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