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Piper ornatum for wound cleansing in diabetic foot ulcers

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Abstract
Macroangiopathy leads to diabetic ulcers due to vascular insufficiency and neuropathy. Treating such wounds requires innovative approaches, including wound washing with a decoction of red betel leaves (Piper ornatum). This case study aims to evaluate the effectiveness of this method in patients with diabetic foot ulcers. The study employs a descriptive design with purposive sampling. The participant, Mrs. S, is a 41-year-old woman with grade 1 diabetic foot ulcers. Data were collected through participatory observation, unstructured interviews, and documentation. Results indicated that wound cleansing with red betel leaf decoction improved wound tissue regeneration. The Bates Jensen Wound Assessment Tool score decreased from 35 to 28 after four treatments, indicating significant wound regeneration. It is hoped that healthcare professionals will adopt this method to optimize wound healing.

Keywords: Wound cleansing agent; innovation; clinical practice; diabetic foot ulcers; healthcare professionals

Introduction

Diabetic foot ulcers are a serious complication that can occur in individuals with diabetes mellitus (Raja, Maturana, Kayali, Khouzam, & Efeovbokhan, 2023). These ulcers are open sores or wounds that typically develop on the feet, often on the bottom or sides of the feet. Diabetic foot ulcers are a significant health concern, as they can lead to severe complications if left untreated, including infection, gangrene, and even amputation (Akkus & Sert, 2022). The primary cause of diabetic foot ulcers is a combination of two main factors: neuropathy and peripheral vascular disease. Neuropathy, or nerve damage, is a common complication of diabetes and can lead to a loss of sensation in the feet. This lack of sensation makes it difficult for individuals to feel pain or discomfort, which can lead to the development of ulcers from minor injuries or pressure on the feet (Feldman et al., 2019). Peripheral vascular disease, on the other hand, is a condition in which the blood vessels in the legs and feet become narrowed or blocked, reducing blood flow to the extremities (Bondar et al., 2021). This reduced blood flow impairs the body's ability to heal and fight infection, making diabetic foot ulcers more likely to develop and more difficult to heal. In addition to neuropathy and peripheral vascular disease, other risk factors for diabetic foot ulcers include poor glycemic control, obesity, smoking, and a history of previous foot ulcers or amputations (Ang, Cowdin, Mizokami-Stout, & Pop-Busui, 2018). Individuals with diabetes are also at a higher risk of developing foot deformities, such as bunions or hammertoes, which can increase the pressure on certain areas of the feet and contribute to the development of ulcers (Mansour & Dahyak, 2008). Proper foot care, including regular foot examinations, proper footwear, and prompt treatment of any foot problems, is essential for preventing and managing diabetic foot ulcers (Sertsu et al., 2023). Early intervention and comprehensive treatment, which may include wound care, offloading, and management of underlying conditions, are crucial for promoting healing and preventing serious complications (Saber & Daoud, 2018).

Healthcare providers utilize a comprehensive approach to diagnose and assess the severity of diabetic foot ulcers. The process begins with a thorough clinical assessment of the affected foot (Ranuve & Mohammadnezhad, 2022). First, the healthcare provider will visually inspect the foot, looking for the presence of an open wound or ulcer, as well as any signs of infection, such as redness, swelling, or drainage. They may also gently probe the ulcer to assess its depth and determine if it has reached the underlying bone or tendon (Hidalgo-Ruiz et al., 2023; Boulton et al., 2008; Johnson, Osbourne, Rispoli, & Verdin, 2018). In addition to the visual examination, the provider will assess the patient's sensation in the affected foot using a monofilament or other sensory testing devices (Pérez-

Panero et al., 2019). This evaluation helps to determine the presence and extent of neuropathy, a common complication of diabetes that can lead to a loss of sensation in the feet (Wang et al., 2017). The provider will also assess the patient's vascular status by checking the pulses in the feet and lower extremities, as peripheral vascular disease can impair blood flow and contribute to the development of diabetic foot ulcers (Dros, Wewerinke, Bindels, & van Weert, 2009). Alongside the clinical assessment, healthcare providers may also utilize various diagnostic tests to gather more detailed information about the ulcer and the underlying conditions. These tests may include wound measurement to track the size, depth, and location of the ulcer, as well as wound imaging techniques, such as X-rays, to assess the involvement of bone or other underlying structures (Chan & Lo, 2020). Additionally, the provider may take a sample of the wound for microbiological analysis to identify any underlying infections **(Figure 1)**.

Figure 1. Illustration of wound care (*Courtesy of newsroom.osfhealthcare.org*).

To further evaluate the patient's vascular status, healthcare providers may perform tests like the Ankle-Brachial Index (ABI) or Toe-Brachial Index (TBI), which measure the blood pressure in the ankles or toes, respectively (Casey, Lanting, Oldmeadow, & Chuter, 2019). These tests can help assess the presence and severity of peripheral arterial disease. Another diagnostic tool, Transcutaneous Oxygen Measurement (TcPO2), can measure the oxygen levels in the skin, providing insights into the adequacy of blood flow and the potential for wound healing (Kmiec et al., 2019). By combining the clinical assessment and diagnostic tests, healthcare providers can accurately diagnose and determine the severity of diabetic foot ulcers. They often use classification systems, such as the Wagner Wound Classification System or the University of Texas Wound Classification System, which take into account factors like the depth of the ulcer, the presence of infection, and the involvement of underlying structures (Vera-Cruz, Palmes, Tonogan, & Troncillo, 2020). This comprehensive approach is crucial for developing an appropriate treatment plan and monitoring the patient's progress over time. Also, the need of using low-risk wound care agent is important for healing optimization. For example, using piper ornatum for wound cleansing.

Piper ornatum, commonly known as red betel leaf, has been traditionally used in various cultures for its medicinal properties (Salehi et al., 2019). This plant is known for its antimicrobial, anti-inflammatory, and antioxidant effects, which make it a valuable resource in wound care (Setyawati et al., 2021). The leaves contain essential oils and bioactive compounds such as eugenol, chavicol, and allylpyrocatechol, which contribute to its

healing properties. When used as a decoction for wound cleansing, Piper ornatum can help reduce bacterial load, prevent infection, and promote a conducive environment for wound healing (Ghazali et al., 2016). The effectiveness of Piper ornatum in wound cleansing is particularly significant for diabetic foot ulcers, which are prone to complications due to poor blood circulation and neuropathy. Traditional wound care methods sometimes fall short in managing such complex wounds, and the introduction of natural remedies like Piper ornatum can provide a complementary approach (Biswas et al., 2022). Piper ornatum is attributed to the plant's ability to stimulate fibroblast activity and collagen synthesis, which are crucial for wound repair. Healthcare professionals are encouraged to consider the use of Piper ornatum **(Figure 2)** as an adjunctive treatment in wound management protocols. Integrating this natural remedy can enhance patient outcomes, especially in cases where conventional treatments alone are insufficient (Trinh et al., 2022). Moreover, using Piper ornatum for wound cleansing aligns with the growing interest in herbal medicine and sustainable healthcare practices (Darmawan, Yusuf, Tahir, & Syahriyani, 2021). Further research and clinical trials could help solidify the understanding of its benefits and pave the way for broader acceptance in medical practice. The use of Piper ornatum in wound care is a promising field, but several gaps remain in the current body of research. Firstly, most studies on Piper ornatum are limited to in vitro experiments and small-scale clinical observations. There is a lack of large, randomized controlled trials that can provide robust evidence on its efficacy and safety in wound care. Without these high-quality studies, it is difficult to make definitive conclusions about the plant's benefits and potential side effects when used on a larger patient population.

Figure 2. Illustration of piper ornatum (*Courtesy of identify.plantnet.org*).

Furthermore, the precise mechanisms by which Piper ornatum aids in wound healing are not fully understood. While it is known that the plant has antimicrobial, anti-inflammatory, and antioxidant properties, more detailed research is needed to elucidate the specific bioactive compounds responsible for these effects and how they interact with the wound healing process. Understanding these mechanisms could lead to more targeted and effective use of Piper ornatum in clinical settings. Finally, there is a gap in standardized protocols for the preparation and application of Piper ornatum for wound care. Variations in how the decoctions are prepared, the concentration of the active ingredients, and the methods of application can lead to inconsistent results. Establishing standardized guidelines based on comprehensive research would help in ensuring the efficacy and reproducibility of treatments using Piper ornatum. Addressing these gaps through rigorous scientific inquiry is crucial for integrating this traditional remedy into modern wound care practices.

Method

This research employs a descriptive case study design, which is particularly suited for an in-depth, detailed examination of a single subject or a small group of subjects (Crowe et al., 2011). The primary goal of a descriptive case study is to provide a comprehensive account of the phenomenon being studied (Das & Singh, 2021). By focusing on a specific instance of a broader condition—in this case, a patient with grade 1 diabetic ulcers—the researchers can gather rich qualitative data and nuanced insights that might be overlooked in broader quantitative studies. This approach allows for a detailed understanding of the subject's condition, the effects of the interventions applied, and the contextual factors that may influence outcomes (Gopikrishna, 2010). The descriptive case study design also facilitates a thorough exploration of the interactions between the patient, the treatment, and the environment (Ortega-Loubon, Culquichicón, & Correa, 2017).

The case study method enables researchers to observe and document the progression of the wound healing process using Piper ornatum, providing valuable empirical evidence on the effectiveness of this alternative therapy. Additionally, the case study format allows for flexibility in data collection methods, including participatory observation, unstructured interviews, and documentation, ensuring a holistic view of the patient's experience. This detailed approach not only contributes to the existing body of knowledge but also offers practical insights that can inform clinical practice and guide future research on wound care treatments. The sampling technique employed is non-probability sampling using purposive sampling. The sample consists of a patient with grade 1 diabetic ulcers. Data for this research was collected using participatory observation, unstructured interviews, and documentation methods. The activities were conducted directly, involving nursing care for the respondent, interviews during data collection, physical examinations, and patient interventions using the Bates Jensen Wound Assessment Tool and wound care procedures. Additionally, data was gathered through documentation of previous health records. The researcher used Piper ornatum for wound cleansing, conducted over four sessions within four days. The intervention technique included several stages: assessing wound characteristics (e.g., drainage, color, size, odor), monitoring signs of infection, treating the wound by washing with Piper ornatum, using appropriate dressings based on wound type, explaining signs and symptoms of infection, and recommending the consumption of high-calorie and high-protein foods.

Results

Data collection revealed a post-operative wound on the respondent's left foot, which initially resulted from itching that persisted for six months. Over time, this irritation developed into a non-healing wound that began to exude pus and eventually became necrotic, turning black. The respondent reported having had Diabetes Mellitus for 12 years. Despite this, the respondent maintained a good appetite and ate three meals a day, including rice, protein, vegetables, and fruits. The respondent also mentioned avoiding sweet foods and beverages. Observations and measurements indicated that the respondent weighed 45 kg and was 155 cm tall, resulting in a Body Mass Index (BMI) of 18.7 kg/m^2, which is within the normal range. The respondent's skin turgor was elastic, and the skin around the wound was dry, tight, and firm. The respondent was capable of independent activity. Wound assessment revealed that the wound was exuding foul-smelling fluid, and the dressing was soaked through. Objectively, the wound on the foot measured approximately 54 cm^2 (9 x 6 cm), appeared red, with soaked dressings and an unpleasant odor. The wound was at stage 1 depth, with clear edges not adhering to the wound bed, no tunnels, necrotic tissue (slough) easily removable, accounting for less than 25% of the wound bed. The exudate was serous and moderate in amount, the surrounding skin appeared white, there was no edema, and there was hardening of the

wound edges extending 2-4 cm, less than 50% of the wound edges. Granulation tissue covered 50% of the wound bed, and epithelialization was between 50-75%. The interventions provided included monitoring wound characteristics such as drainage, color, size, and odor, and checking for signs of infection. Dressings and adhesive tapes were removed gently, and the wound was cleaned with saline solution or non-toxic cleansers (specifically, a decoction of red betel leaves and saline solution). Appropriate dressings were applied according to the wound type, infection signs and symptoms were explained to the respondent, and a diet high in calories and protein was recommended.

Discussion

The case describes a respondent who has had Diabetes Mellitus for 12 years but has maintained a good appetite, eating three meals a day with a balanced diet. Despite this, the respondent's weight and BMI indicate that they are underweight, which could be a concern. The respondent's skin turgor is elastic, and the skin around the wound is dry, tight, and firm, suggesting adequate hydration. The primary concern in this case is the respondent's foot wound. The wound is exuding foul-smelling fluid, and the dressing is soaked through, indicating a potential infection (Li, Renick, Senkowsky, Nair, & Tang, 2021). Wound exudate, or the fluid that is produced from a wound, can lead to infection if not properly managed. One of the primary ways in which wound exudate can contribute to infection is through bacterial growth (Spear, 2012). Wound exudate provides a moist, nutrient-rich environment that can promote the growth of bacteria **(Figure 3)**. Excessive or prolonged accumulation of exudate can create a breeding ground for pathogenic bacteria, leading to the development of wound infection (Kim, 2019).

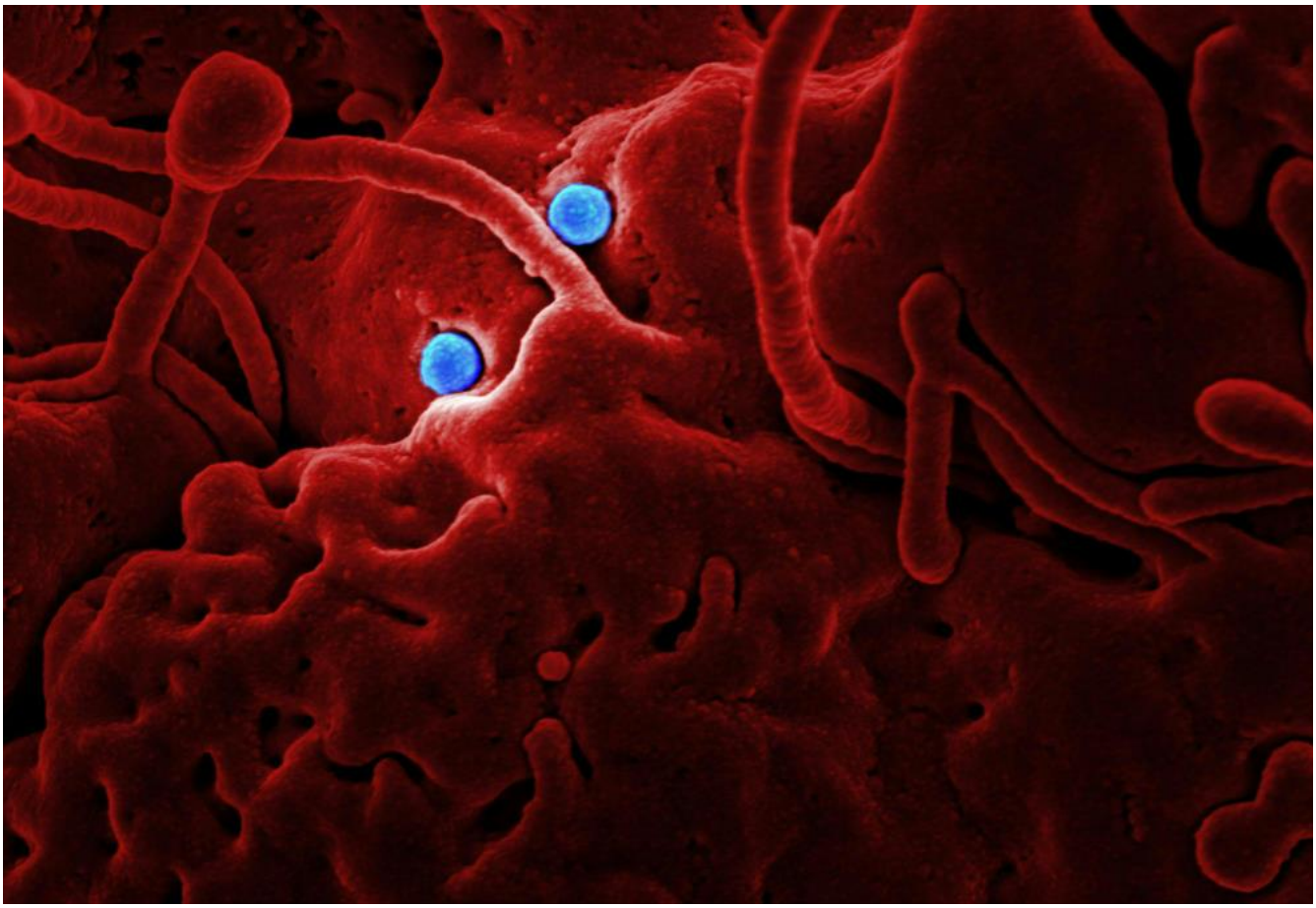

Figure 3. Illustration of pathogenic organism (*Courtesy of pexels.com*).

Furthermore, excessive or inappropriate exudate can also impair the normal wound healing process. Prolonged presence of exudate can macerate the wound bed, damage healthy tissue, and delay the formation of

granulation tissue (Adderley, 2010). This can create an environment that is more susceptible to bacterial colonization and infection. Additionally, wound exudate can become contaminated with bacteria from the surrounding skin, the healthcare environment, or poor wound care practices. If the exudate is not properly managed and the wound is not kept clean, the bacteria can multiply and lead to an infection. Excessive exudate can also impair the immune response by diluting the concentration of immune cells and antimicrobial factors in the wound, reducing the body's ability to fight off infection (Vowden & Vowden, 2003). This can make the wound more vulnerable to the development of infection. To prevent wound infection due to exudate, healthcare providers should assess the wound and exudate characteristics regularly, implement appropriate wound cleansing and dressing techniques, use dressings that can effectively absorb and control the exudate, maintain a clean and aseptic environment during wound care procedures, and educate patients on proper wound care and the importance of keeping the wound clean and dry (Negut, Grumezescu, & Grumezescu, 2018; Liu, Ni, Huang, & Xie, 2022). By effectively managing wound exudate, healthcare providers can help prevent the development of wound infection and promote optimal wound healing.

In this study, the wound measurements and characteristics suggest that the wound is at stage 1 depth, with moderate serous exudate, granulation tissue covering 50% of the wound bed, and partial epithelialization. These findings indicate that the wound is in the early stages of healing but requires proper management to prevent further complications. The healthcare provider's role in this case is crucial in managing the respondent's diabetic foot wound and ensuring optimal wound healing (Heerschap, Nicholas, & Whitehead, 2019). The healthcare provider should continue to monitor the wound characteristics, such as drainage, color, size, and odor, to assess the wound's progress and identify any signs of infection (Wickström, Tuvesson, Öien, Midlöv, & Fagerström, 2020). The healthcare provider should gently remove the dressings and clean the wound using saline solution or a non-toxic cleanser, such as the decoction of red betel leaves and saline solution, as mentioned in the case. Appropriate dressings should be applied based on the wound type and infection signs and symptoms (Shi et al., 2020; Dhivya, Padma, & Santhini, 2015). In addition, the healthcare provider should closely monitor the wound for signs of infection, such as increased pain, redness, swelling, or fever, and provide appropriate antibiotic treatment if necessary. Wound care for diabetic foot care is of utmost importance for patients with diabetes. Diabetic patients are at high risk of developing foot complications, such as diabetic ulcers, infections, and even amputations. Therefore, proper and regular wound care is essential. Wound care begins with gently cleansing the wound using an appropriate saline solution or antiseptic. Debridement is also necessary to remove any necrotic tissue and promote healing. The use of appropriate dressings, such as hydrocolloid or hydrogel-based dressings, can help maintain wound moisture and prevent infection. In addition to wound care, diabetic foot care also encompasses routine foot examinations, skin care, and the use of appropriate footwear. Nurses must ensure that patients perform daily foot checks to detect any problems early on. Skin care, such as the use of moisturizers, is also important to prevent dryness and cracking. The use of proper footwear, such as specialized diabetic shoes, can help protect the feet and prevent trauma. Close collaboration between the patient, the nurse, and the healthcare team is crucial to ensure optimal diabetic foot care.

The role of healthcare providers in developing innovation in wound care is crucial and multifaceted, encompassing research, clinical application, and education. Firstly, healthcare providers, especially those specializing in wound care, are at the forefront of research and development. They identify gaps in current treatment methodologies and conduct rigorous studies to explore new techniques and materials that can enhance wound healing. Their clinical expertise allows them to formulate hypotheses grounded in practical experience, and their access to diverse patient populations enables comprehensive testing of new wound care innovations. By publishing their findings in reputable medical journals and presenting at conferences, healthcare providers contribute to the global body of knowledge and set the stage for evidence-based advancements in wound care. In clinical settings, healthcare providers play a pivotal role in the implementation and evaluation of new wound care technologies and practices. They are responsible for integrating innovative products, such as advanced dressings, negative pressure wound therapy, and bioengineered tissues, into patient care protocols. This requires not only a deep understanding of the latest advancements but also the ability to adapt these innovations to individual patient needs. Providers monitor the outcomes of these interventions, collect data on their effectiveness, and adjust treatment plans accordingly. Their feedback is invaluable for manufacturers and researchers who are refining these products. Furthermore, healthcare providers advocate for patient-centered approaches, ensuring that new treatments are accessible, affordable, and tailored to improve patient outcomes. Education is another critical area where

healthcare providers influence the development of wound care innovations. They serve as educators and mentors, training the next generation of healthcare professionals in the latest wound care techniques **(Figure 4)**.

Figure 4. Illustration of healthcare collaboration (*Courtesy of unsplash.com*).

This includes not only formal education in nursing and medical schools but also ongoing professional development through workshops, seminars, and continuing education courses. By fostering a culture of learning and curiosity, healthcare providers ensure that advancements in wound care are disseminated widely and adopted effectively across the healthcare system. They also engage with patients, educating them about wound care management, which empowers patients to take an active role in their own healing process. This holistic approach to education helps bridge the gap between cutting-edge research and everyday clinical practice, ultimately driving forward the field of wound care.

Conclusion

The use of Piper ornatum for wound care represents a promising and innovative approach to enhancing wound healing and tissue regeneration. The unique properties of this plant, including its anti-inflammatory and antimicrobial effects, offer significant benefits for patients with chronic and acute wounds, particularly in the context of diabetic foot ulcers. The case studies and preliminary research indicate that incorporating Piper ornatum into wound care regimens can improve outcomes, reduce infection rates, and promote faster healing. As healthcare providers continue to explore and validate these findings through rigorous clinical trials, Piper ornatum has the potential to become a valuable addition to modern wound care practices, providing a natural and effective solution for patients in need. Furthet studies are needed to explore the benefits of the leaf in another clinical setting.

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Author's perspective

Key points

- Macroangiopathy leads to diabetic ulcers due to vascular insufficiency and neuropathy
- This holistic approach to education helps bridge the gap between cutting-edge research and everyday clinical practice
- The role of healthcare providers in developing innovation in wound care is crucial

Potential areas of interest

- What is the role of healthcare providers in providing piper ornatum?
- How do patients manage complications related to diabetic foot ulcers?
- When should family be involved in therapy collaboration?

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