



Optimizing Outcomes in Podiatric Wound Care

Successful treatment requires a multi-dimensional approach.

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Podiatric wound care is a specialized field focusing on the treatment and management of wounds on the feet, ankles, and lower extremities. These wounds are often caused by underlying conditions such as diabetes, vascular diseases, or trauma. Effective podiatric wound care is essential for preventing complications, promoting healing, and improving patient outcomes. Podiatric wounds, especially those caused by vascular disease, trauma, renal disease, and diabetes pose significant challenges in healthcare. These wounds are more complex and require a multidisciplinary approach to include podiatrists, vascular surgeons, endocrinologists, infectious disease specialists, cardiologists, primary care physicians, radiologists, nutritionists, prosthetists, wound care nurses, and other healthcare professionals.

Understanding the different types of wounds that podiatrists encounter is essential for effective management and prevention. Podiatrists are well versed in diabetic foot ulcers, neuropathic ulcers, venous stasis ulcers, pressure ulcers, and arterial ulcers. This paper will provide an overview of treatment of the diabetic foot ulcer. The goal is to increase the awareness of providers' ability to effectively treat a DFU.

The International Working Group on the Diabetic Foot (IWGDF) defines the diabetic foot as a foot with an infection, ulceration, or destruction of tissues of the foot associated with neuropathy and/or peripheral artery disease in the lower extremity

of a person with a history of diabetes mellitus. The diabetic foot is a serious complication of diabetes which aggravates the patient's condition, and also places a significant strain on one's socioeconomic status.

Approximately 1.2 million people (5% of a United States diabetic population of approximately 24 million people) develop a foot ulcer every year, 2.9 million people (approximately 12% of patients with diabetes) have a history of foot ulceration, 60% of lower-limb amputa-

vascular status, neurological status, as well as the musculoskeletal system. A thorough patient examination will allow you to establish likely neuropathy and peripheral arterial disease from symptoms such as burning, tingling or numbness, pins and needles, and cramping after short distances. This includes evaluating the size, depth, and condition of the wound, as well as assessing the patient's overall health and any underlying conditions. Regular monitoring is essential to track healing progress

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tions occur in patients with diabetes, and 85% of lower-limb amputations in patients with diabetes are preceded by a foot ulcer. Five-year mortality following amputation was 39% to 68% in various studies. The majority of foot ulcerations will heal (60-80%), while 10-15 % will remain active, and 5-24% will lead to limb amputation. In one year's time, the rate of recurrence of a diabetic foot ulcer within one year is 40%.

Principles of Wound Care

1) Assessment

Effective wound care begins with a thorough assessment. Physical examination of the diabetic foot consists of assessment of the skin,

and make necessary adjustments to the treatment plan. Imaging studies such as x-rays, MRI, CT, bone scans, laboratory tests, and wound cultures should be considered.

Diabetic neuropathy is the most common factor in diabetic foot ulcer. Neuropathy can affect the motor, sensory or autonomic fibers, and result in muscle weakness and atrophy, loss of protective sensation and sweating, and vasodilation respectively. Loss of sensation results in repetitive injuries from internal or external sources that may lead to foot ulcerations. Light touch sensation monofilament testing and temperature sensation as well as proprioception and deep tendon reflexes are essential.

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In addition to diabetic neuropathy, peripheral arterial disease, foot deformity, and medical history of diabetic foot ulcerations are the most important risk factors for new diabetic foot ulcer formation, if preventive measures are not enacted in a timely manner. In addition, poor glycemic control, chronic kidney disease, and smoking play a negative role in healing diabetic foot ulcerations.

Chronic hyperglycemia is a hallmark of diabetes, and it plays a major role in the development of diabetic wounds. Hyperglycemia impairs the wound healing process, including the function of immune cells such as neutrophils and macrophages, which are critical for fighting infection. Hyperglycemia contributes to inflammation and oxidative stress, which can in turn exacerbate tissue damage.

2) Debridement

Debridement is the process of removing dead or infected tissue from the wound to promote healing by creating a clean wound bed (Figure 1). This can be done surgically, mechanically, chemically, or autolytically, depending on the wound and patient condition. The IWGDF Guidelines recommend sharp debridement as the standard of care. Debridement reduces the risk of infection, and allows for healthy tissue, and aids in granulation tissue formation (Figure 2). If there is evidence of new necrotic or fibrotic tissue or there is clinical evidence of active infection, debridement should be repeated every 24-72 hours.

3) Infection Control

Preventing and managing infection are critical components of wound care. This involves using ap-

propriate wound dressings, administering antibiotics if necessary, and educating patients on proper wound hygiene. Signs of infection include increased redness, swelling, warmth, and discharge from the wound. Antibiotic therapy mainly depends on microbiological findings in conjunction with antibiotic resistance. Swab cultures should be avoided when possible and deep tissue cultures of



Figure 1: Image of diabetic foot ulcer prior to debridement.

the wound should be taken. Adequate tissue samples and timely administration of antibiotics play a role in decreasing the amputation rate.

Osteomyelitis is an infection of the bone and is a serious complication of diabetic foot ulcerations. Timely and accurate diagnosis is crucial for the most effective treatment.

Bone biopsy is considered to be the gold standard for confirming osteomyelitis. The combination of bone biopsy with imaging techniques such as MRI can provide a comprehensive diagnostic approach to wound healing. An MRI helps to localize the suspected area of osteomyelitis, allowing for a biopsy to be taken at the area most affected by the organism and improving the likelihood of obtaining a representative example.

4) Vascular Assessment

Adequate blood flow is essential for healing diabetic foot ulcerations. Peripheral arterial disease can lead to prolonged healing time and increased amputation rates.

The IWGDF guidelines suggest that urgent vascular intervention be considered in patients with one of the following criteria: ankle pressure < 50 mm Hg; toe pressure < 30 mm Hg; ankle-brachial index < 0.4 or transcutaneous oxygen pressure < 25 mm Hg.

No signs of wound healing within 4-6 weeks despite optimal management is an indication that further vascular imaging and/or revascularization is needed regardless of the results of the initial vascular diagnostic testing. In patients with ischemic ulcers, revascularization may be necessary to restore adequate blood flow to the affected area through endovascular therapy, angioplasty stenting, or bypass surgery.

5) Moisture Balance

Maintaining an optimal moisture balance is crucial for wound healing. Wounds that are too dry can become desiccated and delay healing, while overly moist wounds are prone to maceration and infection. Advanced wound dressings such as hydrogels, foams, and alginates are designed to maintain the right level of moisture. Ulcers heal more rapidly and have less complications by infection when they are in a moist environment, with the exception being gangrene. The ideal dressing should be contaminant-free, able to absorb excess exudate, maintain a moist environment, be impermeable to microorganisms, and allow gaseous exchange.

6) Off-loading

For diabetic foot ulcers, offloading (reducing pressure on the wound) is essential. Retrospective and prospective studies have shown that elevated plantar pressures contribute to the development of plantar ulcers in diabetic patients. Plantar shear stress as well as vertical plantar pressure are known causative factors of



Figure 2: Image of diabetic foot post-surgical debridement.

diabetic foot ulcers, which result from mechanical loading of the foot during ambulation or activity. The elimination of repetitive stress as well as decrease in plantar pressures are imperative if success in wound healing is going to occur.

Off-loading helps to redistribute or eradicate plantar pressure, result-

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ing in the protection of high-pressure zones in the diabetic foot. The most effective method of offloading, which is considered to be the gold standard, is the non-removal total contact cast (TCC). The TCC help distribute plantar pressure from the forefoot and midfoot to the heel. Contraindications to total contact casting are deep abscess, osteomyelitis, severe foot

9) Amputation

Amputation is unavoidable in some situations despite the limb salvage efforts. Careful approach should be taken when planning for an amputation to restore or maintain function. Amputation may result in increased economic burden, physical burden, and emotional burden. The more proximal the amputation, the greater the amount of energy that is required during activity;

standing the types of wounds that commonly affect the lower extremities and adhering to the basic principles of wound care—assessment, debridement, infection control, moisture balance, off-loading, and patient education—healthcare providers can help promote healing, prevent complications, and improve the quality of life for their patients. Early intervention and consistent care are key to achieving positive outcomes.

The management of the diabetic foot remains a major therapeutic challenge. Regular foot examinations, foot hygiene, patient education, appropriate footwear, prompt vascular and infectious disease referrals, as well as offloading are all essential to promote healing of the diabetic foot. PM

The more proximal the amputation, the greater the amount of energy that is required during activity; therefore more distal amputations are preferred when possible.

ischemia, and poor skin integrity. Other forms of off-loading include the instant total contact cast, DH Pressure relief off-loading shoes, CAM walkers, and half shoes or wedge off-loading shoes. Off-loading helps to prevent further trauma to the wound, allowing it to heal more effectively.

7) Patient Education

Educating patients on proper wound care is vital for successful treatment outcomes. Patients should be informed about the importance of daily foot inspections, proper footwear, and managing underlying conditions like diabetes. They should also be encouraged to seek medical attention if they notice any signs of worsening.

8) Adjunctive Treatment

In addition to the conventional treatment modalities, there are various adjuncts that may assist with wound healing. The IWGDF Guidelines indicate that these modalities can be considered for non-infected diabetic foot ulcerations that fail to heal after 4-6 weeks of optimal management. Other modalities include placenta-derived products, growth factors, platelet-rich plasma, bioengineered skin substitutions, extracellular matrix proteins, MMP modulators, hyperbaric oxygen therapy, and negative pressure wound therapy.

therefore more distal amputations are preferred when possible. The five-year mortality rate following the onset of a diabetic foot ulcer is approximately 30% to 50%.

Conclusion

Diabetic foot ulcers are associated with substantial healthcare costs. The cost of treating an ulceration in the United States ranges from \$20,000-\$40,000 per case, depending on the severity of the complications. The total cost of diabetic foot care in the United States is estimated to be over \$13 billion annually, including direct medical costs as well as costs related to lost productivity. These statistics underscore the importance of early detection, preventative strategies, and comprehensive care. The complexity of podiatric wound care necessitates a multidisciplinary approach to ensure that a patient is evaluated as a whole. The key to successful outcomes includes effective communication with clear instruction, a patient-centered focus to include patient education and resources, and comprehensive care, where all underlying factors contributing to wound development and delayed healing are addressed.

Podiatric wound care is a complex and critical aspect of healthcare, particularly for patients with diabetes or vascular conditions. By under-

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