

A Physiotherapy Study on Diabetic Foot Ulcers and its Clinical Perspectives

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Abstract: *Background:* At least half of all amputations occur in people with diabetes, most commonly because of an infected diabetic foot ulcer. A thorough understanding of the causes and management of diabetic foot ulceration is essential to reducing lower-extremity amputation risk. This compendium elucidates the pathways leading to foot ulcers and enumerates multiple contributory risk factors. The authors emphasize the importance of appropriate screening and wound classification and explain when patients should be referred for specialist care, targeted education, or therapeutic shoes or insoles. They provide a comprehensive review of treatment approaches, including devices for foot lesion off-loading and aggressive wound debridement through mechanical, enzymatic, autolytic, biologic, and surgical means. Because infection and peripheral artery disease are key contributors to amputation risk, the authors discuss the diagnosis and management of these conditions in detail. They also review the expanding armamentarium of evidence-based adjunctive treatments for foot ulcers, including growth factors, skin substitutes, stem cells, and other biologics. Because Charcot neuroarthropathy is a serious but frequently missed condition in people with diabetic neuropathy, the authors explain the differential diagnosis of the hot, swollen foot that is a hallmark of this condition. The article ends with an overview of four strategies for maintaining a foot in remission, followed by a brief look at the future of diabetic foot care.

Keywords: Diabetic foot, Charcot neuroarthropathy, diabetic foot care and Physiotherapy Managements

1. Introduction

Diabetic foot is the most dreaded complication of diabetes mellitus. Diabetic neuropathy is most disabling as it leads to increased morbidity and decreased quality of life in patients with diabetes. Failure to recognize symptoms of autonomic neuropathy may lead to secondary complications in form of diabetic foot ulcers and cardiac arrhythmias. One of the most feared complications of this disease is loss of lower limb and is a challenge to surgeons. This is most dangerous in view of sudden cardio respiratory deaths during and after surgery in diabetics. This case history demonstrates the adverse effects of diabetes on feet, and the multidisciplinary team's contribution to successful treatment and healing of a complex foot lesion. A case of Diabetes mellitus involving both feet is discussed. Foot ulcer complications are the main reason why people with diabetes are hospitalized and have to undergo amputations. 20-40% of all the health care costs comprised for diabetes are for diabetic foot complications. 7-10% of patients with diabetes and neuropathy will develop an ulcer; this increases up to 30% for patients with diabetes and other comorbidities. 5-8% of patients will undergo a major amputation 1 year after developing a diabetic ulcer. A foot ulcer preceded 85% of diabetes related amputations. "Diabetes increases the risk of amputation 8-fold in patients aged >45 years, 8 12-fold in patients aged >65 years and 23-fold in those aged 65—74 years."

2. Specific Foot Conditions

Diabetic Neuropathy

Due to diabetic neuropathy patients do not have the protective sensation in their feet. Thus the patient will not feel any trauma, like stepping on something sharp or wearing tight shoes. This could lead to continuous tissue damage, ulceration, foot deformities, increased plantar

pressure, and infection².



Diabetic Foot Ulcers and Delayed Wound Healing

- In the diabetic foot peripheral arterial disease (PAD) is seen as the primary cause for vascular impairment¹.



- The risk of developing PAD is increased with diabetes and ischemia is considered the biggest culprit delaying wound healing.^[1]
- Diabetic neuropathy and ischemia combined is called neuroischemia. In these cases the wound healing is affected by the severity of the ischemia¹.
- Diabetes Mellitus and Diabetic Ulcers

Diabetic Foot Infections

- The most common sign is increased ulcer exudation rate¹.

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- Diabetic foot infections may lead to poor glycemic control¹.
- There is a 50% delay in diagnosing deep foot infections in diabetes patients because the infection markers in their blood tests are found absent¹.
- Infections in a diabetic foot can rapidly spread to the rest of the body and if not treated properly could lead to a life-threatening general septic infection¹.

Diabetic Foot (Charcot foot/joint)

Also known as Charcot-Marie-Tooth Disease or Diabetic foot arthropathy. They may present with: Muscle weakness in the feet, ankles, legs and hands

- an awkward way of walking (gait)
- highly arched or very flat feet
- numbness in the feet, arms and hands

3. Assessment

Clinical Examination according to Lepántalo et al¹.

- History
- General (Medications, diseases, cardiovascular risk factors, work, hobbies, lifestyle, diabetes symptoms/ complications)
- Foot specific (risk factors and information about present ulcer – duration, treatment, etiology)
- Inspection (at least once a year)
- Vascular
- Dorsalis Pedis Pulse
- Tibialis posterior pulse



- Venous refilling time - >5sec on dependency
- Foot appearance
- Neurological
- 10-gram (5.07) Semmes—Weinstein monofilament
- Vibration (128 Hz-tuning fork)
- Pinprick discrimination and tactile sensation on the dorsum of the foot
- Achilles tendon reflexes
- Observe for foot deformities or bony prominences
- Ulcer – look for perfusion, extent and size, and infection
- Infection
- Local signs and symptoms of inflammation: purulent secretion, redness, warmth, swelling, pain, delayed healing, and or bad odor.
- Systemic signs: fever, and poor general condition
- Increased exudation in the ulcer
- X-rays to determine the presence of foreign bodies, gas, osteomyelitis, osteolysis, or joint effusion
- MRI, bone scan or CT scan to determine the extent of the infection
- Non-invasive vascular studies
- Ankle pressure

- Ankle-brachial systolic pressure index (ABI) (<0.6 indicates significant ischemia in respect to wound healing)
- Toe pressures (<30 mmHg indicates severely impaired healing)
- Vascular imaging
- Sub-talar ROM (any reduction may increase plantar pressures during walking)².

Management / Interventions: Physical Therapy

- Physical Therapists are involved in both the prevention and management of diabetic foot complications⁴. This is done by gait, posture, and foot off-loading education and training⁴.
- Diabetes Medical and Physical Therapy Management
- Charcot Foot Medical Management
- Charcot Foot Physical Therapy Management
- Charcot Foot Medical and Physical Therapy Management
- Diabetic Neuropathy Management/Intervention
- The Physical Therapist is also involved in the rehabilitation process after an amputation.
- Patient education
- Diabetic Foot Care Guidelines
- Diabetes Complication and Amputation Prevention
- Diabetic Foot Overview
- Shoes and Orthotics for Diabetics
- How to care for your diabetic feet
- In a 2009 evidence-based literature review, the authors found that TENS might be effective for pain treatment in diabetic neuropathy⁵.
- The authors of a 2008 control study of 30 neuropathic diabetic patients concluded that as part of the multidisciplinary approach physical therapy plays an important role in the treatment of diabetic neuropathic patients².
- They used the following adjunct on the treatment group every day for twelve weeks:
- Low level laser irradiation for 10-15 minutes/session on the ulcer
- Laser bio stimulation on the peroneal nerve trunk (at the fibula head) at 1000 Hz for 15 minutes
- Specific dorsiflexion and ankle ROM exercises
- Education on foot care and home exercises

Medical Management

- Diabetic Wound Care Management. "> Best Practice Guidelines: Wound Management in Diabetic Foot Ulcers
- Antibiotic treatment is indicated in all infected wounds in combination with wound care, until the infection is cleared up¹.
- Hospitalization, immobilization, and IV antibiotics are indicated for limb threatening or uncontrolled infections¹. Urgent surgery is indicated if the infection is "accompanied by a deep abscess, extensive bone or joint involvement, crepitus, substantial necrosis or gangrene, or necrotizing fasciitis¹". Lepántalo et al. recommend that "surgical

intervention for moderate or severe infections is likely to decrease the risk of major amputation”¹.

4. Discussion

Diabetes can cause damage to the nerve and vascular supply in the feet and legs. Patients with neuropathy have reduced or no sensation and, therefore, might be unaware of any trauma to their feet caused by ill-fitting footwear or an object in their shoes, such as a piece of glass, a stone or a drawing pin. Continued walking on an injured foot will damage it further and minor lesions can become more serious. A simple examination of the feet, feeling inside the shoes before wearing them and not walking barefoot can help to prevent feet as your face or you will bury your feet before your face” Techniques to prevent and treat lower extremity amputation in patients with diabetes vary from simple foot inspection to complicated vascular and reconstructive surgery. Early identification of risk factors, careful and regular evaluation, and aggressive treatment in a multidisciplinary team approach prevent amputation in most cases of diabetic foot ulcer. This case history demonstrates the adverse effects of diabetes on feet. The patient had a dense neuropathy, which meant that he was unaware of the chicken bone embedded in his foot. He continued to put weight on the foot, which resulted in a minor foot injury developing into a serious health problem. Poor blood supply to his feet and legs hindered wound healing. In patients with diabetic foot problems, often a combination of factors cause the tissue to breakdown; in this case it was neuropathy, vascular disease and a minor foot lesion that became infected. All of the co-existing factors must be addressed when treating patients with diabetic foot ulcers.

5. Conclusion

Diabetic foot complications are, as has often been said, common, complex, and costly. Demographic trends suggest that these complications, including ulcers, infections, PAD, and amputations, will continue to be highly prevalent⁶. Future directions should focus not only on the promising therapeutic advances discussed in this monograph, but also on novel monitoring systems^{7,8-12}. For example, efforts designed to identify pre-ulcerative inflammation through the past generation have now culminated in home-based monitors that can alert patients up to several weeks in advance of a potential complication¹⁰. Similarly, smart insoles paired with smart watches may be able to identify potentially damaging pressure, which over time can cause blistering or callusing and tissue loss⁹. Combining the evidence-based and common-sense therapies described here with emerging technologies has the potential to help us maximize ulcer-free, hospital-free, and activity-rich days for our patients.

References

- [1] Lepántaloa M, Apelqvist J, Setaccie C, Riccof JB, de Donatoe G, Beckerg F, Robert-Ebadig H, Caoh P, Ecksteini HH, De Rangok P, Diehml N. Chapter V: Diabetic Foot. *European Journal of Vascular and Endovascular Surgery*. 2011; 42(S2):S60-74.2.
- [2] Zakaria HM, Adel SM, Tantawy SA. The Role of Physical Therapy Intervention in the Management of Diabetic Neuropathic Foot Ulcers. *Bull. Fac. Ph. Th. Cairo Univ*. 2008 Jul; 13(2).
- [3] The Diabetic Foot Exam <https://youtu.be/aVz-Ja9Grvg>.
- [4] 3. Kalra S, Kalra B, Kumar N. Prevention and management of diabetes: the role of the physiotherapist. *Diabetes Voice*. 2007; 52 (3)
- [5] Dubinsky RM, Miyasaki J. Assessment: Efficacy of transcutaneous electric nerve stimulation in the treatment of pain in neurologic disorders (an evidence-based review) Report of the Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology. *Neurology*. 2010 Jan 12; 74(2):173-6. 29.
- [6] Shrapnel GH, Mills JL, Lavery LA, Armstrong DG. Health care service and outcomes among an estimated 6.7 million ambulatory care diabetic foot cases in the U.S. *Diabetes Care* 2017;40:936–942. .
- [7] Khan T, Armstrong DG. Ulcer-free, hospital-free and activity-rich days: three key metrics for the diabetic foot in remission. *J Wound Care* 2018; 27(Suppl. 4):S3–S4.
- [8] Basatneh R, Najafi B, Armstrong DG. Health sensors, smart home devices, and the Internet of Medical Things: an opportunity for dramatic improvement in care for the lower extremity complications of diabetes. *J Diabetes Sci Technol* 2018;12:577–586
- [9] Najafi B, Ron E, Enriquez A, Marin I, Razjouyan J, Armstrong DG. Smarter sole survival: will neuropathic patients at high risk for ulceration use a smart insole-based foot protection system? *J Diabetes Sci Technol* 2017; 11:702–713.
- [10] Roser MC, Canavan PK, Najafi B, Cooper Watchman M, Vaishnav K, Armstrong DG. Novel in-shoe exoskeleton for offloading of forefoot pressure for individuals with diabetic foot pathology. *J Diabetes Sci Technol* 2017; 11:874–882.
- [11] Frykberg RG, Gordon IL, Reyzelman AM, et al. Feasibility and efficacy of a smart mat technology to predict development of diabetic plantar ulcers. *Diabetes Care* 2017;40:973–980
- [12] Armstrong DG, Holtz-Neiderer K, Wendel C, Mohler MJ, Kimbriel HR, Lavery LA. Skin temperature monitoring reduces the risk for diabetic foot ulceration in high-risk patients. *Am J Med* 2007; 120:1042–1046 71. Yap MH, Chatwin KE, Ng CC, et al. A new mobile application for standardizing diabetic foot images. *J Diabetes Sci Technol* 2018;12:169–173