Diabetic foot: primary prevention and the patient in remission

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Key message
Shoes are not primarily suitable for offloading in the case of ulcers. Only when a non-removable knee-high device is contraindicated or not tolerated by the patient it should be considered, and then only when it is acceptable to the patient. The loss of the gift of pain is a very serious impairment and has to be addressed with proper footwear. The examination primarily screens for loss of protective sensation (LOPS) and peripheral artery disease (PAD) to prioritize treatment and guide follow-up scheduling. All patients with diabetes need special attention for their footwear and special education on footcare and shoe adherence. All patients in risk category one or more need regular professional control. The general footwear advises for diabetics are of utmost importance for all foot professionals and diabetics. Proper size and volume (no pressure spots possible), no stitches inside, foot orthosis with pressure distributing properties, proper balanced out the pros and cons of a rocker profile, optimal shoelock with closure.

Etiology and epidemiology of foot complications
The annual incidence of foot ulcers for people with diabetes is approximately 2%, conservatively yielding a 25 - 34% lifetime risk for developing a diabetes related ulceration.\(^1\)\(^2\)\(^3\) Approximately 50% of wounds will become infected, and between 20 and 30% of these cases lead to some form of amputation. Therefore, it should come as no surprise, that every twenty seconds, a limb is amputated worldwide due to diabetic complications.\(^4\) Following any diabetes-related amputation, the five-year patient mortality rate is greater than for most cancers. Unfortunately, many of these amputations could be avoided with proper screening, timely care, and proper prevention. Diabetes has multiple presentations, including type 1 and type 2 diabetes. Type 1 diabetes occurs due to the inability of the human body to produce insulin. Type 2 diabetes results from the body’s developed resistance to insulin. Obesity and metabolic complications resulting from chronically increased blood sugars may also play a role in the harmful effects. Sensorimotor neuropathies and peripheral vasculopathies can increase risk for development of a host of complications, most no-
Limited joint mobility cause increased plantar pressures and play a major role in diabetic foot disease. Decreasing foot pressures has repeatedly been proven to reduce ulcer formation, thus, proper management and offloading through methods such as orthopedic footwear may help prevent against the development of further diabetes related foot complications.

The comprehensive diabetic foot examination (CDFE)

The assessment of lower extremity risk begins with a complete patient history. Essential elements include the patient’s history of cigarette smoking, ulceration, gangrene or necrosis, Charcot neuroarthropathy, or lower extremity surgery such as vascular stenting or amputation. Historically gait alteration, instability, skin ulceration, infection, amputation and premature mortality. Healthy people with intact sensation and proprioception can sense each interaction of the lower extremity during the stance phase. However, diabetic patients with neuropathy and loss of proprioception are unable to experience these sensations, increasing their risk of injury and falls. This loss of the gift of pain causes patients to overexpose their feet to excessive plantar pressures and shear stresses; greatly increasing their risk of soft tissue breakdown, and likely delaying their response time to seeking medical care. The most common triad of causative factors for foot ulceration is neuropathy, deformity, and trauma. Gait abnormalities, biomechanical and osseous deformities, soft tissue changes, and limited joint mobility cause increased plantar pressures and play a major role in diabetic foot disease. Decreasing foot pressures has repeatedly been proven to reduce ulcer formation, thus, proper management and offloading through methods such as orthopedic footwear may help prevent against the development of further diabetes related foot complications.

Figure 35.1
Core components of the diabetic foot examination.
128 Hz tuning forks assess vibration perception quickly and easily over the tip of the great toe bilaterally. An abnormal test requires the patient not detect the vibration while the tester still perceives the vibration while holding the tuning fork (Figure 35.3).

The pinprick examination assesses pain perception. The clinician applies a disposable pin just proximal to the toenail on the dorsal surface of the hallux. Inability of the patient to detect pain represents an abnormal test result. The posterior tibial and dorsalis pedis foot pulses are palpated and characterized as either present or absent. Diabetic patients with claudication, rest pain, or non-healing ulcers also should be referred to a vascular specialist.

Classifying risk for ulceration or reulceration: The American Diabetes Association (ADA) risk classification (Table 35.1)

Following the thorough examination as described above, the patient’s lower extremity risk status is graded on a scale of 0-3 corresponding to very low, low, moderate and high ulceration risk, respectively. In any of the diabetic patients, if mobility seems limited, physiotherapy may be integrated as an adjunct to other therapies. All patients should be educated on proper shoe selection and foot care.

Integration of foot orthoses and footwear modification based on ADA risk Category

With knowledge of the techniques listed above, one now has the tools to integrate therapy in a more precise manner based on a given patient’s risk status.2, 5, 10

ADA risk category 0: Intact sensation, no history of ulcer

This patient is at the lowest tier of risk and may benefit from a simple, annual inspection by a foot specialist. Each visit should include basic risk screening and advice on well-fitting athletic and comfort shoes for daily activity. Because these patients do not have signs of reduced protective sensation or peripheral arterial disease, their risk for developing a wound is very low. These

![Figure 35.2](image)
patients will often do well in regular athletic or walking shoes, and those with substantial pes cavus (high arch) or pes planus (flat feet depression) may benefit from over the counter orthoses for palliative discomfort relief. In cases of complaints because of foot deformities, these deformities should be treated as indicated. It is essential to have an optimal fitting (length and width) and ample space for hammer and/or clawing toes and other deformities for preventing pressure spots, an optimal closure on the instep for preventing slipping and shear forces, and proper pressure distribution on the sole.

ADA risk category 1: Loss of protective sensation, with or without deformity

This patient, by virtue of their LOPS, is now at significantly greater risk for ulceration. Proper footwear is critical for this patient and should be based specifically on location and level of deformity. At the very least, the majority of these patients require some type of custom foot orthosis to reduce peak plantar pressures and a more accommodative athletic or comfort shoe to reduce skin irritation. In fact, fitting patients with diabetes and neuropathy is critically important, as some 9 in 10 patients at risk of ulceration are wearing poorly fitting shoes. People with greater degrees of deformity, such as prominent osseous structures or descended metatarsal heads, may also require a prescriptive shoe. While rare in category 1, severe deformities will require custom moulded shoes and possibly outsole modifica-
tar pressure relieving effect during walking (i.e. 30% relief compared to plantar pressure in standard of care therapeutic footwear), and encourage the patient to wear this footwear.

7. Do not prescribe, and instruct the patient with diabetes not to use, conventional or standard therapeutic shoes to heal a plantar foot ulcer.

8. Consider using shoe modifications, temporary footwear, toe spacers or orthoses to offload and heal a non-plantar foot ulcer without ischemia or uncontrolled infection in a patient with diabetes. The specific modality depends on the type and location of the foot ulcer.

9. Consider Achilles tendon lengthening, joint arthroplasty, single or pan-metatarsal head resection or osteotomy to prevent a recurrent foot ulcer when conservative treatment fails in a high-risk patient with diabetes and a plantar foot ulcer.

10. Consider digital flexor tenotomy to prevent a toe ulcer when conservative treatment fails.

Figure 35.6
in. The higher the heel elevation, the higher the pressure at the metatarsal region, in normal shaped feet.

7. A removable insole makes inspection and adaptations possible.

8. For optimal pressure distribution at least regular check with a Harrismat (qualitative information), preferrably with inshoe foot pressure measurements (quantitative information), is necessary.

9. All patients should be educated on how donning and doffing shoes. Mostly people forget to push the heel to the counter and then lace the shoes. When the foot, during donning, is placed a little bit more forward in the shoe, lacing will not result in firm closing and the foot will slip in and out the heel.

10. In case of doubts if a ready-made shoe or a therapeutic shoe will cause high pressure spots, provide the patient with a custom made shoe.

11. In case of LOPS, diabetic socks without seams should be advised.

12. Treatment with shoe adaptations / custom-made footwear is regular professional inspection.

13. See also Chapter 19 Tips and tricks in pedorthic consultancy after 40 years of experience.
References: