

Examining the diabetic foot in general practice

Neil Baker, Duncan Fowler

Understanding the relationship between diabetes pathophysiology and foot complications is fundamental to their avoidance and management. The foundations of good foot care in diabetes involve adequate monitoring and the opportunity to reinforce messages of self-care and daily foot examination (Boulton, 1992). This article aims to provide a foot examination guide for GPs working with a person with diabetes and to suggest strategies for preventing diabetic foot problems.

The reasons for the increased risk to the diabetic foot are complex but include neuropathy and peripheral arterial disease as well as more controversial areas such as increased susceptibility to infection. During examination of the diabetic foot the trained professional must aim to:

- identify any factors predisposing to foot complications
- administer preventative interventions
- identify pre-existing complications that may require treatment
- emphasise to the patient the importance of foot examination and teach the individuals how to check their own feet
- identify evidence of more general medical problems.

Box 1 details some useful foot inspection advice.

Neuropathy

Peripheral neuropathy is perhaps the most common complication that affects the feet of people with diabetes (Kumar et al, 1994) and prevalence of neuropathy has been shown to increase with diabetes duration (King and Zimmet, 1993).

Sensory neuropathy

Patients frequently describe sensations of pins and needles, cotton wool, numbness, or that their feet

feel cold even when warm to the touch – these are symptoms of sensory neuropathy, which is characterised by an absence or reduced ability to detect stimuli such as light touch, vibration, heat and pain. As a result of sensory neuropathy, injuries often go unnoticed until they have deteriorated to ulceration or become infected. It is this loss of pain sensation that has been clearly implicated as a major causal factor in foot ulcer development (Pecoraro et al, 1990), with up to 61% of foot ulcers having a neuropathic component.

Up to 10% of people with diabetes can develop painful peripheral neuropathy (Young et al, 1993), although, paradoxically, both can be present together as painless–painful neuropathy.

Motor neuropathy

This gives rise to the classically described high arch, claw-toed foot shape. The clawing of the lesser toes is said to be due to the wasting of intrinsic foot muscles (Renwick et al, 1998) with an associated loss of muscle strength, dexterity and general stability.

Autonomic neuropathy

Within feet, manifestations of autonomic neuropathy are subtle but important. Typically these include; reduced sweating, loss of vasoconstriction, bounding pulses, peripheral oedema and dilated dorsal veins. Clinically, the

Article points

1. The prevention of ulcers in the diabetic foot is vital in order to reduce the high number of amputations relating to this condition.
2. GPs should work with people with diabetes to ensure adequate monitoring of feet and educate them about self-monitoring.
3. Feet should be inspected and the degree of neurological and vascular malfunction should then be assessed.

Key words

- Diabetic foot
- Neuropathy
- Peripheral vascular disease

Neil Baker is a Diabetes Specialist and Research Podiatrist. Duncan Fowler is a Consultant Physician and Endocrinologist.

Box 1. Foot inspection advice.

- Before you perform any test, always explain what you are doing and why using language that is clear, precise and easy to understand.
- Share the results with the patient. This reinforces patient empowerment.
- Note whether the patient can see and reach their feet easily. Reduced ability to do so increases the risk of complications.
- Start by inspecting both feet systematically looking at the nails, toes and skin in turn, not forgetting to lift the foot to look at the heels.

Box 2. Sensory testing with a 10 g nylon monofilament.

- Bend the monofilament before use to remove any residual stiffness.
- Explain to the patient what you are going to do and, as an example, apply the monofilament to a sensitive area of their skin such as the inside of the forearm.
- Ask the patient to close their eyes and say YES every time they feel a touch, no matter how light.
- Place the monofilament at 90° to the skin surface slowly push the monofilament until it has bent approximately 1 cm. This should take 1–2 seconds. Do not ‘jab’ the skin.
- Hold the monofilament in this position for 1–2 seconds and then slowly release the pressure, over 1–2 seconds, until the monofilament is straight. At this point remove the monofilament from contact with the skin.
- Repeat this procedure for all testing sites on both feet and record the findings.
- If during this test you find areas where the individual does not respond, repeat the test at the same site twice more and if there is still no response report the test as negative.



Figure 1. Top: Good sites to test for neuropathy using a 10g monofilament. Bottom: a 1 cm bend in the monofilament

skin appears dry, pink and warm to touch with strong, palpable foot pulses, dilated dorsal veins and some oedema.

Clinical testing for ulcer risk due to neuropathy

When screening in a busy clinical environment we would suggest that the plantar surfaces of the big toe and a minimum of three metatarsal heads should be tested using a 10g nylon monofilament (see Box 2 and Figure 1 for usage guides). Increased ulcer risk due to neuropathy can be determined by the inability to detect 1 or more sites on each foot.

In day-to-day clinical practice it is most important to be able to identify those people with neuropathy who are at greater risk of developing foot ulceration rather than those who have nerve dysfunction alone. This can be achieved by good clinical examination and using validated assessment tests collaborated by patient symptoms (Baker et al, 2005a). However, if only one method is to be used as a screening tool in a busy practice,

we would advocate the 10g nylon monofilament as it is quick, easy to use, cheap, reliable and reproducible (Smieja et al, 1999). The literature is unclear about the definitive sites that must be tested for determining ulcer risk.

Peripheral arterial disease

Peripheral arterial disease is reported to be the single most likely cause of lower extremity amputations in people with diabetes (Pecoraro et al, 1990; Apelqvist et al, 1992, Bird et al, 1999) and, importantly, can be rapid in its progression and occurs at a young age (Brand et al, 1989; Strandness et al, 1964). Several clinical features forewarn of its progression, including changes in ankle pressures or Doppler signals, soft tissue atrophy and nail dystrophies. Further information regarding vascular assessment is shown in Box 3.

The use of pharmaceutical agents (such as statins and antiplatelets) in conjunction with lifestyle advice should be implemented for all patients with evidence of vascular disease.

Patients with critical limb ischaemia require urgent referral to vascular surgeons and podiatry for meticulous foot-care provision.

Skin

Xeroderma

Xeroderma (dry skin) can result in altered skin function by reducing its visco-elastic and anti-frictional qualities. In turn this can lead to callus formation, skin fissures and potential infection, tissue loss and ulceration. The frequent and regular use of bland emollients can help address this problem and additionally reinforces the importance of self-care and foot examination.

Fissures

Skin fissures are a common clinical finding occurring most frequently on the heel borders, and are associated with autonomic neuropathy or ischaemia. They can deteriorate rapidly to ulceration and frequently become necrotic in patients with neuro-ischaemia. They must be dealt with appropriately and swiftly, referring to a podiatrist for callus debridement at the fissure margins to allow the edges to knit together. Patients must be encouraged to apply emollients at least once daily, preferably using a urea or

glycerine based cream (Miettinen et al, 1999; Loden, 1996).

Callus

A plantar callus is a common feature of the neuropathic foot. Typically located over the toe apices and metatarsal heads it is generally quite thick and relatively soft (Bevans, 1999). In contrast, callus in the neuro-ischaemic or ischaemic foot is typically thin, dry, glassy and very hard and is particularly evident on the borders of the feet.

Regular podiatrist reduction of callus in neuropathic patients is an essential part of ulcer prevention (Young et al, 1992; Murray et al, 1996). Patients should be encouraged to use emollients daily and a mild abrasive (emery board), but never sharp implements.

The presence of bloodstained callus is highly predictive of ulceration being present in up to 80% of cases (Rosen et al, 1985; Harkless et al, 1987). Clinically this looks like raspberry or blackcurrant jam under hard skin. This situation should be treated as a clinical emergency that requires urgent referral to podiatrists for debridement and pressure relief.

Nail conditions

Onychogryphosis and onychauxis

The nail plate appears generally thickened, distorted and may be discoloured but not friable. These conditions are most commonly caused by either a single major trauma or repeated minor injuries such as toe stubbing. Checking inside the shoe will quickly determine if the toebox area is too shallow, as a depression in the shoe upper will be felt. If a nail plate gets too thick, ulceration of the nail bed can result, which can extend into the bone quite quickly. A podiatrist can help prevent any such problems by reducing the nail-plate regularly.

Fungal infections

Common sites for skin infection are between the toes – presenting as wet or dry fissures – and under the medial arch – presenting as vesicular eruptions with surrounding skin flaking. Nail infections are characterised by thickened, discoloured and friable nail plates.

Box 3. Vascular assessment of the diabetic foot.

- There are two arteries that should be palpable in the foot (see *Figure 2*):
 - Dorsalis pedis
 - Posterior tibial
- If either is palpable then significant arterial ischaemia is unlikely.
- Care must be taken to avoid confusing a weak foot pulse with the pulse present in the examiner's finger.
- Pulses are either palpable or not: grading the magnitude of the pulse (for example, 'barely palpable' and 'easily palpable') should be avoided.
- In the presence of significant pedal oedema, foot pulses may be impossible to palpate, in which case other clinical signs and symptoms of ischaemia should be looked for: thin pale or red hairless skin with collapsed dorsal veins, dusky toes and gangrene.
- If doubt remains, examination of the foot pulses with a Doppler probe can be undertaken if available.
- If both the foot pulses are absent it is important to attempt to palpate the femoral and popliteal pulses in the leg as this can provide information as to the level of any stenoses.
 - *Femoral pulse*: to examine this pulse the patient must lie down. The pulse should be palpable midway between the anterior superior iliac spine and the midline.
 - *Popliteal pulse*: with the patient lying horizontally the knee should be flexed to 135°. Using both hands place the thumbs over the tibial tuberosity anteriorly and hook the hands behind the knee. Using the tips of the fingers, the popliteal pulse should be palpable against the tibia in the lower part of the popliteal fossa.

Although fungal skin infections are not a primary cause of foot ulceration, they erode the epidermis thereby increasing the risk of bacterial infections that can lead to spreading cellulitis and deep web-space ulceration. Even in the absence of any ulcer risk factors skin mycosis should be treated immediately by the application of topical anti-fungal creams such as terbinafine.

Bacterial infection

It is important to note that the cardinal signs of infection (redness, heat, swelling and exudate) may be reduced in those with diabetes. Unexplained raised blood glucose levels and sudden, localised pain or discomfort in neuropathic ulcers can signify the onset of infection well before the presence of any clinical signs. Foot infections are serious and can progress very quickly, which if not managed correctly and aggressively can lead to lower limb amputations. Any infection that does not show signs of responding to antibiotic therapy after 3 days should be treated very seriously and referred to a specialist foot clinic. Close liaison with the microbiology department is essential.



Figure 2. Top: Location of the posterior tibial pulse. Bottom: Location of the dorsalis pedis pulse.

Page points

1. The typical signs of infection can be reduced or absent in cases where the individual has diabetes.
2. Good early indicators of infection include unexplained rises in blood glucose levels and sudden localised pain or discomfort in neuropathic ulcers.
3. The most common foot deformities are clawed or hammer toes and hallux valgus – bunions

Any patient with spreading cellulitis requires an immediate hospital referral as it is a limb threatening condition.

Ulceration

Much has been published about these lesions and as such this article will only briefly mention that their site, size, number and appearance give very clear clues as to their underlying aetiology and healing status. The presence of foot ulceration should prompt early referral to the local specialist diabetic foot clinic – in the presence of infection this is urgent.

Foot deformity

Foot deformities commonly occur as a result of altered foot mechanics, poorly fitting footwear, neuropathy and surgery. The most common deformities are clawed or hammer toes and hallux valgus – bunions. Thus, footwear examination and advice is essential. It is important to remember that the shoes worn to attend clinics may not be those worn most of the time.

Charcot neuroarthropathy

Typically, an active Charcot would present as a foot and leg that is intense pink, warm and swollen with a deformity that has occurred fairly suddenly (Jeffcoate et al, 2000; Jude and Boulton, 2001). Always compare the suspected foot and leg with the contralateral limb. Individuals may describe pain, which, if present, is generally a dull to intense aching in the foot or calf. Pulses will be readily palpable and abnormally high ankle systolic pressures are common due to calcification and dilated dorsal foot veins are often seen. Any suspicion of an acute Charcot should lead to an urgent referral to the local specialist diabetic foot clinic and patients should be advised to avoid weight-bearing until seen.

Conclusion

This short article has attempted to provide a simple overview to help GPs identify the main risk factors for debilitating and disabling diabetic foot complications: namely ulceration, ischaemia and infection. Professor John Ward once described diabetic foot-care as the “PITS” – in order to Prevent we need to Identify, where necessary Treat

and to do that we need a good seamless Service structure that utilises multi-disciplinary skills, expertise seamlessly crossing both primary and secondary care. ■

- Apelqvist J et al (1992) Medical risk factors in diabetic patients with foot ulcers and severe peripheral vascular disease and their influence on outcome. *Journal of Diabetes and its Complications* **6**: 167–74
- Baker NR et al (2005a) A user's guide to foot screening. Part 1: Peripheral neuropathy. *The Diabetic Foot* **8**: 28–37
- Baker NR et al (2005b) A user's guide to foot screening. Part 2: Peripheral arterial disease. *The Diabetic Foot* **8**: 58–70
- Baker NR et al (2005c) A user's guide to foot screening. Part 3: Skin and joints. *The Diabetic Foot* **8**: 168–80
- Bevans JS Bowker P (1999) Foot structure and function: aetiological risk factors for callus formation in diabetic and non-diabetic subjects. *The Foot* **9**: 120–7
- Bird CE et al (1999) Quantitative and qualitative progression of peripheral arterial disease by non-invasive testing. *Vascular Medicine* **4**: 15–21
- Boulton AJM (1992) Peripheral neuropathy and the diabetic foot. *The Foot* **2**: 67–72
- Brand FN et al (1989) Diabetes, intermittent claudication, and risk of cardiovascular events. The Framingham Study. *Diabetes* **38**: 504–9
- Jeffcoate W et al (2000) The Charcot Foot. *Diabetic Medicine* **17**: 253–8
- Jude EB, Boulton AJM (2001) Update on Charcot neuroarthropathy. *Current Diabetes Reports* **1**: 228–32
- Kumar S et al (1994) The prevalence of foot ulceration and its correlates in type 2 diabetic patients: a population-based study. *Diabetic Medicine* **11**: 480–4
- King H, Zimmet P (1993) Global estimates for prevalence of prevalence of Diabetes Mellitus and impaired glucose tolerance in adults. *Diabetes Care* **16**: 157–77
- Loden M (1996) Urea-containing moisturizers influence barrier properties of normal skin. *Archives of Dermatological Research* **288**: 103–7
- Miettinen H et al (1999) Studies on constituents of moisturizers: water-binding properties of urea and NaCl in aqueous solutions. *Skin Pharmacology and Applied Skin Physiology* **12**: 344–51
- Pecoraro RE, Reiber GE, Burgess EM (1990) Pathways to diabetic limb amputation. Basis for prevention. *Diabetes Care* **13**: 513–21
- Renwick P et al (1998) The pathophysiology and treatment of diabetic foot disease. *Journal of Wound Care* **7**: 107–10
- Smieja M et al (1999) Clinical examination for the detection of protective sensation in the feet of diabetic patients. International Co-operative Group for Clinical Examination Research. *Journal of General Internal Medicine* **14**: 418–24
- Strandness DE et al (1964) Combined Clinical and Pathologic Study of Diabetic and Nondiabetic Peripheral Arterial Disease. *Diabetes* **13**: 366–72
- Young M et al (1993) A multi-centre study of the prevalence of diabetic peripheral neuropathy in the United Kingdom hospital clinic population. *Diabetologia* **36**: 150–4

For more detailed descriptions of Neil Baker and colleagues' recommendations for examining the diabetic foot, see:

- A user's guide to foot screening. Part 1: Peripheral neuropathy. *The Diabetic Foot* **8**: 28–37
- A user's guide to foot screening. Part 2: Peripheral arterial disease. *The Diabetic Foot* **8**: 58–70
- A user's guide to foot screening. Part 3: Skin and joints. *The Diabetic Foot* **8**: 168–80