

Screening for diabetic foot complications

Classifying risk of ulceration⁴

| | |
|---|-------------------------|
| Normal sensation, palpable pulses, no deformity | Low current risk |
| Evidence of neuropathy, absence of pedal pulse(s) | Increased risk |
| Evidence of neuropathy, absence of pedal pulse(s) and skin changes or deformity | High risk |

Foot checks should begin immediately after a person has a confirmed diagnosis of type 2 diabetes and at least yearly thereafter (as part of an annual diabetes review). If the patient has characteristics that increase their risk of foot complications (see opposite) or once evidence of diabetic foot complications has been detected, feet should be checked every three to six months.³ Some patients at very high risk of foot damage e.g. loss of feeling in the foot, no detectable pedal pulses or active ulceration may be considered for review even more frequently, i.e. every one to three months. These recommendations are summarised in Table 1.

Table 1: Recommended frequency of examination for diabetic foot complications

| Stage of progression | Recommended frequency of foot check |
|---|---|
| Confirmed diabetes | As soon as possible after diagnosis, annually thereafter |
| First signs of foot problems identified or patient at high risk | Every three to six months |
| Active ulceration and infection or very high risk | Regular assessment until active problems resolved, then every one to three months |

Patients who have the following characteristics are at high risk of developing foot complications:^{3,4}

- Peripheral neuropathy
- Peripheral arterial disease
- Previous foot ulceration or amputation
- Structural foot deformity
- Plantar callus
- Older age (>70 years)
- Māori or Pacific ethnicity

- Longer duration of diabetes
- Smoking
- Other diabetic complications e.g. retinopathy
- Renal impairment
- Continual use of inappropriate footwear
- Living in a lower socioeconomic area

Performing a foot check³⁻⁵

1. **Examine the foot** to identify deformity e.g. abnormal foot shape, clawed or hammer toes, ulceration, skin abrasions, erythema, swelling and pressure points. Assess the skin status i.e. colour, thickness, dryness, cracking. Check if the foot is fixed or flexible by asking the patient to stand and observe whether the toes straighten. Assess how well the patient cares for their feet by checking for cleanliness and trimmed nails. Examine carefully between the toes for tinea pedis. Check whether the patient can both reach and see their feet.

Referral criteria for vascular review

Criteria for referral to a vascular surgeon for a patient with a diabetic foot complication includes the following:

- Foot lesion (ulcer, gangrene) or suggestion of rest pain with peripheral arterial disease
 - Deteriorating ulcer with known peripheral arterial disease or absent pedal pulses
 - Ankle Brachial Index <0.5 or absolute ankle pressure <50 mmHg
 - New foot lesion with previously treated peripheral arterial disease
 - Symptomatic intermittent claudication at <200 m
 - Acute diabetic foot sepsis
 - Osteomyelitis of forefoot or metatarsals
 - Acute osteomyelitis
2. **Ask the patient** if they experience numbness or pain, including what type of pain e.g. burning, tingling, and at what times e.g. walking, resting, day-time, night-time. Ask about the normal temperature of the foot.
 3. **Assess for neuropathy** using a 10 g monofilament ([see below](#)). A vibration test, using a 128 Hz tuning fork or a biothesiometer may also be performed. Absent touch pressure, pin prick or vibration sensation (in a “stocking distribution”), absent ankle reflexes, altered temperature sensation and dry, scaly skin are suggestive of neuropathy.
 4. **Assess peripheral circulation** with thorough palpation of pedal pulses (dorsalis pedis and posterior tibial). If there are no palpable pulses, and if a Doppler machine is available, calculate ankle brachial index (see below) or consider referral to a vascular specialist (see sidebar). Absent pulses, calf claudication, absence of hair on the feet, altered temperature (a cold foot) and thin, bluish skin are suggestive of peripheral

arterial disease.⁶ A bounding, easily detected pulse in a warm, dry foot is suggestive of autonomic neuropathy, which causes abnormal arterio-venous shunting.

Calculating ankle brachial index⁷

Equipment: Blood pressure cuff and hand-held Doppler machine

1. Take the blood pressure in the arm (brachial pressure)
2. Take the blood pressure in the ankle using the Doppler machine (ankle pressure)
3. Calculate ankle brachial index by dividing systolic ankle pressure by systolic brachial pressure e.g. ankle pressure is 120 mmHg and brachial pressure is 132 mmHg, ankle brachial index is $120/132 = 0.9$

| | | |
|----------------------------------|---------------|--|
| Normal | 0.9 – 1.2 | Risk of vascular foot ulcer is small |
| Definite vascular disease | 0.6 – 0.9 | Risk of vascular ulcer moderate, depending on other risk factors |
| Severe vascular disease | Less than 0.6 | Risk of vascular foot ulcer very high |

Ankle brachial index may not be able to be reliably calculated in some people with diabetes as the arteries in the ankles may be calcified.

Performing a test using a monofilament³

A test using a 10 g monofilament is the recommended method for assessing for neuropathy of the foot. Loss of protective sensation at any site on the foot indicates evidence of neuropathy, increasing the risk of ulceration and other complications.

Equipment: 10 g monofilament

Method:

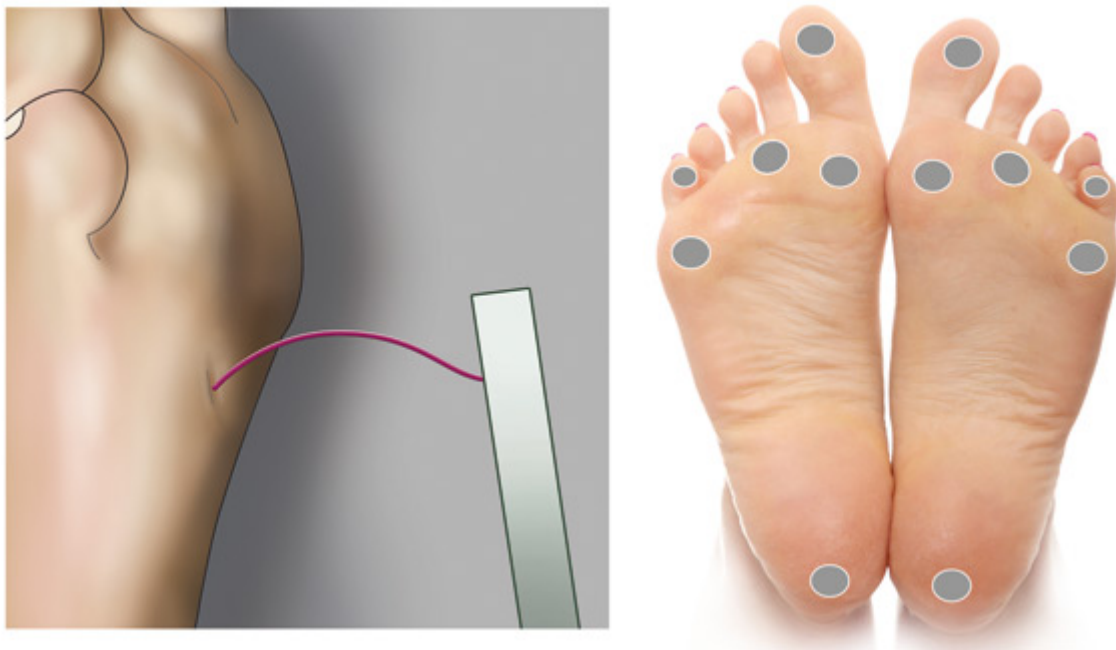
1. Place the patient in a supine position with shoes and socks removed
2. Show the filament to the patient and bend it against their arm to illustrate that it is not painful
3. Ask the patient to close their eyes and to say “yes” when they feel the filament on their feet. Do not prompt the patient by asking “Did you feel that”?
4. Place the filament on one of the designated sites on the foot (Figure 1), press it against the skin until the patient indicates they can feel it, or a C shape is formed, and then lift it off. This should take approximately three seconds.
5. Repeat this sequence at each of the designated sites on the feet and record findings
6. Repeat again in the areas in which the patient did not indicate feeling the monofilament


7. If evidence of neuropathy is detected, further assessment is required

Tips:

- Avoid tapping the filament against the skin or using rapid movements
- Choose the sites on the foot at random and try not to test sites in a predictable pattern that will allow the patient to anticipate when and where the monofilament is likely to be positioned next
- Do not apply the filament directly on an ulcer, callous, scar or necrotic tissue. Apply the filament on near-by normal tissue.
- The filament should be cleaned after use with an alcohol swab or dilute bleach solution and returned to its case
- Filaments should not be used for more than ten patients in 24 hours, as they may buckle

Figure 1: Monofilament bent to form a C shape. Recommended sites for cutaneous sensory pressure perception testing using a monofilament.³



 **Best Practice Tip:** Regular callus removal should be performed in people with diabetes and neuropathy. Calluses may hide underlying pressure ulcerations of the skin. It is recommended that patients at risk of diabetic foot complications are referred to a podiatrist for removal of calluses.

Treating “The Diabetic Foot”

Lesions and ulcers detected during a foot check should be initially treated and any pain managed. It is recommended that patients identified as being at increased risk of serious foot

complications are then referred to a specialist multi-disciplinary team for further management and care.^{3,4}

Urgent referral to secondary care (within 24 hours) should be considered if:⁴

- An ulcer shows no signs of healing or becomes necrotic
- Significant swelling is present
- Discolouration of part or all of the foot is present
- There is suspicion of bone or joint involvement

Treatment of ulcers

Clean, debride and dress the wound

The wound may be cleaned, e.g. with saline, to remove surface bacteria and to allow assessment of swelling, redness and discharge.

Surgical (using a scalpel or tissue nippers), mechanical (using saline and gauze) or hydrogel debridement (applying a gel polymer dressing to the wound) can be used to remove non-viable or necrotic tissue, although this is not recommended in the primary care setting when the debridement area is extensive. Surgical debridement is not recommended when sensation to the foot is intact.^{8,9} There is limited evidence that hydrogel debridement increases the healing rate of ulcers compared to gauze dressings or standard care.¹⁰ Hydrogel may also be preferable in the case of a painful ulcer.⁹ Care must be taken to mask the edges of the wound, so surrounding tissue is not damaged.¹⁰

The ulcer should be kept clean and moist but free of excessive fluids.⁹ There is no evidence that one type of dressing is superior to another for wound healing in diabetic foot ulcers. Dressings should be chosen based on their comfort and durability when worn inside footwear, their ability to absorb exudate without plugging the wound and the ease with which they can be regularly removed for checking the wound.^{4,9}

If the wound does not appear to be infected, a long-term waterproof dressing can be applied and left in place for up to one week before review. If the wound shows signs of infection, a non-adherent dressing can be applied and reviewed every one to two days.

Off-load pressure from the foot

The central principle for healing any neuropathic ulcer is the reduction of pressure through pressure redistribution (off-loading) until healing occurs. This involves resting the foot and using therapeutic footwear. If adherence to treatment is problematic, some specialists may use a total contact cast to reduce pressure on the foot and allow more rapid healing.⁹

Graduated compression therapy (i.e. compression bandages or stockings) has an important role in healing and management of venous leg ulcers and mixed aetiology venous ulceration, in people with diabetes and longstanding venous incompetence. However, it does not usually

have a role in healing neuropathic or arterial ulcerations associated with the diabetic foot and may in fact worsen the condition. Specialist advice is recommended before considering the use of graduated compression therapy in a person with diabetic foot complications.

Consider antibiotics

If the wound shows signs of infection e.g. erythema, oedema, foul odour or purulent discharge, antibiotic treatment is indicated, either orally or intravenously (IV).

Consider admission to hospital for IV antibiotics for patients with extensive infection or where osteomyelitis is suspected (see below).

When treating the infection in the general practice setting, a broad-spectrum antibiotic such as amoxicillin clavulanate 500/125 mg, three times per day, for five to ten days, may be used (as the infection is most likely to be polymicrobial). Alternative agents are cefaclor or co-trimoxazole plus metronidazole. Swabbing the wound for microbiological analysis is usually not necessary but can be helpful if the infection shows no sign of healing with the current antibiotic regimen.^{3,4}

Osteomyelitis

Osteomyelitis is common in infected diabetic foot ulcers. Its presence greatly increases the risk of lower extremity amputation. A probe can be inserted into the wound to check for bone involvement (a probe-to-bone test). A non-healing ulcer, deep ulceration, extensive tissue loss, recurrent ulceration, previous osteomyelitis affecting the same bony region or a history of discharge of bony fragments from an ulcer raises the likelihood of osteomyelitis being present. Visible or palpable bone or joint structures make osteomyelitis a likely diagnosis. Referral to a multidisciplinary specialist team is strongly recommended.

Monitor, review and consider referral

Regular review of the patient is encouraged. An infected wound should be reviewed and re-dressed every one to two days. Note the size of the ulcer and whether it is decreasing.⁹

Check that the patient is following instructions for care and that they have removed pressure from the infected area. If the ulcer shows no signs of healing or if infection is still apparent after antibiotic treatment, then referral to a specialist team is strongly recommended.

Referral for vascular assessment is strongly recommended if limb ischaemia is present and compromising wound healing. This can be corrected through revascularisation procedures.

Sub-optimal treatment can have serious long-term consequences for the patient. Referral to a specialist multidisciplinary team for wound care and off-loading pressure can be considered with any diabetic foot complication to improve healing times and patient outcomes.

Treatment of painful neuropathy

Pain associated with neuropathy is a common feature of diabetic foot complications. Neuropathic pain may be characterised by altered pain sensation, numbness, burning or spontaneous pain.¹²

Treating neuropathic pain can be challenging and there is a lack of clear consensus as to which medicines to use and in what order.¹² Treatment should be tailored to individual circumstances and take into account factors such as the severity of pain, coping strategies and lifestyle/occupational restrictions, e.g. a requirement to operate heavy machinery would preclude using sedating medicines during the day.

Charcot's osteoarthropathy

Charcot's osteoarthropathy (or neuroarthropathy) is associated with severe peripheral neuropathy. It is a progressive condition characterised by collapse and destruction of joints, fractures and bone destruction. In people with severe diabetic neuropathy, Charcot's osteoarthropathy most commonly manifests as acute swelling and deformity of the foot (without open ulceration), leading to collapse of the pedal arch. This is a major risk factor for ulceration and subsequent amputation of the foot.^{4,11}

Acute Charcot's osteoarthropathy can be confused with cellulitis, acute gout, osteomyelitis and abscess. In a patient with a long duration of diabetes, a history of poor glycaemic control and peripheral neuropathy and no history of open ulceration, Charcot's osteoarthropathy should be considered first.¹¹

People with suspected Charcot's osteoarthropathy should be referred immediately for assessment and x-ray. Management includes total contact casting and immobilisation of the joint. Bisphosphonate treatment is sometimes considered.^{4,11}

After beginning any medicine (or medicine regimen) for treating neuropathic pain, the following aspects should be regularly reviewed:¹²

- Pain control
- Adverse effects
- Mood
- Daily functioning
- Sleep patterns

Consider dose adjustment or adding or substituting another medicine if optimum control of these factors is not being achieved.¹²

First-line pain management

Paracetamol may be trialled as first-line management for neuropathic pain and may be continued throughout any regimen.

Second-line pain management

If paracetamol alone is not adequate for controlling pain, a tricyclic antidepressant (TCA) may be added to the regimen (or paracetamol substituted for a TCA).

Nortriptyline is the preferred TCA for neuropathic pain, due to fewer adverse effects than other TCAs. Initiate nortriptyline at 10 mg per day (usually taken at night) and titrate dose upwards until pain is controlled. The dose should not usually exceed 75 mg.¹²

Third-line pain management

If second-line pain management is insufficient, an anticonvulsant may be added to the treatment regimen, or the TCA substituted for an anticonvulsant. Referral to, or discussion with, a pain specialist can be considered.

Carbamazepine and sodium valproate are both effective for neuropathic pain. Gabapentin has also traditionally been used for neuropathic pain but recent evidence suggests that it has limited effectiveness for this indication.¹³



For more information see [“New evidence shows less benefit of gabapentin for neuropathic pain” Snippets, BPJ 28 \(June, 2010\).](#)

Carbamazepine may be initiated at a dose of 100 mg per day. Increase the dose slowly until pain is controlled, to avoid adverse effects such as nausea, vomiting and dizziness. Regular monitoring is required.

Opioids such as methadone or oxycodone may have a limited place in the treatment of neuropathic pain but their use is not advised unless in consultation with a specialist in pain management.¹²

Adjuvants

Capsaicin cream and local anaesthetic gels may be trialled throughout a treatment regimen for neuropathic pain, They should not be applied to broken/ulcerated skin.



For more information about treating neuropathic pain, including considerations for specific patient circumstances, see [“Pharmacological management of neuropathic pain”](#), BPJ 16 (Sept, 2008).

Considerations for Māori and Pacific people with diabetic foot complications

Māori and Pacific people with diabetes are at high risk of diabetic foot disease.

For Māori, tapu and noa are key concepts that underpin many practices. It is important to keep things that are tapu (restricted) separate from things that are noa (unrestricted). In many cases these concepts or tikanga, align with good health and safety practice.



Best Practice Tip: Become familiar with the basic principles of tapu and noa, and practical ways of respecting these concepts. For example:

- For many Māori, it is inappropriate for their feet to be placed on a pillow, which is also used for the head. Avoid propping feet up with a pillow during a foot examination or treatment.
- Māori may prefer their nail clippings and any other body parts (regardless of how minor it is perceived to be) to be returned to them for disposal - ask them.
- Many Māori remove their footwear before entering their house or marae. Encourage the use of slippers or socks to protect feet when inside, if outdoor shoes are considered unacceptable.



Preventing diabetic foot complications

The two main factors in preventing diabetic foot complications are:

1. Maintaining optimal control of risk factors
2. Educating about appropriate care of the feet

Optimal control of risk factors

The development of peripheral vascular disease and neuropathy, leading to foot complications, may be able to be avoided or delayed with optimal management of diabetes and cardiovascular risk factors. This includes:

- Maintaining good glycaemic control – establish an individualised HbA_{1c} target ( “HbA_{1c} targets in people with type 2 diabetes” BPJ 30, Aug 2010)
- Managing hypertension – New Zealand cardiovascular guidelines recommend reducing blood pressure to < 130/80 mm Hg for people with diabetes, however this level may not be achievable for some people. In the presence of microalbuminuria or renal disease more aggressive control may be required to reduce blood pressure to < 125/75 mm Hg.¹⁴
- Reducing blood lipid levels – aim for a reduction towards the target level of total cholesterol < 4.0 mmol/L,¹⁴ although this level may not always be achievable ( “An update on statins” BPJ 30, Aug 2010)
- Smoking cessation – provide advice and treatment options on how to quit
- Weight management – promote exercise and healthy diet

Educating about foot care

The three main aspects of foot care education have been identified as foot hygiene, awareness of fungal infections and appropriate actions required for skin injuries.⁴ There is conflicting evidence on the effectiveness of educational interventions on reducing the occurrence of foot ulceration, and which methods are best.¹⁵ Education is likely to be effective in the short-term, but messages must be periodically reinforced for longer-term behavioural change.⁴

Providing advice about foot care

The following points can be discussed with patients in regards to the care of their feet:⁴

- Clean and thoroughly dry feet (including between the toes) every day
- Moisturise areas of dry skin and apply sun-screen if feet are exposed to the sun
- Inspect feet every day for abrasions, blisters, ulcers, redness, swelling or calluses
- Inspect between the toes for any signs of fungal infection
- Keep toenails trimmed, do not use “corn remover”, seek advice from a podiatrist about the treatment of corns or calluses
- Break in a new pair of shoes gradually, by first wearing for only an hour at a time
- Regularly inspect the inside of shoes for tears, sharp edges or foreign objects
- If neuropathy is present, extra vigilance is needed to avoid burns – check bath temperature, avoid hot water bottles, electric blankets or foot spas
- Seek medical attention if any changes to the foot, abrasions or injuries are detected or pain or numbness develop



Organisations such as Diabetes New Zealand have websites with downloadable patient information and resources that can be helpful to reinforce advice: www.diabetes.org.nz

Due to limited mobility or visual impairment, many people will be unable to adequately inspect and care for their feet. Discuss methods to help self-examination such as the use of a mirror or the possibility of a family member or carer being involved in regular foot care.

Selecting appropriate footwear

One of the most important aspects of preventing diabetic foot complications is wearing appropriate footwear. Patients should be advised to always wear well-fitting, cushioned footwear (including slippers) to protect their feet from injuries. Loose-fitting or open-toed footwear such as gumboots, jandals or sandals, and going barefoot should be avoided.

Patients (especially those at high risk) can be custom-fitted with specialised shoes and orthoses (insoles) by a podiatrist. Specialised shoes for people with diabetes are usually made with extra depth and room to accommodate foot deformities and orthoses. They have increased cushioning and reduce the pressure on certain parts of the foot, therefore reducing the potential for ulcers to occur.¹⁶

Non-customised, specialised shoes are available “off-the-shelf” and are generally the same price as cushioned, high-quality sports shoes, which are also an option. There is a lack of evidence of the superiority of custom-made therapeutic footwear to off-the-shelf varieties in reducing the occurrence of ulcers.⁶ It appears that wearing a well-fitted, cushioned pair of shoes, at all appropriate times, is more important than the actual type of shoe.

Orthoses (specially made insoles) can provide cushioning and redistribution of pressure loading. They may be worn in specially designed or regular shoes.¹⁶

Socks and other hosiery should be well-fitted – neither too tight (leading to decreased circulation) nor too loose (leading to rubbing and abrasions). Padded hosiery may protect the feet, reduce plantar pressure and reduce calluses.¹⁶ Socks made from a breathable fabric such as cotton are preferable to those made from other fabrics.⁵