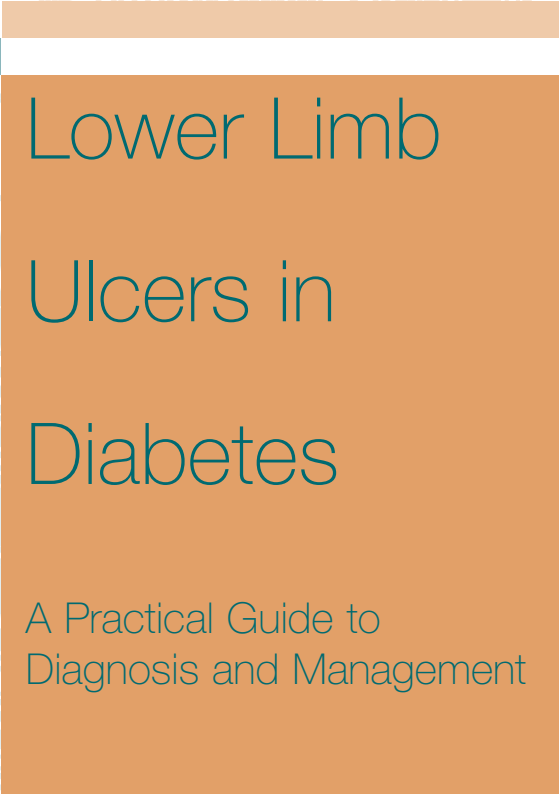




Improving
Diabetes
Care and
Outcomes



Lower Limb
Ulcers in
Diabetes

A Practical Guide to
Diagnosis and Management

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Introduction

Lower limb ulcers are responsible for more hospital admissions of patients with diabetes than any other single cause. Many of these admissions are prolonged. Effective multidisciplinary management of lower limb ulcers in patients with diabetes can prevent many of the complications associated with ulcers such as infections and amputations, resulting in fewer and shorter hospital admissions for treatment of ulcers.

Patients with diabetes can develop ulcers secondary to:

- Peripheral neuropathy, and the resultant foot deformity (motor neuropathy), lack of sensation (sensory neuropathy), callus and dry skin with subsequent fissuring (autonomic neuropathy)
- Ischaemia, because of their propensity to large vessel atherosclerosis
- Venous insufficiency, which is common in all patients, whether they have diabetes or not.

Patients with diabetes are also prone to develop infection in lower limb ulcers if their diabetes is poorly controlled. These guidelines have been prepared as an aid to clinical decision-making and to assist the practitioner in the management of patients with diabetes and lower limb ulcers. Adherence to them does not guarantee a successful outcome in every case, but they do encompass known effective processes of care. The ultimate judgement concerning a particular patient or treatment depends on the exercise of clinical discretion.

Documentation of the neurological and vascular status of the patient with diabetic foot disease is of medico-legal importance as well as being a principle of sound patient care. Timely referral to appropriate health professionals for specialised treatment is also important for optimum patient management.

How to use this document

This document contains a core section that is designed to provide a practical reference source for all health professionals involved in the care of patients with diabetes and lower limb ulceration. Overall identification and treatment of all foot and leg ulcers is covered, including a section on the management of infection. This is followed by three supplements in which further information is supplied to specific health professional groups (general practitioners, podiatrists and nurses) in aspects of ulcer care relevant to them. Prevention of lower limb ulcers by identifying and addressing risk factors should be a major goal of those involved in the care of patients with diabetes. A section on Patient Information has also been included in this document.

Managing the ulcer

There are a few simple principles which can be applied to the assessment and treatment of all ulcers. More information regarding the treatment of specific ulcers is detailed later in this guide.

Identify and treat the cause

Successful management of ulcers is dependent on identifying and treating the underlying pathology responsible for the ulcer.

Assess for infection

Treatment of infection is a priority. Infection must be identified and treated promptly as the presence of infection greatly increases the likelihood of amputation. In general, the use of compression therapy in leg ulcers, should be deferred until any infection has been controlled.

Devise a plan of management

This should include a time frame for improvement in the ulcer. It is vital to determine why an ulcer is not improving. Infection, ischaemia, venous hypertension, localised pressure or trauma can all lead to delayed healing.

Keep a record of the ulcer

It is important to document the progress of the ulcer and the treatment regime. A description of the ulcer should be recorded, including the condition of the wound base, the level and type of exudate, the presence of any odour, the condition of the surrounding skin, and the degree of erythema, swelling and pain. The size of the ulcer should be recorded or alternatively the wound should be traced using acetate film. This information should be regularly updated to provide objective information for evaluation of progress.

Apply local treatment

- Clean the ulcer
- Debride where appropriate
- Apply appropriate dressings
- Provide compression therapy when indicated
- Provide pressure offloading when indicated.

Identifying the ulcer

Lower limb ulcers in patients with diabetes can be classified as neuropathic, neuro-ischaemic, ischaemic or venous. In most cases, the type of ulcer can be quickly identified by assessing:

- Position of the ulcer
- Characteristics of the ulcer
- Clinical signs of ischaemia, peripheral neuropathy or venous hypertension.

Infection

Local signs of infection include swelling, erythema and heat. If an ulcer is infected, there may also be an increase in pain or exudate level, or a deterioration of the wound. However, in a patient with diabetes, particularly in the presence of ischaemia, the normal signs of infection may be absent or diminished. Patients with neuropathy may not feel pain. For this reason, a high index of suspicion of infection is needed for any ulcer in a patient with diabetes.



Neuropathic ulcers

Unusual in people without diabetes.

Position

- Plantar aspect of the foot
- Areas of high pressure or trauma

Characteristics

- Callused border
- Punched out appearance
- May be deep or have undermined areas
- Low to moderately exudative
- Granulating or sloughy base
- Painless

Clinical signs

- Loss of sensation
- Normal to bounding pulses
- Warm foot
- Dry skin



Neuro-ischaemic ulcers

A common type of foot ulcer in people with diabetes.

Position

Anywhere on the foot

Characteristics

- Callused border but often less callus than a neuropathic ulcer
- May be deep or have undermined areas
- Low to moderately exudative
- Pale coloured granulation tissue or sloughy base
- Usually painless

Clinical signs

- Weak or absent foot pulses
- Loss of sensation



Ischaemic ulcers

Can occur in people without diabetes but more common in people with diabetes. Delayed treatment may result in amputation.

Position

- Foot borders
- Apex of toes
- Dorsum of foot

Characteristics

- Irregular edges
- Non-exudative
- May have a pale granulating or sloughy base
- May be covered with dark eschar
- Painful

Clinical signs

- Weak or absent foot pulses
- Cool foot
- Skin pale and shiny
- Dependent rubor



Venous ulcers

The most common lower limb ulcer in all patients, whether they have diabetes or not.

Position

- Lower leg or ankle

Characteristics

- Irregular edges
- Highly exudative
- Shallow
- Granulation tissue
- Slough may be present
- Usually painless if not infected

Clinical signs

- Foot pulses present
- Venous eczema
- Varicose veins
- Ankle flare
- Skin pigmentation
- Possible ankle/eg oedema

Treating the cause

Most lower limb ulcers begin as superficial wounds after local trauma, but their failure to heal is due to underlying pathological processes. These must be addressed for healing to occur.

Neuropathic ulcers

Cause

- Acute trauma that goes unnoticed by the patient due to loss of sensation
- Abnormal pressure due to biomechanical factors (altered foot shape)

Treatment

- Reduction of local plantar pressure on the wound by:
 - Debridement of callus
 - Restriction of walking and by pressure relieving devices such as:
 - Pre-fabricated walking casts
 - Paddings
 - Total contact casts
 - Prescription footwear
 - Prescription orthoses

Neuro-isaemic ulcers

Cause

- Acute trauma that goes unnoticed by the patient due to loss of sensation
- Abnormal pressure due to biomechanical factors (altered foot shape)
- Decreased arterial perfusion due to occlusive macrovascular arterial disease

Treatment

- As for neuropathic ulcer treatment however the use of debridement is dependent on adequate arterial perfusion
- May need revascularisation as for ischaemic ulcers if there is inadequate blood flow for healing

Ischaemic ulcers

Cause

- Decreased arterial perfusion due to occlusive macrovascular arterial disease

Treatment

- Revascularisation by surgical or percutaneous techniques
- Surgical debridement in theatre may be necessary
- AVOID compression or elevation

Venous ulcers

Cause

- Chronic venous hypertension due to venous valvular reflux

Treatment

- Graduated compression therapy
- Leg elevation when resting
- Walking
- Continued use of graduated compression hosiery after ulcer has healed

Applying local wound care

Dressings are only an adjunct to treatment, and are not a substitute for treating the pathological process underlying the ulcer formation.

Dressings have the potential to facilitate wound healing, but inappropriate application of dressings can also retard the healing of an ulcer.

It is best to become familiar with a small group of dressings for ulcers, with perhaps one type of dressing from each treatment group (see table).

The frequency of dressing changes is dependent on the amount of exudate produced by the ulcer. Highly exudative ulcers need daily dressing changes.

Regular inspection of the ulcer to assess the effectiveness of therapy is essential. This is particularly important if the ulcer is infected.

Antimicrobial dressings and preparations such as silver sulphadiazine, cadexomer iodine and the recently introduced dressings impregnated with silver may be of value as an adjunctive treatment for infected wounds or wounds that are likely to be heavily colonised. The ongoing need for anti-microbial

dressings should be reassessed every 7-14 days and their use limited to a short duration.

Neuropathic ulcers

Dressing

- Foam dressing with or without alginate/hydrofiber to control exudate

Neuro-ischaemic ulcers

Dressing

- Foam dressing with or without alginate/hydrofiber to control exudate

Ischaemic ulcers

Dressing

- Foam dressing

Hydrophilic gel to hydrate and debride, should not be used if there is inadequate blood flow for healing. If using, apply sparingly.

Venous ulcers

Dressing

Select a dressing that is:

- Absorbent
- Non-adherent

Hydrofiber/alginate may be useful in initial stages to assist with exudate management, protect peri-wound skin, promote granulation and debridement of slough. Use this under a secondary dressing.

Caution: The use of occlusive dressings is contraindicated in diabetic foot ulcers.

Assessing for infection

There is no definite way to determine whether an ulcer is infected or not. Clinical suspicion is the most important criterion. In patients with diabetes, an important sign of infection can be elevated blood sugar levels and difficulty in controlling blood sugar levels with medication.

Wounds should be gently probed with a sterile blunt instrument to establish their depth and to determine the involvement of deeper tissues. **The ability to probe bone within a wound is highly predictive of osteomyelitis.**

The ulcer may not be painful if the patient has peripheral neuropathy.

Heat, swelling and redness around the ulcer may be absent if the patient has severe ischaemia.

Constitutional signs and symptoms of infection (fever, rigors, malaise, and elevated white cell count) are often lacking in diabetic patients with infected lower limb ulcers.

Local signs of infection

- Heat, swelling, erythema in the area surrounding the ulcer
- Pain
- Increased exudate from the ulcer
- Tender inguinal lymph nodes
- Odour from the ulcer
- Increased size or depth of ulcer

Non-healing ulcers

Ulcer healing requires both adequate perfusion for granulation and good quality surrounding skin for epithelialisation. Many of the factors responsible for poor healing can be corrected. Since the time-course of ulcer resolution is measured in weeks or months, it is helpful to have a record of the progress of the ulcer. Size can be

measured two-dimensionally by tracing the contour of the ulcer on transparent film.

Persistence or deterioration of an ulcer after all the potentially correctible factors have been addressed is an indication for referral to a specialist clinic for further evaluation.

Factors which may retard healing

Local

- Ischaemia
- Inadequate debridement of callus and necrotic wound debris
- Infection
- Inappropriate dressings (eg. Inadequate control of exudate leading to maceration)
- Foreign body in ulcer base
- Poor condition of surrounding skin (eg. eczema, maceration or scar tissue)
- Inadequate primary treatment (eg. compression bandaging, callus debridement, redistribution of pressure)
- Allergy to dressing materials
- Oedema.

General

- Poorly controlled diabetes (persistent hyperglycaemia)
- Anaemia (if severe)
- Poor compliance with treatment.

Foot care advice for people with diabetes who are at high risk of amputation

Patients with diabetes should have their feet assessed every 6 months. This assessment should include testing for neuropathy (using the 10g monofilament and ankle reflexes), palpation of pedal pulses and detection of other possible risk factors.

If patients are at high risk of amputation because of previous ulceration or amputation, peripheral neuropathy and/or severe peripheral vascular disease, they require intensive foot care education.

It is the responsibility of all health professionals to give patients information that can help to prevent lower limb ulcers.

The following advice should be given to those people who are at high risk of ulceration/amputation.



Patient Information

Check feet every day

Look very carefully at your feet every day. If you can't see well, ask someone else who can. A mirror can help if you cannot reach your feet. This ensures you can have any small foot injuries treated promptly. With prompt treatment, they are more likely to heal quickly and avoid amputations.

Have your doctor check your feet

Ask your doctor to look at your feet regularly. You can help by taking your shoes off when you are in his/her office.

Always wear shoes

Never go barefoot (either indoors or outdoors) because you may not feel a stone or sharp object, or feel that the surface underfoot is too hot.

Avoid heat

Because you may not feel a burn:

- Never put your feet in front of a heater
- Do not use hot water bottles
- Do not walk barefoot on concrete or hot sand at the beach
- Do use sunscreen on bare legs and feet

- Do check the water temperature of baths, showers and spas with your forearm first
- Only use electric blankets on low and switch them off before you go to bed.

Treat injuries straight away

First Aid for a small injury (eg. scratch, blister or red rubbed area):

- Wash the foot with tap water or saline (salt water)
- Pat the foot dry with a clean towel
- Cover the injury with a non-stick dressing
- Fix the dressing in place with tape (from chemist)
- Avoid using plastic dressing strips or dressings with a strong adhesive
- Change the dressing every day.

If the injury does not look better within 24-48 hours or the area becomes red, hot, swollen or smelly, contact your doctor or podiatrist for further treatment. If you are unable to contact your doctor or podiatrist, go to your local hospital emergency department for treatment.

Remember, you may not feel pain!

Treat any common foot problems

Small injuries

Use First Aid.

Dry skin

Ask the chemist for a moisturising cream. Urea based creams work best for very dry skin. Rub it well into the feet at least once a day, but do not apply cream to broken skin or between the toes.

Raw or peeling skin between toes

Treat with First Aid as for an injury, but seek medical advice if it persists, as tinea may be present.

Moist white skin between toes

Dry very carefully between the toes after bathing. If there is no improvement within a week, ask your doctor or podiatrist to advise you on which other medicine you can use, as tinea may be present.

Hard skin (corns and calluses)

See a podiatrist for treatment if you have areas of hard skin such as corns or calluses. Do not attempt to cut these yourself. Never use corn plasters.

Wear socks

Choose mixtures of cotton or wool with some polyester or padded acrylic socks. Choose padded socks if possible, but ensure that shoes are big enough to take them. Avoid:

- Tight elastic
- Darns or bulky seams
- Socks and stockings which are too loose or too tight
- Knee high stockings.

Choose the right shoes

If you have damage to your nerves or blood supply you need to wear shoes that fit well and protect your feet. The wrong shoes can cause a lot of foot problems.

Choose shoes with:

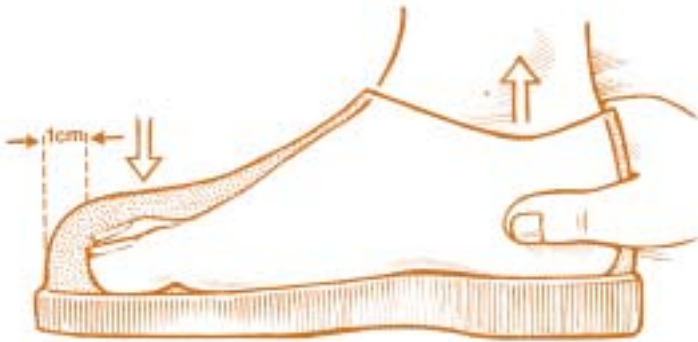
- A soft leather upper or a sports shoe
- No rough seams or stitches inside the shoe that could rub over toe joints
- Laces or velcro to keep the shoe on the foot
- Flexible rubber or synthetic soles that cushion your feet
- A wide deep toe area to fit the toes
- No tight spots
- The widest heel base possible
- A firm heel counter (back of shoe).

Avoid slip-on styles, moccasins, thongs and shoes with heavy stitching across the toes that may not stretch.

Take your insoles, orthoses, or padded socks with you when buying shoes. Have a fitting done each time you buy shoes, as sizes can vary between brands.

Have shoe fittings done late in the day when your feet are at their largest. Wear new shoes for one hour at first, then check feet for signs of pressure such as redness. Slowly increase the wearing time each day. Total wearing time should add up to 20 hours inside the house before wearing the shoes outside.

If you are in doubt, take your new shoes to the podiatrist for advice before you wear them.



Resources

The management of lower limb ulcers requires a multidisciplinary team approach. Ulcer treatment is often protracted and frequent assessment is vital to detect any complications at an early stage. Timely assistance from the resource areas outlined below can be of considerable benefit in the assessment and treatment of lower limb ulceration.

Where to refer for advice and help with ongoing management

High Risk Foot Clinics

These are ambulatory care clinics experienced in the management of serious diabetic foot disease. Enquire through your local hospital or Area Health Service to find out if there is a multidisciplinary High Risk Foot Clinic or foot ulcer clinic in your area. The clinic should provide podiatry, nursing and medical management. Regular communication between the clinic, general practitioner and other health professionals involved in the patient's care is very important.

Consider referral to a High Risk Foot Clinic if:

- The ulcer is infected and does not respond promptly (24-48 hours) to treatment
- There is a question about the aetiology of the ulcer
- The ulcer is deteriorating despite treatment
- There is callus associated with the ulcer
- Pressure offloading is indicated
- The ulcer is persistently painful
- Diabetes control is poor.

Telemedicine

Some rural and regional centres have access to telemedicine programs linking the rural health professionals with specialist clinics such as those offering multidisciplinary care for people with diabetic foot disease. Enquire with your Area Health Service for their telehealth co-ordinator.

Community Nursing

Many patients with lower limb ulcers are unable to apply dressings or bandages to their ulcers unaided. They may also find it difficult to visit surgeries or medical centres/clinics on a frequent basis.

Community Nurses provide an invaluable service in:

- Advising on appropriate ulcer dressings
- Ensuring that ulcer dressings and bandages are correctly applied
- Assessing progress or deterioration
- Alerting the general practitioner or High Risk Foot Clinic to any developing problems.

Podiatry

Podiatrists are allied health professionals trained in the treatment of foot problems. They have a vital role to play in the prevention and management of foot ulcers.

Services that podiatrists provide include:

- Assessment of abnormal pressure areas which are the precursors of ulcer formation, especially in patients with peripheral neuropathy
- Advice regarding footwear which may prevent ulcer development
- Foot orthoses to re-distribute pressure away from potential or actual ulcer areas
- Debridement of callus
- Prescription of offloading devices such as paddings, digital devices, post operative and healing sandals, footwear modifications and prefabricated walking casts

- Total contact casting to offload pressure from a neuropathic ulcer (when appropriately trained and experienced in this specific treatment).

To find a private podiatrist with particular experience in diabetic foot management, contact the Australian Podiatry Association or Diabetes Australia branch in your State.

Specialised vascular investigation and assessment

The consequences of failure to recognise ischaemia as a cause or contributor to lower limb ulceration can result in limb loss. For this reason, objective assessment of perfusion is desirable in cases where there is reasonable doubt about the adequacy of peripheral circulation.

The cornerstone of objective peripheral arterial assessment is the **Doppler pressure measurement**. This simple and inexpensive screening test is routinely provided by **Vascular Laboratories** and by some radiological facilities. In addition, the assessment of the patient's ankle brachial index (ABI) may be performed by other appropriately trained staff. If the ratio of the ankle (posterior tibial/dorsalis pedis artery)

systolic pressure to the arm (brachial artery) systolic pressure is < 0.75 , then significant ischaemia is present. Vascular calcification, which is common in diabetes, can falsely elevate Doppler pressure values. Other Doppler pressure techniques such as systolic toe pressure assessment may be useful in cases of vascular calcification.

For more detailed information about the circulation, vascular ultrasound (**duplex scanning**) allows sequential sampling of flow within arteries using Doppler techniques. Narrowing or obstruction of blood vessels can be localised by duplex scanning through detection of either disturbance or absence of flow. An accurate "road map" of all the arteries of the leg can be generated by this technique, which is relatively non-invasive and inexpensive. Duplex ultrasound avoids the pitfalls associated with interpretation of Doppler pressure measurements in patients with diabetes, and arterial calcification. Patients who require such studies should be referred to a Vascular Laboratory or to a Radiology practice with expertise in this area. Other imaging techniques such as infusion of radio-opaque dye (angiography) or magnetic resonance imaging (MRI) may be required prior to surgical intervention to improve perfusion in a limb.

Specialists in vascular disease (vascular surgeons or vascular physicians) can offer a comprehensive assessment and treatment service for lower limb ulcers in which a vascular component is suspected. Vascular clinics are available in many public teaching hospitals, and many hospitals also provide a leg ulcer clinic. Consider urgent referral to a vascular specialist if the ulcer is thought to be of ischaemic origin.

General Practice Supplement

If the cause of an ulcer is not apparent after clinical assessment, investigations may be required to establish the aetiology and to plan effective treatment. Specific management strategies appropriate to the major ulcer types are detailed here. These comments are accompanied by treatment flow charts for ulcer management. The investigation of unusual ulcers is considered in a separate section.

Neuropathic and Neuro- ischaemic ulcers

Foot ulcers that are painless are almost certainly neuropathic. However, investigation of the patient's feet to confirm the presence of neuropathy is still valuable.

Investigation

Test for neuropathy

All patients with diabetes should be assessed for peripheral neuropathy. Testing should be performed using a standardised approach. Such testing can include vibratory perception using a 128hz tuning fork or biothesiometer, deep tendon reflexes at the ankle and the 10 g monofilament. Observe for

signs of autonomic neuropathy such as bounding pedal pulses and very dry skin.

A useful standard way of testing sensation is by means of a 5.07 (10g) monofilament. The following method uses the plantar aspect of the first and fifth metatarsal heads. These sites have demonstrated reasonable sensitivity and specificity in detecting loss of sensation.

Using these two sites on both feet:

- Ask the patient to close their eyes and tell you when they feel the monofilament
- Depress the monofilament perpendicular to the skin with sufficient force for the monofilament to buckle
- Repeat at each site
- Avoid areas of callused skin
- The foot is considered to be insensate, if the patient cannot feel both sites.

Assess perfusion

The clinical assessment of any ulcer should include:

- Palpation of peripheral pulses
- Assessment for elevation pallor.

Question the patient as to any history of intermittent claudication, rest pain or previous vascular studies or surgery.

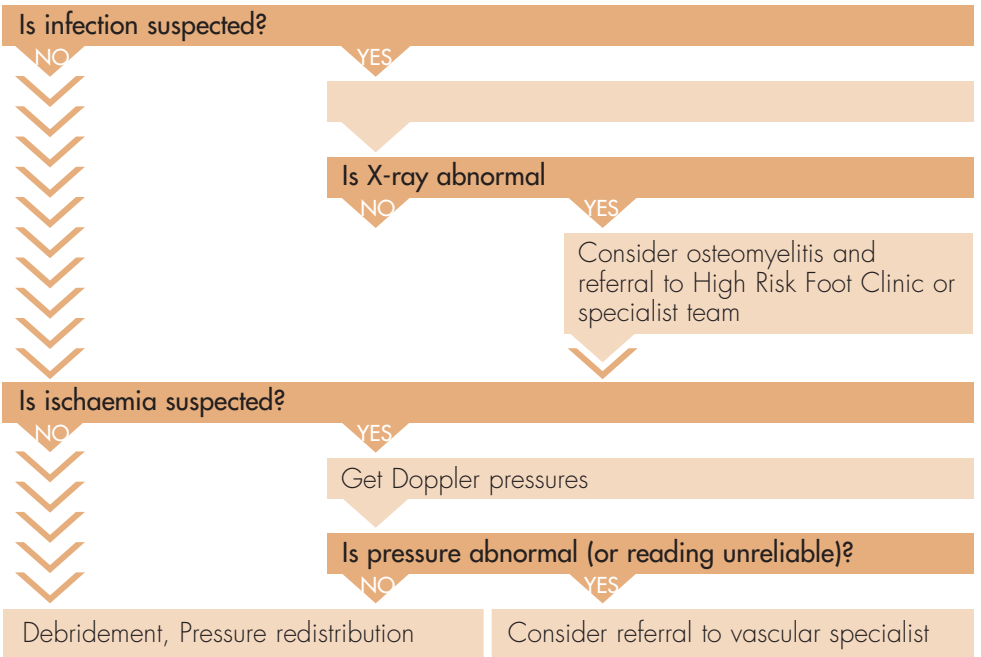
Remember, claudication may not be felt if the patient has peripheral neuropathy or is able to walk a short distance only. If pulses are impalpable or there are other signs or symptoms of ischaemia, this should be confirmed by **Doppler pressure studies**.

Arrange referral to a vascular specialist if ischaemia is confirmed to investigate the possibility of revascularisation.

Obtain foot X-rays

Foot X-rays should be obtained in all cases of neuropathic ulceration. X-rays are useful in providing a baseline for future X-rays and in identifying osteomyelitis, bone mal-alignment, any radio-opaque foreign body, or the

Treatment flowchart for neuropathic ulcers



presence of gas in the soft tissues which may suggest Clostridial infection. Bone may appear normal on X-ray in the early stages of osteomyelitis. If clinical suspicion is high despite normal X-ray findings, then a white cell scan and bone scan can assist in the identification of infection located within the bone. MRI can also be very reliable if available.

Management

Debridement

To promote healing, the callus surrounding the ulcer should be debrided to expose healthy tissue and reduce pressure. This task is best performed by a podiatrist (preferably as part of a High Risk Foot Clinic) on a regular and frequent (often weekly) basis.

If pulses are palpable and there are no other signs or symptoms of ischaemia, treat as a purely neuropathic ulcer.

If pulses are impalpable, refer for vascular assessment and possible revascularisation. No debridement should be performed until adequacy of blood flow can be confirmed.

Do not debride if pulses are impalpable, the ABI (ankle brachial index) is <0.5 or the absolute ankle pressure is $<55\text{mmHg}$. These values indicate there is insufficient blood flow for healing.

Pressure offloading

Methods of pressure reduction over ulcerated areas include the use of prefabricated walking casts, paddings, orthoses (insoles), shoe modification, temporary new footwear such as post-operative boots, and total contact casting.

Access to a good podiatry service preferably as part of a High Risk Foot Clinic is essential to provide these treatments. When the ulcer is healed, attention must be paid to supplying appropriate footwear to prevent re-occurrence of the ulcer.

Ischaemic ulcers

Investigation

Check for signs of arterial insufficiency:

- Palpation of peripheral pulses
- Assessment for elevation pallor.

Question the patient as to any history of intermittent claudication, rest pain or previous vascular studies or surgery. Remember, claudication and rest pain may not be felt if the patient has peripheral neuropathy or can walk only short distances. If ischaemia is suspected, further investigations should be arranged along with referral to a vascular specialist.

Persistent pain in a foot without palpable pulses is often a sign of severe arterial compromise and is an indication for urgent referral for revascularization of the limb. Often patients complain particularly of pain in the foot during the night, which is relieved temporarily by putting the foot in a dependent position.

Quantify perfusion

The extent of arterial insufficiency should be quantitated by Doppler pressure measurements (see page 20). A foot ulcer associated with an ABI of <0.5 or absolute foot pressure of < 55 mmHg is unlikely to heal without revascularization of the limb; if the ABI is between 0.5

and 0.75 (or absolute ankle pressure between 55 and 100 mmHg), it may heal in time, but revascularisation remains an important option.

Note that pressure measurements provide vital information about adequacy of leg perfusion. Imaging techniques such as duplex ultrasound and angiography provide documentation of areas of stenosis or occlusion rather than an overall assessment of perfusion.

Vascular calcification is a problem encountered frequently in patients with diabetes, and this can prevent accurate measurement of pressure using the pedal arteries by the Doppler method. If ABI is reported as >1.1 , then such results are unreliable. Toe pressures can be more reliable as these vessels are rarely affected by calcification. Toe pressures need to be >30 mmHg for any possibility of wound healing.

Management

Palliative measures

Elevation of the head of the bed can sometimes be of benefit in increasing foot perfusion during the night. Drugs such as beta-blockers should be avoided.

Reperfusion

There is no drug therapy that has been proven to heal ischaemic ulcers.

Consider early referral to a vascular specialist or clinic if an ulcer of ischaemic origin is recognised or suspected, as revascularization can result in limb salvage in many cases.

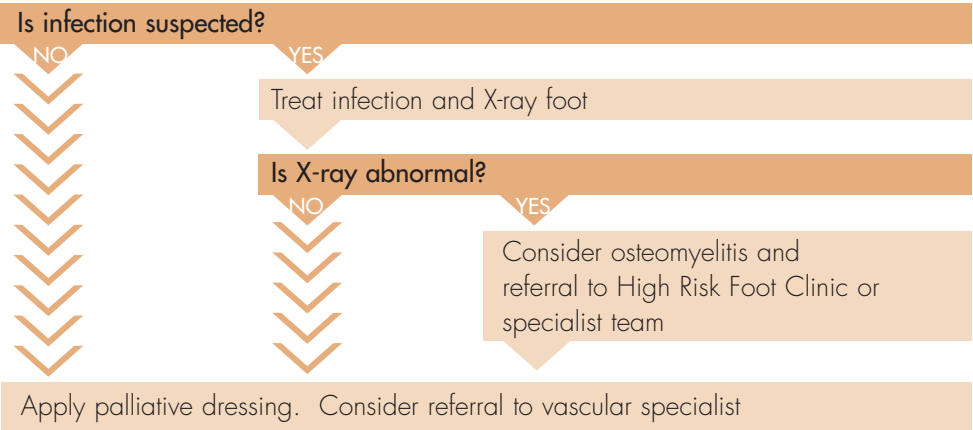
Revascularization may take the form of angioplasty (balloon dilatation, stent placement, endarterectomy), or bypass grafting may be required.

Debridement

Debridement should not be performed if pulses are impalpable or if there is insufficient blood flow for healing (ABI<0.5 or absolute ankle pressure < 55mmHg).

If debridement is indicated, this should be done in an operating theatre.

Treatment flowchart for ischaemic ulcers



Venous Ulcers

Investigation

Uncomplicated venous ulcers do not usually require any investigations. Detailed assessment of the distribution of varicose veins or investigation of the deep venous system is not necessary unless vein surgery is being planned. Under these circumstances, the surgeon involved will usually organise the appropriate tests.

Assess perfusion

The clinical assessment of any ulcer should include:

- Palpation of peripheral pulses
- Assessment for elevation pallor .

Question the patient as to any history of intermittent claudication, rest pain or previous vascular studies or surgery.

If pulses are impalpable, or there are other signs or symptoms **of ischaemia** then the ulcer should be suspected as having a significant ischaemic component and this should be confirmed by **Doppler pressure studies**. If these reveal significant ischaemia, then this must be considered the more important contributor to the aetiology of the ulcer and the ulcer should be treated as a primarily ischaemic one. **If there is clinical suspicion of ischaemia, further**

investigations should be carried out even if the Doppler pressure studies appear to be normal, because of the tendency for artificially high pressures in cases of vascular calcification.

Management

Compression bandages

Compression treatment is contra-indicated by leg ischaemia (pulses impalpable or ankle brachial index <0.8) or ulcer infection. If either condition is suspected, compression treatment should be withheld.

Compression bandages are either a combination of elastic and cotton, or just elastic, and are usually applied to produce a pressure of 15-25 or 25-35 mmHg. They are placed over the dressings, and wound in a spiral fashion with a 50% overlap, from the base of the toes to just below knee level. Any excess bandage should be cut off.

There are some types of bandages that incorporate a topical healing agent such as zinc and there are several bandage systems that incorporate several layers, both elastic and non-elastic.

Many bandages are designed to remain in place for several days at a time. Most compression bandages

come with instructions, though patients may require the assistance of a carer or community nurse to apply bandages correctly. Patients should be instructed to remove any bandages immediately if they are causing pain, tingling or numbness of the foot or toes, or a change in colour of the toes.

Elevation

The patient's leg should be kept in an elevated position when sitting or lying. It may be possible to elevate the foot of the patient's bed to improve venous return at night.

Debridement

Debridement to the base of some venous ulcers may be beneficial if there is a thick yellow layer of fibrin. This can be accomplished using a pair of metal

forceps and a scalpel to remove any loose or dead tissue. If there is considerable necrotic tissue that cannot be easily removed or loosened, surgical debridement in theatre may be indicated. NO debridement should be carried out if pulses are impalpable or there are other signs indicative of ischaemia.

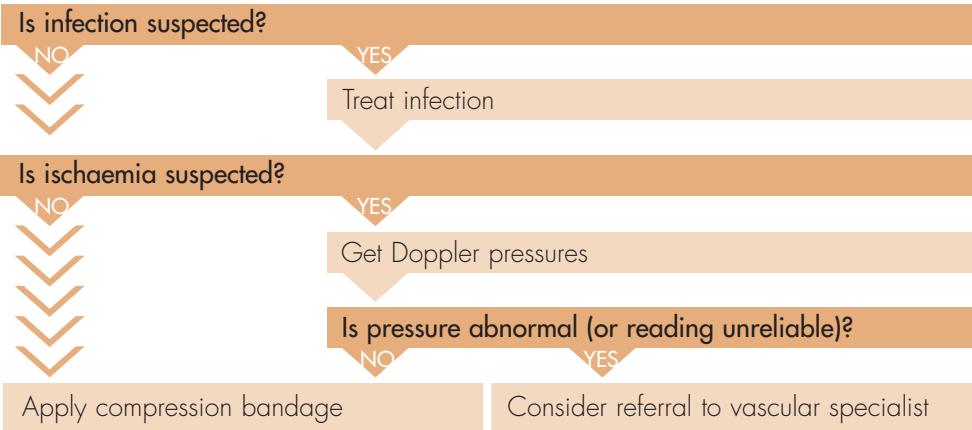
Skin grafting

Accelerated healing can sometimes be achieved by means of a split skin graft. This technique is useful for ulcers with a large surface area which have a healthy granulating base and are not infected.

Varicose vein surgery

Consideration of varicose vein removal is usually deferred until after the ulcer has healed.

Treatment flowchart for venous ulcers



Infection

Local signs of infection include redness, swelling, and heat. There may also be purulent discharge or increased pain. Note that signs of infection can be masked in ischaemic ulcers because poor perfusion may limit the local white cell inflammatory response. A high index of suspicion for infection is called for in such cases. Wound swabs do not indicate whether a wound is infected or not.

Antibiotic therapy for infected ulcers is empiric. Since *Staph. aureus* and *Strep. pyogenes* are often pathogenic organisms in diabetic ulcers, treatment should aim to cover these organisms. While a swab for culture may be useful, do not wait for swab results to commence oral antibiotic treatment if there are signs of infection.

Antibiotics that are often prescribed include:

- Dicloxacillin (Flucloxacillin is also used however Dicloxacillin is associated with less liver toxicity)
- Augmentin duo forte (Has some anti-anaerobic activity)
- Cephalexin
- Clindamycin (Also used when there is allergy to penicillin).

Penicillin is effective against *Strep. pyogenes*, but should usually be

combined with an anti-staphylococcal agent. The addition of penicillin is particularly useful when there is cellulitis.

Anaerobic infection (commonly manifested by a malodorous ulcer) can be treated with metronidazole. Augmentin duo forte will also cover anaerobes. It is usually not necessary to cover for gram-negative organisms unless the patient is obviously unwell.

If there is no improvement within days of commencing oral antibiotic therapy, the antibiotic should be changed (considering the wound swab result) or the patient referred for intravenous therapy.

Intravenous antibiotics should be used in cases of severe ascending cellulitis or when the patient exhibits systemic signs or symptoms of infection.

Swabs are useful in identifying MRSA (Methicillin-resistant *Staphylococcus aureus*) and should be performed when MRSA is suspected. Swab results should be considered if there is a lack of response to empiric treatment. Swab the wound only after it has been cleansed with normal saline and obtain a deep swab or tissue sample if possible. The swab result will provide information regarding organisms in the wound but are not always reliable in distinguishing

between colonising organisms and pathogenic ones. The clinical response to antibiotics is more important than the results of wound culture in determining the effectiveness of the antibiotic.

Renal function should be monitored if nephrotoxic antibiotics are used and dosage adjusted as required.

Topical antimicrobial preparations such as silver sulphadiazine, cadexomer iodine and the recently introduced dressings impregnated with silver can reduce the bacterial load in wounds. As such they may be of value as an adjunctive treatment for infected wounds or wounds that are likely to be heavily colonised. The ongoing need for antimicrobial dressings should be reassessed every 7-14 days and their use limited to a short duration.

Infections arising in foot ulcers, especially those ulcers that are chronic, deep or greater than 2cm in diameter, may be associated with underlying osteomyelitis. An X-ray is mandatory in chronic foot ulcers to identify osteomyelitis or underlying structural problems creating pressure. Foreign bodies can also be associated with infection. Bone may appear normal on X-ray in the early stages of osteomyelitis. If clinical suspicion is high despite a normal X-ray, then a white cell scan and bone scan

can assist in the identification of infection located within the bone. MRI can also be very reliable if available.

If osteomyelitis is diagnosed, prompt referral and hospitalization can limit bone loss due to infection and may save the foot from amputation. If osteomyelitis is proven or if the patient is unwell, intravenous antibiotics are recommended initially, followed by a minimum of 10-12 weeks of oral therapy. Monitor for signs of toxicity by performing baseline and follow up liver function tests. If osteomyelitis is extensive or fails to respond to antibiotic therapy, surgical resection of infected bone may be necessary. If surgery is indicated, consideration must be given to the shape of the residual foot and its weight-bearing area in order to prevent new pressure areas or ulceration.

Infected ischaemic ulcers are also very difficult to treat effectively, since antibiotic penetration to the site of infection is limited by poor perfusion. If infection does not resolve promptly (within days) with oral antibiotics, intravenous antibiotics and possibly revascularization of the limb, may be required.

Non-healing ulcers

A plan of action with clearly defined deadlines for clinical improvement and parameters of progress that can be easily measured can help to identify ulcers that are failing to respond to treatment. If there has been no improvement after several weeks of treatment, re-assessment is necessary. Treatment failure is usually due to one or more of a number of causes as set out on page 14. The following paragraphs refer to some important causes.

Infection and/or ischaemia

An empiric course of antibiotics is often the only practical way to determine if infection plays a role in retarding ulcer healing. Response should be prompt (within a week). Ischaemia if suspected should be assessed by Doppler pressure measurements as set out on page 20-21.

Inadequate treatment of the underlying pathological process

For venous ulcers, this may be due to insufficient compression bandaging, while for neuropathic ulcers, it could be due to failure to correct abnormal pressure at the site of the ulcer.

Use of inappropriate dressings

Occlusive or non-absorbent dressings on exudative ulcers can trap exudate beneath the dressing, which can lead to

maceration of the ulcer edge and prevent healing at the wound interface. Maceration can be recognised by a moist white appearance to the ulcer edge or surrounding tissue. If this is found, a change of dressing to better manage the exudate and prevent maceration is indicated. (For example : foam with or without alginate or hydrofiber should quickly resolve the problem).

Insufficient debridement

Lack of debridement can retard healing by allowing build-up of dead skin, callus or necrotic material within or surrounding an ulcer. This prevents healthy new skin or granulation tissue from developing. Mechanical approaches to debridement are the most satisfactory. This is best achieved by use of a scalpel and forceps to gently remove non-viable tissue. Experience is necessary to perform this task satisfactorily. Callus debridement is best done by a podiatrist. It is often required on a weekly basis in neuropathic ulcers. Debridement should not be attempted if an ischaemic aetiology for the ulcer is suspected.

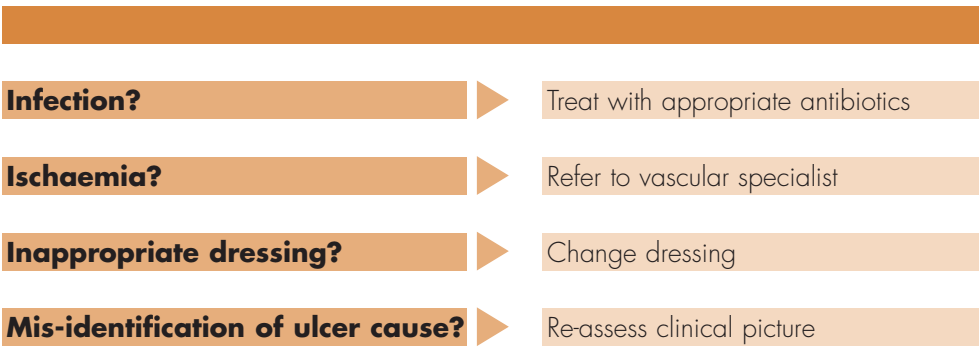
Dressing allergy

Dressing allergy is uncommon. It can sometimes be recognised by inflammation of the tissue surrounding

the ulcer which matches the area of the dressing, but infection must be suspected first if inflammation is seen. Sometimes an allergy can be manifested by failure of an ulcer to granulate satisfactorily.

Changing the type of dressing should result in a prompt response within a week. Record any allergy in the patient record.

Treatment flowchart for non-healing ulcers



Unusual causes of ulceration

Certain characteristics of an ulcer can suggest an unusual cause. An uncommon cause of ulceration in the lower limb should be considered if an ulcer:

- Is in an unusual site (eg. upper calf)
- Has failed to respond to management
- Exists at multiple sites
- Is associated with constitutional symptoms without local signs of infection
- Is painful in the presence of normal pulses and in the absence of infection.

Unusual causes of lower limb ulcers include:

- Inflammatory ulcers (eg. pyoderma gangrenosum)
- Immunologic ulcers (eg. vasculitis)
- Neoplastic ulcers.

Investigation of unusual ulcers usually involve a biopsy of the ulcer edge. This procedure yields more information than any other single test. If there is uncertainty about the nature of an ulcer or if an unusual cause is suspected, referral to a specialist clinic is indicated.

Podiatry Supplement

Podiatrists have a unique role in the prevention and treatment of foot complications in diabetes through education and the use of specialised procedures in foot care.

Patients with diabetes should have their feet assessed every 6-12 months to detect risk factors. If foot problems are present, referral to a podiatrist for treatment is recommended.

Assessment of risk factors for ulceration and amputation

Neurological Assessment

- Vibratory perception with biothesiometer or tuning fork
- Ankle reflexes
- Ability to feel the 10g monofilament.

Vascular Assessment

- Palpate pedal pulses
- Perform Buerger's test (elevation pallor, dependent rubor).

Question the patient as to their history of claudication, rest pain and previous vascular investigations or surgery. Symptoms of claudication may be absent in patients with peripheral neuropathy or

those who can walk a short distance only. If ischaemia is suspected, further investigations should be arranged along with referral to a vascular specialist.

Biomechanical Assessment

- Joint range of motion
- Strength of extrinsic foot muscles: evaluate for the presence of foot drop or posterior tibial dysfunction
- Gait
- Presence and nature of foot deformity
- Presence and cause of localised callus.

Active Foot Problem Assessment

Observe, document and treat (where appropriate);

- Ulceration and infection
- Localised callus or pre-ulcerous lesion
- Abnormal toenails: Ingrown, thickened and mycotic
- Areas of trauma
- Skin fissures associated with severe dry skin
- Interdigital maceration or fungal infection.

Other risk factors include poor self care or inability to see or reach the feet in the absence of a suitable carer.

Foot Problems	Preventive Treatment
Clawed toes	<ul style="list-style-type: none"> • Assess if fixed or reducible • Advise on footwear • Fabricate orthodigital devices to assist in straightening the toe (if possible) or to deflect or pad any pressure areas • If reducible, advise on appropriate stretching and strengthening exercises
Localised callus	<ul style="list-style-type: none"> • Identify cause • Debride callus • Advise on appropriate footwear and foot care • Prescribe and fit insoles/orthoses to cushion and redistribute pressure when needed
Hallux limitus/rigidus	<ul style="list-style-type: none"> • Provide regular debridement of any associated callus • Prescribe appropriate insoles/orthoses (not rigid) • Consider the use of a forefoot rocker on footwear
Heel fissures	<ul style="list-style-type: none"> • Treat any open fissure as an ulcer • Advise of footwear with enclosed heels • Debride any associated callus • Advise on use of urea based heel balms to prevent recurrence when healed

Foot Ulceration

Podiatry has much to offer in terms of treatment and prevention of all foot ulcers. However, **if there is ulceration or suspicion of infection, the patient will require both medical and podiatry care.**

Referral to a local multidisciplinary High Risk Foot Clinic should be arranged promptly in consultation with the general practitioner or specialist. In the absence of a suitable high risk foot service the GP, podiatrist and relevant specialist should work together to provide the necessary treatment.

In the case of severe, limb threatening infection, refer patient to the emergency department.

Identify cause of ulceration (see pages 6-8) before commencing treatment.

Refer all vascular (ischaemic or venous) ulcers to the appropriate specialist service via the patient's general practitioner.

Arrange base line X-ray to exclude osteomyelitis.

Treatment

- Assess and monitor for signs of infection
- Perform biomechanical assessment and prescribe the most appropriate method of pressure offloading for the patient such as:
 - a pre-fabricated walking cast
 - deflective padding
 - a healing shoe
 - foot orthoses
 - total contact casting
- Select and prescribe appropriate non-occlusive dressing
- Debride wound of callus and necrotic tissue if blood flow is adequate (see page 20-21 in GP Supplement).

Recurrence rates are high. Ensure a secondary prevention strategy is in place when the ulcer has healed. This should include:

- Regular follow-up
- Foot-care education for improved patient self care
- Appropriate shoes and orthoses.

Charcot Foot (neuroarthropathy)

Acute:

- Organise an immediate offloading strategy (wheelchair or crutches)
- Advise elevation of limb and possibly light compression to minimise oedema prior to casting
- Perform baseline assessment of foot shape, skin temperature and swelling
- Arrange baseline X-ray with or without bone scan
- Organise or perform total contact casting. Casting is best performed under the care of the High Risk Foot Clinic. Alternatively, casting technicians or physiotherapists experienced in casting the neuropathic limb can also apply the cast. Ensure there are no contraindications for casting and ensure frequent follow up.
- Advise patient regarding the safe use and potential risks of casting. Patients should be given instructions about general cast care and told to report immediately such symptoms as swelling of toes, discolouration, unusual sensation especially pain, odour, temperature changes or discharge
- Review the cast regularly and replace as required based on closeness of fit and condition of cast. Do not leave longer than 4 weeks

- Monitor using clinical signs of shape change, swelling and temperature difference, regular x-rays (every 6-12 weeks) and possibly quantitative bone scanning to determine when the foot has healed
- Once healed and appropriate footwear and orthoses have been fitted, weight-bearing may be gradually introduced.

Sub acute Charcot's neuroarthropathy

that is healing and has become relatively stable can be treated with a prefabricated walking cast or bi-valved cast. Because these devices are removable, their effectiveness relies on patient compliance in wearing the appliance at all times. Ensure the cast is fitted correctly and advise patient regarding its safe use and potential risks (as per Total contact cast). A custom made insole can be fabricated to fit inside the boot. Continue to monitor the foot for progress.

Chronic (bones healed with residual established deformity):

- Treat any calluses or ulceration
- Consider surgery for residual bony deformity. Arrange referral to an orthopaedic surgeon preferably with experience in diabetic foot surgery
- Organise orthopaedic footwear and orthoses.

Nursing Supplement

First Aid on discovery of an ulcer:

1. Wash the area with tap water or saline but do not soak the foot.
2. Gently pat dry the surrounding skin
3. Apply a non-stick dressing
4. Fix the dressing in place with permeable tape
5. Clean the area and change the dressing every day
6. If there is no improvement in 24-48 hours, the patient should seek medical attention.

If there is pain, redness, heat, swelling, leaking fluid or an unpleasant odour associated with the ulcer, this could mean infection. The patient should go to the local doctor, High Risk Foot Clinic or hospital emergency department.

Patients with neuropathy should check the ulcer daily for the above signs, as they may not feel pain in the foot. If the patient cannot easily see the ulcer because of its position or because of visual impairment, a carer or nurse should inspect the ulcer daily. A mirror may also be of assistance.

Neuropathic and neuro-ischaemic ulcers

Assess neurological and vascular status as it could be a combination of neuropathic and ischaemic ulcer.

Management

Debridement

Weekly debridement of the surrounding callus by a podiatrist if there is adequate blood flow for healing (preferably as part of a High Risk Foot Clinic) is an important part of treatment. Callus should be reduced by pressure off-loading strategies.

Cleaning the ulcer

Keep the foot dry in the shower. This helps prevent maceration of the area and reduces the likelihood of contamination and infection. Wash the foot separately but do not soak.

To clean the ulcer, remove the dressing and gently clean with normal saline or tap water.

Reduction of pressure

- Reduce weight-bearing on wound area
- Assess causes of pressure on the wound. In most cases, patients should not continue wearing their regular footwear and will need referral to the podiatrist for pressure offloading
- Use dressings that do not apply or increase pressure to the ulcer or surrounding skin.

Dressing recommendations

Recommended dressing is a foam dressing. Do not use an occlusive dressing or dressing that sticks to the wound, such as hydrocolloids or films. If using a gel on a weight-bearing sloughy ulcer, use sparingly.

To hold the dressing in place, the preferred method is to “picture frame” the dressing with tape. If tape is to be used “over” the dressing, use one that is permeable so the dressing is not rendered occlusive by the tape.

Do not use bandages or peripads as they can add pressure and increase the risk of further ulceration.

Ischaemic ulcer

Management

Liaise with General Practitioner with regard to referral to a vascular specialist for urgent assessment for revascularisation.

Ulcer may be associated with severe pain that tends to be worse when the limb is elevated so encourage patient to keep foot down.

Do not debride with a scalpel, scissors or any other mechanical means.

Encourage exercise such as walking if this does not traumatise the area.

Dressing recommendations

If the ulcer has a dry eschar no dressing is required until the patient has been seen by the vascular specialist.

If the ulcer is moist and deep, use foam or another non-adherent, non-occlusive dressing.

No bandaging

To hold the dressing in place, the preferred method is to “picture frame” the dressing with tape. If tape is to be used “over” the dressing, use one that is permeable so the dressing is not

rendered occlusive by the tape. Do not use any constricting bandages or compression stockings.

Venous ulcer

Management

- Encourage exercise such as walking
- Elevate the limb when at rest
- Facilitate and encourage compression therapy
- Monitor leg oedema and report any deterioration to the doctor.

Determine suitability for compression therapy:

- Palpate peripheral pulses. If they are weak or impalpable, measure ankle brachial index or refer for vascular assessment. If ABI is < 0.9 , do not use compression therapy. Refer to vascular specialist for further investigation and treatment
- Assess sensation. Seek medical advice and use compression therapy with caution in people with loss of sensation from peripheral neuropathy.

Dressing recommendations

Choose the dressing according to:

- The amount of exudate
- Condition of ulcer base (ie. Granulating or sloughy)
- Patient comfort
- Availability.



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