

# Using compression therapy in complex situations

Patients presenting with ulceration will often have other chronic illnesses such as diabetes mellitus and osteoarthritis. Compression therapy remains the mainstay of treatment for the majority of these patients, although in some it will be contraindicated. This article stresses the importance of assessment of ulcer aetiology and will discuss the treatment of patients with ulceration who have complex health needs, including those with diabetes, rheumatoid arthritis, haematological problems such as sickle cell anaemia, cardiac problems, and wounds caused by trauma.

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## KEY WORDS

Compression therapy  
Ulceration  
Diabetes  
Rheumatoid arthritis  
Sickle cell anaemia  
Pre-tibial crest injuries

There is increasing evidence that the proportion of patients with complex ulceration is increasing (Moffatt et al, 2004). There may be many reasons for this, the most important factor being the increase in peripheral arterial occlusive disease in the very elderly (Morison et al, 2007). As age increases, so does the chance of having other chronic illnesses such as diabetes mellitus and osteoarthritis. Identification of the ulcer aetiology remains a key priority of assessment. The true role that other health issues play in ulcer healing is often difficult to determine. Nevertheless, compression therapy remains the mainstay of treatment for the majority of these patients despite their complex healthcare needs and healing can be achieved, although more slowly, in many cases.

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## Patients with diabetes

Many textbooks state that compression therapy should not be used in patients with diabetes. This is because of the risk of concurrent peripheral arterial occlusive disease and the concern that sensory neuropathy will prevent a patient from detecting whether the compression is causing trauma. However, patients with diabetes are just as likely to suffer from a venous ulcer as those without.

Such patients with venous ulceration require compression therapy and, providing their condition is stable, they may heal uneventfully. Others may take longer to heal, although the exact reason for the delay may not be obvious (Marston, 2007).

There are a number of factors thought to affect wound healing in the patient with diabetes (*Table 1*), who frequently present with other medical conditions or complications of diabetes.

## Assessment issues

To use compression safely and effectively, a number of issues must be addressed within a comprehensive, structured assessment. If there is any doubt, the patient should be referred for a specialist opinion before treatment with compression commences.

## Table 1

### Factors affecting wound healing

- » Peripheral arterial occlusive disease that leads to reduced perfusion and low oxygen levels that result in tissue breakdown and gangrene (Kite and Powell, 2007)
- » Smoking is a major risk factor for peripheral vascular disease (PVD) (Burns et al, 2003). In addition to its role in accelerating arterial disease, it is also a potent vasoconstrictor, further reducing local tissue oxygen perfusion
- » Poor immune function, placing the patient at risk of overwhelming infection (Kite and Powell, 2007).
- » Reduced neutrophil activity increases the risk of opportunistic bacteria causing severe infection (Edmonds, 2007).
- » Increased risk of infection with a blood glucose of >7 mmol/l (International Working Group on the Diabetic Foot, 2003).
- » Patients with two or more factors complicating the ulcer aetiology (International Working Group on the Diabetic Foot, 2003)
- » Reduced serum albumin levels of <30 gm/dl due to infection, starvation, renal failure or acute stress (International Working Group on the Diabetic Foot, 2003)
- » Other diabetic complications, such as retinopathy and nephropathy, are important indicators that delayed wound healing may occur (International Working Group on the Diabetic Foot, 1999).



Figure 1. The at-risk diabetic foot, with hallux valgus, crowded toes and callus formation over the metatarsal heads.



Figure 2. Arterial emboli.

The following key priorities relate to the safe use of compression in patients with diabetes.

**Exclusion of peripheral arterial occlusive disease**

A patient's arterial status should be assessed using a clinical history and Doppler ultrasound. Recording a resting pressure index in a patient with diabetes can be difficult, due to:

- ▶▶ Calcification of the arteries which prevents the artery from being occluded. As a result, a false, very high systolic pressure is recorded which does not give an accurate picture of the patient's arterial status
- ▶▶ Toe pressure may be useful in this group as calcification of the toe



Figure 3. Deep pressure necrosis.



Figure 4. Heel pressure ulcer.



Figure 5. Crowding of toes.

vessels rarely occurs, therefore, it gives a more accurate assessment of the arterial status

- ▶▶ If the arterial status of the patient cannot be determined, specialist referral for further vascular assessment should be made.

**Assessment of peripheral neuropathy**

Neuropathy occurs in the majority of patients with diabetes (Edmonds, 2007). This places the patient at risk of callus formation and foot ulceration due to the changed biomechanics of the foot that cause areas of high pressure and friction (Figure 1). Regular assessment of neuropathy using a 10g monofilament should be undertaken in all patients with diabetes. In addition, it is important to pay particular attention to:

- ▶▶ Areas at risk of pressure damage from compression
- ▶▶ Areas of callus formation or previous foot ulceration
- ▶▶ Foot deformities, eg. hammer toes, hallux valgus, Charcot deformity, prominent metatarsal heads, dropped arch
- ▶▶ Toes, interdigital infection, emboli (Figure 2)
- ▶▶ Joint function
- ▶▶ Quality of the skin and signs of trauma
- ▶▶ Nails, nail deformities and infection
- ▶▶ Footwear.

**Removal of callus**

Callus formation can be rapid, particularly in patients suffering from hyperglycaemia. Common areas of callus formation are over the plantar surface of the foot, particularly where there are exposed metatarsal heads. Compression bandaging traditionally extends to the base of the toes. This will mean that the compression is applied over this area acting as a secondary source of pressure and friction. The callus area may need to remain exposed to avoid this risk and to allow for the regular removal of callus by the diabetic podiatrist.

**Identification of sub-keratotic haematoma**

If the patient has neuropathic foot ulceration or evidence of haemorrhage below the callus, compression should



not be applied without specialist advice. These patients require an urgent specialist referral to the diabetic team and debridement by the diabetic podiatrist

#### Foot deformities and pressure damage

Foot deformities, such as claw toes, hammer toes, prominent hallux valgus (bunions) and bunionettes are all areas at risk of compression damage. Other neuropathic changes include loss of the small intrinsic muscles and subcutaneous tissue in the forefoot area. High compression can result in deep pressure necrosis over the dorsum of the foot (Figure 3). The extensor tendon may be prominent, requiring extra protection.

The area of the heel is rarely described as an area that is associated with compression damage. However, compression may exacerbate the risk of heel pressure ulceration in immobile patients who keep their limb in the same position for long periods of time (Figure 4). The loss of sensation prevents these patients from being alerted to the need to change position.

While compression bandaging should not extend over the toes, care must be taken to ensure that compression will not exacerbate toe deformities or cause tissue damage. Crowding and overlapping of toes are common problems leading to interdigital pressure ulceration with increased risk of infection (Figure 5).

#### Reduced mobility

Many factors influence the mobility of these patients. Reduced ankle movement is a common problem. There are a number of reasons why this may occur. Long-term venous ulceration is associated with a progressive loss of ankle function, particularly when compression is being used. Patients who have a completely fixed ankle joint are at particular risk of delayed healing due to poor venous return. Patients with diabetes also develop reduced ankle function due to the glycosylation in the subcutaneous tissues causing stiffness and reduced function (Edmonds, 2007).



Figure 6. Charcot foot deformity.

#### Footwear

It is vital to assess the patient's footwear. Patients with neuropathy are frequently found to be wearing shoes that are too tight and the feet should be checked for signs of pressure damage (Edmonds, 2007). When compression is being considered, it is important to assess how this will influence their regular footwear:

#### Previous history of foot ulceration

Specialist advice should be sought before applying compression to patients with a previous history of foot ulceration or those wearing custom-made shoes. It is vital that the compression does not become wrinkled when the foot is placed in the shoe, as the patient with neuropathy will be unable to tell if damage is occurring.

#### Contraindications to compression therapy

There are a number of clinical situations when compression should not be used in a patient with diabetes except under specialist supervision.

#### Concurrent neuropathic foot ulceration

Venous ulceration may occur in a patient with concurrent neuropathic foot ulceration. In addition to the risks associated with reduced sensation, compression should not be applied over the ulcerated area, as this may act as an additional pressure source and can prevent regular inspection of the foot. In a similar manner, a Charcot deformity with ulceration should not be treated with compression therapy (Figure 6).



Figure 7. Vasculitic ulceration associated with rheumatoid arthritis.

#### Patients with a reduced ankle to brachial pressure index (ABPI)

Although reduced compression is recommended for patients without diabetes with a reduced ABPI of 0.6–0.8, compression should be avoided in patients with diabetes with an ABPI below 0.8 until specialist opinion has been sought. Marshall (2004) outlines a recommended protocol to assist practitioners when undertaking an ABPI.

#### How to choose the correct compression

Elastic or inelastic, multi-layer high compression bandaging is the treatment of choice. In young patients who wish to self-care, compression hosiery may be a useful option.

**Table 2**

**Different compression regimes for patients with diabetes**

Self-care regimens, using bandages and compression garments, to be considered for patients:

- » With good eyesight who are able to undertake dressings and observe their wound for signs of progress or deterioration
- » Wishing to self-manage
- » With an adequate hyperglycaemic control
- » With a clear understanding of their condition and its treatment
- » With no neuropathy
- » With no history of neuropathic foot ulceration
- » With the ability to concord with professionally prescribed treatment.

Elastic multi-layer high compression bandaging (higher resting pressure), suitable for patients who:

- » Are young and fit
- » Have a normal ankle to brachial pressure index with triphasic waveforms
- » Have no history of cardiovascular disease
- » Have no previous treatment for peripheral arterial occlusive disease
- » Have minimal or no peripheral neuropathy
- » Have varying levels of mobility, including poor mobility and those who are chairbound
- » Have control of oedema, particularly in the immobile patient.

Inelastic multi-layer high compression bandaging (lower resting pressure), suitable for patients with:

- » Ankle to brachial pressure index > 0.8 with biphasic or triphasic waveforms
- » Good mobility (to assist the action of the bandage during walking)
- » Concerns over distal perfusion at night when wearing bandaging with the foot elevated
- » Severe pain which prevents the use of high pressure elastic bandaging.

When choosing a regimen for a patient with diabetes, the factors in *Table 2* may help decision-making.

**Application issues**

It is important to consider the principles of safe application of compression and reduction of pressure damage. In addition, the following points should be considered:

- » The use of foam dressings or podiatric felt to redistribute pressure away from vulnerable areas
- » Applying small, soft foam shapes between the toes to prevent interdigital ulceration
- » Reshaping the limb to protect prominent extensor tendons
- » Changing to a bandage or bandage system with a lower sub-bandage resting pressure
- » Reducing pressure over vulnerable areas by changing the technique of bandage application
- » Ensuring that the shoes are large

enough to safely accommodate compression

- » If patient is wearing or requires custom-made shoes because of foot ulceration or previous ulceration, a specialist referral should be made
- » In rare cases, compression can be applied from ankle to knee in patients who wear custom-made shoes due to foot deformities. This type of footwear prevents oedema formation in the foot. This type of problem should only be managed under specialist supervision.

**Patients with rheumatoid arthritis**

Rheumatoid arthritis is a chronic, progressive inflammatory tissue disorder of unknown origin causing joint stiffness, ankylosis (fixation of a joint), and associated joint deformity. In addition, the auto-immune component of the disease can affect other systems including the skin (Oliver and Mooney, 2002). People with rheumatoid



**Figure 8. Patient with rheumatoid arthritis and ulceration from compression damage.**



**Figure 9. Ulceration due to sickle cell disease.**

arthritis are substantially more at risk of developing leg ulceration, and an estimated 5–10% will experience ulceration at some point in their lives (Cawley, 1987; Pun et al, 1990). About 18% of these ulcers are vasculitic (Pun et al, 1990) (*Figure 7*). Poor ankle mobility causing loss of calf muscle pump and 'pseudo-venous disease' is another major factor (Cawley 1987; Moffatt et al, 2004). The general health status of many of these patients is poor. Poor nutrition due to loss of appetite, functional difficulties, fatigue, stress and anxiety are common (Ryan, 1995).

**Recognising rheumatoid ulceration**

These ulcers are often associated with high levels of rheumatoid factor and severe arthritis. However, they may also be seen in those with stable rheumatoid arthritis. The ulcers tend to have a scalloped, undulating border. It is not uncommon for rheumatoid ulcers to have a component of

ischaemic or venous insufficiency, which often makes the condition more difficult to diagnose. Rheumatoid ulcers are generally considered to be multifactorial in aetiology.

#### Medical management

It is important to recognise that this is a type of leg ulcer caused by a systemic disease process. The initial priority in these circumstances is to ensure that the appropriate systemic therapy is used, in addition to local treatment of the wound and the use of appropriate levels of compression. Medical treatment of this condition is difficult. Many patients are already receiving high doses of corticosteroid therapy and other immunosuppressive drugs. Delayed wound healing and susceptibility to infection are common problems.

#### Using compression therapy

Compression therapy may be of some value with rheumatoid arthritis because of the associated venous insufficiency. However, it may cause excruciating pain in a small percentage of patients and in these cases should not be used until the condition has stabilised and the pain reduced. It is often difficult to predict which patients will experience pain and it is essential to ensure that vasculitis has been excluded, as compression will not only cause excruciating pain but may cause rapid tissue necrosis due to the already damaged microcirculation (Figure 8).

Compression should always be introduced slowly (a low pressure of less than 25 mmHg) and tailored to the patient's tolerance and pain level. The level of pressure can be increased if well tolerated. The risk of tissue trauma from poor bandaging is high and limb deformities require additional padding for protection.

Great care should be taken to ensure correct application of the bandage. A number of other factors should be considered when managing these patients, namely:

- ▶▶ The presence of rheumatoid arthritis will be contributing to

poor healing, even if it is not the primary cause of the ulcer

- ▶▶ If there is poor ankle mobility, venous hypertension is likely to be impeding healing. Leg elevation and ankle exercises will need to be taught and encouraged, as tolerated
- ▶▶ If vasculitis is suspected, refer for an urgent specialist opinion before starting compression
- ▶▶ Liaising with the patient's rheumatologist ensures a coordinated approach to care
- ▶▶ Monitoring and controlling wound infection. The drugs used for rheumatoid arthritis may also reduce immunity so that fungal infections such as tinea pedis and ringworm may develop and place the patient at risk of severe bacterial infection. Osteomyelitis is a common complication and is particularly found in the toes.

#### Haematological problems, such as sickle cell ulceration

Up to 70% of people with sickle cell anaemia are likely to develop a leg ulcer (Serjeant, 2001). Ulceration often begins in the mid- to late-teens and is most frequent in males of Caribbean origin. The exact mechanisms are not fully understood, but it is thought to involve a combination of chronic anaemia, venous hypertension, trauma and localised microcirculatory damage, due to the affected cells clumping in the small vessels. Factors to consider when managing these patients include:

- ▶▶ Sickle cell ulcers tend to be slow to heal and recurrence is common
- ▶▶ Ulceration occurs most frequently in those with sickle cell disease, but can also occur in those with sickle cell trait
- ▶▶ Ulceration is rare in those with Beta thalassaemia
- ▶▶ Ulcers have a similar appearance to atrophe blanche
- ▶▶ They occur around the malleoli and tend to be painful and sloughy and are frequently misdiagnosed as a venous ulcer (Figure 9).

There is as yet no evidence-based treatment for sickle cell ulceration.

Management requires a co-ordinated approach with the haematology team playing an important advisory role (Olujohungbe and Anionwu, 2007). Blood transfusions (simple 'top up' or exchange) have been successfully used in an uncontrolled manner to treat sickle cell leg ulcers. The healing effect may be directly due to relief of tissue anoxia of the corrected haemoglobin but also by limiting ischaemia arising from repeated vaso-occlusion (Chernoff et al, 1954; Serjeant, 2001).

Pain may be severe, excruciating and neuropathic in origin. Simple analgesia is inadequate and opioid analgesia and neuroleptic drugs may be required. Referral to a pain specialist is frequently necessary. Additional management issues include:

- ▶▶ Wound debridement — adequate pain relief during and after the procedure is essential
- ▶▶ Compression therapy
- ▶▶ Overnight high leg elevation — this may drastically improve the chances of healing
- ▶▶ Preventing wound infections
- ▶▶ Systemic antibiotics — these should be reserved for acute infection with cellulitis. Treatment may need to continue for a number of weeks due to poor tissue perfusion. Consultation with a microbiologist is helpful if recurrent infections occur
- ▶▶ Skin grafts — these may be very effective at reducing pain, although the recurrence rate is high. Following grafting, compression therapy must be used as soon as the patient is mobile to prevent graft rejection
- ▶▶ Avoidance of standing for prolonged periods of time
- ▶▶ Psychological support — this is essential as many of these patients are young and are struggling with careers and the financial implications of this disabling condition.

Many patients with sickle cell ulceration tolerate multi-layer compression regimens.



### Patients with cardiac failure

There is considerable debate concerning the use of compression therapy in patients with heart failure. This is because compression reduces the local blood volume of the legs by redistributing blood towards the central parts of the circulation (Mostbeck et al, 1977). This can seriously affect cardiac function by increasing the preload to the heart and influencing cardiac output by 5%. This can precipitate cardiac failure in those at risk and worsen the situation in those with established heart failure. Although rare, death has been reported from the introduction of compression therapy in patients with decompensated heart failure.

### Recognising oedema due to heart failure and combination oedemas

It is important to differentiate oedema caused by cardiac failure from other forms of oedema. If heart failure is suspected, a medical assessment should be performed and appropriate drug therapy with diuretics commenced. Compression should not be started until a correct diagnosis is made. In a proportion of patients the leg oedema is due to a combination of factors, these may include:

- ▶▶ Cardiac insufficiency
- ▶▶ Venous disease
- ▶▶ Lymphoedema
- ▶▶ Certain drug therapies
- ▶▶ Dependency oedema due to problems with mobility and breathlessness on lying flat
- ▶▶ Respiratory disease
- ▶▶ Renal disease
- ▶▶ Liver failure
- ▶▶ Peripheral arterial occlusive disease.

Features of cardiac oedema include:

- ▶▶ Quick or more insidious development of oedema
- ▶▶ The oedema is predominantly soft and pitting, although chronic heart failure may eventually lead to the fibrotic skin changes seen in lymphoedema
- ▶▶ The sudden increase in oedema may cause pronounced erythema and leakage of fluid from the tissues

- ▶▶ Large blisters may develop that may eventually lead to ulceration
- ▶▶ Oedema may extend to the thighs and eventually to the genitalia and sacral area
- ▶▶ Increased shortness of breath on exertion, during exercise or when lying down
- ▶▶ The jugular vein may be distended
- ▶▶ Patients may feel generally unwell
- ▶▶ Generalised tiredness
- ▶▶ Other cardiac symptoms may include atrial fibrillation
- ▶▶ Previous associated cardiovascular disease such as myocardial infarction.

### Using compression therapy

When the cardiac failure has been assessed and treated it is possible to slowly introduce compression therapy. The following issues should be considered:

- ▶▶ Apply reduced compression of less than 25 mmHg initially
- ▶▶ In severe cases of heart failure, begin by applying compression to one leg
- ▶▶ Carefully monitor any increase in symptoms such as breathlessness
- ▶▶ Check that fluid is not accumulating in the thigh or groins
- ▶▶ If well-tolerated and the cardiac symptoms are stable, compression can be introduced to both limbs
- ▶▶ Levels of high compression may be tolerated in patients with controlled heart failure
- ▶▶ If there has been extensive erythema and blistering, ensure all these areas are covered with a non-adherent dressing to prevent the cotton tubular bandage from adhering to the broken skin
- ▶▶ If symptoms worsen, stop compression therapy and refer the patient for a medical assessment.

### Traumatic causes of ulceration

Many ulcers begin following a minor trauma and it is the underlying disease process that prevents normal wound healing from occurring. The definition of when a wound becomes an ulcer has not been established, although epidemiologists frequently refer to a wound that fails to progress over a period of four or six weeks (Kantor

and Margolis, 2007). A number of wounds that are initially considered traumatic may ulcerate, one of the most frequent being the pre-tibial laceration.

### Pre-tibial crest injuries

Pre-tibial crest injuries are common in the elderly due to falls and knocks to the leg. They are frequently treated in accident and emergency units where the flap of tissue is either glued or secured back in position using 3M™ Steri-Strip™ Skin Closures. If the skin is damaged, the flap may be removed and a dressing applied.

In patients who are fit and young with no factors influencing healing, the wound can heal uneventfully. However, in the elderly, the wound often fails to heal and a haematoma may develop beneath the flap. Infection is an important complication of haematoma due to the breakdown products that accumulate in the wound and the presence of bacteria. The area may rapidly deteriorate into an ulcer with the skin flap sloughing off.

One of the reasons for poor healing over the tibial crest is the relatively poor vascular supply to this area. Lack of subcutaneous tissue over the bony prominence may also delay healing. Inappropriate early treatment of the wound may influence the patient's progress.

Patients attending A&E may be poorly assessed. Skin flaps that are no longer viable may be replaced rather than removed, and risk factors such as the presence of venous disease or mild ischaemia that will influence healing, may not be identified.

Oedema frequently occurs following this injury, further influencing the potential for delayed wound healing. The following aspects should be considered when treating these patients:

- ▶▶ Any loose dead skin should be carefully removed ensuring that there is no further damage
- ▶▶ Any residual haematoma should be drained (debridement and removal

of the haematoma should only be carried out by a suitably trained specialist nurse)

- ▶ Antibiotics should be prescribed if there are signs of cellulitis (pain, erythema, increased exudate and oedema)
- ▶ The wound should be covered with a totally non-adherent dressing that allows for exudate to wick away from the wound. Dressings such as Mepitel® (Mölnlycke Healthcare) that incorporates silicone are useful. Mepitel can be left in place to allow uninterrupted wound healing and only the secondary dressing renewed. The open texture of the dressing allows the wound to be inspected at each dressing change
- ▶ Control of oedema is an essential component of treatment. If there is no evident venous disease, reduced compression of < 25 mmHg may be sufficient to remove oedema and promote healing
- ▶ Patients with venous disease may require high compression multi-layer bandaging
- ▶ Particular care should be taken when applying compression to pad the area of the tibial crest to avoid any excess of pressure to this vulnerable area
- ▶ In rare cases, if healing does not progress within a few months with conventional treatment, the patient should be referred to a plastic reconstructive surgeon for consideration of a skin graft. **WUK**

This article was originally published in *Compression Therapy in Practice*, edited by Christine Moffatt, published by Wounds UK. To buy a copy go to [wounds-uk.com/bookstore.shtml](http://wounds-uk.com/bookstore.shtml)

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## Key Points

- ▶ Compression therapy remains the mainstay of treatment for ulceration despite some patients' complex healthcare needs.
- ▶ Before compression therapy can be used for patients with diabetes a few key factors need to be addressed, such as the exclusion of peripheral arterial occlusive disease, the assessment of peripheral neuropathy and the removal of calluses.
- ▶ If the patient has neuropathic foot ulceration or evidence of haemorrhage beneath a callus, compression should not be applied without specialist advice.
- ▶ Compression therapy may be of some value with rheumatoid arthritis because of the associated venous insufficiency. However, it may cause excruciating pain in a small percentage of patients.
- ▶ Up to 70% of people with sickle cell anaemia are likely to develop a leg ulcer (Serjeant, 2001) and these ulcers tend to be slow to heal and recurrence is common.
- ▶ Care should be taken when considering using compression therapy for patients who have had cardiac failure.