Wound Essentials

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Effective compression therapy

how to guide

Venous disease is common and most healthcare professionals will encounter patients who need or are receiving compression therapy, either with hosiery or bandages. Compression is the mainstay of treatment or prevention for venous ulcers and the aim must always be to ensure safe application and effective therapy. This 'how to' guide is intended to help practitioners understand the rationale for applying compression therapy and aid them in managing patients with lower limb venous ulceration.

MANAGEMENT OF VENOUS LEG ULCERS

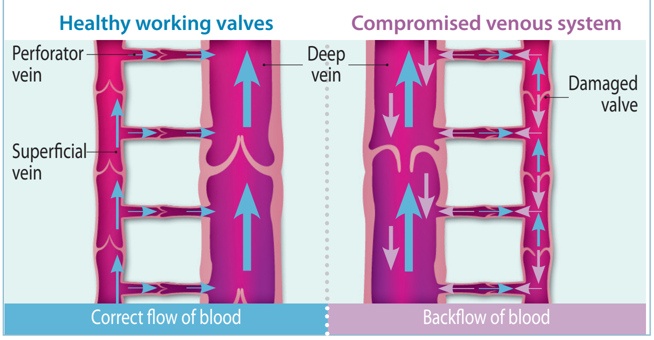
Chronic venous insufficiency affects up to 50% of the adult population (Venous Forum, 2011) and it is estimated that 1% of the UK population will suffer from leg ulceration during their lifetime (Callam, 1992). The majority of these ulcers are caused by vascular disease (venous, arterial and lymphatic), with venous disease accounting for between 60–80% of leg ulceration (Callam, 1992).

Correctly applied compression therapy is now recognised as the mainstay of treatment for both the preventative and therapeutic care of venous disease, with high compression bandaging now established as the treatment of choice for venous leg ulceration (O'Meara et al, 2009). Studies would suggest that healing rates above 50% after 12 weeks of care should be achievable (Vowden et al, 1997; Barwell et al, 2004) and guidelines indicate that patients failing to respond to care within this time frame should be referred for vascular and specialist wound care assessment (Marston and Vowden, 2003).

UNDERSTANDING VENOUS DISEASE

In a healthy individual, venous pressure at the ankle falls during exercise due to the action of the calf muscles and the presence of functional venous valves that prevent venous reflux. Figure 1 illustrates normal venous physiology and how valvular disease affects venous return. Calf muscle pump failure due to inactivity or paralysis, failure of the venous valves due to varicose veins, or damage to the deep veins secondary to venous thrombosis, trauma or venous obstruction, decrease the efficiency of this system. This results in a higher venous pressure, a condition known as chronic venous hypertension. Chronic venous hypertension has a number of consequences and changes occur in the microcirculation. This is associated with lower limb discomfort, swelling and skin changes and ultimately may lead to venous ulceration. The progression of venous disease is classified using the CEAP grading system (Eklof et al, 2004) (see Table 1).

Figure 1: In healthy individuals venous blood flows from the superficial veins, through the perforator veins to the deep venous system, returning from there to the heart. When valves are damaged or compromised (made incompetent) this system fails, venous reflux (backward flow) occurs and the pressure in the veins increases (venous hypertension) which over time causes progressive skin damage.



In a normal limb a balance exists between the pressure in the capillary bed, tissue pressure and oncotic pressure. As venous pressure rises this balance is disturbed. Blood moves more slowly through the capillaries and veins increasing the risk of thrombosis and activation of white blood cells. The raised pressure also leads to increased vessel permeability with the leaking of fluid and protein into the tissues (Partsch, 2003).

Treatment of venous disease is aimed at correcting, as far as possible, the effects of valvular incompetence and reducing the damaging effects of venous hypertension. This is achieved by applying compression therapy in the form of hosiery or bandages and undertaking corrective venous surgery, endovenous ablation therapy or sclerotherapy where investigations have demonstrated superficial venous reflux (varicose veins) to be present (Venous Forum, 2011). Treating venous disease has been demonstrated to:

- Significantly improve a patient's quality of life
- Relieve lower limb symptoms
- Delay or prevent the long-term complications of chronic venous insufficiency
- Be a cost-effective use of resources.

Table 1: CEAP Grading System

C_0	No visible or palpable signs of venous disease
C_1	Telangiectasia or reticular veins (thread veins)
C_2	Varicose veins (diameter >3mm)
C_3	Oedema
C_4	Changes in the skin and subcutaneous tissue: pigmentation, eczema, lipodermatosclerosis or atrophic blanche
C_5	Healed venous ulcer
C_6	Active venous ulcer

UNDERSTANDING COMPRESSION

Compression therapy aims to reverse the effects of venous hypertension by:

- **Decreasing the capacity of and pressure within the superficial veins. This aids venous return by increasing the blood flow velocity in the deep veins**
- **Reducing oedema by decreasing the pressure difference between capillaries and the surrounding tissue and transferring tissue fluid back into the vascular space. This can reduce exudate**
- **Minimising or reversing skin changes, to aid the healing of venous ulceration.**

For compression to work it must be graduated, generating a pressure that is highest at the ankle. This must be sufficient to overcome the pressure in the lower limb veins when the patient is standing and sustained in order to deliver the necessary benefits over time. In addition, it must be tolerable to the patient.

Elastic and inelastic bandage systems

The level of compression produced by any bandage system is established by a series of complex interactions, including the size, shape and the physical structure of the limb, the type of bandage used, the layers incorporated in the bandage system, the overlap of the bandage, and the skill and technique of the bandager (Clark, 2003). Compression may contain elastic or inelastic materials or a combination of both:

- **Elastic** (also referred to as long-stretch) **contains elastomeric fibres that are capable of stretching and returning almost to their original size.**
- **Inelastic** (also referred to as short-stretch) **contains few or no elastomeric fibres and have minimal extensibility.**

Bandages are classified according to their ability to apply and maintain a safe, predetermined level of compression (Hopkins and Worboys, 2005). When applying a bandage system to a limb the aim is to provide a 'stiff', but shaped container against which muscles in the calf can contract. This generates a high 'working' pressure, which in a graduated system, aids venous return to the heart while maintaining a lower 'resting' pressure during inactivity (Fig 2).

Stiff bandaging may be achieved by using either inelastic bandages or elastic bandages in a multi-layer system such as the 4-layer bandage (Partsch, 2005). Elastic bandages are rarely used in isolation in current practice, as they provide little or no stiffness. For a table showing the classifications for the different compression bandages see Beldon, 2009.

One of the beneficial effects of compression with a high static stiffness index (SSI) (Fig 3) is a rapid initial change in limb size as oedema is reduced. One consequence of this is that the bandage system will need to be re-applied more frequently due to the rapid reduction of oedema. This is particularly relevant when using inelastic materials as, without elastomeric fibres, their effectiveness will decrease and bandage slippage is more likely to occur as these systems fail to accommodate for the change in limb circumference. The importance of SSI in restoring venous function is shown in Figure 4.

Fig 2: Working versus resting pressures

- At rest, the bandage system applies a constant pressure to the skin (resting pressure).
- When muscles contract (eg during walking), they expand, increasing the sub-bandage pressure temporarily (working pressure) (Clark, 2003).

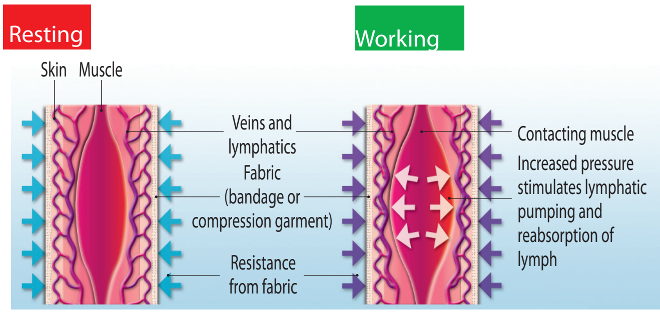
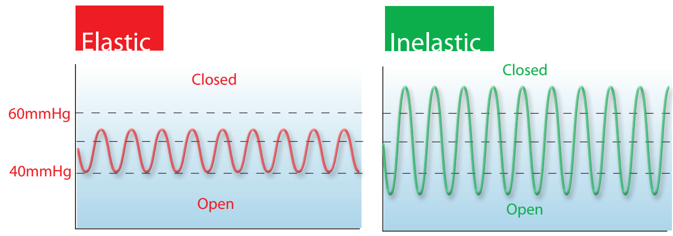


Fig 3: What is the static stiffness index?

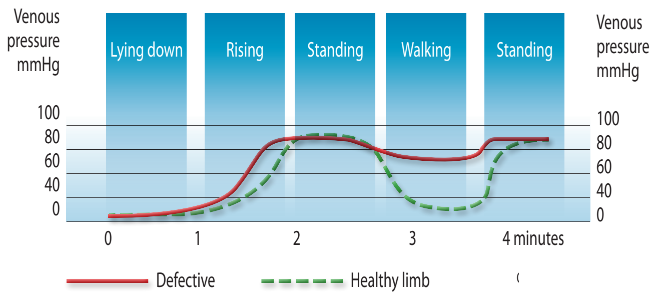
The static stiffness index (SSI) of a bandage is the difference between the working and resting pressures. When patients are mobile, bandages with a high SSI will produce higher pressures, generating intermittent high pressure peaks during exercise and low pressure peaks when at rest. The more elastic (extensible) a bandage is, the less resistance it provides, creating lower pressure peaks during exercise. Inelastic bandages and multi-layer systems generally have a higher SSI than elastic bandages.



These pressure peaks create intermittent, short duration venous occlusions which, in much the same way as a valve, are thought to reduce venous reflux and lower venous hypertension (WUWHS, 2008)

Fig 4: Fluctuations in venous pressure during exercise

The diagram below shows the fluctuations in pressure that should occur during exercise. In the normal limb venous pressure falls during walking while in a patient with venous disease it does not. Compression should aim to mimic the normal closing action of the valves in a healthy limb, assisting venous return and restoring the normal fall in venous pressure during exercise. This may be achieved using bandage systems with a high SSI to generate intermittent high pressure peaks during exercise.



Tips for reviewing patients with compression therapy

This information should be used to define the method, level and frequency of compression bandage changes and should allow adjustment of dressing and padding. Failure to address any or all of these factors may influence patient concordance (Moffatt, 2004) and decrease ulcer healing rates.

Finding	Implication
Before bandage removal	
Has there been strikethrough?	Heavy exudate levels may suggest a wound problem such as infection or that desired levels of compression have not been achieved
Is the bandage wet?	Consider if incontinence is a problem. If the foot is wet consider footwear
Has the bandage stayed in place?	Bandage slippage may be caused by: – Reduction in limb volume (effective compression). Change bandages more frequently until stable limb size achieved – Poor bandage technique; slippage with ridging can cause pressure damage – Abnormal limb shape: a very conical limb will cause bandages to slip. Consider shaping limb with padding and proximal fixation – Possible concordance issue: bandage push down by patient
Has the bandage been 'adjusted'?	May reflect pain and discomfort. Consider adjusting bandage application technique and using extra padding
Is there swelling above (knee) or below (toes/forefoot) the bandage?	Consider the type of compression used and the bandaging technique. Ensure that there is graduated compression. Possibly include toes in bandaging and encourage limb elevation
Does the patient report numbness or discolouration of their toes?	Consider if the bandage is too tight around the foot and ankle. Recheck Doppler ABPI. Encourage the patient to elevate the limb
Has the bandage been painful?	Consider pressure levels and padding. Check for contact sensitivity or infection and bandage profile (elastic or inelastic)
Has the ulcer been painful?	Look for changes in the ulcer related to infection or the dressing. Look at the periwound skin
Is the bandage/dressing smelly?	Consider infection. May use odour control system. Consider if social/care problems
On bandage removal	
Are the inner layers of a multi-layer system wet?	Reflects high exudate levels check wound for cause. Consider more absorptive dressing and check level of compression adequate
Has compression been maintained?	If the bandage is slack at the time of removal it has not been effective. Either change more frequently of review bandaging technique/bandage system
Is there guttering or ridging from the bandage?	Guttering which runs parallel to the leg occurs following rapid oedema reduction. Ridging occurs around the leg and indicates uneven compression and may progress to skin damage
Is there evidence of skin damage?	Possible poor bandaging or insufficient padding. Recheck assessment and ABPI
Is there evidence of wound infection or cellulitis?	Consider antimicrobial therapy
Is there evidence of contact sensitivity?	Use latex-free bandages. Consider referral to dermatology for patch testing
Has there been loss of ankle mobility?	Encourage exercise. Allow time during dressing changes to encourage ankle exercises
Has the wound improved?	Map/photo to document improvement. Demonstrates effective compression

UNDERSTANDING COMPRESSION LEVELS

Bandage systems and compression hosiery are graded according to the level of compression they generate. Several classification systems exist. To avoid confusion when describing the level of compression applied to the limb, WUWHS suggests using the following terminology (2008):

- Mild (less than 20mmHg)
- Moderate (20–40mmHg)
- Strong (40–60mmHg)
- Very strong (greater than 60mmHg).

Strong compression (>40mmHg) is generally recommended for the treatment of a venous leg ulcer. For some patients factors such as mild arterial disease, neuropathy or cardiac failure render strong compression unsafe or painful and mild or moderate compression may be required (eg using inelastic compression). Patients with more severe arterial disease should not receive compression (Marston and Vowden, 2003).

Factors affecting sub-compression system pressure

Using a compression system (bandages or hosiery) alone does not guarantee a level of compression. Pressure will vary according to the limb size and shape, level of calf muscle activity, the bandage or hosiery characteristics, bandage width and the degree of overlap and the application tension. Many of these factors are controlled by the bandager whose skills will also affect the graduation of compression and the comfort and durability of the bandaging.

Most bandage systems give advice on variations to accommodate differing ankle circumference. Larger limbs, ie those with a higher circumference, will require a higher classification bandage to exert the desired level of compression. Similar constraints apply to hosiery. Careful measurement and fitting is important as is the choice of hosiery itself; the characteristics of circular (elastic) and flat knit (inelastic) differ in a similar way to bandages.

ASSESSING PATIENTS BEFORE APPLICATION

Arterial assessment using Doppler ultrasound to calculate the ankle brachial pressure index (ABPI) should be undertaken before considering compression therapy (SIGN, 2010; Vowden and Vowden, 2001). The ABPI defines both the level of compression and the need for onward referral to vascular specialists. In addition, before selecting patients for application of compression, assess the skin condition and limb shape, as well as the presence of neuropathy or cardiac failure and patient-known allergies as these may affect both the level of compression and the components of the compression system used (Marston and Vowden, 2003). The assessment process should identify potential problems that may affect healing and recurrence.

Assessment should also identify potentially vulnerable areas such as bony prominences, which may require padding for protection. Padding may add to the comfort of the bandage but excessive padding may reduce compression levels and lead to bandage slippage and generate a bulky bandage system. When assessing for hosiery, consider the patients' and their carers' ability to apply and remove stockings.

CHOOSING AND APPLYING COMPRESSION

A recent Cochrane review has identified that multi-component bandage systems have been shown to be more effective than single-component bandage systems (ranging from cohesive single layer through to zinc paste bandages and Unna's boot) in healing venous leg ulcers (O'Meara, 2009). Box 1 highlights the requirements for an ideal compression system.

The choice of compression system for each patient will depend on the results of the assessment process, the patient's preferences, healthcare professionals' skills and the available resources. Effective compression should provide a balance between exerting too little pressure, which is ineffective, and too much pressure, which causes damage or is not tolerated by the wearer. Other considerations may relate to the bulk of the bandage, the impact on footwear and temperature discomfort during hot weather. If the chosen bandage system is bulky ensure that the patient has or is provided with suitable footwear. This will encourage mobilisation, increase the effectiveness of treatment and aid concordance.

For compression to be fully effective, patients should be provided with appropriate education on the underlying disease and be encouraged to elevate their legs when resting (WUWHS, 2008).

CHOOSING AND USING HOSIERY

Hosiery remains the mainstay of prevention, but 2-layer 'strong' hosiery systems can also be an effective method of providing compression therapy in selected patients with small, low exudate wounds. Such patients can be encouraged to self-care under the supervision of an appropriate healthcare professional. Provision of application aids can help to facilitate this.

It is important to measure the leg accurately and select appropriately sized hosiery with the correct compression level. Ensure that the patient is shown how to apply the hosiery and understands when to wear the garment. Give instruction on skin care and hosiery maintenance, including washing and drying. Hosiery constituents vary and it may be necessary to try different makes of stocking if concordance is to be improved for individual patients.

IMPROVING CONCORDANCE

A patient's initial experience with compression therapy may colour their subsequent opinion of this form of therapy. Patients should be engaged in treatment planning and be provided with sufficient information for them to understand the rationale for treatment. Adherence with treatment is also dependent upon patient motivation, which can be affected by factors such as social isolation or treatment discomfort. Effective symptom control, either with dressings or analgesia, can improve quality of life and patient tolerance of compression therapy, aiding concordance (Briggs and Nelson, 2010). Miller et al (2011) in their study on predicting concordance concluded that pain, wound size and depth and patient age all influenced concordance.

BOX 1: An ideal compression system (adapted from Marston and Vowden, 2003)

- ✓ A clinically and cost-effective evidence-based treatment
- ✓ Provides sustained pressure (with an appropriate SSI) for one week or more
- ✓ Enhances calf muscle function
- ✓ Adaptable to a range of limb sizes and shapes
- ✓ Easy to apply
- ✓ Conformable and comfortable (non-slip)
- ✓ Non-allergenic
- ✓ Durable

For further guidance on the use of compression therapy in venous leg ulcers, please see the recommended treatment pathway developed by the International Leg Ulcer Advisory Board (Marston and Vowden, 2003. Available from www.woundsinternational.com)

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