Compression bandaging in patients with venous insufficiency


**Summary**
This article explains the effects of compression therapy and discusses the treatment options available in the management of patients with venous disease of the lower limb.

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**Aims and intended learning outcomes**
This article aims to highlight the effects of compression therapy, discuss the importance of accurate application and introduce some of the therapies available. It focuses on venous ulcer management. Patients with mixed aetiology ulcers where there is co-existent venous and arterial disease, or ulcers complicated by other diseases, will require variations in therapy or no compression at all depending on the underlying condition (Anderson and King 2006). These patients will also require specialist supervision of treatment to maintain therapeutic safety.

After reading this article you should be able to:
- Identify the reason for compression therapy.
- Understand the physiological effects of compression therapy.
- Explain the correct application technique for compression systems.
- Recognise when compression therapy is effective.
- Rationalise selection of compression systems.

**Introduction**
Effective compression therapy is key to healing venous ulcers, which affect at least 1-2% of the population (Briggs and Closs 2003). A significant proportion of nurses’ time, particularly community nurses, is spent applying compression therapy. Compression therapy involves applying bandages or hosiery to the lower leg. The pressures exerted can be around 40mmHg at the ankle (resting pressure) gradually reducing to about 17mmHg just below the knee. As the calf muscle contracts on walking or ankle movement these pressures become higher (working pressure). Although extremely effective, pressures of this magnitude have the capacity to cause considerable damage to a person with vulnerable lower leg tissue and skin. For this reason, it is vital that the practitioner applying the therapy is competent in application, capable of ongoing patient assessment throughout the treatment, and is aware of his or her accountability at all times (Anderson 2004).

**Venous ulceration**
Venous blood flows in the direction of the heart and is prevented from flowing back down the vein by valves which, in the leg, open and close mostly by the action of the calf muscle, which squeezes the veins pushing the blood upwards. When the muscle relaxes the valve closes to
Sometimes people try to manage the condition and wounds on their own; however this may exacerbate the condition and may also increase the risk of sensitivities to topical applications used to try to alleviate itchiness and pain (Cameron 2007).

Elevation of the limb, walking or any exercises that make the calf muscle contract are important to speed up the blood flow and reduce oedema, but graduated compression therapy is the most important treatment (Cullum et al 2001, Royal College of Nursing (RCN) 2006).

**Physiological effects of compression**

The application of graduated compression with the highest pressure at the ankle will squeeze the leg. As the calf muscle changes shape on movement of the lower leg the muscle movement will be constrained by the compression. This has the effect of increasing the squeeze on the veins in the leg as the muscle movement is concentrated inwards. If the vein valve is relatively intact it will be more likely to close with the extra pressure from the compression. This closure prevents back flow of blood. As the push from the calf muscle is much stronger the speed of the venous blood is increased, which means that white blood cells are less likely to clump together, so reducing inflammation in the blood vessel (Oduncu et al 2004).

Compression of this nature increases blood flow, makes the valves more efficient and reduces prevent the blood from flowing back again (Tortora and Grabowski 2000). Venous ulceration is caused by venous insufficiency leading to venous hypertension. The effect of venous hypertension is a larger volume of blood than is normal in the veins of the lower leg. As the vein capacity increases the valves are pushed apart, allowing backflow of blood which increases the volume in the vein.

### Time out 1

Refresh your understanding of venous blood flow in the lower leg, the aetiology of leg ulceration and the physiological effects of compression therapy. You may find the following sources helpful:

- Tortora and Grabowski (2000).

As well as increased vein pressure pushing the valves apart, the valves may have been damaged as a result of trauma or surgery, which means they are unable to function properly, or not at all. The increased volume of blood leads to distension in the veins and leakage of cells and fluid into the tissues. The leaking fluid is visible as oedema and as the condition worsens the extent of the oedema increases (Waugh and Grant 2001). Red blood cells leak into the tissue and as they break down they cause staining in the tissue known as haemosiderin staining.

The congestion in the veins also means that the blood flow slows down and, as a consequence, white blood cells clump together. White blood cells trigger inflammatory reactions, which exacerbate tissue damage, making the situation worse. Over time the slowing of the blood flow and the venous distension reduce the nutrients available to maintain healthy skin. The skin becomes dry and itchy and loses elasticity. Fibrosis occurs in fatty tissue and the leg can change shape, becoming indurated, hard and ‘woody’ to the touch; this condition is called lipodermatosclerosis (Anderson 2008).

The patient will feel considerable discomfort and perhaps pain. Oedema makes limbs heavy, and fluid may increase to such an extent that it leaks out on to the skin.

Lipodermatosclerosis and dry flaky skin will make the skin itch and will make the leg extremely fragile. Scratching or other trauma which breaks the skin will lead to ulceration—a chronic wound which will take a considerable time (weeks, months or even years) to heal.

### Time out 2

During an assessment of a patient with a leg ulcer look at how the individual walks, and the shape and presentation of the leg. Try to answer the following questions (you may want to refer to Anderson (2008) and Cameron (2007) for further information):

1. Does the patient walk normally with flexibility at the ankle?
2. What shape is the lower leg? Is there bulk to the calf muscle?
3. Is there oedema present? Does the oedema increase during the day?
4. Look at the skin: Is there any discolouration?
5. Is fluid leaking from the skin or the wound?
6. Is the skin dry and flaky?
7. Are there any signs of irritation to the skin?
8. Does the patient experience pain? What factors contribute to, or alleviate, pain?

Look at the assessment form available in your practice area. Are the points outlined above included on the form?
circumference should be measured to ensure the reduced itching and dryness. Ankle asked about improvements in skin comfort, and results if they so wish. The patient should be encouraged to share the assessment.

Visible signs will also be present and patients have the physiological effects mentioned above. Pain and anxiety. Correctly applied therapy will cause damage to patients’ legs, with concomitant pain and anxiety. Inappropriately applied has the potential to inappropriately applied has the potential to.

Compression hosiery that is inaccurately or incorrectly applied is being managed by the compression therapy. It is not a cure and, if removed, the back flow of blood and oedema will increase rapidly. In most cases the therapy is lifelong and patients need to be properly supported to manage their lives with this particular form of treatment.

Graduated compression
In compression therapy, the highest pressure applied is at the ankle because this is the furthest point from which the blood has to be pushed upwards. If the compression is applied (or manufactured as is the case with compression hosiery) consistently and accurately, then the shape of the leg determines the gradual reduction in pressure towards the knee. This will happen in a normal graduated leg shape, where the ankle has a smaller circumference than the calf. If the ankle is oedematous it may well be larger than the calf before treatment. Some patients may have little calf muscle bulk and the leg will have the same circumference up to the knee.

In these scenarios wool padding is used to correct the shape of the leg to a graduated shape. In patients where the ankle is oedematous the situation will be improved as the compression bandaging reduces oedema and the leg takes on a more regular shape. If the leg shape is irregular, compression hosiery may not be appropriate and bandaging will be preferable, as application can be moderated in line with the clinical presentation. The practitioner must be sufficiently skilled and knowledgeable to do this (Anderson 2004).

Ongoing assessment and measuring effectiveness of therapy
Compression hosiery that is inaccurately or inappropriately applied has the potential to cause damage to patients’ legs, with concomitant pain and anxiety. Correctly applied therapy will have the physiological effects mentioned above. Visible signs will also be present and patients should be encouraged to share the assessment and results if they so wish. The patient should be asked about improvements in skin comfort, reduced itching and dryness. Ankle circumference should be measured to ensure the correct compression system is being applied and to note whether oedema is reducing or increasing. Although some patients may find full compression therapy uncomfortable and difficult to tolerate, most will find they have pain reduction, particularly as oedema reduces and the limb feels less heavy. As the fluid load in the leg reduces, exudate production from the wound will decrease, which will help to reduce skin irritation (Cameron 2007).

Pain assessment should be recorded carefully and any improvement or deterioration of pain levels should be documented, with immediate action if there is an increase in pain. Monitoring the psychological wellbeing of the patient should not be neglected. In long-term treatments there are often stumbling blocks and complications. An open dialogue is important, as is working collaboratively with colleagues, doctors and specialist practitioners to ensure the patient has a cohesive and effective care plan.

Types of compression therapy
There are many ways of applying compression therapy. Guidelines indicate that some compression is better than no compression (Cullum et al 2001, RCN 2006). Systems should be effective, tolerated by the patient and adaptable to the individual’s needs. Compression bandages should be capable of staying in place for up to a week. In the early stages of treatment there may be rapid oedema reduction and bandages may need to be applied more often until the leg shape and ankle circumference settle. Elastic bandage systems are more tolerant of reduction in limb volume, but may still need application more than once a week in the early stages. Likewise, if exudate levels are high, bandages may become soaked through. This may cause distress and discomfort for the patient and may also increase the risk of skin damage.

In most cases, once the oedema is under control and any complications such as infection have been managed, the ulcer will heal relatively quickly. For many, healing occurs within approximately 12 weeks (Moffatt et al 1992). Larger ulcers, those with complex co-morbidities and ulcers that have
been present for a longer time will take longer to heal. For a minority of patients healing may take months or years and some ulcers may not heal at all (Palfreyman et al 2007). Nevertheless, effective treatment should help to reduce symptoms and improve the quality of life for many people.

**Compression systems**

Bandages used to be classified fairly neatly as elastic (long stretch) and inelastic (short stretch) but this categorisation is not straightforward as systems often incorporate elastic and inelastic material, and newer materials and manufacturing processes blur boundaries. However, the systems are loosely categorised for ease here.

**Elastic bandages** Thomas (1998) produced an elastic bandage classification system:

- **Class 1** – bandages are light and conforming.
- **Class 2** – for light support.
- **Class 3** – for compression therapy. The category is split into four sections, 3a, 3b, 3c and 3d, from light to strong compression.

In multi-layer elastic bandage systems a layer of wool padding is used for protection, shaping and absorption (Figure 1). A Class 2 crepe bandage to smooth out the wool covers this (Figure 2). Layers three and four add the compression. Layer three is a light compression bandage (3a) applied in a figure of eight to produce pressures up to 20mmHg (Figure 3). Layer four is a cohesive (sticks to itself) bandage in Class 3a or 3b depending on the manufacturer and delivers pressures between 17-24mmHg (Figure 4).

Class 3c bandages are sometimes used over a layer of wool padding, as above, and before multi-layer systems were developed they were the main treatment available. Class 3c bandages are sometimes used with multi-layer kits as layer three for ankles that have a large circumference, generally more than 25cm (Palfreyman et al 2007).

Based on the manufacturer’s instructions elastic bandages are applied with a 50% stretch and at a 50% overlap with the previous bandage turn. Any deviation from this technique will result in higher or lower levels of pressure for patients, which risks being ineffective or damaging.

There are newer types of bandages available which are two-layer kits that have an inner layer of foam and an elastic outer layer, and kits which are responsive over a range of application techniques, because of the way fibres are woven.
Inelastic bandages

Inelastic or short-stretch bandages also apply effective compression, and because of the non-stretching materials, such bandages can be applied in a different way to elastic systems. A layer of padding is used as before. The bandage is applied in a spiral with a 50% overlap on each turn but it is applied at full stretch. There can be variations in the application technique to take account of the leg shape. For example, the St Charles technique (Charles 1999) (Figure 5) involves the bandage being applied and stretched from below the calf to just under the knee and then rolled back down to cover the gaps (Figure 6). This application helps to keep the pressure constant over a larger calf. There are cohesive versions of short-stretch bandages available, which are applied over padding and may help to prevent slipping. There has been debate about short-stretch bandages and patient mobility, the premise being that only mobile patients would benefit (Lindsay et al 2003). However, studies and clinical experience have shown the system to be effective even with small changes in calf muscle shape (Lindsay et al 2003).

Compression hosiery

Compression hosiery is most often used to maintain the leg in a healed state by managing the underlying venous disease. The system can also be used to treat active ulcers but only if the primary dressing material is not too bulky as this would make the hosiery difficult to apply and may result in uneven pressure on the leg. The recurrence rate of venous ulcers is high and hosiery helps to reduce this risk and prolongs the time in a healed state (Bradley 2001).

**Time out 4**

Look at the range of compression bandages in your clinical area. Roll the bandages out and feel how much tension is required to stretch them. Read the application instructions and note any differences in how they are applied. Note that some bandages have application aids to help with accurate placement of the bandages. For further information refer to Partsch (2003) and Clark (2003).

There are many types of hosiery and in some cases it can be made to measure for patients with challenging leg shapes. Hosiery is available as above and below knee types and socks are also an option. There is no evidence to suggest any therapeutic difference between above and below knee types of hosiery (Bowskill 2001), so choice may depend on patient preference. Above knee may be better for people with larger legs and an indistinguishable knee, otherwise there is a risk of the material rolling down and cutting into the skin, or causing a tourniquet effect and therefore impeding the venous blood flow. Hosiery is also available as open or closed toe. Open-toe versions help to prevent constriction of misshapen toes and bunions and allow access for nail care.

Hosiery comes in three or four classes depending on whether it is under a European or UK classification (Coull et al 2005). This can cause some confusion, as often the UK system is used in the community and the European system is used in hospitals (Table 1). Class two (UK) is commonly used because it gives the most pragmatic balance between effectiveness and ease of application.

A key challenge with compression hosiery is how patients manage it. The elasticity of the material means that the individual (applier) has to have strength and dexterity in his or her hands and also needs to be able to bend down. Developments have been made to help with such challenges.

**Table 1**

<table>
<thead>
<tr>
<th>Class</th>
<th>Pressure range (ankle) UK mmHg</th>
<th>Pressure range (ankle) European mmHg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14-17</td>
<td>18.4-21.1</td>
</tr>
<tr>
<td>2</td>
<td>18-24</td>
<td>25.2-32.3</td>
</tr>
<tr>
<td>3</td>
<td>25-35</td>
<td>36.5-46.6</td>
</tr>
<tr>
<td>4</td>
<td>N/ A</td>
<td>Over 59</td>
</tr>
</tbody>
</table>

(Adapted from Coull et al 2005)
learning zone wound care focus

problems. Some manufacturers have developed two-layer systems. A light inner layer is applied first (Figure 7) and the stronger layer is applied on top (Figure 8), providing the equivalent of Class 3 compression. The inner material is relatively slippery and can help the outer layer to slip over. Ideally, hosiery should be removed at night and applied first thing in the morning before getting up and moving around (which is when oedema begins to develop). This is often not possible so a two-layer system may help manage this. A zipped stocking is also available but still requires bending and physical dexterity and strength.

There are application aids available (Wassall 2007), such as a nylon slipperette (Figure 9) for open-toed hosiery; rigid frames and special slippery material can be used on open and closed-toe systems (Figures 10 and 11). Rubber mats are also available and can help with application over the foot (based on the same technology that helps prevent plates sliding on a table). Some aids are available on prescription, which is beneficial, but they still require a degree of manual dexterity.

Time out 5

Read the Best Practice Statement for Compression Hosiery (Coull et al 2005).

- Find out if the UK or European system is used in your area of work.
- Check what limb measurements are required before hosiery is prescribed.
- How often should hosiery be renewed?

FIGURE 7
Inner liner for compression hosiery

FIGURE 8
Two-layer compression hosiery

FIGURE 9
Chinese slipper for open-toed hosiery application

FIGURE 10
Application aid for open or closed-toe hosiery

FIGURE 11
The slippery material is pulled upwards, leaving the hosiery in place
Conclusion

Compression therapy is the most important method of preventing and managing venous disease and ulceration. There are many systems available and modern systems are effective if used properly. Practitioners applying the therapy need to be competent and knowledgeable about the physiological effects and application techniques based on patient need and presentation of the limb. The choice of therapy should be discussed with the patient and if appropriate, the individual’s carers. Ideally, there should be an element of choice and a willingness to try different options to find one that suits the patient.

Manufacturers have demonstrated to some extent that they are responsive to the clinical challenge of venous ulceration so professionals need to communicate the needs of patients to ensure that technology is used to best advantage, and that robust data are produced to support performance and clinical benefits of compression therapies.

References


Time out 6

Now that you have completed the article, you might like to write a practice profile. Guidelines to help you are on page 60.