Compression therapy for venous leg ulcers: padding layer

Venous leg ulceration causes misery to patients, who suffer pain, wet dressings/bandages, disappointment with treatment, reduced mobility, loss of sleep, altered body image and, consequently, reduced quality of life (Hareendran et al, 2005). This article looks at one technique for the management of this condition — compression bandaging.

- Padding bandage
- Inelastic
- Short-stretch bandage
- Multi-layer bandaging
- High compression bandages
- Compression hosiery kits

The development of a concordant relationship with the patient must be one of the main aims of treatment

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Prior to the application of therapeutic compression bandaging, the clinician, must have undertaken a compressive assessment of the patient, to include lifestyle, co-morbidities, mobility, skin assessment, as well as a Doppler ultrasound, to exclude arterial disease (RCN, 2006). Without an assessment, the clinician may overlook an aspect of care, which then leads to non-compliance with treatment.

The cause of venous leg ulcers

While arteries carry oxygen and nutrition to all the tissues of the body, it is the function of the lymphatic system and the venous system, working together, to rid the body of excess water and metabolic waste. Veins in the legs have a disadvantage as blood flow has to move against gravity and, on mobilisation, the muscles of the calf muscle pump squeeze against the deep veins, propelling blood towards the heart (Lindsay et al, 2003).

In order to assist the flow of blood to the heart, there are valves within the veins that close to prevent the backflow of blood (Tortora and Grabowski, 2000).

If the valves are damaged due to trauma or deep vein thrombosis, or are unable to close because the vein is congested due to oedema, they cannot prevent the backflow of blood due to gravity and this increases the pooling of blood in the lower leg.

If, in addition, the individual's mobility is affected and the foot and calf muscle pumps are not working effectively, then blood is no longer efficiently propelled towards the heart. This may be due to increasing age and loss of mobility, calf muscle atrophy or an acute illness, which has rendered the individual immobile (Anderson, 2006).

As a consequence of increased blood volume in the veins of the lower leg and non-functioning valves, the walls of the vein become over-stretched and tiny breaks appear, allowing the leakage of fluid, red cells and protein into the tissues. It is this that gives rise to symptoms such as haemosiderin staining — the red-purple staining of the skin — and irritation, such as varicose eczema and increased oedema.

This condition is known as venous hypertension (Morison and Moffatt, 2004), and, if untreated, leads to venous ulceration. Ulceration is also caused by an accumulation of fluid within the tissues, whereby, eventually, the dermal tissue breaks

down and an ulcer forms. This may be triggered by an injury to an already oedematous limb.

Causes of lower limb oedema include (*Figure 1*):

- Inflammatory oedema caused by arthritis or cellulitis
- Cardiac oedema caused by cardiac failure
- Venous oedema caused by venous insufficiency or dependency syndrome
- Lymphoedema caused by failure of the lymphatic system
- Hypoproteinaemic oedema caused by kidney failure, liver failure or low levels of protein in the blood (Adapted from Partsch, 2003).

Patient/clinician relationship

The development of a concordant relationship with the patient must be one of the main aims of treatment. This relationship must be based on mutual respect for each other — clinicians listening to patients and respecting their own knowledge of their bodies, and patients listening to the knowledge of clinicians and understanding how care will be delivered (Bell et al, 2007).

A successful relationship is unlikely to be formed if the clinician does not listen to what the patient has to say, especially regarding those aspects of ulceration that cause pain and loss of sleep. Failure to appreciate this does not inspire confidence in the clinician and may lead to non-compliance.

If the treatment is to be successful, the clinician has a responsibility to ensure that the treatment is explained to the patient and that he or she is made aware of the importance of compliance and full participation.

There are now several means of delivering therapeutic compression therapy for a patient with venous leg ulceration and it is advisable that clinician understands and becomes competent in these methods, in order to be able to deliver the most appropriate compression therapy for an individual patient, based not only on his/her physical assessment, but lifestyle and preference.

The purpose of compression therapy bandaging is to:

- Reduce oedema and decrease the volume of blood in the venous system in the lower leg. Compression bandaging supports and squeezes the veins, thus enabling the valves within the veins to close, which speeds up the venous blood flow, easing congestion in the veins and allowing fluid to move from the tissues into the veins, reducing oedema (Anderson, 2006)
- Reduction of oedema subsequently reduces pain, improves mobility, enables sleep and improves the quality of the patient's life.

How does compression therapy work?

The application of a compression bandage reduces the diameter of the veins in the lower leg. This has the effect of decreasing the volume of blood within the venous system and redistributing that blood towards the central area of the body.

Caution is, therefore, needed when treating patients with cardiac disease, as the volume of blood redistributed can be sufficient to cause cardiac embarrassment (Mostbeck et al, 1977).

Reduction of the diameter of the veins also increases the venous flow velocity, so further reducing the venous blood volume (Partsch, 2003). Therefore, the net effect of compression is to push the veins back into a shape and size that allows the valves within the veins to meet and prevent backflow of blood, thus forcing the veins in the lower legs to become competent.

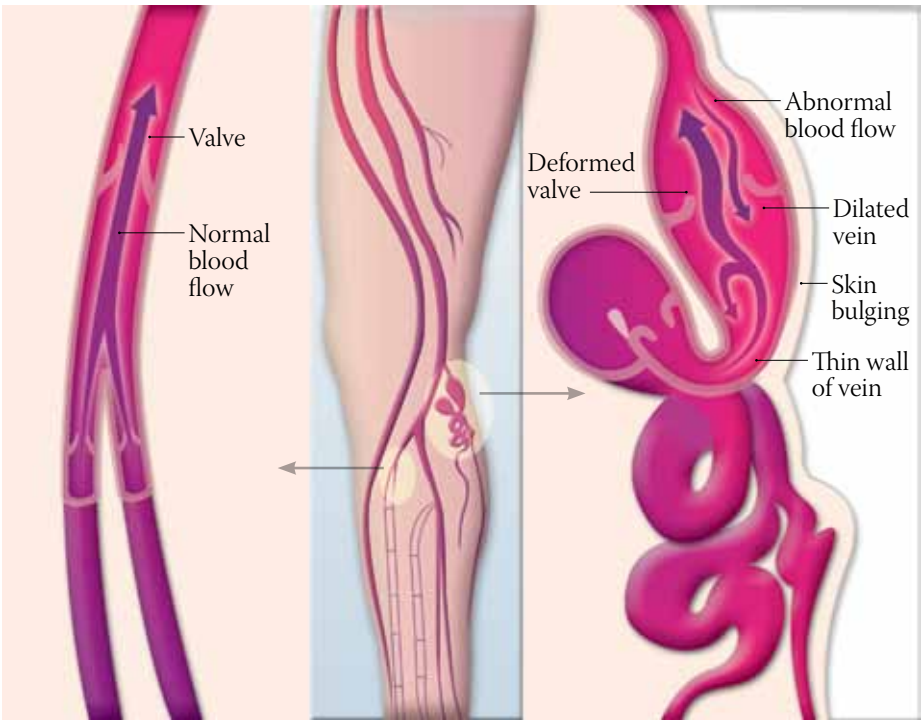

Figure 1. ***The veins on the left show normal blood flow, with the valve opening to allow blood flow upwards, the valves would then close to prevent gravity dragging blood downwards. The veins on the right are fully dilated and this has caused the valves to be stretched apart, preventing them from closing. The vein then becomes even more dilated as blood cannot be moved efficiently in one direction towards the trunk. The skin overlying the varicose vein is stretched and if trauma occurs to this area, the individual may bleed profusely.***

Figure 2. Deep ulceration exposing the tendon, caused by insufficient padding bandage and poor application of compression bandage. Note oedematous foot and wrinkled skin, again demonstrating poor bandage technique.

Figure 3. The patient has had a poorly applied bandage, which has resulted in a misshapen limb.

Figure 4. Patient has an oedematous foot and limb, with a heavily exuding venous leg ulcer. The padding bandage will provide extra absorbency.

An equation based on Laplace's law demonstrates how compression affects the lower leg when applied:

Pressure (exerted by the bandage in mmHG)
= *Tension* (how much the bandage is stretched)
X *Number* of layers of the bandage / *Circumference* (width of the ankle)
X *Width* (of the bandages)

The amount of pressure applied by the bandage is affected by:

- **Tension**: how tight the bandage is applied — this should always be at 50% stretch of an elasticated bandage
- **Number** of layers of compression bandage that are applied: for example, a bandage applied in a figure of eight application overlaps four times, therefore, applies more pressure than a bandage applied in a spiral with a 50% overlap
- **Circumference** of the ankle: the pressure is inversely proportional to the ankle circumference; for example, an ankle with a circumference of 17cm will have a greater pressure applied by a bandage (applied at a 50% stretch), than an ankle of 22cm circumference. The larger the ankle size equals less pressure, while the smaller the ankle size, the greater the pressure
- **Width** of the bandage: a bandage that is 8cm wide applies a greater pressure than a bandage 10cm wide.

Compression bandages

The type of compression bandage used is dependant upon several factors: the size of the patient's legs, how much oedema is present, lifestyle and footwear. It is vital that the decision of which compression bandage to wear is made by both patient and clinician as this helps with the concordant relationship, as well as enabling the patient to feel engaged in his or her care. Compression bandages include:

- Four-layer systems — comprising a padding layer, crepe bandage, class 3a elasticated bandage and a class 3b cohesive compression bandage, application of which ensures that compression is gradually applied via the number of layers of bandage. For example, Profore™ (Smith & Nephew), K-Four™ (Urgo Medical), System 4™ (Seton), Veno 4 (Hartmann)
- Two-layer systems — usually a padding bandage layer and an elastic, high tension bandage. For example K-Two™ (Urgo Medical), ProTwo™ (Smith & Nephew)
- Short-stretch bandages — these are inelastic bandages, often used

Figure 5: Measuring the narrowest part of the ankle.

Figure 6. Measuring the widest part of the calf.

Figure 7 (left). Patient has an ankle circumference of 20cm and a calf circumference of 25cm, while Figure 8 (right) shows an extra padding bandage has been added at the calf.

Figure 9 (left) and Figure 10 (right) both show pressure damage due to insufficiant padding bandages, with the foot in Figure 10 displaying further damage caused by compression bandage.

to reduce oedema and may be used, with guidance, on patients with mixed aetiology disease. For example: Actico™, Actiban™ (both Activa), Comprilan™ (BSN Medical).

Applying compression

Although no pressure is exerted by the padding layer within compression therapy, it is arguably the most important layer. Its prime function is to protect the skin from the pressure of the bandage, without which the patient would undoubtedly develop pressure damage (*Figure 2*).

This layer cannot, under any circumstances, be excluded from a compression bandaging system, but individuals will occasionally report irritation from the padding bandage, in which case, a layer of tubular 100% cotton bandage, such as Stockinette™ (Mölnlycke Health Care) — available on prescription — or Tubinette® (Mölnlycke Health Care), should be used. If the patient suffers from any skin sensitivity it is advisable to avoid those tubular bandages that contain any elastane, as this may trigger another sensitivity (Beldon, 2009).

In addition, the padding layer enables the clinician to reshape a misshapen limb, whether this is due to oedema or poor previous bandaging (*Figure 3*).

Lastly, the padding bandage provides extra absorbency in the presence of a heavily exuding leg ulcer (*Figure 4*). Whenever bandaging is saturated it should be changed to avoid maceration of the peri-ulcer skin (World Union Wound Healing Societies [WUWHS], 2007), which would exacerbate the existing problem. The frequency of bandage change should be dictated by the volume of exudate and whether or not the bandage has remained in place without losing its therapeutic function, not the expectation of the patient, nor a clinician who is applying the bandaging.

Before applying compression therapy, clinicians need to undertake a comprehensive assessments of the patient's lifestyle and footwear, and, using Doppler ultrasound and ankle brachial pressure index (ABPI), assess arterial supply to the lower leg to exclude arterial disease. Baseline measurements of the patient's limb are vital, as these direct the clinician as to how many layers of padding are required to maintain the shape of the limb (*Figures 5 and 6*).

In order to provide graduated compression, the compression should be at its strongest at the ankle and lessened as the leg naturally widens towards the calf. The calf must be at least 10cm wider than the ankle.

If the patient has an oedematous ankle and calf muscle atrophy (where the muscle has decreased due to lack of use), there may be little difference between the ankle and calf circumference and, in this case, an extra padding bandage must be added at the calf to ensure graduation of compression (*Figures 7 and 8*). Good practice dictates that the ankle and calf are measured each time bandaging is reapplied. If oedema has resolved, the girth will alter and application of the padding bandage should be adjusted to accommodate changes in size.

If the patient has very thin legs due to muscle wastage, with an ankle circumference of 18cm or less, he or she will lack the required natural gradient to ensure graduation of compression. It is necessary to apply a second layer of padding bandage from the ankle upwards, to ensure the protection of the bony prominences, such as the malleolus (ankle) and the tibial crest (Moffatt, 2007) — failure to do so can result in pressure damage (*Figures 9 and 10*).

Discussion

Following application of the padding bandage the patient is safe from the danger of pressure damage. This layer can never be left out of any compression therapy bandaging or replaced by surgical pads or gauze, which are not an adequate substitute.

Conclusion

The decision regarding the type of compression bandage system to be used must be based on an assessment of the patient, their underlying arterial status, how well they are likely to tolerate compression therapy, their footwear, lifestyle, the circumference of their ankle and co-morbidities.

This decision should be made with the patient to foster a concordant relationship and be led by a clinician who is knowledgeable and competent in compression therapy bandaging. We

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