

# Compression bandaging of the lower limb for chronic oedema and lymphoedema

**Marie Todd** Clinical Nurse Specialist in Lymphoedema,  
Glasgow Specialist Lymphoedema Service

**Jane Harding** Macmillan Lymphoedema Specialist Physiotherapist,  
Sheffield Macmillan Specialist Lymphoedema and Chronic Oedema Centre

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# Guide to compression bandaging of the lower limb for chronic oedema and lymphoedema

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The lymphatic system absorbs excess water and waste products, especially protein and fat molecules, that collect at the interstitial spaces in tissue, and transports them back to the venous system. In chronic oedema and lymphoedema, the lymphatic system fails to effectively remove fluid from the interstitium and swelling develops distal to the defect, usually in the limbs but also sometimes in the trunk, face, head and genitalia.

Chronic oedema is the term used to describe all types of swelling that have been present for more than 3 months, and includes lymphoedema, lymphovenous oedema, lymphostatic oedema and lipoedema. Causes of lymphovenous and lymphostatic oedema are listed in *Box 1*.

The term lymphoedema is used only when the primary cause of the swelling is a failure in the lymphatic system. This can be either an internal malformation (primary

## Box 1. Causes of lymphovenous and lymphostatic oedema

- **Chronic venous insufficiency** — flow of venous blood from the legs up to the heart is impaired. When people with healthy circulation walk, the muscles in the calf and feet pump blood upwards towards the heart. Valves in the veins close to stop the blood flowing back down the vein. If the walls of the veins are stretched and the valves are damaged, backflow of venous blood will occur, resulting in venous hypertension
- **Obesity** — the weight of the intra-abdominal bulk exerts pressure on the inguinal vessels, hindering venous and lymphatic return from the legs (Todd, 2009)
- **Prolonged immobility and dependency** — lack of exercise (and the ensuing lack of calf-muscle activity), combined with the effects of gravity, causes blood to pool in the distal veins

These factors will result in the formation of excess fluid in the interstitium. Initially, the lymphatic system will remove this excess fluid, but it will eventually be unable to cope with the overload and swelling will occur.

lymphoedema) or external damage (secondary lymphoedema) resulting from cancer and its treatments, infection, trauma or surgery (Foldi et al, 2003).

## Management

Lymphoedema/chronic oedema is a long-term chronic condition requiring a comprehensive, multidisciplinary approach. Management is holistic and includes skin care, compression (bandaging, inelastic wrap or hosiery), exercise, weight management and lymphatic massage (Lymphoedema Framework, 2006). The overall aim is to help the patient self-manage his or her condition.

If lymphoedema/chronic oedema is left untreated, the swelling may reach extreme proportions, and the skin and subcutaneous tissues may thicken, leading to hyperkeratosis (thick, waxy skin scales, ranging from pale yellow to brown), papillomata (wart-like protrusions), fibrosis (increased interstitial fibrous tissue) and skin folds.

Venous disease, which can progress into chronic oedema (see *Box 1*), results in a variety of initial skin changes, including varicose veins, venous eczema and haemosiderin staining (brown marks on the skin). The patient will also be at increased risk of cellulitis (infection).

A meticulous skin-care routine should therefore be implemented to prevent

skin breakdown and reduce the risk of infection (Flour, 2012). Figure 1 shows a limb with chronic oedema and skin changes. The skin should be washed and dried daily, and an emollient applied to improve its condition. Close attention should be paid to areas between the toes and under skin folds.

A comprehensive assessment must be undertaken, so a patient-focused, needs-based treatment plan can be designed, depending on the stage of the swelling (*Table 1*). Care must be reviewed regularly, so the treatment plan can be altered if necessary.

*Table 1* outlines management strategies for lymphoedema. Historically, this comprised skin care, compression, exercise and lymphatic drainage (Lymphoedema Framework, 2006). Manual lymphatic drainage (MLD) is performed by a practitioner, whereas simple lymphatic drainage (SLD) is performed by the patient/carer. If excess weight is the cause of or



*Figure 1: skin changes in chronic oedema: hyperkeratosis, dry skin, inflammation and skin folds*

**Table 1. Staging and management of lymphoedema**  
(International Society of Lymphology (ISL), 2013)

	Presentation	Severity	Management
<b>Stage 0 (latent subclinical stage)</b>	No overt swelling, but lymphatic pathways have been disrupted. This stage can persist for several years		<ul style="list-style-type: none"> <li>• Observe limb for skin changes</li> <li>• Implement preventive measures, such as skin care and exercise</li> </ul>
<b>Stage I (early stage)</b>	Mild pitting oedema that resolves with elevation	Mild: <20% increase in limb volume	<ul style="list-style-type: none"> <li>• Compression hosiery</li> <li>• Exercise</li> <li>• Self-lymphatic drainage</li> <li>• Preventive skin care</li> </ul>
<b>Stage II</b>	Swelling does not resolve with elevation. Less evidence of pitting as fibrosis occurs	Moderate: 20–40% increase in limb volume	<ul style="list-style-type: none"> <li>• Custom-made hosiery/ compression bandaging</li> <li>• Exercise</li> <li>• Self or manual lymphatic drainage</li> <li>• Skin care</li> </ul>
<b>Stage III (late stage)</b>	Non-pitting with skin changes (papilloma, fibrosis, hyperkeratosis)	Severe: >40% increase in limb volume	<ul style="list-style-type: none"> <li>• Compression bandaging</li> <li>• Skin care</li> <li>• Exercise</li> <li>• Manual lymphatic drainage</li> </ul>

a contributing factor to the swelling, then this must also be addressed.

## Compression therapy

Compression therapy is used to reduce swelling in both lymphatic and venous disease. The two problems often occur together, in that many people with venous hypertension develop both venous leg ulcers and lymphovenous oedema. Compression therapy can reduce oedema because it:

- Reduces capillary filtration (flow of excess fluid into the interstitial tissues), thereby decreasing the lymphatic load
- Increases interstitial pressure, enabling the reabsorption of excess fluid into the lymphatic system
- Breaks down fibrotic tissue
- Helps move excess fluid into non-compressed areas of the body
- Assists the venous leg pump. The pressure applied supports the weakened valves, improving their

function, which in turn reduces venous hypertension

- Applies pressure, which stops the veins dilating during walking or standing, thereby preventing backflow of blood down the vein
- Increases the velocity of venous blood flow, which stops leucocytes becoming trapped and therefore reduces inflammation
- Reduces valvular insufficiency, which prevents venous backflow
- Improves blood flow, which in turn improves the transport of nutrients to the skin, thereby accelerating healing (Partsch and Jünger, 2006; Partsch and Moffatt, 2012; Foldi et al, 2003).

In accordance with the law of Laplace (Thomas, 2003), the amount of compression that is applied (sub-bandage pressure) is influenced by:

- Type and width of bandage
- Method of application
- Number of layers used
- Limb size
- Condition of underlying tissues.

## Type of bandages used

Two main types of bandage are used in the management of lymphoedema/chronic oedema: inelastic and elastic, although it is best practice to use an inelastic system for oedema (Partsch et al, 2008). Inelastic Velcro wraps are also increasingly being used, and retention bandages are available for the toes.

## Inelastic bandages

These provide a casing around the limb that remains firm during exercise, when muscle contraction increases the limb circumference. The resulting variation between resting and working sub-bandage pressures creates a pulse effect and stimulates the lymphatic collectors, improving lymphatic flow. Even when applied at full stretch, they provide tolerable rest pressure, yet still deliver a high exercise pressure during muscle contraction (Partsch et al, 2008). However, an 80% stretch is recommended when applying inelastic bandages, especially when undertaken by a non-specialist practitioner.

## Toe bandages

When bandaging a lower limb, excess fluid will find its way to non-compressed areas. The toes, therefore, should always be bandaged to stop them swelling; a 4 cm conforming bandage is applied with slight tension (not full tension) to each digit in even layers, avoiding bulk.

## Inelastic Velcro wraps

These consist of a series of inelastic straps, connected in the middle (the spine), which overlap the leg and are secured with Velcro (Lawrance, 2008) (Figure 2). They can be used as an adjunct to hosiery or when the patient is unable to travel to clinic for bandaging. A specific foot piece must

be worn with the leg piece, to prevent or control foot swelling. Patients can apply, tighten, loosen and remove the wrap, which gives them control over the management of their swelling.

The bands closest to the ankle are wrapped first, at or near end stretch. The remaining bands are fastened in the same manner. This ensures that the correct level of compression is applied. These wraps are particularly useful for:

- Managing post-rebound oedema following a programme of intensive bandaging
- Patients with weak hands or back problems who cannot apply stockings
- Patients who cannot tolerate compression bandages or hosiery.

## Application

The degree of compression applied to a limb is based on Laplace's law, and is determined by the bandage width, limb circumference and number of layers applied. Based on this law:

- Higher compression is achieved with a narrow bandage, over a small circumference and using more layers
- Reduced compression is achieved with a wider bandage over a larger circumference with fewer layers, less overlap and reduced stretch or tension.

Only competent and experienced practitioners should adjust the

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*Figure 2: inelastic Velcro wraps*

bandaging technique to apply higher levels of compression. Contraindications and cautions for compression bandaging in patients with chronic oedema or lymphoedema are listed in *Box 2*.

## Bandaging technique

Traditional application of compression bandages for

### Box 2. Contraindications/ cautions to the application of compression bandaging

- Acute deep vein thrombosis
- Acute cellulitis
- Unstable congestive heart failure
- Severe peripheral arterial disease
- Severe peripheral neuropathy
- Untreated truncal or genital oedema



*Figure 3: toes are first phase*

lymphoedema/chronic oedema of the lower limb usually proceeds in the following order:

- Toe bandaging (often required to reduce or prevent swelling) (*Figure 3*)
- Application of a tubular bandage from toe to knee, or groin. This provides a protective and absorbent layer between the skin and bandages
- Application of padding to protect the bony prominences and give the limb a cylindrical shape. This ensures that a natural graduated compression is achieved
- Application of inelastic bandage from the toe to knee or groin (narrower bandage at foot, 6 cm or 8 cm, depending on size of the foot) increasing in width to 10 cm or, where appropriate, 12 cm as the leg circumference expands (*Figure 4*).

Depending on the bandage used, treatment is either daily or three times per week and the duration can range from 1 to 3 weeks, or until ulcer



*Figure 4: below-knee inelastic compression bandage in place on the lower limb*

healing occurs, or the limb shape and volume have improved enough to apply compression garments. Frequency of application will depend on many factors, especially rate of oedema reduction, need to observe the limb, and the patient's ability to attend the clinical setting.

Following this, the patient is fitted with appropriate compression hosiery (and/or self-banding/inelastic wrap) to prevent rebound swelling. Indications for bandaging and hosiery are given in *Table 2*. Indications for different levels of compression and use of Velcro wraps are in *Table 3*.

The patient is then reassessed and monitored regularly to ensure the improvement is maintained and, where necessary, further intensive bandaging is implemented. Only when their oedema is stable and controlled should the patient be discharged to his or her GP. Patients should be encouraged to self-manage their condition in the long term. This can be achieved by providing them with education on the rationale for compression hosiery, empowering them to become partners in their care, and providing support when required.

**Note:** compression bandaging must only be applied by skilled practitioners following training on the application technique

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**Table 2. Indications for compression bandaging and hosiery** (Doherty et al, 2006; Hopkins, 2008; Quere and Sneddon, 2012; Wigg, 2012)

Bandaging	Hosiery
<ul style="list-style-type: none"> <li>• International Society of Lymphology (ISL) stage II, late II and III</li> <li>• Limb shape distortion</li> <li>• Excess limb volume: &gt;20% difference</li> <li>• Skin problems: fragile, ulceration</li> <li>• Poor skin condition</li> <li>• Lymphorrhoea</li> <li>• Patients receiving palliative care</li> <li>• Patients who are unable to apply or tolerate hosiery</li> <li>• Thickened subcutaneous tissues/ fibrosis</li> </ul>	<ul style="list-style-type: none"> <li>• ISL stage I</li> <li>• Minimal or no shape distortion</li> <li>• Excess limb volume: &lt;20% difference</li> <li>• Minimal pitting oedema</li> <li>• Intact skin</li> <li>• Following intensive lymphoedema treatment</li> <li>• Patients with excess limb volume who are unable to tolerate bandages</li> </ul>



**Table 3. Indications for compression bandaging, modified bandaging, hosiery and Velcro wraps**

<b>Compression bandaging</b>	<ul style="list-style-type: none"> <li>• Complex/severe lymphoedema/chronic oedema</li> <li>• Excess limb volume</li> <li>• Shape distortion</li> <li>• Skin folds</li> <li>• Poor skin condition</li> <li>• Fibrotic skin changes</li> <li>• Lymphorrhoea</li> </ul>
<b>Modified/reduced compression bandaging</b>	<ul style="list-style-type: none"> <li>• Palliative lymphoedema/oedema in advanced malignancy</li> <li>• Frail/elderly patients</li> <li>• Mild arterial insufficiency or patients who are unable to tolerate full compression</li> </ul>
<b>Elastic circular knit hosiery</b>	<ul style="list-style-type: none"> <li>• Venous insufficiency</li> <li>• Mild lymphoedema</li> <li>• Good skin condition</li> <li>• Normal limb shape</li> </ul>
<b>Flat-knit hosiery</b>	<ul style="list-style-type: none"> <li>• Lymphoedema/chronic oedema</li> <li>• Shape distortion where bandaging cannot be tolerated</li> <li>• Lipoedema</li> <li>• Skin folds when bandaging is inappropriate</li> <li>• Patients who have difficulty applying circular knit hosiery</li> </ul>
<b>Inelastic Velcro wraps</b>	<ul style="list-style-type: none"> <li>• Patients who are unable to tolerate bandaging</li> <li>• Patients/carers who cannot apply stockings</li> <li>• For use with hosiery (e.g. at night) following a period of intensive bandaging</li> <li>• Patients with fragile skin</li> </ul>

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