

# Compression therapy for chronic venous insufficiency, lower-leg ulcers, and secondary lymphedema

Many compression systems are available. Which one is the right type for your patient?

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**A**n estimated 7 million people in the United States have venous disease, which can cause leg edema and ulcers. Approximately 2 to 3 million Americans suffer from secondary lymphedema. Marked by abnormal accumulation of protein-rich fluid in the interstitium, secondary lymphedema eventually can cause fibrosis and other tissue and skin changes.

In lymphedema, the lymphatic system can't transport the lymphatic load effectively due to reduced transport capacity. Secondary lymphedema results from such factors as surgery, radiation therapy, injury, and obesity. When caused by chronic venous insufficiency (CVI), secondary lymphedema is termed *phlebo-lymphostatic edema* or *phlebolymphedema*. Phlebolymphedema incidence isn't fully known.

CVI generally develops over a long period due to increased pressure within the venous system. Changes in venous pressure may stem from any disruption that alters normal venous flow. Incompetent valves in the superficial or deep venous system and an altered calf muscle pump contribute to venous hypertension. Additional contributing factors include venous

thrombosis, traumatic injury, obesity, pregnancy, sedentary lifestyle, prolonged standing, paralysis, and female gender.



CVI-related venous ulcerations with secondary lymphedema (phlebo-lymphedema)

During initial patient evaluation, try to determine the cause of leg ulcers and underlying edema by obtaining a thorough history, performing a physical exam, and completing a diagnostic work-up. Once acute causes (such as acute cellulitis, deep vein thrombosis, or heart failure) are ruled out, a treatment plan can be initiated.

Compression therapy is the standard of care for CVI, venous ulcerations, and lymphedema-related ulcers. By countering the effects of venous pressure, compression therapy reduces edema and

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promotes venous and lymphatic return.

Many compression systems are available. To choose an appropriate compression product for a patient with leg ulcers, you must have a thorough understanding of these products. However, this choice can be difficult because of lack of standardized compression classifications, confusion over terminology, and lack of evidence as to which type of compression system is most effective.

### Basic bandage materials

It's important to understand the type of material in the bandage system because this affects other aspects of the bandage. Compression bandage materials may be elastic, long-stretch, inelastic, or short-stretch bandages. The terms *elastic* and *long-stretch* (elastic/long-stretch) bandages are often used synonymously, as are inelastic and *short-stretch* (inelastic/short-stretch) bandages.

## Compression bandages may be elastic, long-stretch, inelastic, or short-stretch.

Extensibility differs markedly between these two basic types. Extensibility refers to the degree to which the bandage can be stretched when pulled. Generally, an elastic/long-stretch bandage has a maximal extensibility greater than 100%, whereas an inelastic/short-stretch bandage has a maximal extensibility of less than 100%.

### Bandage application methods

The next factor to consider is how much pressure the bandage system will exert on the limb and the effect of the materials on pressure. Gradient compression (where pressure is greater distally and gradually de-

creases proximally) is the basic principle for all compression therapies currently used.

To better understand the pressure exerted by a bandage and thus ensure safe and gradient compression, you need to understand and apply the Law of Laplace: pressure (P) = tension (T) divided by radius (R). This law is the basis for calculating pressure or simply determining if pressure is higher or lower in certain areas of the limb.

- *Tension* is the amount of stretch used on the bandage as it's applied; it's determined by the person applying the bandage. When you apply a bandage on a limb, are you stretching it to 100% of its extensibility or only 25%? Are you stretching equally along the entire limb, or using different amounts of stretch at certain parts of the limb? These are crucial considerations.
- When considering *radius*, think of a cylinder, or the conical shape of most limbs. When a bandage is applied to a cylinder or cone with equal tension (stretch), pressure is determined by the radius. A smaller radius (such as that of the distal part of the leg) has a higher pressure than a larger radius (such as that of the calf or thigh area).

When applying a compression bandage, always consider the Law of Laplace. What happens when you bandage a leg that has lost its cone shape—for instance, when the distal leg has a larger radius than the area proximal to it? If you apply the compression bandage to this limb with equal tension in all areas, the pressure will be higher proximally than distally; this wouldn't allow for the gradient compression most practitioners try to achieve. To avoid this mistake, you need to build up the limb regions appropriately with padding and foam to create the desired cylinder shape that ensures both a proper pressure application and gradient compression (much as you might place foam or padding around a bony prominence, such as the ankle or

foot.) Problem solving each individual case and applying key principles to the bandage system and bandage application can promote edema reduction and ensure appropriate compression.

Once you've applied the bandage, keep in mind how the bandage materials affect resting pressure and working pressure on the limb. *Resting pressure* refers to pressure on the limb from the bandage itself, generally while the patient is at rest or supine. *Working pressure* is the pressure created when the limb is moved and muscles contract against the bandage. An elastic/long-stretch bandage (such as an ACE™ wrap) has a high resting pressure and low working pressure. In contrast, an inelastic/short-stretch bandage (such as that used in lymphedema treatment) has a low resting pressure and a high working pressure.

Some clinicians believe inelastic/short-stretch bandages may be tolerated better than elastic/long-stretch bandages because of the variation between resting and working pressure. Research also shows that inelastic/short-stretch bandages are more effective than elastic/long-stretch bandages in reducing deep venous refluxes and venous volume.

### Multilayer bandages

Traditionally, multilayer short-stretch bandages are used during the decongestive phase of lymphedema treatment. In standard lymphedema compression bandaging, a trained clinician (typically a certified lymphedema therapist [CLT]) applies a series of short-stretch bandages of varying widths, in combination with padding, to ensure gradient pressure. This bandage system can be used to accommodate limbs of any size or shape, and can be applied from toes to groin as needed. The CLT determines the number of bandages and use of materials based on the patient's individual needs. Multilayer bandage systems are washable and reusable.

Multilayer bandages also are used to treat

### View: Application of a bandage



CVI and related ulcerations. Many of these systems come as kits. Typically disposable, they're usually applied only from the base of the toes to the knee and can't accommodate the thigh or toes. However, the term *multilayer* can be confusing. Although it commonly refers to bandage systems with two to four layers, a multilayer bandage may combine inelastic/short-stretch and elastic/long-stretch bandages. Research has found that bandage systems made of elastic/long-stretch materials take on properties of inelastic/short-stretch bandages due to friction between the layers. Therefore, experts have proposed using the term *multicomponent* instead of *multilayer* bandages.



Four-layered compression wrap consisting of both short-stretch and long-stretch materials



Multicomponent short-stretch compression bandage for phlebo-lymphedema treatment, including toe wraps, cotton liner, foam padding, and short-stretch bandages in varying widths applied distally to proximally

## Quick guide to compression bandages

This chart gives examples of inelastic/short-stretch, elastic/long-stretch, and multicomponent compression bandages. (No product preference is intended.)

Material and extensibility	Product examples
<b>Inelastic/short-stretch bandages</b> Less than 100% extensibility	Comprilan® bandage Rosidal K® bandage Zinc oxide bandage (nonmodified)
<b>Elastic/long-stretch bandages</b> More than 100% extensibility	ACE™ wrap Coban™ wrap SetoPress® bandage SurePress® bandage
<b>Multicomponent bandages</b> May combine short-stretch and long-stretch materials	Coban™ 2 Layer wrap Modified Unna boot (Unna paste wrap, absorbent cotton layer, self-adhesive wrap) Profore®, Profore Lite® bandage

This terminology change and an understanding of how bandaging materials work enhance communication between clinicians who use traditional lymphedema compression bandages and those who use various wound-management compression systems, as they work together to treat phlebolymphe-  
dema patients. (See *Quick guide to compression bandages*.)

### Which bandage system should you use?

As described above, clinicians must consider several factors to determine the type of compression bandage to use. Also, research is underway to identify the best form of bandaging, the sub-bandage pressures of different materials and applications, and physiologic responses to varying degrees of compression. Besides choice of material, bandaging technique and clinician experience in applying bandages also play a role in bandage effectiveness. You must consider each patient individually

and choose and apply the materials properly. This is especially critical for phlebolymphe-  
dema patients with ulcerations, for whom a multicomponent bandaging system may be more appropriate than certain products traditionally used in wound management. No matter which bandage system you use, be sure to follow the Law of Laplace when applying it to ensure safe and successful edema reduction.

There are endless ways to combine various compression bandages and garments to meet a patient's needs. Also consider contraindications to compression, such as cardiac edema, acute infection, acute deep vein thrombosis, and severe arterial disease.

In patients with an arterial component, keep in mind that you'll need to adjust compression level to accommodate the compression wrap and the compression hose/garment system while treating the ulcer and once it is healed. Other patient factors to consider include sensory deficits, cancer, diabetes, paralysis, hypertension, cognitive status, and allergies—as well as age, functional ability, social support systems, and financial status.

In managing phlebolymphe-  
dema and ulceration, a multidisciplinary team approach and patient participation in and understanding of treatment are paramount. Appropriate diagnosis and treatment recommendations must rest on a sound understanding of pathophysiology and compression therapy. Across all disciplinary levels, competency demonstrations in using compression therapy, as well as compression therapy contraindications, should be mandatory. Recommendations for future study include research to establish phlebolymphe-  
dema prevalence, a consensus on appropriate compression systems for treatment, and a consensus on transprofessional terminology for disease classification and compression therapy. ■

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