CHAPTER 19

Introduction

Venous leg ulcers account for 40%–70% of chronic lower-extremity wounds.1 As the population ages, the proportion of pure venous ulcers is decreasing with more patients presenting with mixed venous and arterial disease. Compression therapy, in the form of bandaging, is the cornerstone of management in the absence of any significant arterial disease. Compression therapy, in the form of bandaging, is the cornerstone of management in the absence of any significant arterial disease.2 Compression therapy is contraindicated in decompensated chronic congestive heart failure and peripheral vascular disease where arterial disease predominates over a co-existing venous component.3

In a 2006 comprehensive systematic review update of the 2001 systematic review, Cullum et al4 reassessed the evidence for compression therapy. The authors tabulated the randomized, controlled trials that compared the effectiveness of various compression systems and alternative therapies for the treatment of venous ulcers. Some important findings are summarized in Table 1.

In this systematic review, compression bandaging facilitated faster healing of venous ulcers compared to no compression. The review also concluded that the multilayer elastic systems were superior in the 5 studies that qualified for inclusion. High compression also produced higher venous ulcer healing rates than low compression with single-layer bandaging. There was no difference in trials with the 4-layer bandage compared to other equivalent multilayer bandaging systems. A high compression stocking was also more effective combined with a thromboembolic stocking under-layer than a short-stretch system for venous ulcer healing. This

Objectives

The reader will be challenged to:
• Select appropriate compression therapy for edema control and ulcer healing considering arterial circulation, pain, and other patient-related factors
• Differentiate between inelastic (support) and elastic systems of compression
• Analyze the types of stockings/hosiery available to maintain edema control and prevent ulcer recurrences.

Additional Resources:
Association for the Advancement of Wound Care (AAWC): Professional Resources.
https://aawconline.memberclicks.net/resources

Cochrane review: Compression for venous leg ulcers

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may be predictable, because short-stretch bandage effect depends on the skill of the bandage applier, and as the edema is reduced, the bandage will loosen or fall down. Often, this bandaging system has to be reapplied frequently.

There is a 3-class bandage classification system in the United Kingdom: retention, nonelastic, and elastic. Retention bandages include continuous cotton bandage rolls, such as Kling® (Johnson & Johnson Wound Management, Somerville, NJ) or Kerlix® (Kendall HealthCare, Mansfield, Mass). Retention-type bandages may not provide compression but are designed as secondary dressings to keep the primary wound dressings in place and provide protective padding. The second type of bandages, nonelastic (support) bandages, includes the short-stretch bandages, such as Comprilan® (BSN-JOBST, Inc, Charlotte, NC), and bandages impregnated with zinc oxide or gelatin, such as Viscopaste® (Smith & Nephew, Largo, Fla). The third type of bandages, elastic bandages, can be divided into low, medium, or high compression subclasses. The low elastic subgroup includes Tubigrip® (ConvaTec, Princeton, NJ). This product is a tubular rolled bandage in different sizes that can be cut and applied with 1 or more layers. A single layer will provide approximately 8 mmHg, and 2 layers will provide approximately 16 mmHg. A simple elastic nonadhesive bandage applied in a spiral would provide approximately 14 mmHg to 17 mmHg compression at the ankle. A noncohesive elastic bandage (eg, Tensopress™, Smith & Nephew) is in its relaxed state when it is taken out of the package, and when fully stretched, it will reach the stopping distance. For a maximum application of elastic energy, the bandage should be applied at half stretch between the relaxed and stopping distance. The bandage should start at the base of the toes, usually includes a heal lock, and is applied to just below the knee with no gaps visible. Moderate elastic systems combine 1 or 2 under-layers with a cohesive elastic bandage (18 mmHg–24 mmHg). The high compression elastic systems often combine 1 or 2 padding under-layers with an elastic mid-layer and a cohesive layer on top. The elastic layer can be applied in a spiral for slightly lower compression or in a figure-of-8 to apply higher pressures around the ankle. The last cohesive layer is usually applied using a spiral technique at 50% or full stretch with a 50% overlap of each layer.

In summary, the main conclusions from the most recent systematic review of compression therapy have remained unchanged:

- High compression was better than low compression in the treatment of venous edema provided there is no co-existing significant arterial disease
- There was no clear difference in the effectiveness of the different types of multilayer high compression systems
- There may be an advantage of elastic systems over nonelastic systems
- The increased use of any correctly applied high compression treatment should be promoted.

The Cochrane site provides periodic updates on a number of reviews in wound care and can be accessed at the Cochrane site: http://www.cochrane.org/reviews/en/ab000265.html (you may need an institutional or personal license for access). It is important to remember that this evidence base must be interpreted for clinical practice. Not all patients tolerate all compression systems, and there may be other contraindications to both elastic and inelastic systems. For example, patients with significant lower leg pain may tolerate inelastic systems with a lower pressure at rest and can be transitioned to an elastic system with pain control.
Vascular Assessment: Doppler Ankle to Brachial Pressure Index (ABPI)

A thorough vascular assessment should be performed prior to considering the use of any compression therapy on a patient. The presence or absence of pedal pulses should be determined, but this alone is inadequate as a vascular assessment. In addition to clinical assessment, clinicians should perform a Doppler assessment. The ankle to brachial pressure index (ABPI) helps identify any coexisting arterial disease.\(^5\)-\(^7\) Moffatt and O’Hare\(^8\) have demonstrated that if clinicians rely on the presence of a palpable pulse alone (approximately 80 mmHg for the foot), they will misclassify 17%-20% of patients who have significant arterial disease. Portable Doppler with 4-MHz to 8-MHz probes can be utilized in the community or ambulatory clinic to measure the arterial ABPI.\(^5\)-\(^7\)

The following steps are required for obtaining ABPI:

1. Patient should be in supine position 15 minutes before the procedure
2. Obtain the brachial blood pressure in both arms and use the higher systolic pressure
3. Apply the blood pressure cuff around the ankle just above the malleoli
4. Apply ultrasound gel over the dorsum of the foot to obtain a dorsalis pedis pulse and over the notch below the medial malleolus to obtain tibialis posterior pulse (probe should be at a 45-degree angle pointing upward to meet blood flow)
5. When the pulse signal is audible, inflate the sphygmomanometer until the signal disappears
6. Slowly release the cuff until the pulse signal is heard representing the systolic pressure
7. Divide the ankle systolic pressure by brachial systolic pressure (eg, 80 [ankle] ÷ 100 [brachial] = 0.8 ABPI).

The Doppler is more accurate than a stethoscope, but in the presence of calcified arteries (commonly seen in people with diabetes), falsely elevated readings of systolic dorsalis pedis and posterior tibial pressures may occur. In these patients, toe pressure analysis and waveforms will be more reliable.\(^9\)-\(^11\) Depending on the patient’s history, clinical examination, and the ABPI, one can decide the type and level of compression therapy that may be required. In patients with an ABPI > 0.8 (toe pressure usually > 80 mmHg) high compression (30 mmHg–40 mmHg or higher) can be applied. An ABPI between 0.6–0.8 (toe pressure usually > 50 mmHg) is considered borderline or indicative of some arterial insufficiency, and modified low level compression can be applied. For patients with an ABPI < 0.6 and toe pressure < 50 mmHg, no compression should be used.\(^12\) Refer to Table 2 for a guideline for interpreting the ABPI.\(^16\) Patients with an ABPI between 0.6–0.8 may have claudication with prolonged walking; for patients with an ABPI of 0.4–0.6 claudication often occurs with walking short distances; those with an ABPI between 0.2–0.4 have pain with leg elevation; and

<table>
<thead>
<tr>
<th>ABPI</th>
<th>Toe Pressure</th>
<th>Toe Brachial Index</th>
<th>Ankle Doppler Waveform</th>
<th>TcPO(_2)</th>
<th>Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 0.8</td>
<td>&gt; 80 mmHg</td>
<td>&gt; 0.6</td>
<td>Normal/Triphasic</td>
<td>&gt; 40 mmHg</td>
<td>No arterial disease</td>
</tr>
<tr>
<td>&gt; 0.6</td>
<td>&gt; 50 mmHg</td>
<td>&gt; 0.4</td>
<td>Biphasic/Monophasic</td>
<td>30 mmHg-39 mmHg</td>
<td>Some arterial disease: Modify compression</td>
</tr>
<tr>
<td>&gt; 0.4</td>
<td>&gt; 30 mmHg</td>
<td>&gt; 0.2</td>
<td>Biphasic/Monophasic</td>
<td>20 mmHg-29 mmHg</td>
<td>Arterial disease predominates</td>
</tr>
<tr>
<td>&lt; 0.4</td>
<td>&lt; 30 mmHg</td>
<td>&lt; 0.2</td>
<td>Monophasic</td>
<td>&lt; 20 mmHg</td>
<td>High risk for limb ischemia</td>
</tr>
</tbody>
</table>

Table 2: Vascular assessment criteria for treatment
an ABPI < 0.2 is associated with potential rest pain.

How is the Ideal Compression Bandage Determined for Individual Patients?

Ideal compression is determined by the modified Laplace’s law. According to this law, sub-bandage pressure is determined by the number of layers of bandage applied and the tension by which it is applied. This is also influenced by the leg circumference and the width of the bandage:

Laplace’s law:
Sub-bandage pressure =
\[ T \times N \times C \times W \]

In Laplace’s law, the circumference of the limb is in the denominator of this equation—the larger the circumference, the less the compression. This is why a relatively thin ankle will achieve 25 mmHg–45 mmHg with the same bandage that will give only 15 mmHg–20 mmHg compression to a larger circumference leg just below the knee. In summary, obtained compression is the inverse of the circumference with smaller circumferences receiving higher compression. In addition, narrow bandage widths will also give greater compression (also an inverse relationship).

Laplace’s law also tells us that the bandage tension is important. An elastic bandage comes out of the package in the relaxed state. As it is stretched as far as it can go, the bandage reaches the stopping distance (and a loss of elastic energy), making it a support system. As previously stated, proper bandage technique requires any elastic bandage to be applied halfway between the relaxed state and stopping distance, maximizing the elastic energy in both directions. Some bandage systems have indicator systems that will determine 50% or higher levels of stretch (for example, rectangles become squares). It is also known that the more layers present, the greater the compression. If there is extra bandage left by the time the knee is reached, do not apply extra elastic layers at the knee. This increases the compression proximally. If this is done, the venous blood is sent back down to the foot. Instead, some bandages may be cut, or the bandage can be rewrapped with greater overlap between the layers to utilize the extra bandage length. Inelastic bandage techniques may criss-cross and go up and down the leg. It is important that the clinician be familiar with each of the systems to determine the appropriate adjustments needed to accommodate extra bandage length.

Padding may be used to even out the leg circumference in irregular shaped legs, effectively redistributing the pressure in a uniform fashion. Padding may also be used to protect bony prominences of the pretibial and Achilles areas.

Role of the Calf Muscle Pump

Good calf muscle pump function is important in the healing of venous leg ulcers. High venous pressures are found in patients with venous leg ulcers often due in part to the partial or complete failure of the calf muscle pump. Major injuries, neurological disease, vascular insufficiency, bone and joint pain, as well as an altered gait can all adversely impact the calf muscle pump. Calf muscle pump function can also be affected by ankle range of motion, as ankle dorsiflexion of 90 degrees occurs in the normal walking pattern.

As activation of the calf muscle pump is a critical component of leg ulcer healing, regular exercise, such as walking, as well as exercises to increase ankle mobility should be prescribed. Referral to an occupational or physical therapist for those patients who have difficulty adhering to an exercise program or who have limitation in joint mobility should be considered. A physical or occupational therapist can assist the patient to find an alternative form of exercise that will foster adherence as well as employ techniques to improve joint range of motion.

Mechanism of Compression versus Support (Figure 1)

There is a difference between compression and support. Compression is an elastic system with high pressure at rest and high but less pressure with muscle contraction. A support system is relatively rigid (inelastic), giving little pressure at rest and high pressure with muscle contraction against fixed resistance. Despite the differences in these 2 systems, the nomenclature is often used in a less precise and interchangeable fashion.

Three- and 4-layer, as well as long-stretch
Compression Therapies

Various high compression systems are available. High compression systems have been used with increasing frequency to treat venous ulcers in the absence of any co-existing arterial disease. High compression systems include 4-layer systems and long-stretch systems.

**High Compression/4-Layer Systems**

The 4-layer system (Profore™, Smith & Nephew) is a high pressure elastic bandage consisting of:

- Layer 1: natural cotton padding roll that is applied in a spiral bandage technique
- Layer 2: light, conformable bandage; a crepe layer is applied in a spiral bandage technique
- Layer 3: light compression bandage; an elastic bandage is applied in a figure-of-8 fashion at 50% stretch
- Layer 4: flexible cohesive bandage; a cohesive elastic bandage applied in a spiral with 50% overlap of each layer and 50% stretch (keeps the bandage in place without slippage).

The first, second, and fourth layers are applied in a spiral fashion, and the third layer is applied in a figure-of-8. A figure-of-8 wrapping style will give 10 mmHg to 15 mmHg more compression than a spiral technique using the same bandage. The third layer is responsible for approximately 17 mmHg of the 42.5 mmHg sustained pressure obtained from the bandage during a 1-week average wear time.

Multilayer bandages are somewhat bulky but are usually comfortable. They should not be used if significant coexisting arterial disease is noted (Doppler ABPI < 0.8). They are designed for single use but, because they reduce the number of follow-up visits, can be cost effective and efficient. Multilayer bandages are not recommended for ankle circumferences of < 18 cm (unless the third layer is omitted), because high ankle pressures in excess of 60 mmHg may be obtained, resulting in the potential for local skin breakdown and pain. With ankles > 26 cm in circumference, an extra third layer should be added; otherwise, a lesser level of compression at the ankle will be achieved. **Four-layer bandages are considered to be the gold standard of compression therapy and represent a major advance over previous methodologies.** They combine the advantages of 4 layers (that help to minimize bandaging er-

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<table>
<thead>
<tr>
<th>Type of system pattern of pressure</th>
<th>Compression</th>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest</td>
<td>High pressure</td>
<td>Low pressure</td>
</tr>
<tr>
<td>Muscle Contraction</td>
<td>High pressure but less</td>
<td>High pressure</td>
</tr>
<tr>
<td>Low Compression</td>
<td>Single layer elastic bandages</td>
<td>Unna’s boot</td>
</tr>
<tr>
<td>High Compression</td>
<td>Long stretch 4 layer</td>
<td>Short stretch Modified Unna’s boot (Duke boot)</td>
</tr>
</tbody>
</table>

**Figure 1.** Compression is an elastic system with high pressure at rest and high but less pressure with muscle contraction. A support system is relatively rigid (inelastic) giving little pressure at rest and high pressure with muscle contraction against a fixed resistance.
ror) with the elastic properties of a cohesive layer (that prevents slippage). Patients with fragile skin, loss of muscle tone, and severe pain may not tolerate multilayer bandage systems. High elastic pressure at rest can cause the fragile skin of people with rheumatoid arthritis or neuromuscular conditions with loss of muscle tone to develop new areas of breakdown.

Other High Compression and Support Systems

A long-stretch bandage (SurePress™ and SetoPress®, ConvaTec; Tensopress™, Smith & Nephew) consists of an orthopedic wool under-layer and a long-stretch elastic system (so named due to the long stopping distance or maximum stretch ability compared to the relaxed state). One system (SurePress) has small rectangles printed in the center of the bandages that become squares when the bandage is applied at a 50% stretch for ankle circumferences between 18 cm and 26 cm. For ankle circumferences above 26 cm, a two-thirds stretch is recommended, allowing the larger rectangles in the middle of the bandage to become squares. The long-stretch system, like a 4-layer bandage, may give too much compression to a smaller ankle (< 18 cm circumference) and not enough compression for ankles > 26 cm. One practical advantage of this system is that the elastic layer can be reused, replacing only the orthopedic wool layer with each application, facilitating regular review of an unstable, possibly infected wound. It is also less bulky than a 4-layer system and is cost effective. This inelastic bandaging system technique does not need to start at the tip of the toes but often starts on the ankle, with a complicated overlapping system with 2 separate bandages. In the authors’ clinic, an orthopedic wool or continuous bandage is recommended as a primary layer. A 6-cm bandage is applied on the foot with two-thirds overlap in a spiral. An 8-cm bandage is then used in a similar fashion from the ankle to below the knee. This simplified technique allows reproducible bandaging in community and other care settings with minimal slippage. A flexible, cohesive bandage (eg, Coban) can be used to fix the bandage and minimize slippage, but if this is applied at full stretch or becomes bunched, a high local pressure may be obtained. Alternatively, a cotton cohesive bandage without a major elastic component has been developed (Easifix®, Smith & Nephew). Because short-stretch bandaging is so effective at reducing edema, bandages need to be changed more frequently (every 24 to 72 hours) unless they are applied with a cohesive outer layer, such as Easifix. Short-stretch systems are excellent for thin ankles (< 18 cm in circumference) and edematous feet. The balloon foot is often due to too much compression at the ankle, impairing edema drainage from the foot. Short stretch is useful with decreased muscle tone or muscle atrophy. There is low pressure at rest, preventing new areas of breakdown. The bandage can be washed 10 or more times. Short-stretch bandages can also be modified depending on edema level noted after removal of the bandages. Increased therapeutic action can be achieved with narrower bandaging or an increased overlap. Conversely, wider bandages with less overlap will have decreased clinical edema reduction. Their drawback is that they take considerable training and skill to apply cor-
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A short-stretch bandage may also be useful for mixed arterial and venous disease where the resting pressure is low. The nonelastic systems are also useful for patients with pain and can be tolerated in some individuals where elastic systems become problematic and painful. When the major leg edema and pain have decreased, these patients may be switched to appropriate elastic systems when necessary.

The gold standard for support therapy in the United States has been the modified Unna’s boot (Uniflex®, ConvaTec; Viscopaste®, Smith & Nephew) or Duke boot. Professor Unna, a German dermatologist, introduced zinc oxide paste bandages in 1896. In their modern form, wet zinc oxide bandages are applied in a continuous spiral fashion or using an interrupted strip technique with 50%–80% overlap. The patient should be reminded to keep his or her foot in the dorsiflexed position during the wrapping. The Duke boot adds a hydrocolloid wafer over the wound and a flexible cohesive bandage as an outer layer. The flexible cohesive bandage is often applied at full stretch as an extra layer to reinforce the boot, increase the support, and even out irregular areas of the zinc oxide paste layer. The 4-layer elastic system and the inelastic Duke boot have the same outer layer, but the 4-layer system has the flexible cohesive bandage applied at 50% stretch.

Each of the 4 high compression/support systems has advantages and disadvantages, and each patient will benefit from different systems. Patients should be checked for edema control, comfort, local wound discharge, and new areas of breakdown. Remember to address patient-centered concerns when selecting a compression system.

Pain is common with venous disease and should be addressed (see Chapter 9). Constant pain may be due to infection or superficial or deep phlebitis. The cause of the pain must be treated, but patients also need co-existing edema control. This may be achieved initially with short-stretch systems, which do not cause pressure at rest, minimizing additional pain from the bandage. These patients may then progress to the elastic systems. Local practices may reflect tradition, or therapy may be dictated by drug tariffs, reimbursement plans, or institutional formularies. Knowledge of bandage characteristics can optimize treatment. There is no doubt that 1 bandage system is not optimal for all patients, and clinics providing several options can often optimize patient care outcomes.

### Low Compression

Patients with ABPIs ranging from 0.6 to 0.8 have mixed arterial/venous disease and may still benefit from compression for the venous component of their ulcers. Edema control must be balanced against decreasing arterial circulation. Although sub-bandage pressure locally may be well below adjacent arterial pressures, distal arterial digit perfusion may be significantly reduced, leading to critical ischemia. These patients may complain of local pain, and clinical examination may reveal signs of vascular compromise (cold foot/dusky erythema). For these patients, a simple single-layer elastic bandage or short-stretch system may be sufficient. Patients should be told to remove this if any discomfort develops. Bandages can be modified and a layer of padding used underneath when tolerated. This will, however, increase compression. Other ways to increase

<table>
<thead>
<tr>
<th>Comparison of recurrence rates</th>
<th># of RCTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression hosiery &gt; no compression</td>
<td>2 out of 2</td>
</tr>
<tr>
<td>High compression = moderate compression hosiery (higher patient adherence rates)</td>
<td>1 trial (300 patients)</td>
</tr>
<tr>
<td>Two types of medium compression hosiery are equal</td>
<td>1 trial (166 patients)</td>
</tr>
</tbody>
</table>
Compression if edema control is not adequate include changing the bandage from a spiral to a figure-of-8 all the way up the leg. Be cautious with these patients, because edema may represent clinical signs of congestive right heart failure, low albumin, or other medical causes.

**Compression Hosiery and Stockings**

In general, bandaging is for healing, and compression hosiery or stockings are for maintenance and preventing recurrence. Thromboembolic stockings are designed for bedrest and compression stockings for ambulatory patients.

Once healing has been achieved with compression bandaging, patients should be advised to wear compression hosiery for life (unless coexisting arterial disease exists) in order to maintain healing. Compression stockings have elasticity providing compression at rest and also with muscle contraction. Results of 2 randomized, controlled trials have qualified for a recent Cochrane review on the prevention of venous ulcers with compression hosiery. The results are listed in Table 3.

Various types of compression hosiery on the market meet varying patient needs. The qualified healthcare provider ordering the stockings has several decisions to make. As the prescriber, you must decide several things. The first decision is to determine the appropriate stocking strength based on the ABPI and patient considerations (will they wear them and can they put them on). Dress support stockings may be used for prominent veins without edema (very light, 8 mmHg–15 mmHg; light, 16 mmHg–20 mmHg). Once the venules become leaky or venous edema develops, the patient will often require hosiery of 25 mmHg pressure (Class 1, 20 mmHg–30 mmHg pressure). When lipodermatosclerosis (woody fibrosis or nonpitting edema) develops with chronic disease, the capillaries are leaky to fibrin, and 30 mmHg to 40 mmHg pressure (Class 2) is often required. The development of lymphedema requires even higher pressure stockings of strengths > 40 mmHg (Class 3) (Table 4).

The qualified clinician should next decide on the length. Knee-high stockings may be with or without toes and with or without a grip. Mid-thigh, full-thigh, or pantyhose variations are available for men and women. One can choose the type, such as natural latex or synthetic. If the clinician chooses natural latex hosiery, the wear time is longer, but the chance of allergic reaction is much higher.

Support stockings are not a good option as initial treatment because of rapid change in the leg’s circumference. It is better to order compression stockings when the limb circumference has been stabilized. Also, stocking should be applied immediately after getting up in the morning before local edema has a chance to accumulate. The other challenge is severe lipodermatosclerosis that can be associated with an inverted champagne bottle-shaped leg. Fitting a stocking on an irregularly shaped leg such as this is a challenge.

Patients often complain of compression hosiery application difficulties. The healthcare team should advise patients on how they can overcome these difficulties. For example, various assistive devices are available for use with the high pressure stockings. These include small devices that go up the leg and larger devices that allow the patient to

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**Table 4. Level of compression stockings**

<table>
<thead>
<tr>
<th>US standard</th>
<th>UK standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I: 20 mmHg–30 mmHg (light)</td>
<td>14 mmHg–17 mmHg</td>
</tr>
<tr>
<td>Class II: 30 mmHg–40 mmHg (light)</td>
<td>18 mmHg–24 mmHg</td>
</tr>
<tr>
<td>Class III: 40 mmHg–50 mmHg (light)</td>
<td>25 mmHg–35 mmHg</td>
</tr>
<tr>
<td>Class IV: 50 mmHg–60 mmHg</td>
<td>N/A</td>
</tr>
</tbody>
</table>
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step into a prestretched stocking (Stocking Donner®, BSN-JOBST, Inc). Other patented devices, such as rip-stop nylon (Easy Slide®, Sigvaris, Inc, Peachtree, Ga), can be used with open or closed-toed stockings. Another suggestion for patients having problems applying high-pressure hosiery is a nylon or cotton under sleeve with a compression stocking on top. By using an under sleeve, the compression will increase by approximately 10 mmHg. This illustrates Laplace’s law: with the addition of more layers, we have increased the total compression. The patient may also find applying 2 low-strength stockings on top of each other easier than applying 1 high-pressure stocking. This often gives the patient greater flexibility. Another tip is to use a zippered stocking (Jobst Ulcer Care™, BSN-JOBST, Inc). The wearer can pull the zipper down at night and pull it up in the morning. Patients with arthritis may put a key ring on the zipper and use a hook to pull the zipper up. The zippered stockings are often used with a nylon under sleeve to increase pressure and protect the stocking. For those patients who experience the tourniquet effect at the knee or edema just above the stocking, a knee-length stocking with grip or elastic bandage above the stocking may be used. Most patients prefer knee-high stockings. If a large amount of edema occurs above the knee, local hemorrhage may result from this large pressure gradient differential. These patients may not only require the grip as described but also mid-thigh or full-length stockings. Full pantyhose are available as well in maternity designs for women or in a chap style for men. For patients with lymphedematous legs, there is a unique, nonelastic, sustained compression system utilizing Velcro® adjustable straps (CircAid® Thera-Boot, Coloplast Corp, Minneapolis, Minn). The tabs may be tightened as the edema changes. With lymphedema, the 4-layer bandage is modified with an extra third layer. Patients may be referred to a specialist center for intermittent pneumatic compression with a lymphedema pump.

Anti-thrombolic anti-embolism hose (Thromboembolic Stockings TED®, Kendall HealthCare) provides low level compression, but it does not provide calf muscle support during ambulation. Anti-embolism hose is a single-layer stocking designed for patients on bed rest.

It is important to emphasize to patients that they must wear their stockings at all times except while sleeping. The recurrence rate is high for an individual with a venous ulcer who is not adherent to the treatment plan. It is important that the healthcare team and patient work together to design an effective program. When stockings lose their elasticity, they must be replaced. Many patients require more than 1 stocking to facilitate daily use. Clinicians should examine patients with their stockings on as part of their ongoing evaluation and to assess adequate edema control. Elderly patients with arthritis may have difficulty in applying the stockings, so a lower compression may be easier to manage than the ideal compression.

Adherence with Treatment Recommendations

The best compression therapy system is the one the patient will wear. Even after the wound has healed, patients must use “compression for life” to minimize recurrence. However, clinicians must always watch for newly developing arterial disease. Coaching patients with leg ulcers toward adherence with compression therapy and healthy lifestyles can improve health and quality of life in patients and should be undertaken without delay. The latest Cochrane review reminds us that a lower compression stocking is better than non-adherence or leaving the stocking in the drawer.

Conclusion

As the population ages, venous ulcers are more common—22% of the population have their first ulcers by age 40, and 72% have ulcers by the age of 60. Recurrent ulcers were seen in 72% of treated subjects, suggesting the importance of support or compression therapy for life. Healthcare professionals need to differentiate between elastic and inelastic bandaging systems to achieve the best possible compression for patient-centered concerns including pain, quality of life, and ideal edema control. It is essential to use a handheld Doppler or perform a thorough vascular assessment prior to prescribing any compression therapy. The clinical decision is a compromise between the patient’s concerns and best evidence. Clinicians must make their patients their partners in the treatment plans and reinforce the importance of adherence with the particular compression
Take-Home Messages for Practice

• Compression is the gold standard for the treatment of venous ulcers
• High compression is ideal for patients with venous ulcers in the absence of significant arterial disease
• Compression therapy needs to be modified for patients with mixed arterial and venous disease, and is contraindicated in arterial predominant disease
• Any form of high compression therapy has been shown to be beneficial. The clinician needs to assess the advantages and disadvantages of the various elastic and inelastic systems (slight advantage to elastic systems in recent studies)
• Bandaging is for healing and compression stockings or hosiery is for maintenance and to lower the incidence of recurrences
• Thromboembolic stockings are for bed rest patients and compression stockings are for the ambulatory patient.

therapy prescribed to prevent recurrence. Ongoing patient education (continuous and repetitive) is most likely to increase the rate of success.

Self-Assessment Questions

1. Compression therapy is indicated in which of the following conditions?
   A. Patient with symptomatic congestive heart failure
   B. Patient with peripheral vascular disease
   C. Patient with ABPI > 0.8 and toe pressure > 80 mmHg
   D. Toe pressure < 40 mmHg

2. Support stockings are used mainly:
   A. To heal ulcers
   B. For patients on bed rest
   C. For patients with arterial predominant disease
   D. For control of venous edema and prevention of ulcer recurrence

3. Which of the following bandages provide non-elastic (support) compression therapy?
   A. 4-layer bandage (Profore)
   B. Zinc oxide impregnated bandage (Viscopaste)
   C. Long-stretch bandage (SurePress)
   D. Cohesive bandage (Coban)

Answers: 1–C, 2–D, 3–B

References

18. Franks PJ, Posnett J. *Cost effectiveness of compression therapy*


