Compression therapy for venous leg ulcers

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INTRODUCTION

Compression therapy is the mainstay of treatment of venous leg ulcers (VLU). Good wound care and compression therapy will heal majority of small venous ulcers of short duration.[1] Goals of compression therapy are ulcer healing, reduction of pain and edema, and prevention of recurrence.[2] Compression is used for VLU and narrows veins and restores valve competence and reduces ambulatory venous pressure, thus reducing venous reflux (VR). It also helps decrease inflammatory cytokines, accelerates capillary flow, and lowers capillary fluid leakage thereby alleviating limb edema. It also softens lipodermatosclerosis, improves lymphatic flow and function, and enhances fibrinolysis.[3]

Indications

The aim of compression therapy is to improve the venous function without compromising arterial function.

Contraindications

The contraindications of compression therapy are the following[4,5]

- Advanced peripheral obstructive arterial disease (ankle brachial pressure index [ABPI] <0.8) (Evidence level A)
- Systemic arterial pressure <80 mm Hg at ankle
- Phlegmasia cerulea dolens
- Uncontrolled congestive heart failure
- Abscesses
- Septic phlebitis
- Advanced peripheral neuropathy.

CLASSIFICATION

Compression can be broadly divided into bandages and compression stockings. The details are mentioned in Table 1.[6,7] The compression bandages can be classified as inelastic (short stretch bandages [SSB]) and elastic (long stretch bandages [LSB]). The differences between the two groups of bandages are elucidated in Table 2.

COMPRESSION BANDAGES

All bandages used in compression must be applied on top of padding (subcompression wadding bandage) to prevent friction and pressure damage over bony prominences by spreading pressure across a greater area. Bandages should generally be applied toe to knee at 50% stretch and with 50% overlap but specific manufacturer's instructions should be followed for each bandage. Interface pressure peaks on the leg during walking exceeding 50-60 mm Hg reduce VR and increase venous pumping function. This may be achieved by stiff compression textiles like multicomponent bandages, especially when containing cohesive material or by zinc paste bandages. These compression types exert high stiffness which is characterized by a tolerable resting pressure and high pressure peaks during walking ("working pressure"), but need to be applied by well trained and experienced staff. Short stretch adjustable Velcro-wraps and (double) compression stockings may be promising alternatives allowing self-management.

INTERMITTENT PNEUMATIC COMPRESSION

Intermittent pneumatic compression constitutes inflating and deflating an airtight bag worn around leg. IPC controls edema in case compression bandage and stocking has failed. IPC upon compression therapy may accelerate ulcer healing.[8] It is particularly useful in patients with restricted mobility and when concomitant arterial disease is detected, where it helps reduce edema and enhance arterial blood flow.[9,10] IPC may improvement in hematologic, hemodynamic and endothelial effects which explains its role in healing of VLU.[11]

Table 1: Types of compression therapy

Compression system	Advantages	Disadvantages
Single component bandage		Has only one layer/aspect. Since padding layer is present in most systems, they cannot be described as single component
Elastic wraps E.g.: Elastocrepe	Inexpensive, can be re-used	Applied incorrectly by patients, tends to unravel, no sustained compression delivered, lose elasticity on washing
Light support (crepe)	For holding dressings in place, as a layer within multilayer bandage	Pressures are too low for affectivity in treating VLU. 40-60% pressure lost in first 20 min of application
Cohesive compression bandages E.g.: Tensoplus forte, coban	Self-adherent but non adherent to skin, prevents slippage; provides light support; useful over non adhesive bandages like elastocrepe and paste bandages, compression well sustained	Expensive, cannot be reused
Inelastic bandages (SSB) E.g.: Comprilan	Bandages with minimal or no elastomers. These bandages have low extensibility and high stiffness. Low resting pressures and high working pressures are delivered. Patient comfort ensured	Needs to be applied at full stretch
Inelastic paste bandages (Unnas boot)	Cost effective. Comfortable. Protects against trauma, full ambulation status possible, minimal activity interference	Pressure changes over time, needs to be applied by trained physicians and nurses, does not accommodate highly exudative wounds, no leeway for fluctuating edema
Multilayered (four layered) bandaging E.g.: Velfour High compression bandage system (SBP of 35-40 mm Hg at the ankle) that incorporates elastic layers to achieve sustained compression Layer 1 is orthopedic wool Layer 2 is a cotton crepe bandage Layer 3 is a light weight elastic compression bandage maintains SBP of 20 mm Hg at ankle Layer 4 is a cohesive compression bandage and it retains the bandage in position, maintains a pressure of 30 mm Hg at the ankle	Comfortable, can be left in place for 7 days, protects against trauma, maintains constant pressure for 7 days, used for highly exudative wounds, pressure distribution is even, adequate balance between resting/working pressures, useful for bigger legs and active patients	Needs to be applied by well trained nurses/physicians
High elastic compression bandages (LSB) E.g.: Tensopress, setopress, surepress	Sustained compression, can be worn up to 1 week, can be washed and reused	
Graduated compression stockings 3 classes are available depending on the desired degree of ankle pressure in mm of Hg Class I (18-21 mm Hg) Indicated in mild varicosis, early varicosis in pregnancy and heaviness of legs Class II (23-32 mm Hg) Indicated in severe varicose veins, moderate edema, pronounced varicosis in pregnancy, post healing minor ulcerations, superficial thrombophlebitis and post sclerotherapy Class III (34-46 mm Hg) For severe chronic venous insufficiency, marked edema and induration of skin	Reduces ambulatory venous pressure, increases venous refilling time, improves calf pump function, different stocking types accommodate different legs, dressings underneath can be changed frequently, offers mid-level compression between elastic and inelastic bandage systems	Often cannot monitor patient compliance, difficult to put on, particularly arthritics; lack of consensus on compression scales
IPC Used in those who do not respond to stockings or compression bandages Pressure is applied via a boot inflated by a machine either continuously, intermittently or in sequential cycles	Useful as a solo and adjuvant, good tolerability in mixed arteriovenous ulcers, augments venous return, improve hemodynamics, microvascular functions, enhances fibrinolysis, useful when other modalities of compression fail, stiff ankle, edema and immobile patient	Expensive, requires immobility for a few hours/day; contraindicated in congestive heart failure, inflammatory phlebitis

VLU: Venous leg ulcers, SBP: Sub bandage pressure, LSB: Long stretch bandages, IPC: Intermittent pneumatic compression, SSB: Short stretch bandages

Table 2: Comparison between elastic (LSB) and inelastic compression bandages (SSB)

Elastic/active (long stretch)	Inelastic/passive (short stretch)
Stretch provides pressure	Movement of calf muscles provide pressure
Low stiffness	High stiffness
Self-applied	Trained staff required
Daytime use only	Day and night use
Pressures are less on walking and low tolerability in resting pressures	Intermittent pressure peaks of 60-80 mm Hg during walking and tolerable resting pressure
Bandage pressure maintained for longer time	Bandage pressure reduces by 25% in first hour after application
Standing increases pressure by 8 mm Hg, less working pressures, more resting pressures	Standing increases pressure by 22 mm Hg; high working pressures, no resting pressures
Materials applied at lower tension	Material applied at higher tensions
Technique easy	Technique determines success
Contraindicated in arterial insufficiency	Can be used in moderate arterial insufficiency

LSB: Long stretch bandages, SSB: Short stretch bandages

HEAD-TO-HEAD COMPARISON BETWEEN VARIOUS MODALITIES OF COMPRESSION

Compression versus no compression/usual care/simple dressings

Various guidelines have recommended that some compression is better than no compression[12,13] (evidence level A). A Cochrane review in 2009[4] (evidence level A) compared compression with either primary dressing, noncompressive bandages and usual care that always did not include compression and concluded that venous ulcers healed faster with compression and some form of compression is better than no compression in healing VLU.

High compression versus low compression

High compression bandages provide and maintain high levels of compression pressures in the range 25-35 mm Hg at the ankle. High compression is useful for bigger legs or more active patients. They can be used over padding on their own or as part of a layered system, and should be applied in a spiral according to manufacturer's instructions. Evidence exists that high compression is better than low compression in managing VLU[4,12-15] (evidence level A).

Single component versus multicomponent bandage systems and single layer versus multilayer

Studies have emphasized the fact that multi-layering increases stiffness of bandages and increases sub bandage pressure (SBP), thereby being inelastic practically. It ensures even distribution of SBP[4,12,16] (evidence level A). SBP of 30-40 mm Hg is recommended for healing of VLU (level of evidence A). Multicomponent multilayered compression is superior to a single component, single layer compression bandage systems.

Inelastic versus elastic bandages (long stretch bandages vs. short stretch bandages)

Two studies[17,18] demonstrated superiority of inelastic bandages in healing venous ulcers and reducing VR over elastic bandages. Short stretch compression (inelastic) and Unna's boot was found to support the pump function better than a long stretch compression (elastic)[19,20] (evidence level A).

Compression stockings

Use of a Class I or II stocking in patients with chronic venous insufficiency (CVI) led to reduction in the lower leg volume of 55-70 ml[14] (evidence level C).

Stockings (single layer/two-layer) versus bandages

A Cochrane review[4] identified two trials of compression bandages versus single layer compression stocking. No difference was detected among single layer stocking when compared to paste based bandages (Evidence level A). However healing outcome was better when a two layered stocking was compared to SSB (evidence level A). A meta-analysis of eight heterogenous randomized-controlled clinical trials (RCTs) concluded that stockings are better than compression bandages. There was better impact on pain, quicker healing by 3 weeks and increased ease of use with stockings[21] (level of evidence B). Pain scores were better for compression stockings than compression bandages[4,22] (level of evidence A). A well-chosen and correctly calibrated compression stocking exerting a pressure of 35 mm Hg or more is a good alternative to bandages in healing VLU[23,24] (level of evidence B).

Compression and surgery

Multiple sources and studies have shown that selective compression enhances sclerotherapy results[25,26] (level of evidence B). A RCT compared subfascial endoscopic perforator surgery with ambulatory compression and concluded that healing rates and recurrence rates in both modalities of treatment were same. However, the study recommended a combination of both for optimal results[27] (level of evidence B).

Intermittent pneumatic compression with or without compression versus compression alone

Berliner *et al*.[28] (evidence level A) reviewed eight studies, three of which showed that compression pumps could alleviate symptoms of CVI and assist with the healing of longstanding chronic ulcerations**.** A systematic Cochrane review identified four trials of IPC + Compression versus compression alone (Unnas boot/four layer dressing/stockings)[29] (evidence level A). Only one trial showed lesser time to heal and increased rate of reduction in ulcer area, although it could not identify any difference in ulcer healing between the two groups. Further

studies are required to assess the status of IPC as alternative/adjuvant to compression and to optimize cycle times and IPC duration per day to effectively heal VLU.

Compression therapy modification in peripheral arterial disease

In patients with arterial occlusive disease (ABPI 0.6-0.8) modified compression using stiff material applied with reduced pressure (<40 mm Hg) under careful control may increase both arterial flow and venous pumping function. Compression decreases the elevated pressure within the venous system and may also increase arterial blood flow according to recent data in patients with mixed ulcers[30-35], (evidence level B).

Drawbacks of compression therapy

- Correct application of compression bandages need expertise
- Older debilitated patients with comorbidities find it difficult to use compression stockings
- Peripheral vascular compromise in patients with mixed-arterial venous ulcers with low ABPI
- Reduced compliance due to wearer discomfort.

CONCLUSION

Compression therapy is a highly effective treatment for VLU. Care should be taken while administering this therapeutic modality in case of mixed-arteriovenous ulcers. The minimum tolerable compression pressure tailored to the patient's requirement should be ensured so as to maximize compliance.

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