Compression Therapy

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Introduction

For this presentation compression is defined as:
the application of external garments
(bandages or stockings)

to the lower limb

for the purpose of managing

(treating or preventing)

oedema and its complications

Oedema

- Oedema is the accumulation of fluid in extra-vascular tissues
- Whether oedema forms or not is governed by Starling's Equation
  - The **oncotic pressure** – the pressures created by proteins across the semi-permeable membrane of capillaries
  - The **permeability of the capillary membrane**
  - The **gradient of hydrostatic and oncotic pressure** between blood and tissue

Cause and effect

Physiology	Possible cause	Effect
↑ Capillary permeability	Cellulitis, Arthritis, Cyclic hormonal	Inflammatory oedema Idiopathic oedema
↑ Venous (capillary) pressure	Heart failure, Venous insufficiency, Dependency	Cardiac oedema, Venous oedema
↑ Oncotic pressure	Lymph drainage failure	Lymphoedema
↓ Oncotic pressure	Hypoalbuminaemia, Nephrotic syndrome Hepatic failure	Hypoproteinaemic oedema

Venous oedema

- Standing venous pressure 80-100 mmHg
- Walking venous pressure 10-20 mmHg
- In a person with competent venous valves:
- Venous return accelerated by
  - Calf muscle pump
  - Foot pump
- In a person with incompetent venous valves:
  - Retrograde venous flow occurs
  - Venous pressures increase (hypertension)
  - Oedema results

Consequences of venous insufficiency

- Oedema
- Pain
- Haemosiderin staining
- Eczema
- Ulceration
  - Exudate
- Fibrosis
- Atrophie Blanche
- Depression & social isolation

Venous leg ulcers

- 55-70% of leg ulcers are due to venous hypertension
- Graduated compression therapy is recognised as a primary treatment for:
  - Venous hypertension leading to insufficiency
  - Venous leg ulcers
  - Lymphoedema
  - Some other causes of oedema

Caution!

- The cause of oedema should always be determined prior to application of compression
- Not all oedema should be treated with compression
  - Cardiac oedema
  - Hypoproteinaemic oedema (eg renal failure)
  - Autonomic neuropathic oedema (eg diabetes)
- EG compression of cardiac oedema could lead to pulmonary oedema

Compression - Physiology

- Reduces diameter of major veins
- Reduces local blood volume
- Increases cardiac pre-load and increases cardiac output by 5%
- Accelerates blood flow in microcirculation
- Reduces white cell adhesion to capillaries
- Increases tissue pressure - ↓ capillary filtration and ↑ reabsorption
- ↓ high levels of endothelial growth factor
- May influence level of free radicals

Compression - Mechanical

- Laplace's Law
- Sub bandage pressure = $\frac{\text{tension x no. layers}}{\text{circumference x width}}$

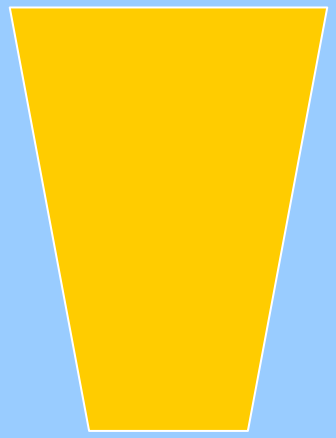
- ↑ bandage tension = ↑ sub bandage pressure
- ↑ number of layers = ↑ sub bandage pressure
- ↑ circumference = ↓ sub bandage pressure
- ↑ bandage width = ↓ sub bandage pressure

Compression in practice

Ideally, compression must be

- Graduated
- Adequate
- Sustained

- To achieve graduated compression therapy
- Ankle circumference must be less than calf
- Graduation should be gradual
- Beware of:
  - ‘Champagne bottle’ legs
  - ‘Cankles’
  - Bulky dressings



Laplace in practice

- A series of studies demonstrated that when sub-bandage pressure was measured on healthy legs under various types of compression the pressures achieved in clinical practice were not consistent with the theoretical values of Laplace's law
- In some cases they exceeded the expected theoretical values and in other cases they did not reach the expected theoretical values

Classification of compression

- Current compression ‘classes’ vary between countries
- Pressures achieved are declared by manufacturers using laboratory tests
- Simple descriptions are usually used
  - Short stretch (inelastic)
  - Long stretch (elastic)
  - Multi-layer
- However, there are now significant variations within these groups and new fabric technology

Bandage characteristics

- ‘Lock out’
  - A bandage will reach a point where it cannot be stretched any further – ‘lock out’
- Elasticity
  - The ability of a bandage to return to its original, unstretched length once tension is removed
- Power
  - The amount of force required to extend an elastic bandage to a known length
  - Will determine sub-bandage pressure

To stretch or not to stretch

Extensibility

- Bandage extensibility refers to the ability of a bandage to increase its length in response to applied force
- Depends on:
  - The characteristics of the textiles used
  - The weave of the material
- In recent years there have been advances in textile manufacture leading to new types of bandage that may not be easily classified into existing systems

The static stiffness index

- Elasticity of compression devices can be measured by its stiffness
- Stiffness is defined as the increase in pressure that occurs as the leg increases in circumference eg during walking
- The static stiffness index (SSI) is defined as the difference between the sub-bandage pressure (mmHg) when lying and standing
- SSI is useful to consider in addition to compression to assess bandage performance

Effect

Sub-bandage pressures achieved in clinical practice vary significantly depending on:

- Physical bandage structure and properties of the textiles used
- Skills and technique of the practitioner
- Bandage care and appropriate replacement
- Size and shape of the limb
- Ability of the bandage to remain in place
- Patient tolerance and interference
- Patient mobility

Short & Long stretch

- Short stretch (inelastic)
  - Do not contain elastic
  - Ideally ‘lock out’ at 30-40% stretch
  - (but some may not ‘lock out’ until 70% stretch)
  - EG Comprilan, Lastolan, Coban 2, Acrylastic
- Long stretch (elastic)
  - Contain elastic
  - Usually do not ‘lock out’ until about 140% stretch
  - EG Surepress, Setopress, Rowden foote, Tensopress

Short stretch bandages

- High working pressure & low resting pressure
- Changes to calf muscle size (during walking) results in large changes in sub-bandage pressure
- Low elasticity – do not conform well to changes in leg volume (may need frequent re-application)
- Traditionally recommended for ambulant persons
- Can be useful for increasing tolerance
- Can be useful for persons with pain or mild arterial disease (mixed leg ulcer)
- Safer bandage for novice practitioners

Long stretch bandages

- High working pressure & high resting pressure
- Changes to calf muscle size (during walking) do not result in large changes in sub-bandage pressure
- Traditionally recommended for non ambulant persons
- Can be uncomfortable at night due to high resting pressure
- Often applied with inadequate tension – low sub-bandage pressure

Multi-layer bandages

- Uses a combination of long and short stretch to provide the advantages from each
- Can be useful for ambulant & non ambulant
- Sustain pressure over time
- Good evidence base
- Comfortable
- Bulky
- EG Profore, Veno4

Vari-stretch

- Self adjusting (‘vari-stretch)
- Two component elastomer

  (hard limits stretch & soft provides stretch)
- Claims to be able to adjust the sub-bandage pressure to achieve adequate compression level even when applied between 30-70% stretch
- EG ProGuide

‘Modified’ compression

- One compression layer is omitted from a multi-layer system
  - Layer III (light long stretch) = 17-18 mmHg
  - Layer IV (cohesive short stretch) = 22-23 mmHg
  - If modified used layers 1, 2, 4 recommended
- Less tension is applied to a long stretch bandage
- Inadequate sub-bandage pressure is a common reason for failure to heal as sub-bandage pressure may be inadequate to enhance venous return to an adequate degree
- However, some compression is better than none

Stocking systems

- Multi-layer compression stocking systems
  - System designed for healing ulceration
  - Use a two layer system to achieve therapeutic compression
  - Low compression understocking – can be worn 24/7
  - Higher compression overstocking – can be removed overnight
  - Low profile
  - Washable
  - Cost effective
  - Requires low profile adhesive dressing to ulcer
  - Patient must be able to apply and remove stockings
  - EG Health Support Multi-Layer System, UlcerCare

Anti embolic stockings

- Inappropriate for management of oedema
- Indicated for prevention of DVT in the supine position
- Why?
  - Supine position only requires pressures of > 10 mmHg over the calf to reduce venous stasis
  - Upright position requires much higher pressures to influence venous return
- Anti-embolic stockings provide inadequate sustained pressure in the upright position

Tubular compression stockings

- EG Tubigrip
- Tubular compression stockings generally provide inadequate – minimally therapeutic effect for management of venous oedema
- Must be graduated
- Parallel tubular compression stockings can result in a reverse pressure gradient
  - If only parallel is available – use 2-3 different sizes to obtain compression
- Can cause damage to the tarsus area
- Need frequent replacement

Myths

- Long stretch bandages must be taken off overnight
  - Incorrect: due to their high resting pressure they can be uncomfortable overnight but there is no physiological reason for their removal
- Crepe bandages can be used as a light compression bandage
  - Incorrect: crepe bandages (and other retention bandages) deliver inadequate and unsustainable pressure
  - Crepe bandages can make an excellent tourniquet!

Myths

- Compression is only required over the ulcer
  - Incorrect: compression must be applied from the base of the toes to just below the knee & include the heel as the physiological affects of venous insufficiency include the whole leg and oedema will simply be moved above and below the bandage
- Compression is only required until the ulcer heals
  - Incorrect: unless other treatments have been undertaken, venous insufficiency is only controlled by compression – not cured. Once compression is ceased the problems return

Myths

- A normal ABPI confirms venous disease
  - Incorrect: An ABPI only assesses arterial supply. It does not assess venous patency.
- Compression cannot be applied without an ABPI
  - Incorrect: Adequate arterial supply must be confirmed prior to application of compression. However this can occur via several methods including clinical assessment (including pulse assessment), ABPI, toe pressures, or Duplex ultrasound. Where formal vascular assessment cannot be performed, clinical assessment by a skilled and trained practitioner is adequate to commence compression

Myths

- Compression cannot be commenced without a medical order
  - Incorrect: Appropriately skilled and trained practitioners of various disciplines can commence compression
  - Many medical practitioners have never received training in leg ulcer management
  - The practitioner is responsible and accountable for their actions – or lack of actions

Conclusion

- There are many different compression bandage systems on the market and new systems are being developed and released
- A chosen system must be:
  - Clinically effective
  - Cost effective
  - Easy for practitioners to use
  - Acceptable to patients