When to use inelastic compression therapy

Veith 2019

Peter J. Pappas, M.D.
Regional Medical Director
Venous and Lymphatic Program Director

Background: History

Types of Bandages

- **Elastic Stockings**
  - High interface pressure at rest. Working pressure changes little with ambulation.
  - Multiple dosing levels
  - Pressure lasts over months
  - Works well for small, uncomplicated ulcers.

- **Short Stretch, rigid bandages**
  - High working pressure and lower interface pressure than elastic stockings. Good for recalcitrant ulcers. Pressure decreases quickly over days
  - Multi-layer vs single layer

Medical & Surgical Compression

- T.E.D. Stockings
- Graduated Compression Stockings
- Circaid (Rigid Inelastic)
- Inelastic (Short-Stretch) Cotton
- Utma Boot

Elastic Bandages

**Advantages**

- Easy to apply (patient, untrained staff)
- Does rather “forgive” incorrect application
- High “resting pressure”
- Several layers increase stiffness

**Disadvantages**

- If resting pressure is too high: not well tolerated. Only option is to remove the garment
- “gives way” during walking
- Knee high garments can cut into popliteal fossa and thigh highs can create a tourniquet effect in the thighs if they roll down
- If stocking tears, garment is no longer functional
- Difficult to don and doff with large limbs
Elastic Garments: Disadvantages

Inelastic bandages

Advantages
• Pronounced action on deep veins and tissue
• High “working pressure” during walking
• Tolerated during rest because of pressure fall
• Sustained pressure (day and night)
• Ideal for lymphedema patients

Disadvantages
• Loss of pressure due to reduction of edema
• To be renewed after 2-3 days initially
• Application needs training and manual skill
• Does not “forgive” incorrect bandaging

Reduction of the calf circumference by

5cm - 5 days after compression
2cm
1cm

Indications: Elastic vs Inelastic

“Therapy phase”
• Reduction of edema
• Softening of LDS
• Healing of ulcers
• Reduction of inflammation
• Reduction of pain (phlebitis, DVT)
• Inelastic or short stretch bandages preferred

“Maintenance phase”
To keep extremity
• Free from edema
• Free from skin changes
• Ulcer-free

• Free from inflammation and pain
• Elastic material (e.g. stockings) sufficient for most cases

Elastic Garments: Advantages

• Reduces compression
• Reduces swelling

Inelastic Customizable Compression Wrap components

Reduction of the calf circumference by

Subcutaneous edema

After 5 days of compression
Edema reduction
Diehm et al; Lancet 1996

- Randomized trial (N=262)
  - Class II compression
  - Horse chestnut seed extract (HCSE)
  - Placebo
- Plethymographic volume reduction at 12 weeks
- Compression > HCSE > Placebo
- 25% mean edema volume reduction

EVRA Trial Results

<table>
<thead>
<tr>
<th>Median time to ulcer healing</th>
<th>56 days: Endovenous</th>
<th>86 days: Compression</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 Week Healing</td>
<td>65% Endovenous</td>
<td>51.6 Compression</td>
</tr>
<tr>
<td>Recurrence before one year</td>
<td>11.4% Endovenous</td>
<td>16.5% Compression</td>
</tr>
</tbody>
</table>

Conclusion

- Inelastic compression garments are best utilized when the following are needed:
  - Quick/immediate edema reduction
  - Healing venous ulcer
  - Lymphedema maintenance edema reduction
- Moderate indication
  - Inability to tolerate or don an elastic compression garment
  - Elderly and/or morbidly obese patients.
  - Arthritic patients
- Short stretch bandages need placement by a trained professional and therefore are not ideal for maintenance therapy.

Prevention of PTS
Brandjes et al Lancet, 2007

- 194 pts randomized
  - Stockings (40 mmHg)
  - No Stockings
- 5 yr follow-up
- Objective scoring system
- Mild to moderate PTS
  - Stockings - 20%
  - No stockings - 47%
- Severe PTS
  - Stockings - 15%
  - No Stockings - 27%

Circaid Devices

- Provides the highest level of leg pressures due to its rigid nature compared to other leg appliances.
- Devices are adjustable to accommodate changes in leg circumference.
- Can be managed by those unable to use stockings.
- Ideal device for wheelchair bound individuals with neurologic problems.
Physiologic Benefits of Compression

...But, is there any evidence of a clinically relevant benefit?

GRADE Recommendations
Guyatt et al, Chest 2006

<table>
<thead>
<tr>
<th>Grade</th>
<th>Benefit vs Risk</th>
<th>Methodology</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Clear</td>
<td>High quality</td>
<td>Strong recommendation, Generalizable</td>
</tr>
<tr>
<td>1B</td>
<td>Clear</td>
<td>Moderate</td>
<td>Strong Recommendation, Applies to most patients</td>
</tr>
<tr>
<td>1C</td>
<td>Clear</td>
<td>Low</td>
<td>Strong recommendation, but may change with better evidence</td>
</tr>
<tr>
<td>2A</td>
<td>Balanced</td>
<td>High quality</td>
<td>Weak recommendation, Action differs with patient/societal values</td>
</tr>
<tr>
<td>2B</td>
<td>Balanced</td>
<td>Moderate</td>
<td>Weak recommendation, Action differs with patient/societal values</td>
</tr>
<tr>
<td>2C</td>
<td>Uncertain</td>
<td>Low</td>
<td>Very weak recommendation, Alternatives equally reasonable</td>
</tr>
</tbody>
</table>

Calf Muscle Pump Function and Activity
Poterio-Filho et al, Angiology 2006

- Treadmill walking in 10 subjects
  - Barefoot
  - 7 inch stiletto heels
- Pressure changes measured with 7 cm calf cuff
- Greater pressure changes / muscular activity with heels

“the use of high heeled shoes is very popular since it brings a greater elegance to walking and posture. These persons often perceive leg edema.”

C5-6 Disease - The ESCHAR Trial
Barwell JR, Lancet 2004

- Prospective randomized trial
  - High ligation, stripping, & phlebectomy
  - Multilayer compression bandaging
- 500 patients with CEAP 5 and 6 disease
  - Isolated superficial reflux - 300 (60%)
  - Mixed superficial / deep reflux - 200 (40%)
- Endpoints
  - 24 week ulcer healing
  - 12 month ulcer recurrence

ESCHAR Trial - Ulcer Healing
Barwell JR, Lancet 2004

- 24 week ulcer healing - 65% in both groups

ESCHAR Trial - Ulcer Recurrence
Barwell JR, Lancet 2004

- 12 month freedom from recurrence (p < 0.0001)
  - Surgery + Compression - 12%
  - Compression - 28%
Varicose Veins and Quality of Life
Smith et al; J Vasc Surg 1999

• 137 patients undergoing GSV and/or SSV surgery
• Improvements in both generic & specific instruments

SF-36
p < 0.05 for mental health

AVVO
p < 0.0001

VTE Prophylaxis in Hospitalized Patients
Geerts et al, Chest 2008

<table>
<thead>
<tr>
<th>Thromboembolic Risk</th>
<th>Incidence Without Prophylaxis</th>
<th>Recommended Prophylaxis*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Minor surgery in mobile patient</td>
<td>2.0%</td>
</tr>
<tr>
<td>Moderate</td>
<td>Most general, gyn, urology patients</td>
<td>15 – 40%</td>
</tr>
<tr>
<td>High</td>
<td>Medical patients, ill or immobile</td>
<td>40 – 80%</td>
</tr>
</tbody>
</table>

* Consider mechanical prophylaxis if bleeding risk high, pharmacologic prophylaxis when risk decreases

T.E.D. Stockings
Amaragiri & Lees, Cochrane Database Syst Rev 2000

• Metaanalysis of 16 RCTs
• Group I – T.E.D. stockings vs no prophylaxis
• Group II – (T.E.D. + other modality) vs other
• Group I (7 trials, all surgical)
• DVT
  - T.E.D. – 41/322 (12.7%)
  - No prophylaxis – 66/426 (15.6%)
  - Odd ratio 0.76 (0.50 – 0.99)
• Group II (8/9 surgical trials
• DVT
  - T.E.D. + other modality – 18/108 (25.9%)
  - Other modality alone – 38/135 (28.1%)
  - Odd ratio – 0.71 (0.42 – 1.20)

Are T.E.D.s Effective in Medical Patients?
Labarere et al, J Gen Intern Med 2006

• Observational study with propensity adjustment
• 1664 non-surgical patients
• Age > 65
• Hospitalized in post acute care facilities
• Routine compression U/S at 27 days (median)
• Proximal DVT

<table>
<thead>
<tr>
<th>Stockings</th>
<th>No Stockings</th>
<th>Odds Ratio</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unadjusted</td>
<td>21/371 (5.7%)</td>
<td>49/939 (5.2%)</td>
<td>1.09 (0.64-1.84)</td>
</tr>
<tr>
<td>Propensity-Matched</td>
<td>13/240 (5.4%)</td>
<td>14/240 (5.3%)</td>
<td>0.92 (0.42-2.02)</td>
</tr>
</tbody>
</table>

Treatment of Confirmed VTE
Kearon et al; Chest 2008

• Initial short-term treatment (All Grade 1A)
  • Subcutaneous low molecular weight heparin
  • IV unfractionated heparin
  • Monitored or fixed-dose subcutaneous UFH
  • Subcutaneous fondaparinux
  • Start warfarin on day 1 at 5 - 10 mg (Grade 1A)
  • LMWH / UFH / fondaparinux at least 5 days and until INR > 2 for 24 hours (Grade 1C)
  • Warfarin for at least 3 months at INR 2.0 to 3.0 (1A)
  • Compression stockings (30-40 mm Hg) for 2 yrs (1A)

Compression & Walking in DVT
Partsch J Vasc Surg 2000

• 45 patients with US confirmed proximal DVT randomized to
  • Inelastic (short stretch) compression + walking
  • Thigh high surgical compression stockings + walking
  • No compression + bedrest
  • Walking distance on day 9
  • Short stretch compression – 4665 (± 2947) meters
  • Compression stockings – 3660 (± 2983) meters
  • Bedrest – 179 (± 161) meters
  • No difference in new PE by routine V/Q
Compression & Walking in DVT
Partsch JVasc Surg 2000

- Significant edema reduction in compression groups
- Significant pain reduction (VAS) in compression groups

Compression in Acute DVT
Roumen-Klappe EM, J Thromb Thrombolysis 2009

- 69 patients with acute DVT randomized to LMWH and
  - Bandaging (calf – short stretch; thigh – elastic)
  - No bandaging
  - Graded compression stockings in all patients at 7 – 14 days
  - No difference in PTS at 12 months (29% versus 33%)

Elastic Compression in DVT

- A critical adjunct in prevention & management of acute DVT
- Compression modalities
  - TED stockings
  - Graduated compression stockings
  - Short & long stretch bandages
- Prevention of DVT
  - Less effective than pharmacoprophylaxis in surgical patients
  - Doubtful efficacy in medical patients
- Treatment of DVT
  - Early reduction of symptoms & edema
  - 50% reduction in late post-thrombotic sequelae

Prevention of PTS
Brandjes et al Lancet, 2007

- 194 pts randomized
  - Stockings (40 mmHg)
  - No Stockings
  - 5 yr follow-up
  - Objective scoring system
  - Mild to moderate PTS
    - Stockings - 20%
    - No stockings - 47%
  - Severe PTS
    - Stockings - 15%
    - No Stockings – 27%

Why Don’t We Follow The Guidelines?
Winkowsky AK, J Thromb Thrombolys 2008

- Survey of 151 Anticoagulation Forum attendees
- Represents 22,925 DVT patients in AC clinics
- Only 17.9% of patients prescribed stockings

<table>
<thead>
<tr>
<th></th>
<th>ACC that prescribe GCS (n=28)</th>
<th>ACC that don’t prescribe GCS (n=123)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength of compression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-40 mm Hg</td>
<td>16 (57.1%)</td>
<td>12 (9.8%)</td>
</tr>
<tr>
<td>Other</td>
<td>14 (50%)</td>
<td>20 (16.3%)</td>
</tr>
<tr>
<td>0-20 mm Hg</td>
<td>5 (17.9%)</td>
<td>37 (29.8%)</td>
</tr>
<tr>
<td>Don’t Know</td>
<td>0 (0%)</td>
<td>73 (59.3%)</td>
</tr>
<tr>
<td>Duration of compression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 years</td>
<td>18 (53.6%)</td>
<td>7 (5.7%)</td>
</tr>
<tr>
<td>1 year</td>
<td>9 (25.8%)</td>
<td>30 (24%)</td>
</tr>
<tr>
<td>None</td>
<td>0 (0%)</td>
<td>13 (10.6%)</td>
</tr>
<tr>
<td>Don’t Know</td>
<td>0 (0%)</td>
<td>70 (56.9%)</td>
</tr>
</tbody>
</table>
Conclusions

• Many putative physiologic benefit to compression
• Clinically relevant benefits of compression are variable
• Grade recommendations for chronic venous disease
  – Class 5 - 6 disease
    – Ulcer healing - Grade 1A for compression
    – Ulcer recurrence - Grade 1A for surgery
  – Class 2 - 3 disease
    – Grade 2C for compression
    – Grade 1A for surgery
  – VTE prophylaxis and treatment
    – Grade 1A

... But, the evidence supports quality of life for patients with class 2 - 3 chronic venous disease intervention for ulcer healing and cost effective improvement in...

Graduated Elastic Compression Stockings

• 8-15mmHg - Thromboembolic deterrent (TED)
  • Main use is for thrombo-prophylaxis.
  • Decreases venous diameter slightly to help prevent venous over distention.
  • Designed to function in the bedridden but not ambulatory patient.
  • Seven day half life
  ◆ Not useful for swelling.

Elastic Compression Stockings

• 20-30mmHg – European class II (US class I)
  • Use for most trivial venous disorders including after sclerotherapy for spider veins.
  • Can be employed in the aged or crippled where heavier hose cannot be used.
  • Most common dose utilized in the Unites States.
  • Somewhat easier to apply than higher dose garments.

Elastic Compression Stockings

• 30-40mmHg – European class III (US class II)
  • Mainstay for the treatment of leg swelling, aching, tiredness, VTE, and those with postphlebitic syndrome.
  • Can be used as a therapeutic test to evaluate the relationship between leg symptoms and varicose veins.
  • Provides dressing and support following major venous surgery or sclerotherapy.

Elastic Compression Stockings

• 40-50mmHg – European class IV (US class III)
  • Used when grade 2 hose fail to control symptoms including recurrent ulceration.
  • Heavy rubber gloves greatly facilitate hose application and removal.
  • Difficult to use, expensive, and fabric hot. Not commonly utilized in the United States
  • Calf length effective and remain the most popular style.