

HOSIERY IN LOWER LIMB LYMPHOEDEMA

Debra Doherty, Philip Morgan, Christine Moffatt

As part of its work to establish a national provision of lymphoedema services in the UK, the Lymphoedema Framework project has developed guidelines for the use of compression hosiery in lower limb lymphoedema. The guidelines, to be presented in two parts, have drawn together existing hosiery classifications and linked a new classification with clinical descriptions of lymphoedema. This, the first paper, provides clear guidance on practical aspects such as assessment of arterial status and measurement for hosiery. The second paper, to be published in a subsequent issue of *JOL*, will explore recommendations for compression hosiery in lower limb lymphoedema and describe strategies for addressing problems that may be encountered.

Key Words

Compression hosiery
Measuring
Arterial status
Ankle brachial pressure index

Compression hosiery plays a pivotal role in the management of lymphoedema. However, systematic reviews have revealed a lack of robust evidence to support treatment decisions (Badger et al, 2004a, b, c). The Lymphoedema Framework project in the UK recognised the lack of empirical evidence and consequently adopted a rigorous consensus approach to defining best practice (Murphy et al, 1998). The recommendations that emerged for the use of compression hosiery in adults with lower limb lymphoedema, or related conditions such as phlebolymphoedema and lipoedema, form the basis of this series of papers.

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They emphasise that patients require hosiery that meets their clinical and lifestyle needs.

Compression hosiery enhances self-care and can be used in the management of all clinical stages of lower limb lymphoedema (International Society of Lymphology [ISL], 2003). Its main role is in long-term management, usually following a period of intensive treatment (skin care, exercise, multi-layer inelastic [short-stretch] lymphoedema bandaging ± manual lymphatic drainage [MLD]) (Moffatt et al, 2005). However, hosiery can also be used to prevent complications in subclinical and very early lymphoedema, and following intensive therapy with bandaging (Twycross et al, 2000).

An algorithm for decision-making in compression hosiery

The algorithm in *Figure 1* summarises the recommendations, which are patient-focused and designed to promote flexible decision-making. Importantly, they include the need to assess arterial status in order to ensure safety, particularly when high levels of compression are being considered (Royal College of Nursing [RCN], 1998). Clear clinical descriptions of the different stages of lymphoedema (British Lymphology Society [BLS], 1999) are related to recommendations for the type of hosiery to use and the role of other compression modalities.

To use the algorithm effectively, practitioners must be skilled in assessment and be able to define the type and severity of lymphoedema. Appropriate training is required to ensure skilled measurement and fitting, and an understanding of the range of hosiery and materials available (Morgan et al, 2005). Access to specialist intervention will be required for patients with severe complex lymphoedema.

Clinical factors influencing the use of compression hosiery

The suitability of compression hosiery for a patient is influenced by a number of factors (*Box 1*). Practitioners should consider these factors to ensure that garments are comfortable and offer an appropriate level of compression that helps to control swelling.

Dexterity

Application and removal of compression hosiery requires considerable dexterity and strength. The high compression hosiery that may be used in lymphoedema may be challenging.

Patients who have severe arthritis may find application and removal particularly difficult. Grossly obese patients may be unable to reach their feet, and patients with complex medical conditions, such as heart failure, may be unsuitable for hosiery because the extra exertion may exacerbate

their symptoms (acute heart failure is a contraindication to compression hosiery) (Partsch et al, 1999).

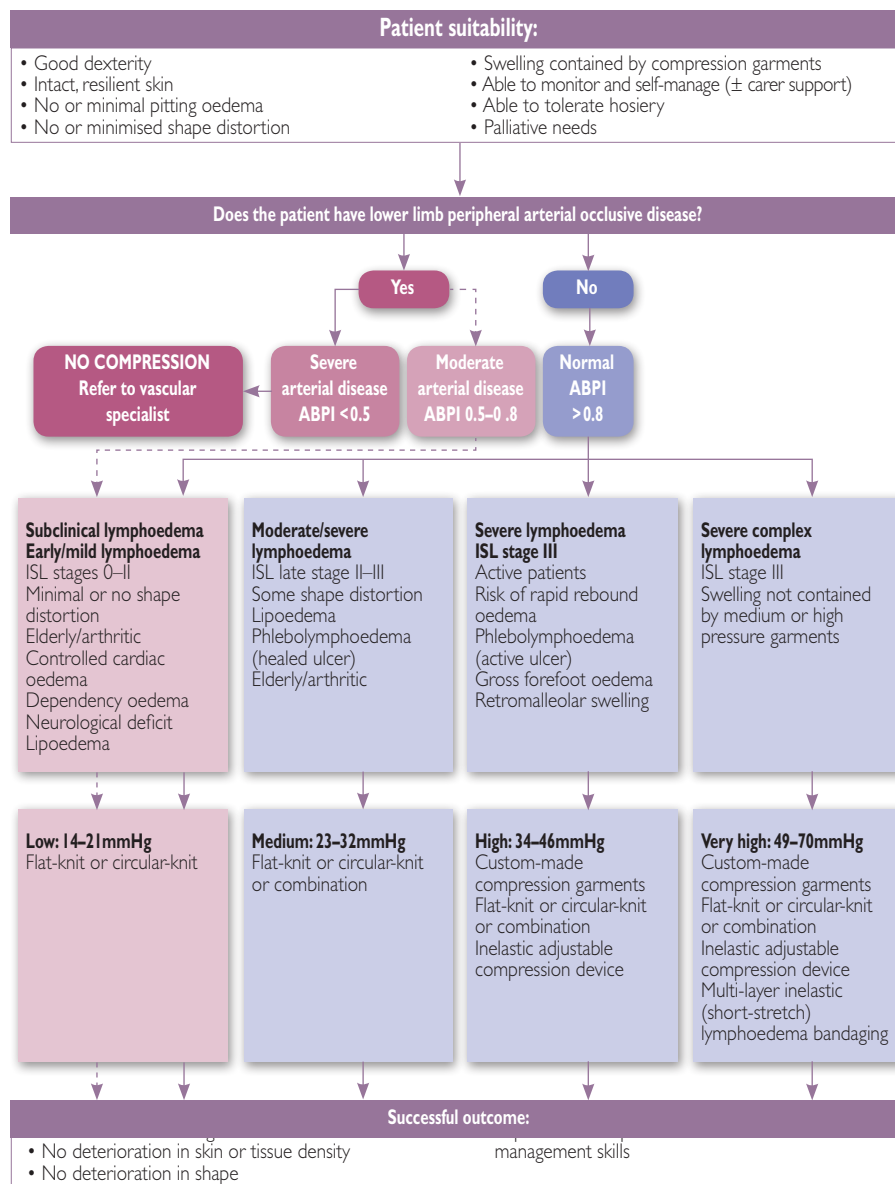
Patients may require aids to assist application or removal, and some patients may find flat-knit compression hosiery easier to apply than circular-knit. Where patients cannot manage their hosiery, carers should be taught the necessary skills and shown how to monitor limb condition. Patients who find hosiery removal difficult should be discouraged from only partially removing their garments by pulling them down to their ankles. Patients and carers should be warned that incomplete removal of hosiery can cause a tourniquet effect and tissue trauma if the garment becomes doubled over or is rolled.

Practitioners should be able to modify their choice of material, style of garment and level of pressure to overcome these issues.

Skin resilience

A common problem that may complicate the use of compression hosiery is poor skin resilience and quality. If the skin is fragile, trauma can easily occur. Skin problems including varicose eczema and lymphorrhoea can be treated by appropriate skin care regimens and the use of cotton liners beneath compression hosiery. If eczema and lymphorrhoea are severe, hosiery may be inappropriate and a period of intensive treatment involving bandaging may be required to stabilise the condition.

During an episode of cellulitis, compression hosiery is not usually tolerated. It may be possible to continue compression using reduced pressure multi-layer inelastic (short-stretch) lymphoedema bandaging (MLLB). If pain is too severe, it may be necessary to stop compression therapy. However, long periods without compression should be avoided. Once the pain and inflammation are sufficiently reduced and the patient is able to tolerate it, the usual level and/or mode of compression should be resumed.



International Society of Lymphology lymphoedema staging (ISL, 2003)				
<p>Stage 0 A subclinical state where swelling is not present despite impaired lymph transport. This stage may exist for months or years before any oedema becomes evident</p>	<p>Stage I This represents early onset of the condition where there is accumulation of tissue fluid that subsides with limb elevation. The oedema may be pitting at this stage</p>	<p>Stage II Limb elevation alone rarely reduces swelling and pitting is manifest</p>	<p>Late stage II There may or may not be pitting as tissue fibrosis is more evident</p>	<p>Stage III The tissue is hard (fibrotic) and pitting is absent. Skin changes such as thickening, hyperpigmentation, increased skin folds, fat deposits and warty overgrowths develop</p>

Figure 1. Algorithm for decision-making in compression hosiery, adapted from Földi et al, 2003. This algorithm is a guide and treatment should be tailored to the needs of the individual patient. If the patient is unable to tolerate the therapeutically indicated level of compression, lower levels of compression may be appropriate to encourage concordance with hosiery. The tolerability of high levels of compression may be enhanced by using flat-knit hosiery.

Skin sensitivity and allergy can occur in a small proportion of patients to some components within hosiery, including latex, elastane and dyes

(Cameron, 1998). Allergy can be avoided or resolved by using cotton liners to prevent direct contact with the skin or by changing to a different product.

Box 1: Patient factors influencing the suitability for compression hosiery

- Ability to manage and tolerate hosiery.
- Skin condition.
- Lymphoedema stage and severity.
- Shape, size and function of the limb.
- Patient build, eg. tall, short, obese.
- Lower limb arterial status.
- Concomitant medical conditions, eg neuropathy.
- Patient lifestyle, mobility, age and psychosocial status.
- Patient choice.

Box 2: Choosing the appropriate compression hosiery style

Toe caps

- Lymphoedema of the toes (*Figure 2*).
- Following treatment of lymphorrhoea or interdigital mycosis.
- Forefoot swelling and risk of, or presence of toe swelling.
- Tissue thickening in the forefoot — toe caps will provide additional pressure and reduce slippage of an open-toe garment up the foot.

Below knee*

- Swelling and skin changes limited to below the knee.
- Venous ulceration without thigh swelling.
- Inability to apply full-length garment.
- Obesity.

Thigh length*

- Swelling extending to thigh.
- Papillomatosis on medial aspect of thigh.
- Fat or arthritic knees (*Figure 3*).
- Limb distortion.
- If below-knee hosiery cuts into the skin and other causes, eg. inaccurate measurement, have been excluded.

Pantyhose*†

- Swelling extending to genitalia or abdomen‡.
- Full-length hosiery does not stay in place.

*Open-toe hosiery is easier to apply than closed-toe and may be sufficient for mild forefoot swelling. If toe caps are impractical and toe swelling is mild, closed-toe hosiery may be preferable to open-toe. Flat-knit is often preferred for treating swelling of the forefoot.

†Incontinent patients requiring pantyhose may benefit from flat-knit, custom-made open gusset garments.

‡Bermuda shorts may be useful in patients who have lymphoedema of the thigh secondary to an abdominal tumour without swelling of the lower leg.



Figure 2: Swelling of forefoot and toes. Treatment with toe caps and below-knee hosiery would be the preferred treatment for this patient.



Figure 3: Arthritic knees in patient with lower limb lipolymphoedema. This patient may find a two-piece combination, eg. overlapping Bermuda short-style compression garment and below-knee stockings, easier to manage. An orthopaedic knee support may help to relieve knee pain.

Poor measurement and fitting, and inappropriate choice of hosiery may lead to tissue trauma, even in patients with intact skin.

Shape distortion

Ready-made hosiery may be suitable for patients with minimal shape distortion. For patients with severe

shape distortion, a period of intensive treatment may be required to normalise shape before hosiery can be prescribed (Moffatt et al, 2005).

Most patients with shape distortion are better treated with custom-made flat-knit hosiery, which does not curl, twist or tourniquet. Flat-knit hosiery is often stiffer and so is more likely to prevent rebound oedema. Compression hosiery can be modified to accommodate shape distortion by using fillers and shaped pads under or built into the garment.

Patients with shape distortion and swelling extending into the genitalia and trunk will require specialist intervention to ensure the appropriate selection and fit of garments.

Containment of swelling by compression hosiery

In some patients, lymphoedema is not contained by compression hosiery alone, and concomitant use of therapies such as bandaging at night and MLD may be required.

The needs of the palliative patient are complex. In some cases, treatment emphasis may shift from containment of swelling to provision of comfort and improvement in quality of life. It may be necessary to use hosiery with reduced levels of compression and/or utilise alternative garments, eg. closefitting shorts with Lycra® (such as cycle or running shorts) or a shaped elasticated tubular bandage, to provide compression. Bandaging may be the preferred option for those palliative patients whose symptoms preclude the use of compression hosiery.

Ability to monitor and self-manage

Patient engagement and commitment are essential foundations for effective self-management (Barlow et al, 2002). Factors that influence self-management include beliefs about the condition and psychological factors that may affect motivation, eg. depression and anxiety. Access to social support may be of critical importance. Concordance is enhanced by appropriate patient education and affected by a number of practical issues (Rockson, 2002). Fit, style and material influence appearance,

comfort and willingness to persevere with treatment. Patients must be able to wear comfortable footwear with their hosiery to facilitate mobility.

Additional instruction, support and monitoring may be required for patients with cognitive impairment to ensure that they wear garments appropriately and that skin problems are avoided. Similarly, patients with neurological impairment (eg. stroke, spinal injury or spina bifida) and their carers need to be vigilant because warning mechanisms, such as pain, may be compromised.

Assessment should also take into consideration problems of toileting, the presence of a colostomy, and the ability of the patient to remove and reapply hosiery. Skin excoriation may occur under compression garments in patients with incontinence. Many of the hosiery needs of larger patients can be addressed by using custom-made garments. Grossly obese patients present a complex challenge in terms of fitting appropriate hosiery that they are able to apply and remove and will usually require custom-made hosiery. Pronounced skin folds can become excoriated and develop fungal infections.

Box 3: Measuring for ready-made compression hosiery

For below-knee garments:

- Take measurements in lying or standing position.
- Measure the circumference of the ankle at its smallest diameter; usually just above the malleoli.
- Measure the circumference of the calf at its greatest girth.
- For closed-toe garments: measure foot length from the tip of the big toe to the end of the heel.
- For open toe garments: measure foot length from the base of the big toe to the end of the heel.
- Measure length from heel to 2 cm below popliteal fossa to determine whether the patient requires standard, petite or longer length fitting.

For above-knee (thigh length) garments:

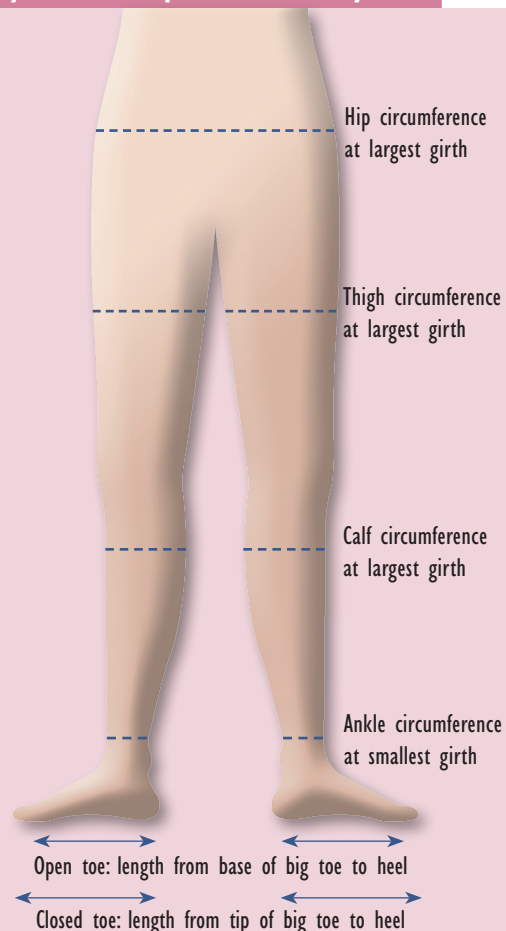
Measure as for below-knee and:

- Measure the circumference of the thigh at its greatest girth.
- Measure length from heel to where garment is to finish to determine which hosiery length is required.

For pantyhose:

Measure as for below-knee and above-knee and:

- Measure circumference of hips at their greatest girth.



Box 4: Measuring for custom-made compression hosiery

For below-knee garments:

- Take measurements in lying or standing position.
- For open-toe garments: measure length from the base of the big toe to the end of the heel along the side of the foot.
- For slanted-toe garments: also measure length from the base of the little toe to the end of the heel along the side of the foot.
- For closed-toe garments: measure length from the tip of the big toe to the end of the heel along the side of the foot.
- Measure circumference A around the base of the toes.
- Measure circumference H around the instep and heel when the foot is dorsiflexed. If the patient is unable to dorsiflex, measure H and add 1 cm.
- With the foot against the floor or a measurement board, measure circumference B at 2 cm above the medial malleolus.
- Measure length a-B (from heel to B).
- Measure circumference B1 where the calf starts to widen, and measure length a-B1.
- Measure circumference C and length a-C at the widest girth of the calf.
- Measure circumference D at 2 cm (two finger widths) below the knee cap and length a-D.

For above-knee (thigh length) garments:

Measure as for below-knee garments and:

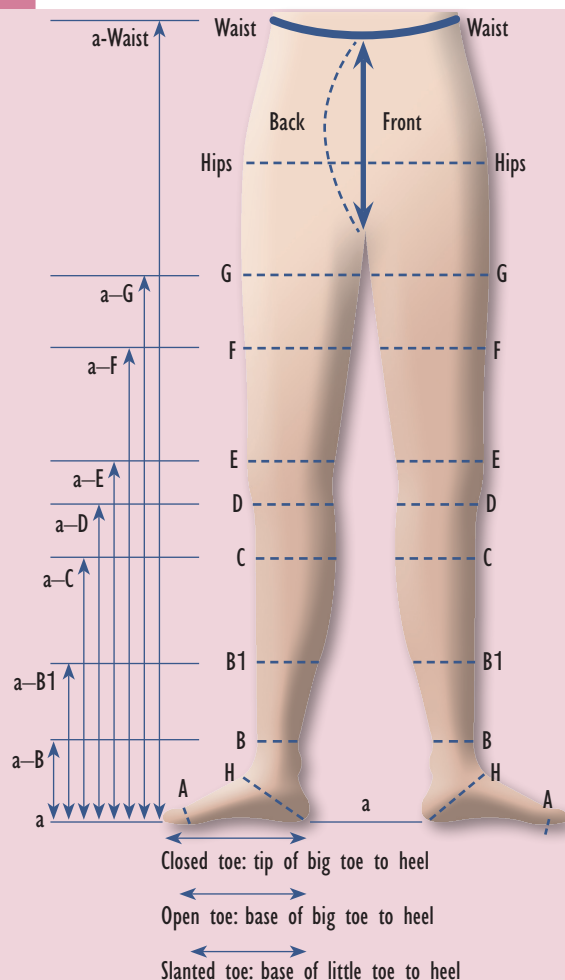
- Measure length a-E to the middle of the knee cap with the leg extended.
- Measure circumference E over the knee with the leg slightly bent.
- Ask the patient to stand if possible.
- Measure circumference F at mid-thigh and measure length a-F.
- Measure circumference at maximum thigh girth (G).
- Measure length from a to 2 cm below the gluteal fold (G) for thigh-length garments.

For pantyhose:

Measure as for below-knee and above-knee garments and:

- Measure length a to 2 cm below the gluteal fold (G).
- Ask the patient to put their hands on their waistline. Measure length from a to the waistline.
- Measure waist circumference.
- Measure greatest circumference around the hips.
- Measure length in the centre at the front from waist to crotch. If the abdomen is soft, apply gentle pressure to this area during measurement to mimic the action of the garment.
- Measure length at the back from the waist over the buttocks to the gluteal fold while applying gentle pressure.

NB: Unless specified, length measurements should be longitudinal and should not follow body contours.

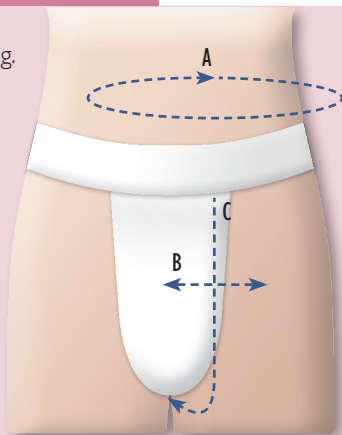


After measurement, bandaging should be continued until the time of garment fitting, otherwise rebound oedema can occur; sometimes within a few hours of discontinuation.

It is essential that practitioners are fully trained in measurement and fitting and have the relevant clinical experience. Specialist advice and measurement is required in patients with limb distortion or swelling involving the abdomen and the external genitalia.

Box 5: Measuring for scrotal support garments

- If possible, measure while the patient is standing.
- Ask patient to indicate on the waist where they want the scrotal support waistband to sit.
- Measure circumference A of the waist at this point.
- Measure circumference B at the widest part of the scrotum.
- Measure length C from indicated waistband position over the scrotum to the perineum.

**Box 6: Recording ankle brachial pressure index (ABPI)**

Recording an ABPI is essential to ensure that patients with lower limb peripheral arterial occlusive disease are identified: high compression in these patients may cause tissue ischaemia and result in amputation. However, the reliability of recordings in patients with lymphoedema is unknown and clinical judgement should be used in determining a patient's suitability for a particular level of compression.

The lower resting pressure of flat-knit hosiery may be preferable in patients with lower limb peripheral arterial occlusive disease (Marston and Vowden, 2003).

- **ABPI >0.8:** High compression (34–46 mmHg) is considered safe for ABPI >0.8. Very high compression (49–70 mmHg) may be used in selected patients with ABPI >0.8 (Burns *et al*, 2003). However, patients should be encouraged to monitor their limb for signs of ischaemia such as altered sensation or colour, or pain. If there is any concern about the patient's arterial status, high and very high compression should not be commenced without specialist clarification.
- **ABPI 0.5–0.8:** Compression hosiery can be used in moderate peripheral arterial occlusive disease (ABPI 0.5–0.8). Reduced levels of compression will be required and will be significantly influenced by the patient's tolerance of compression. Rigorous monitoring is required to detect symptoms of ischaemia — these patients have established occlusive arterial disease that can deteriorate rapidly. Compression up to 21 mmHg can be considered in this group.
- **ABPI <0.5:** Compression therapy should not be applied to patients with ABPI <0.5 because it may exacerbate tissue ischaemia; all patients should be referred for a vascular assessment and monitoring. Very low levels of compression may be used in some of these patients under close vascular supervision.

Ability to tolerate compression hosiery

An individual's willingness and ability to tolerate therapeutic levels of compression should be considered and garment choice modified when necessary.

Assessment of the general health status of the patient is integral to decision-making (Mortimer and Levick, 2004). Compression hosiery moves fluid from the peripheral circulation to the central circulation, and may

precipitate decompensated heart failure in patients with cardiac oedema (Partsch, 2003).

Measurement for hosiery

Accurate measurement is essential for correct garment fit and optimal patient comfort. Badly fitting hosiery may not contain the lymphoedema, may cause tissue damage, may be uncomfortable and poorly tolerated, and may dissuade the patient from wearing hosiery long-term.

Boxes 3–5 provide a guide to measuring for compression hosiery. Careful attention should be paid to the measuring instructions of the manufacturers from which garments are ordered. Measurement must be performed by those who are adequately qualified, including lymphoedema practitioners, specialist pharmacists or orthotists.

The type of hosiery prescribed will be strongly influenced by the site and extent of the swelling, but must also consider the patient's comfort, lifestyle, preferences and ability to apply and remove garments. Patients may require a range of garments to wear in different situations.

Ready- or custom-made hosiery?

Once full assessment has indicated the need for hosiery, the appropriate style (Box 2) and type of hosiery should be determined. Patients with complex lower limb and torso lymphoedema will often require custom-made garments. In general, custom-made flat-knit hosiery may be required when there is severe shape distortion, when different levels of pressure are required within the same garment at different anatomical sites, or when special adaptations are required.

Flat-knit hosiery may be easier to apply than circular-knit, and where layers of hosiery are to be combined, application may be aided by using a flat-knit garment next to the skin with a circular-knit garment on top. Patients may express a preference, eg. for a particular garment style, for the more open weave of flat-knit

Box 7: Measuring toe brachial pressure index (TBPI)

Note: TBPI should only be performed when ABPI is not possible. See Vowden and Vowden (2001) for a description of how to perform ABPI.

- Lie the patient as flat as possible for 15–20 minutes and explain the procedure.
- Place the appropriate size sphygmomanometer cuff around the arm and apply gel over the brachial pulse.
- Move the Doppler probe over the brachial pulse until a good signal is obtained.
- Inflate the cuff until the signal disappears, then gradually deflate until the signal returns. This is the brachial systolic pressure. Repeat.
- Repeat using the other arm and record the highest of the four brachial readings (the highest brachial reading is used to calculate the TBPI for both legs).
- Place an appropriately sized toe cuff around the base of the big toe.
- Apply gel and locate the digital artery using the Doppler probe.
- Inflate the cuff until the signal disappears, then gradually deflate until the signal returns. This is the toe systolic pressure.
- Repeat the process and record the highest of the readings.
- Repeat to measure the highest toe systolic pressure in the other leg.



Calculate TBPI for each leg:

$$\text{TBPI} = \frac{\text{highest toe systolic reading for that leg}}{\text{highest brachial systolic reading}}$$

TBPI <0.64 indicates the presence of lower limb peripheral arterial occlusive disease.

garments in hot weather; or for the more aesthetically acceptable thinner material of circular-knit garments. Therapists should take patient preference into consideration when determining optimal therapy, while encouraging patients to have the most appropriate treatment.

When to measure

Measurement for hosiery should take place when any intensive therapy has been completed and the limb is in the best possible condition, with

stable limb volume and minimal or no residual pitting oedema. If soft pitting oedema is present, treatment with compression bandaging is advisable before garment measuring (Moffatt et al, 2005). The skin needs to be robust enough to withstand garment application and removal.

After measurement bandaging should be continued until the time of garment fitting, otherwise rebound oedema can occur, sometimes within a few hours of discontinuation.

For patients already wearing compression hosiery, measurement should take place:

- ▶ Prior to garment renewal to ensure that the correct size of garment is being prescribed and that deterioration is not occurring
- ▶ If the patient is moving from ready-made garments to custom-made garments or vice versa
- ▶ If a different style of garment is required
- ▶ If adaptations to the hosiery are required or a different garment pressure is required.

Overcoming practical difficulties

Measurement can be difficult in patients with complex lower limb lymphoedema who are often immobile and obese.

In the clinic situation, measurement of the limb can be performed with the patient lying on a couch or standing. Where possible, use of a measuring board is recommended.

Patients who are wheelchair bound can be measured with their legs in a dependent position. However, if a thigh-length garment is required, measurement on a couch is recommended.

The tension applied by the practitioner to the tape during measurement for compression hosiery will be influenced by the therapeutic effect desired, the age of the patient, the ability of the patient to tolerate compression and the patient's peripheral arterial blood supply.

Assessment of arterial status

The first decision within the algorithm concerns the patient's arterial status, and aids the practitioner in choosing a safe and appropriate level of compression for the stage and severity of lymphoedema.

Palpation of pedal pulses is very difficult in lymphoedema and is also a poor predictor of arterial status (Moffatt and O'Hare, 1995). Assessment of arterial status should

use Doppler ultrasound to determine ankle to brachial pressure index (ABPI) (Box 6). Recording ankle pressures may be difficult to achieve in patients with severe lymphoedema. A larger cuff size and change of Doppler probe to a lower frequency may enable measurement (Vowden and Vowden, 2001).

In patients with diabetes mellitus or where there is considerable oedema and/or tissue thickening (fibrosis), ABPI may produce unreliable readings; toe brachial pressure index (TBPI) may provide a more accurate evaluation of the patient's peripheral arterial status (Box 7). In some centres, duplex scanning or plethysmography may be used.

At present, the prevalence of peripheral arterial occlusive disease in patients with lymphoedema remains unknown. However, since prevalence rises with increasing age and many patients are asymptomatic (Burns et al, 2003), it is likely that some older patients will have a degree of concurrent arterial impairment. Assessment of peripheral arterial status is therefore of particular importance in older patients being assessed for compression hosiery.

The recommendations used in the algorithm (Figure 1) reflect international guidelines on the use of compression in patients with varying degrees of peripheral arterial occlusive disease (Marston and Vowden, 2003).

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Key points

- ▶▶ Compression therapy plays a pivotal role in the management of lymphoedema.
- ▶▶ The suitability of compression hosiery for a patient is influenced by a number of factors.
- ▶▶ Accurate measurement is essential for correct garment fit and optimal patient comfort.
- ▶▶ After measurement, bandaging should be continued until the time of garment fitting, otherwise rebound oedema can occur, sometimes within a few hours of discontinuation.