Queensland Health lymphoedema clinical practice guideline 2014

The use of compression in the management of adults with lymphoedema

Queensland Health lymphoedema clinical practice guideline 2014

Published by the State of Queensland (Queensland Health), March 2014

For more information contact:
Allied Health Professions' Office of Queensland Department of Health, GPO Box 48, Brisbane QLD 4001, email Allied_Health_Advisory@health.qld.gov.au, phone 07 3328 9298.

An electronic version of this document is available at www.health.qld.gov.au

Contents

Figures

Tables

Appendices

1. Summary

The purpose of this clinical practice guideline (CPG) is to provide practical, evidence-based recommendations for the use of compression therapy to treat lymphoedema in adults. The recommendations should be implemented, subject to clinical reasoning by the clinician, with consideration of the person's individual factors.

This guideline is for use by occupational therapists, physiotherapists and registered nurses—in particular, 'new' lymphoedema-trained clinicians.

This CPG does not replace the need for any clinician providing lymphoedema therapy to complete an appropriate lymphoedema training course.

1.1 Lymphoedema

Lymphoedema is a chronic, progressive, high-protein form of oedema resulting from an abnormality in the lymphatic system.[1] Lymphoedema is commonly defined as swelling or accumulation of fluid (lymph) containing protein, water and cell debris in the tissue space due to an imbalance between interstitial fluid production and transport capacity.[2,3] Földi and Földi describe lymphoedema as a 'chronic inflammatory lymphostatic disease caused by mechanical failure of the lymphatic system' which can affect all regions of the body.[1(p224)]

A four-stage system used to classify lymphoedema in terms of skin condition and degree of swelling is shown in Table 1.

Table 1 Lymphoedema staging

Stage	Signs and symptoms
Stage 0	A subclinical state where swelling is not present despite impaired lymph transport. This stage may pre-exist before any oedema becomes evident.
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 in this stage.
Stage II	Limb elevation alone rarely reduces swelling and pitting is manifest.
Late stage II	There may or may not be pitting as tissue fibrosis is more evident.
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.

Adapted from International Society of Lymphology (2009).

Lymphoedema is classified as primary or secondary (acquired) depending on the aetiology. These classifications are described in more detail below.

1.1.1 Primary lymphoedema

Primary lymphoedema results from congenital abnormality or malformation of the lymphatic system and is associated with one or a combination of the following:

- dysplasia—malformation of the lymphatics
- hypoplasia—number and/or diameter of lymph collectors is below normal
- hyperplasia—higher number of lymph collectors than normal and tortuous like varicose veins.[1]

1.1.2 Secondary lymphoedema

Secondary or acquired lymphoedema results from obstruction, damage or mechanical insufficiency of the lymphatic system which may result from a number of causes. These are outlined in Table 2.

Table 2 Classification of causes of secondary lymphoedema

Classification	Example
Trauma and tissue damage	• surgical removal of lymph nodes and vessels • radiotherapy to lymph nodes and vessels • varicose vein surgery/harvesting • other surgical procedures to the affected limb • severe burns • large and/or circumferential wounds • significant scarring (deep or circumferential) • compound fractures or extensive soft tissue injuries
Venous disease	• chronic venous insufficiency • venous ulceration • post-thrombotic syndrome (can occur following venous thromboembolism) • intravenous drug use
Malignant disease	• lymph node metastases • infiltrative carcinoma • lymphoma • pressure from large tumours (note: may be new or previously detected)
Infection	• fungal • bacterial— cellulitis/erysipelas, lymphadenitis • parasitic—filariasis (transmitted by mosquito bites) and other insect/spider bites • tuberculosis
Inflammation	• psoriatic arthritis • rheumatoid arthritis • dermatitis/eczema • sarcoidosis and oro-facial granulomatosis • podoconosis/lymphonoditis (silicates) • pretibial myxoedema (rare endocrine disease)

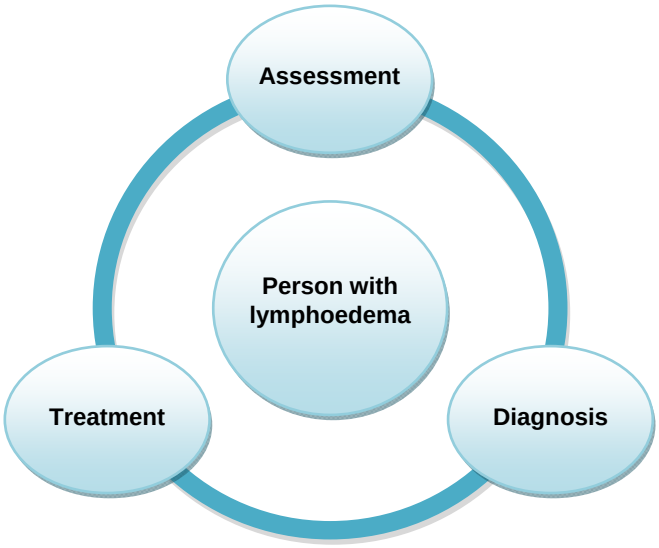
Immobility/dependency	• severe/chronic dependency oedema • morbid obesity • paralysis
Factitious/artificial lymphoedema	• self harm (self-mutilation)

Source: Lymphoedema Framework (2006), Clinical Resource Efficiency Support Team (2008).

1.2 Lymphoedema management

The diagnosis and assessment of a person with lymphoedema should be holistic in its approach and encompass any physical, functional or psychosocial issues a person may be facing. A complete initial assessment of a person with lymphoedema includes obtaining a history, conducting a physical examination, determining the staging of the condition, measuring the severity of the oedema and arranging or interpreting diagnostic tests to confirm a diagnosis if appropriate.

Figure 1 Lymphoedema management



The measurement of the severity of lymphoedema is an essential component of any treatment regimen and is important for determining treatment programs and documenting outcomes. Treatment outcomes should be routinely reported in a standardised manner throughout treatment.

The *Lymphoedema Framework International Consensus* defines best practice management of lymphoedema as being holistic and multidisciplinary.[3]

There are many treatment modalities available for lymphoedema management. Some common techniques used by lymphoedema trained nursing and allied health professionals within Queensland Health include:

- manual lymphatic drainage (MLD)—use of specific massage techniques which mobilise the skin and stimulate the lymphatic system[3,4]
- self lymphatic drainage—self-administered version of MLD[3]
- lymphoedema compression bandaging (LCB)—specialist bandaging technique where short-stretch bandages are applied in multiple layers in combination with other products[3]

- compression garments—firm fitting custom made or ready to wear garments that are designed to provide compression to a limb or body part usually for long term management[3]
- intermittent pneumatic compression (IPC)—a form of compression therapy that utilises an electrical air compression pump[3]
- exercise—specific exercises designed to enhance the efficiency of the muscle pump and increase lymph circulation[3]
- skin care—a skin care regimen involving meticulous hygiene, regular moisturising, protection of skin and early identification and management of skin infections[3]
- education—verbal and written information about lymphoedema and its management.[3]

This guideline aims to focus on compression therapy for established lymphoedema. For the purposes of this CPG, compression therapy includes compression bandaging, compression garments and IPC. Compression therapy is used across all phases of lymphoedema treatment.

1.3 Contraindications for compression

Contraindications for compression include:

- severe arterial insufficiency*
- uncontrolled heart failure
- severe peripheral neuropathy.[3,5,6]

*Prior to commencing lower limb compression, a comprehensive vascular assessment is recommended to rule out any underlying arterial insufficiency.[7]

Vascular assessment may involve a review of subjective symptoms, palpation of pulses and/or measurement of ankle brachial pressure index (ABPI). However, palpation of pulses can be unreliable and the use of an ABPI is considered to be a more reliable predictor of arterial status.[8] The ABPI should be performed by a trained health professional and repeated as clinically indicated and as per local guidelines. An ABPI between 0.8 and 1.2 is usually considered indicative of good arterial flow in the absence of other clinical indicators for arterial disease.[6] An ABPI below or above this range requires further assessment as it may indicate that compression is not appropriate. People wearing compression should be taught to monitor their limb/s for signs of ischaemia, including altered sensation, colour or pain.[7]

1.4 Caution to all forms of compression

Though not contraindicated, caution is advised when compression is used with people who have the conditions listed below:

- an ABPI less than 0.8 or greater than 1.2 [6]
- high arterial blood pressure[5]
- cardiac arrhythmia or cardiac stenosis[5]

- controlled heart failure[3]
- scleroderma[5]
- chronic polyarthritis[5]
- complex regional pain syndrome[5]
- malignant lymphoedema[3]
- acute cellulitis/erysipelas[3]
- diabetes mellitus [3]
- paralysis[3]
- sensory deficit[3]
- fragile or damaged skin.[3]

Clinical reasoning and careful monitoring is recommended when these complications arise. For example, with controlled heart failure it is important to consider the haemodynamic effects of compression as fluid is shifted from the limb to the trunk and alters the circulating fluid volume in the body. Light compression may be tolerated with careful monitoring.[7] For patients with cellulitis, compression may be applied after the commencement of antibiotics and as tolerated by the person.[9]

In addition, the following good practice points (GPPs) are advised:

GPP Medical advice should be sought prior to using compression for people with a low platelet count <75 x 10^9/L due to the potential for tissue trauma.

GPP If the person undergoing lymphoedema treatment is also undergoing chemotherapy, the clinician must protect themselves by adhering to cytotoxic precautions.

Assessment and clinical reasoning are required for everyone to determine the appropriate compression. Where compression is required for people with any of the above clinical conditions, advice should be sought from an advanced lymphoedema practitioner to assist with clinical reasoning.

GPP Education including indications and wearing regimen should always occur before commencement of compression use. This will assist the person to commit to and prepare for the challenges of compression wear.

GPP People undergoing compression therapy should be educated about monitoring and precautions to encourage self-reporting of any pain and changes in circulation.

1.5 Summary of key findings

The following table highlights recommendations and GPPs supporting the effectiveness of compression in the management of adults with lymphoedema in the Queensland health clinical setting.

Table 3 Effectiveness of compression

	Recommendations/Good practice points	Section
Compression bandaging	As part of combined treatment programs, LCB is more effective at reducing upper limb lymphoedema volume than: • compression garments • Kinesiotape • 'standard' bandaging, elevation and exercise.	2.4
	No significant difference in volume reduction was identified between LCB application with high and low sub-bandage pressures in breast cancer related lymphoedema (BCRL). However, low pressure (20–30mmHg) bandaging may be better tolerated than high pressure bandaging (44–58mmHg).	2.7.4
	GPP If there is no limb volume reduction during the first week of intensive therapy, treatment should be re-evaluated to determine the cause of this unexpected result and to modify the treatment program accordingly.	2.8.1
	GPP LCB should not be commenced without availability of a compression garment and consideration of a person's intent and ability to wear the garment required for sustained treatment success.	2.9
Compression garments	No recommendations as the evidence does not meet the requirements for inclusion	
	GPP People with a high proportion of lymphoedema related adipose tissue in their lymphoedematous limb may benefit from compression garments to prevent further deterioration of their condition.	3.8.1
	GPP Each person requires appropriate and well-fitting garments determined by clinical assessment.	3.10
	GPP Compression garments should maintain the volume reduction achieved in the initial management phase.	3.14.1
	GPP Limb volumes may take up to 6–12 months to stabilise.	3.14.1
	GPP Garments may need to be replaced more frequently when changes in limb size or body weight occur causing the garment to become ill-fitting.	3.14.5
Intermittent pneumatic compression	IPC can be effective as part of a combined lymphoedema treatment program for reducing BCRL in the short term, up to two months post treatment.	4.4
	IPC can reduce limb volume in BCRL irrespective of the number of chambers and the cycle time used.	4.7.1
	GPP Extreme limb deformity may impede correct use of IPC and therefore other treatment modalities should be considered.	4.6
	GPP IPC should be used with other modalities and not as a stand-alone treatment, in order to enhance its effectiveness.	4.7.2
	GPP IPC should only be used after the person's trunk has been prepared with MLD or use of modern IPC devices that clear the trunk.	4.7.2
	GPP The therapist should adjust the duration and pressure intensity of IPC in order to target therapeutic goals.	4.7.1
	GPP If there is no limb volume reduction during the first week of intensive therapy, treatment should be re-evaluated to determine the cause of this unexpected result and to modify the treatment program accordingly.	4.7.2

2. Compression bandaging

Compression bandaging is a common treatment for people with lymphoedema. Short-stretch bandages are primarily used for this treatment. Short-stretch bandages exert pressure that increases when movement causes muscles to contract.[10] They have an extensibility of less than 100 per cent and are applied in multiple layers, in combination with other products. When effective, lymphoedema compression bandaging (LCB) reduces swelling to enable functional movement, without causing tissue damage, allergy or altered sensation.[11]

2.1 Aims

The aims of LCB include:

- correcting limb distortion
- reducing limb size/volume
- reversing tissue changes
- improving skin condition
- managing skin exudate.[11,12]

2.2 Mechanism of action

There is limited research evidence to explain the precise mechanism of action of compression bandaging. However, the following mechanisms have been proposed:

- reduction in capillary filtration
- shift of fluid into non-compressed parts of the body
- increase in lymphatic reabsorption and stimulation of lymphatic transport
- improvement in the venous pump in people with veno-lymphatic dysfunction
- breakdown of fibrosclerotic tissue.[13]

2.3 Common indications

Common indications for compression bandaging are:

- moderate to severe lymphoedema (20–40 per cent excess volume)
- distorted limb shape
- lymphorrhoea/broken skin
- subcutaneous tissue thickening.[12]

2.4 Effectiveness

LCB is a common treatment used to reduce limb volume in people with lymphoedema. LCB is often incorporated into a treatment program with a number of other modalities and consequently its efficacy in isolation is difficult to determine. However, when combined with other treatment modalities, LCB has been shown to be an effective treatment.

Badger, Peacock and Mortimer[14] conducted a randomised controlled trial (RCT) (n=83) examining the effect of compression bandaging compared with compression garments in people with upper and lower limb lymphoedema (greater than 20 per cent excess volume). The treatment group received 18 days of daily compression bandaging followed by compression garments whilst the control group received only compression garments. The treatment with compression bandaging was significantly more effective at reducing limb volume when compared with garments alone ($p<0.001$) at 12 and 24 weeks.[14]

Tsai, Hung, Yang, Huang and Tsauo[15] conducted a RCT (n=42) examining the effect of compression bandages as part of a multimodal treatment program for people with moderate to severe (greater than 20 per cent excess volume) unilateral breast cancer-related lymphoedema (BCRL) of more than three months duration. All participants had a four week period of no treatment followed by prescribed treatments, five days per week for four weeks. The treatment group received Kinesiotape plus standard care involving skin care, manual lymphatic drainage (MLD), intermittent pneumatic compression (IPC) and exercise. The control group received compression bandaging plus standard care. The control group (LCB and standard care) had a significantly greater volume reduction ($p<0.05$) at four weeks compared with the treatment group (Kinesiotape and standard care).[15]

Didem, Ufuk, Serdar and Zumre[16] conducted a RCT (n=53) examining the effects of two different treatment programs for people with unilateral BCRL. The treatment group received MLD, LCB, exercises and skin care whilst the control group received standard care with 'standard' bandaging (not defined), elevation and exercises. Treatments were provided three days per week for four weeks plus a home program. The mean volume reduction was significantly higher ($p<0.05$) in the treatment group (with LCB) compared with the control group ('standard' bandaging).[16]

Recommendation

As part of combined treatment programs LCB is more effective at reducing upper limb lymphoedema volume than:

- compression garments[14]
- Kinesiotape[15]
- 'standard' bandaging, elevation and exercise.[16]

2.5 Contraindications

General contraindications for compression include:

- severe arterial insufficiency*
- uncontrolled heart failure
- severe peripheral neuropathy.[3,5,6]

*Prior to commencing lower limb compression, a comprehensive vascular assessment is recommended to rule out any underlying arterial insufficiency.[7]

Vascular assessment may involve a review of subjective symptoms, palpation of pulses and/or measurement of ankle brachial pressure index (ABPI). However, palpation of pulses can be unreliable and the use of an ABPI is considered to be a more reliable predictor of arterial status.[8] The ABPI should be performed by a trained health professional and repeated as clinically indicated and as per local guidelines. An ABPI between 0.8 and 1.2 is usually considered indicative of good arterial flow in the absence of other clinical indicators for arterial disease.[6] An ABPI below or above this range requires further assessment as it may indicate that compression is not appropriate. People wearing compression should be taught to monitor their limb/s for signs of ischaemia, including altered sensation, colour or pain.[7]

2.6 Caution

Though not contraindicated, caution is advised when compression is used with people who have the conditions listed below:

- an ABPI less than 0.8 or greater than 1.2 [6]
- high arterial blood pressure[5]
- cardiac arrhythmia or cardiac stenosis[5]
- controlled heart failure[3]
- scleroderma[5]
- chronic polyarthritis[5]
- complex regional pain syndrome[5]
- malignant lymphoedema[3]
- acute cellulitis/erysipelas[3]
- diabetes mellitus[3]
- paralysis[3]
- sensory deficit[3]
- fragile or damaged skin.[3]

Clinical reasoning and careful monitoring is recommended when these complications arise. For example, with controlled heart failure it is important to consider the haemodynamic effects of compression as fluid is shifted from the limb to the trunk and alters the circulating fluid volume in the body. Light compression may be tolerated with careful monitoring.[7] For patients with cellulitis, compression may be applied after the commencement of antibiotics and as tolerated by the person.[9]

In addition, the following good practice points (GPPs) are advised:

GPP Medical advice should be sought prior to using compression for people with a low platelet count <75 x 10^9L due to the potential for tissue trauma.

GPP If the person undergoing lymphoedema treatment is also undergoing chemotherapy, the clinician must protect themselves by adhering to cytotoxic precautions.

Assessment and clinical reasoning are required for everyone to determine the appropriate compression. Where compression is required for people with any of the

above clinical conditions, advice should be sought from an advanced lymphoedema practitioner to assist with clinical reasoning.

GPP People undergoing bandaging should be educated about monitoring and precautions to encourage self-reporting of any pain and changes in circulation whilst wearing compression bandages.

GPP People undergoing LCB should be educated about the expected treatment regimen before commencement of bandaging. Education will assist the person to commit to the duration of bandaging and prepare for the challenges of treatment.

2.7 Sub-bandage pressures

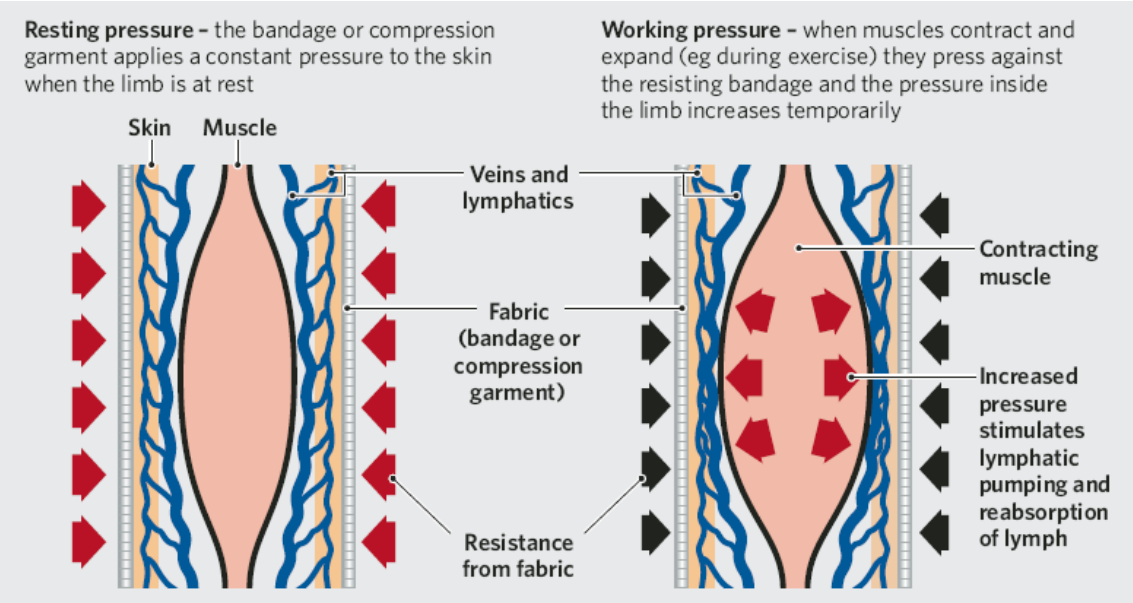
The efficacy of LCB is determined by the amount of pressure under the bandage (sub-bandage pressure). The sub-bandage pressure is influenced by the resting pressure, working pressure, elasticity of the application and the pressure at which it is applied.

2.7.1 Resting and working pressure

The short-stretch bandages which are commonly used in LCB have low extensibility. They exert high working pressure and low resting pressure.[3,13]

> Resting pressure is the constant pressure externally applied by the bandage.[5(p565)]
>
> Working pressure is temporary pressure that is generated internally in the muscle and that also affects the deeper tissues.[5(p566)]

Figure 2 Resting and working pressures



Reprinted with permission: Lymphoedema Framework (2006).

The advantage of using bandages with high working and low resting pressures is that they are usually well tolerated by the wearer. When compared with long-stretch bandaging, relatively higher working pressures are produced by short-stretch bandaging during muscle contraction. These forces are transmitted into the limb to soften fibrotic tissue and facilitate movement of fluid.[17] The relatively lower resting

pressure of short-stretch bandages, when compared with long-stretch bandages improves tolerance of compression and helps to minimise circulatory compromise.[5,17]

2.7.2 Bandage elasticity

The static stiffness index (SSI) of a bandage describes its resistance to the deformation caused by a change in limb circumference.[18] The SSI explains the performance of a bandage when transitioning between supine (resting) and standing (working) positions. When a limb changes circumference moving from supine to standing position, a bandage with high SSI will resist deformation and will maintain its original shape. The higher the SSI of a bandage, the greater the pressure increase exerted upon the limb when standing. In general, compression materials that have a high SSI combine high working pressure during standing and walking with a relatively low and tolerable resting pressure when lying.[19] Pascal's law determines how a bandage with a high SSI applies pressure to a limb.

> Pascal's law states that, when there is an increase in pressure at any point in a contained fluid, there is an equal increase at every other point in the container.[20(p431)]

In other words, in a compression system with a high SSI the movement of muscles creates pressure that is evenly distributed throughout the area of the limb under compression.[20]

The SSI of a bandage system can be described using the PLACE system:

- **P**ressure equals
- **LA**yers of the bandage applied
- **C**omponents of the bandage system—this factor considers the functions of different materials e.g. padding, protection and spot pressure.
- **E**lastic properties—this describes the effect of all combined materials on the resting and working pressures. The elastic properties of a bandage system can be affected by many factors. If multiple layers of materials are used, the friction between the layers will result in an end product that has a higher SSI and is less elastic than the individual components. Adhesive or cohesive layers (which affix to themselves) will also increase the stiffness of a bandage.[19]

New bandaging systems are emerging to address the recommendation for an increased SSI compared with traditional short-stretch bandages. For example multi-layer compression systems are available where short-stretch bandages are used in combination with adhesive or cohesive bandages. These layering systems aim to increase the rigidity of the LCB and as such, the systems exhibit higher working pressures.[13]

Long-stretch bandages are rarely used as a primary treatment modality in lymphoedema but may be used in combination with short-stretch bandages to increase the SSI of an application.[5] One study has examined the use of semi-rigid alginate bandages on weekends as an alternative to short-stretch bandages during a four week course of treatment. Short-stretch bandages can soften over a weekend causing re-accumulation of oedema. Semi-rigid alginate bandages were found to resist fluid re-

accumulation over a weekend more effectively than short-stretch bandages however alginate bandages have not been investigated as a primary treatment to date.[21]

2.7.3 Tailoring bandage pressure to a limb

The pressure a bandage exerts is determined by three principle factors:

- the tension in the fabric
- the number of layers applied
- the degree of curvature of the limb.[11]

The relationship between these three factors is determined by the Law of Laplace. The Law of Laplace states that the pressure applied by a bandage is directly proportional to the tension of the bandage and is inversely proportional to the size of the limb to which it is applied.[22]

Law of Laplace:

$$\text{Pressure} = \frac{\text{Tension (tension of the bandage)}}{\text{Radius (radius of the limb)}}$$

Compression bandaging should be applied with a pressure gradient which steadily decreases from the distal to proximal end of the limb to prevent pooling of fluid.[5] Using the Law of Laplace, if bandages are applied at the same tension on a limb where circumference increases from distal to proximal, the pressure will be higher distally and lower proximally creating the desired pressure gradient. The ideal shape of a limb for LCB is a cylindrical shape in cross section and a conical shape along the length of the limb.[22]

If a limb is an irregular shape, a graduated compression gradient can be achieved by:

- the use of padding to obtain a more desired shape
- changing the tension of the bandage
- varying the number of layers used.[22]

Using the Law of Laplace, bandaging compression forces are usually evenly distributed around the circumference of the limb. However, in practice, additional pressure may be applied to specific locations. This pressure is achieved by the use of higher density products e.g. stasis pads behind malleoli.[5] Conversely, irregularities such as bony prominences require padding to ensure protection from higher pressures. Padding of irregularities can be achieved with the use of low density products e.g. low density foam.

2.7.4 Amount of pressure applied by lymphoedema compression bandaging

The optimal pressures of compression bandaging have not been identified.[13] Research has indicated that in upper limb BCRL, lower sub-bandage pressures (20–30mmHg) appear to be better tolerated than higher sub-bandage pressures (44–58mmHg) with no significant difference in effectiveness after 24 hours wear.[23] The evidence for

specific levels of compression required for LCB in people with lower limb lymphoedema is not as strong; however, relatively higher levels of pressure are usually indicated when compared with upper limb LCB.[24]

Lower or reduced pressures are used in the long term treatment phase, for night bandaging or in people with palliative conditions.[3] All bandages lose pressure after application and with repeated use.[5] Damstra and Partsch[23] examined the reduction in sub-bandage pressures in people with upper limb lymphoedema and found 41–48 per cent reduction in pressure two hours after bandage application and 55–63 per cent reduction in pressure 24 hours after bandage application. A bandage applied in a figure of eight pattern produces approximately 1.5–2 times the pressure than the same bandage applied in a spiral pattern with a 50 per cent overlap.[25]

Recommendation

No significant difference in volume reduction was identified between LCB application with high and low sub-bandage pressures in BCRL. However, low pressure (20–30mmHg) bandaging may be better tolerated than high pressure bandaging (44–58mmHg).[23]

2.8 Lymphoedema compression bandaging treatment programs

LCB is used in the following lymphoedema treatment programs:

2.8.1 Lymphoedema compression bandaging in intensive therapy

During intensive therapy phase a combination of treatments (skin care, MLD, exercise and LCB) is undertaken daily. The frequency of treatment and the degree of compression are adapted for each person depending on the severity of their lymphoedema.[3,12] The greatest volume reduction is usually seen in the first week of LCB treatment.[12] However, intensive treatment is commonly carried out over a period of 2–4 weeks to allow reductions to continue and then stabilise. LCB is commonly applied to the whole affected limb.[11] If only part of the limb is bandaged, the bandage must extend beyond the area of swelling and may need to include the knee or elbow to prevent movement of fluid into these joints.[11] Pressures greater than 45mmHg are commonly used to bandage the lower limb.[3,12]

GPP If there is no limb volume reduction during the first week of intensive therapy, treatment should be re-evaluated to determine the cause of this unexpected result and to modify the treatment program accordingly.

Standard intensive therapy can be modified in terms of the level of compression applied and frequency of application.

- Level of compression—Conditions commonly requiring reduced bandage pressure include mild arterial disease, neurological deficits, lipoedema, palliative conditions or

lymphoedema in those who are frail or elderly. The oedema reduction achieved with modified intensive therapy may be slower. Standard intensive therapy can be modified to reduce the bandage pressure so treatment is better tolerated.[12]

- Frequency of application—Concurrent medical, mobility or transport issues may limit people from attending daily treatment sessions. Treatments may then be reduced to less frequent sessions such as second daily. Cohesive or adhesive bandages may be required to prevent the bandage from slipping between visits. More frequent visits may be required during the first week of treatment when the oedema loss is greatest.[12]

2.8.2 Lymphoedema compression bandaging in the transition phase

The transition phase aims to consolidate the effects of the intensive treatment phase, to maintain oedema reduction, and to ease the person into the long term management phase. During this phase a combination of LCB and compression garments may be required to reduce fluctuations and prevent swelling from recurring i.e. rebound swelling.[12]

GPP A transition phase may also be instituted to balance resource needs with volume reduction maintenance whilst awaiting delivery of a compression garment.

During the transition phase the use of therapy-led treatments should gradually decrease and the use of self-management strategies should gradually increase. Treatments used in this phase may include LCB and/or compression garment, skin care, self lymphatic drainage, exercise, MLD and IPC.[3,12]

2.8.3 Lymphoedema compression bandaging in long term management

In the long term management phase the focus of control is moved from the clinician to the person with lymphoedema.[3] Compression garments are the primary compression modality used in the long term management phase. Ongoing LCB may be required in the longer term with people who have:

- swelling reduction not maintained by other treatments
- fragile or ulcerated skin
- difficulty tolerating or applying compression garments
- swelling in end of life palliative conditions.[12]

Service availability may limit the capacity for long term bandaging. If ongoing bandaging is required, self or carer bandaging can be taught where appropriate.[11]

GPP Prior to commencing self/carer bandaging it is important to consider the person/carer's functional capabilities:

- Do they have the physical dexterity required to apply bandaging?
- Do they have a clear understanding of the technique involved?
- Have they demonstrated adequate skills in application?

2.9 Therapy considerations

Prior to commencing any treatment program, a comprehensive assessment is required. The assessment should examine the type and severity of lymphoedema to identify an appropriate treatment program.[12] Additionally, the assessment should review the social and psychological factors of the person to determine if the treatment program is appropriate for the individual.[12] People undergoing LCB require individual assessment and monitoring as each person's response to compression may vary.[3]

If a person is deemed to be appropriate for LCB, their commitment to treatment must be established to ensure they are willing/able to participate. Any course of LCB should not be undertaken without planning and consideration of individual factors and the requirements of therapy. A compression garment is usually required to maintain volume reduction after LCB.[3]

GPP A person's ability to access a relevant treatment facility needs to be considered prior to commencement of a bandaging regimen as multiple visits will be required.

GPP LCB should not be commenced without availability of a compression garment and consideration of a person's intent and ability to wear the garment required for sustained treatment success.

2.9.1 Response to treatment

Clinicians need to monitor individual responses to compression and adapt the treatment regimen accordingly as people differ in their ability to tolerate compression. While some respond well and report no difficulties, others report poor tolerance and skin irritations.[3]

GPP Clinicians should check circulation and capillary refill prior to commencement of bandaging and again once the bandaging application is complete. The capillary refill time after bandaging should be the same as the capillary refill time prior to bandaging and/or less than three seconds to refill.

GPP Clinicians should advise people undergoing bandaging to remove bandages and contact the clinician if changes to colour, temperature and sensation occur (e.g. numbness, pins and needles) to avoid long term damage to circulation or tissues.

GPP Clinicians should educate people undergoing LCB about the following potential challenges with LCB:

- difficulty with personal hygiene
- difficulty performing functional tasks
- restrictions on clothing choices
- restrictions when mobilising (particularly on stairs)
- pelvic floor symptoms (e.g. increased urinary frequency).

2.9.2 Skin protection

Given the humid environment in Queensland, particular attention needs to be paid to skin condition when bandaging. A cotton tubular liner should be used under the bandages and/or padding to protect the skin and to absorb moisture. In cases of

extreme heat or humidity, additional layers of liner or thicker terry towelling style liners can be used.[5]

GPP In humid environments such as Queensland, clinicians should monitor for skin irritation and/or fungal infections that can occur with excessive sweating under LCB.

2.9.3 Driving

Given the functional limitations when wearing bandages, there are additional considerations for drivers undergoing LCB. Queensland drivers must ensure accordance with Queensland Transport medical condition reporting at all times (www.tmr.qld.gov.au/Licensing/Medical-condition-reporting.aspx).

GPP Clinicians should recommend people undergoing lower limb LCB do not drive a manual vehicle. However, if only their left lower limb is bandaged, the person may be able to drive an automatic vehicle.

GPP Clinicians should recommend people undergoing upper limb LCB do not drive as bandages may impair their ability to drive safely.

2.9.4 Psychosocial

People with lymphoedema may experience adverse psychosocial effects associated with their condition.[3] Where lymphoedema is cancer-related, it can be a persistent reminder of the person's cancer. Lymphoedema treatment is time intensive and presents a difficult commitment for many people while the heaviness and physical presence of an enlarged limb can exacerbate body image issues.

GPP If a person is undergoing LCB for the first time, clinicians should consider bandaging only half the limb on the first day and/or decrease the tension of the bandage to enable the person to adapt to wearing bandages.

2.10 Resources required for lymphoedema compression bandaging

LCB requires a number of components.[3,5] Traditional short-stretch bandaging requires the following products:

- moisturising product to protect and hydrate the skin
- non-compressive tubular bandage as a liner to protect the skin underneath the bandages and to absorb moisture
- padding to improve comfort and limb shaping. Padding may take the form of cotton or synthetic wadding, foam bandages or foam sheets.
- dense foam or other materials to apply local spot pressure where required
- bandages including combinations of finger or toe bandages, short-stretch bandages and/or cohesive or adhesive bandages
- tape to secure bandages.

If an alternative compression bandaging system is used, sufficient kits to complete the treatment course will be required as recommended by the manufacturer.

GPP Two sets of bandages are required for daily treatment to allow for washing, drying and wear.

GPP Clinicians should ensure appropriate privacy is available for treatment to be provided with confidentiality and consideration of the need for the person to undress for treatment.

GPP Health facilities should provide access to bathing facilities to ensure adequate limb hygiene between bandaging applications.

2.11 Training required for lymphoedema compression bandaging

Appropriate training is required for clinicians undertaking LCB.[3,12] Specialist level training is recommended when using LCB for people with severe lymphoedema, extensive skin changes, skin sacs or lobes, medical co-morbidities or lymphoedema of the head, neck, breast or genitals.[3,26]

Within Queensland Health, appropriate training is described as:

GPP All clinicians applying limb LCB are recommended to have level one lymphoedema training with additional continuing professional development as outlined by the National Lymphoedema Practitioner Register (www.lymphoedema.org.au). This professional development will assist the clinician with complex problem solving and/or the ability to respond to changes in clinical presentation throughout the treatment course.

GPP Level two training and/or access to an experienced level two trained clinician is recommended for complex problem solving when using LCB for people with severe lymphoedema, extensive skin changes, skin sacs or lobes, midline oedema or medical co-morbidities.

2.12 Summary of recommendations

As part of a combined treatment program, LCB at high or low pressure is effective at reducing upper limb lymphoedema volume. There is no strong research examining the effect of lower limb LCB.

Refer to Table 4 for a summary of the evidence used to develop these recommendations for LCB.

Table 4 Summary of evidence for recommendations for compression bandaging

Level of evidence	Author	Year	Design	Country	N	Treatment	Control	Randomisation	Blinding	Follow up	Result	Limitations	Outcomes
II high risk of bias	Didem	2005	RCT	Turkey	n=53, female, BCRL, unilateral lymphoedema more than 2–5 cm difference in total limb circumference for more than one year	Complex decongestive therapy including: • MLD • LCB • remedial exercises • skin care. Three days/week for four weeks plus home program	Standard physiotherapy including: • bandage • elevation • head, neck, shoulder exercises. Three days/week for four weeks plus home program (LCB and 'bandage' details not reported)	Cards in unmarked envelopes	Participants blinded	Four weeks	Primary outcome addressed volume reduction. The mean reduction in oedema was significantly higher (p<0.05) in the treatment group (55.7%) than the control (39.6%).	Raw scores, confidence intervals were not presented and there was limited explanation of the difference between 'compression bandage' in the treatment group and 'standard bandage' in the standard physiotherapy group.	As part of a comprehensive treatment program, LCB can reduce mild to moderate lymphoedema when compared with standard physiotherapy alone.
II low risk of bias	Damstra and Partsch	2009	RCT	Netherlands	n=36, female unilateral moderate to severe (more than 20% difference) BCRL more than one year post treatment	Low bandage pressure—short-stretch bandages applied with low interface pressure (20–30mmHg)	High bandage pressure—bandages applied with high interface pressure (44–58mmHg)	Sealed envelopes	Assessors blinded	2 hours and 24 hours	Primary outcome addressed volume reduction. Volume reductions were achieved in both groups. After 2 hours low pressure group lost 104.5mL (51.2, 184.2) p<0.001 and 217mL (143.9, 280.2) p<0.01 after 24 hours. The high pressure group lost 56.5mL (-2.7, -123.1) p>0.05 after two hours and 167.5mL (105.2, 316.1) p<0.01 after 24 hours. No significant differences between groups at 2 or 24 hours.	Short study period (2 and 24 hours). Did not achieve desired sample size recommended by power calculation	High and low pressure LCB applied for 24 hours significantly reduced limb volume when compared to baseline however there was no significant difference between the two groups of people with BCRL at 2 or 24 hours. Lower pressures were better tolerated by patients.

II moderate risk of bias	Tsai	2009	RCT	Taiwan	n=42, female, moderate to severe difference at any circumferential point, unilateral BCRL more than three months.	Four weeks no treatment, then: • Kinesiotape • skin care • MLD (30 min) • IPC (1 hour) • exercise (20 min). Two hours five days/week for four weeks then garment	Four weeks no treatment then: • compression bandage • skin care • MLD (30 min) • IPC (1 hour) • exercise (20 min). Two hours five days/week for four weeks then garment	Sealed envelopes	Assessor blinded	Three months	Primary outcome addressed reduction in volume and circumference. From the start of treatment (second evaluation) to the end of treatment (the three month evaluation) the treatment group (Kinesiotape) did not have a significant reduction in volume (34.1mL p>0.05). The control group (bandage) had a significant reduction in limb volume (85.9mL p<0.05). Both groups increased their average volume (Kinesiotape 3.0mL; bandage group 22.6mL) between the end of treatment and the fourth evaluation (three months) however the increases were not significant.	No group comparison data was provided. Study was underpowered as the desired sample size was not reached. Minimal details are provided about treatment and adherence in the follow up period.	LCB, skin care, MLD, IPC and exercise was more effective than, Kinesiotape, skin care, MLD, IPC and exercise in reducing limb volume and total limb circumference in people with BCRL when applied for four weeks (five days/week).
II high risk of bias	Badger	2000	RCT	UK	n=83, male and female, unilateral upper limb and lower limb lymphoedema more than 12 months post treatment with more than 20% excess volume	Compression bandaging daily for 18 days, followed by garment (total time 24 weeks).	Garment alone plus standard care (total time 24 weeks).	Centralised phone system	Not reported	24 weeks	Primary outcome addressed reduction in limb volume. The treatment group had a greater reduction in limb volume than the control group. There was a highly significant difference in mean reduction in limb volume between groups overall (mean 14.8%, *p*=0.001) and at 12 weeks (mean 15.2%, p=<0.001) and 24 weeks (mean 15.5%, p=0.001)	Minimal details are provided about treatment instructions and adherence in the follow up period	18 days of LCB followed by garment wear for 24 weeks was significantly more effective than garment wear alone in reducing limb volume in patients with more than 20% volume difference.

3. Compression garments

Compression garments are an integral component of lymphoedema management in every stage of treatment from risk minimisation to early development and long term management.[27] Achieving well fitting, effective garments to manage lymphoedema is imperative, yet at times challenging.

Along with considerations of the physical characteristics of the lymphoedema, clinicians treating lymphoedema need to consider the following factors regarding the use of compression garments:

- co-morbidities[3,7]
- preferences, comfort and lifestyle of people with lymphoedema[3,7]
- the ability of people with lymphoedema and/or their carers to don and doff garments[3,7]
- psychosocial needs of people with lymphoedema.[3,7,28]

3.1 Aims

The aims of wearing compression garments include:

- controlling swelling
- maintaining volume reduction achieved after intensive therapy
- long term management of lymphoedema
- minimising impact from high risk activities that potentially overload the lymphatic system.[3]

3.2 Mechanism of action

Compression garments function by creating external pressure therefore increasing interstitial pressure in the limb. The effects of this pressure are to:

- encourage movement of fluid from compressed areas into uncompressed areas
- improve lymph reabsorption through stimulating lymphatic contractions
- break down fibrotic tissue in combination with movement
- enhance the action of the venous muscle pump
- improve tissue fluid drainage.[27,29]

Although the above mechanisms of action for compression garments have been well documented, further studies are required to definitively explore the physiological and structural effects of compression garments in lymphoedema.[30]

3.3 Common indications

Multiple factors need to be considered when determining whether compression garments are suitable for people with lymphoedema. Compression garments are suitable for people who have:

- swelling that can be controlled with compression garments[3]
- normal limb shape or minimal shape distortion.[3,7] However, some limb shape distortion can be overcome by the use of custom made garments[7, 31] or by intensive therapy prior to garment prescription[12]
- no or minimal pitting oedema. Where pitting oedema exists, intensive therapy may be required prior to garment prescription[3,7]
- adequate dexterity to don and doff garments[3,7]
- intact, resilient skin[3,7]
- willingness and ability to cope with the daily wearing of garments with or without the support of a carer[3,7,31]
- the ability and motivation to actively engage in self-monitoring[3,7] and risk minimisation with or without carer support[3]
- palliative needs which require symptom based management.[3,7]

3.4 Effectiveness

Compression garments are widely accepted as an important component of lymphoedema management,[27] however only low level evidence exists to support their use. Therefore, in this clinical practice guideline, no recommendations have been made for the use of compression garments but the findings from the studies below can be used to support clinical practice.

Badger, Peacock and Mortimer[14] conducted a randomised controlled trial (RCT) (n=83) examining the effect of compression bandaging compared with compression garments in people with upper and lower limb lymphoedema (greater than 20 per cent excess volume). The treatment group received 18 days of daily compression bandaging followed by compression garments whilst the control group received only compression garments. The treatment with compression bandaging was significantly more effective at reducing limb volume when compared with garments alone (p<0.001) at 12 and 24 weeks. The volume reduction was also maintained with garments alone over the six months of follow up.[14]

A RCT (n=42) by Andersen, Hojris, Erlandsen and Andersen[32] assessed the effect of manual lymphatic drainage (MLD) in addition to standard care. Standard care included daytime garment wear utilising reducing sizes of ready to wear (RTW) garments followed by the prescription of a custom made garment plus education regarding exercise, skin care and safety precautions. Results showed the wearing of reducing sizes of RTW compression garments during daytime hours for one month can significantly reduce (p<0.001) lymphoedema volume in patients with breast cancer-related lymphoedema (BCRL) and be maintained over the 12 months of follow up time.[32]

Irdesel and Kahraman (2007) conducted a small RCT (n=19) to investigate the efficacy of compression garments in addition to an exercise program in women with BCRL.[33] During a period of six months both the intervention and control groups completed upper limb exercises which included light resistance exercises, pulley exercises and stretches. Additionally the intervention group wore a compression garment of 40mmHg through waking hours. Although the small sample size did not allow statistical analysis, results indicated the combination of exercise therapy and a compression garment of

40mmHg, worn daily for six months, was more effective in reducing wrist and forearm circumference than exercise alone in the treatment of BCRL.[33]

3.5 Contraindications

General contraindications for compression include:

- severe arterial insufficiency*
- uncontrolled heart failure
- severe peripheral neuropathy.[3,5,6]

*Prior to commencing lower limb compression, a comprehensive vascular assessment is recommended to rule out any underlying arterial insufficiency.[7]

Vascular assessment may involve a review of subjective symptoms, palpation of pulses and/or measurement of ankle brachial pressure index (ABPI). However, palpation of pulses can be unreliable and the use of an ABPI is considered to be a more reliable predictor of arterial status.[8] The ABPI should be performed by a trained health professional and repeated as clinically indicated and as per local guidelines. An ABPI between 0.8 and 1.2 is usually considered indicative of good arterial flow in the absence of other clinical indicators for arterial disease.[6] An ABPI below or above this range requires further assessment as it may indicate that compression is not appropriate. People wearing compression should be taught to monitor their limb/s for signs of ischaemia, including altered sensation, colour or pain.[7]

The Lymphoedema Framework[3] lists additional contraindications specific to the use of compression garments:

- extreme limb shape distortion
- very deep skin folds
- lymphorrhoea or other weeping skin conditions
- extensive ulceration.[3]

3.6 Caution

Though not contraindicated, caution is advised when compression is used with people who have the conditions listed below:

- an ABPI less than 0.8 or greater than 1.2 [6]
- high arterial blood pressure[5]
- cardiac arrhythmia or cardiac stenosis[5]
- controlled heart failure[3]
- scleroderma[5]
- chronic polyarthritis[5]
- complex regional pain syndrome[5]
- malignant lymphoedema[3]
- acute cellulitis/erysipelas[3]
- diabetes mellitus[3]

- paralysis[3]
- sensory deficit[3]
- fragile or damaged skin.[3]

Clinical reasoning and careful monitoring is recommended when these complications arise. For example, with controlled heart failure it is important to consider the haemodynamic effects of compression as fluid is shifted from the limb to the trunk and alters the circulating fluid volume in the body. Light compression may be tolerated with careful monitoring.[7] For patients with cellulitis, compression may be applied after the commencement of antibiotics and as tolerated by the person.[9]

In addition, the following good practice points (GPP) are advised:

GPP Medical advice should be sought prior to using compression for people with a low platelet count <75 x 10^9/L due to the potential for tissue trauma.

GPP If the person undergoing lymphoedema treatment is also undergoing chemotherapy, the clinician must protect themselves by adhering to cytotoxic precautions.

Assessment and clinical reasoning are required for everyone to determine the appropriate compression. Where compression is required for people with any of the above clinical conditions, advice should be sought from an advanced lymphoedema practitioner to assist with clinical reasoning.

GPP Education including indications and wearing regimen should always occur before commencement of compression garment use. This will assist the person to commit to and prepare for the challenges of garment wear.

GPP People wearing compression garments should be educated about garment monitoring and precautions to encourage self-reporting of any pain and changes in circulation whilst wearing compression garments.

3.7 Compression garment characteristics

Compression garments are available in a wide variety of designs, fabrics and compression levels. It is important to understand the science of compression therapy and the technical aspects of garment construction in order to optimise garment prescription. An appreciation of the complex needs of people with lymphoedema and a flexible approach is required to provide garments which fit well, are comfortable and effective.[34]

Compression garments can be categorised according to their:

- manufacturing method
  - knitting technique
  - cut and sew
- elasticity
- fitting options.

3.7.1 Manufacturing method

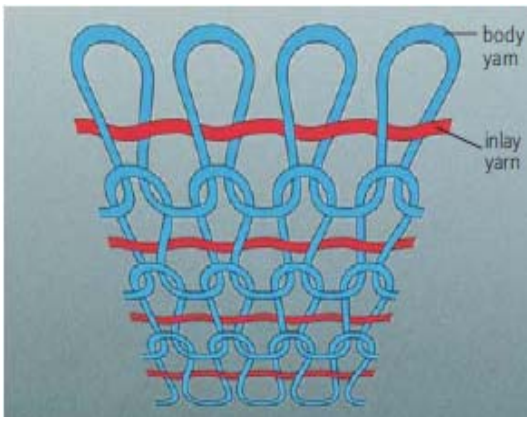
Garments used in lymphoedema management are commonly flat or circular knit. Their longitudinal and transverse elasticity is achieved by using two yarns in the knitting process. The compression is achieved by the type of yarn and the knitting technique used.[5,35]

The fabric for compression garments is produced by knitting two yarn systems together:

- body yarn creates the thickness and stiffness of the fabric
- inlay yarn provides the level of compression.

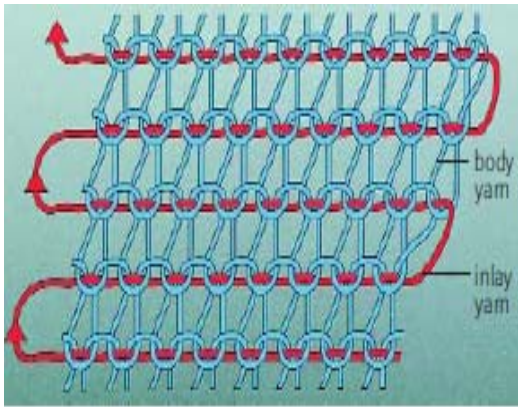
Both yarns are fabricated using an elastic core which is covered by either polyamide or cotton. By adjusting these wrappings the thickness, stiffness and compression levels can be influenced.[35] Refer to Figure 3 and Figure 4.

Figure 3 Inlay and body yarn in a circular knit garment



Source: Clark, M and Krimmel, G (2006).

Figure 4 Inlay and body yarn in a flat knit garment



Source: Clark, M and Krimmel, G (2006).

3.7.1.1 Knitting techniques

Flat knit garment construction utilises:

- thicker yarn and fewer needles per inch producing a coarser material.[3,35] The thicker fabric 'is better at bridging skin folds and is less likely to cut in or cause a tourniquet effect'.[35(p3)]
- variations in the number of needles altering the knitting process by adding/removing stitches to change the width and shape of the overall garment. This accommodates for shape distortion.[35]
- a seam whereby the flat knitted piece of fabric is stitched together to form the final garment.[3,35]

Figure 5 Flat knit below knee garment before sewing

Source: Clark, M and Krimmel, G (2006).

Circular knit garment construction utilises:

- yarns that are machine knitted into a tubular seamless garment.[3,35]
- a consistent number of needles throughout the knitting process. Variations for size and shape are made by altering the stitch height and tension of the inlay yarn. There is less accommodation for severe limb shape distortion.[5,35]
- a finer finish which is often more cosmetically acceptable to the wearer.[3,35]
- thinner material compared to flat knit garments, conforming easily to the shape of the limb. Where skin folds exist, circular knit garments may cut into the limb, particularly when worn for prolonged periods.[7,35]

Figure 6 Circular knit below knee garment

Source: Clark, M and Krimmel, G (2006).

3.7.1.2 Cut and sew

Compression garments can also be made of lycra, cut into a pattern and sewn into the required shape. The compression content of these garments is based on the weight of the lycra and the size of the pattern produced. Suppliers of these garments should provide information regarding fabric composition and expected levels of compression.

GPP Cut and sew garments are available as RTW and custom made garments, however they are not commonly used for lymphoedema management due to their relatively lower compression levels and higher elasticity i.e. lower static stiffness index (SSI), refer to section 3.7.2. An advantage of prescribing cut and sew garments is they can be used for challenging co-morbidities such as flaccid paralysis, palliative conditions, limb contractures and deformities through modifications such as inserts, panels, zips and pockets.

3.7.2 Elasticity

The pressures exerted by compression garments at rest or at work are determined by the stiffness of the garment. SSI is the increase in interface pressure (pressure produced by a compression system on the skin's surface) that occurs from lying down to standing up.[18,27] For further details, refer to Section 2.7.2.

The higher SSI in inelastic compression systems—such as short-stretch garments or flat knit garments—results in a higher working and lower resting pressure which is most effective for lymphoedema treatment. Conversely, long stretch garments—such as some circular knit and/or lycra garments—are more elastic and tend to exert a lower working and higher resting pressure which might not be tolerated as comfortably by the wearer.[5,27]

3.7.3 Fitting options

A person's clinical presentation will dictate the need for either custom made or RTW garments. Flat knit, circular knit and cut and sew garments are available in custom or RTW sizes. Custom made garments are made to the specific measurements of the person while RTW garments are pre-made to standard sizing specifications.[3]

3.8 Compression garment use in lymphoedema treatment

Compression garments are widely accepted as an important part of lymphoedema management.[27] The role of compression garments in the management of lymphoedema extends from early intervention to treatment and long term management.[3]

3.8.1 Initial management

Compression garments can be used in the initial management phase for people with:

- mild upper or lower limb lymphoedema
- no or minimal pitting
- minimal subcutaneous tissue changes
- no shape distortion
- palliative needs.[3,7]

People with these clinical features may not have a need for intensive therapy.

GPP If a person with lymphoedema is suspected to have an increased proportion of adipose tissue it is imperative to diagnose this (i.e. with pitting tests and medical investigations such as ultrasound). When a high proportion of adipose tissue exists in the lymphoedematous limb, the overall volume reduction will be less than expected because there is less fluid. Realistic goal setting with these people is important.

GPP People with a high proportion of lymphoedema related adipose tissue in their lymphoedematous limb may benefit from compression garments to prevent further deterioration of their condition.

3.8.2 Intensive therapy

Intensive therapy does not commonly involve the use of compression garments. It includes a number of modalities such as skin care, MLD, exercise and lymphoedema compression bandaging (LCB) to reduce limb volume. Planning for intensive therapy needs to incorporate long term management with compression garments after completion of bandaging as cessation of compression may cause rapid return of oedema volume.[7,36]

GPP Prior to commencement of intensive therapy, the person needs to be committed to 23 out of 24 hours per day of garment wear.

GPP Compression garments may be of some benefit even if intensive treatment is not able to be performed.

3.8.3 Transition phase

The transition phase aims to consolidate the effects of the intensive therapy phase, maintain oedema reduction and ease the person into the long term management phase.[12] During this phase, a combination of LCB and compression garments may be required to reduce fluctuations of lymphoedema and prevent rebound swelling.[7,12] Other interventions used in this phase may include skin care, exercise, MLD, self lymphatic drainage and intermittent pneumatic compression provided with clinician support and guidance.[3,12]

GPP A transition phase may be instituted to balance resource needs with volume reduction maintenance whilst awaiting delivery of a compression garment.

Treatment in the transition phase should aim to gradually decrease the use of clinician-led treatments and increase the use of self-management skills.

If pitting oedema, shape distortion and fluctuations in lymphoedema persist, continued bandaging may be more appropriate than compression garments.[3] Service constraints such as resource limitations must also be considered during this treatment phase.

3.8.4 Long term management

The aim of this phase is to ensure that limb volume reduction can be maintained with the acquired self-management skills. Clinician input should be reduced to monitoring during this phase.

Garments are the primary form of compression used in this phase of lymphoedema management, often after a period of intensive therapy.[3,12] The ability for compression garments to maintain the gains made by intensive treatment relies on the appropriate choice of garment and the adherence of the person to the wearing regimen.[4]

3.9 Determining compression levels for garments

3.9.1 Physical properties of the garment

Compression levels for garments are determined by garment properties and need to be tailored to the stage of lymphoedema. Yarn, knitting type (tension) and the size and shape of the limb to which it is applied (radius) should be considered as per the Law of Laplace.[22] The level of compression can also be influenced by the activity of the wearer.

Law of Laplace:

$$\text{Pressure} = \frac{\text{Tension (garment construction)}}{\text{Radius (radius of the limb)}}$$

The compression levels of garments are rated according to various national standards (refer to Table 5) and ‘cover parameters such as testing methods, yarn specification,

compression gradient and durability'.[35(p3)] Existing standards are only established for lower limb compression garments.[35] Whilst standards assist with uniformity in compression grading, there are conflicting national standards across the world. For example, a class II compression garment manufactured under one standard may not provide the same amount of compression as a class II garment produced under a different standard. It is important for clinicians to be aware of the garment's country of origin to ensure the correct compression level and classification of the garments prescribed.

Table 5 Compression level of garments: an international comparison of hosiery classification

The mmHg range refers to the pressures applied at B (ankle circumference at smallest girth) by the compression hosiery.				
	British standard BS 6612:1985	French standard AFNOR G 30.102	German standard RAL-GZ 387:2000	USA (no national standards; below is most widely used)
Testing method	HATRA	IFTH	HOSY	
Unclassified				15–20mmHg
Class I	14–17mmHg	10–15mmHg	18–21mmHg	20–30mmHg
Class II	18–24mmHg	15–20mmHg	23–32mmHg	30–40mmHg
Class III	25–35mmHg	20–36mmHg	34–46mmHg	40–50mmHg
Class IV	Not reported	>36mmHg	>49mmHg	50–60mmHg

Adapted with permission from: Lymphoedema Framework (2006)

There is minimal evidence regarding the compression levels required for treating the varying degrees of lymphoedema.[7] Some common concepts discussed in the literature include:

- A person's vascular status, ability to tolerate compression and to manage the garment should be considered when prescribing the compression level and style of garment.[3,7]
- Higher compression levels are needed to treat people
  - with lymphoedema than those with venous disease[28]
  - with 'increased lymphoedema stage and severity'.[7(p17)]
- Lower compression is used for people with palliative needs.[3,7]
- The pressure applied by the garment should counteract capillary filtration pressure which is higher in the leg in standing than in supine. Therefore, the garment needs to exert a higher pressure in standing.[27]
- Lower limb compression garments exert graduated pressure with the highest pressure applied at the ankle.[5]
- 'The highest compression level tolerated by the patient is likely to be the most beneficial'.[2(p6)]
- In some circumstances layering of garments might be necessary to control swelling.[37] When layering garments the following should be considered

– With lower limb garments, full leg compression may be layered with a below knee garment to enable greater tolerance of higher levels of pressure and easier donning.[5]
– When using a combination of flat and circular knit garments, the inner layer should be flat knit and the outer layer circular knit.[3]
– The total pressure applied by two layered garments may not be equal to the sum of their totals in the upper limb. Furthermore, caution should be used to ensure higher compression does not result at the proximal end of the sleeve compared with the wrist.[38]

GPP If compression garments are worn while sleeping they should be prescribed with lower compression than those worn when in an upright position. When sleeping in a supine position, the lymphatic system does not require as much support due to the elimination of gravity and muscle activity.

3.9.2 Compression levels for stages of lymphoedema

Lymphoedema can be classified into stages (Table 1). These stages are based on limb volume and tissue consistency. The compression level required for a compression garment alters depending on the stage of lymphoedema present (refer to Table 6 and Figure 7 for treatment algorithms). If a person cannot tolerate the suggested compression ranges, lower levels of compression are advised.

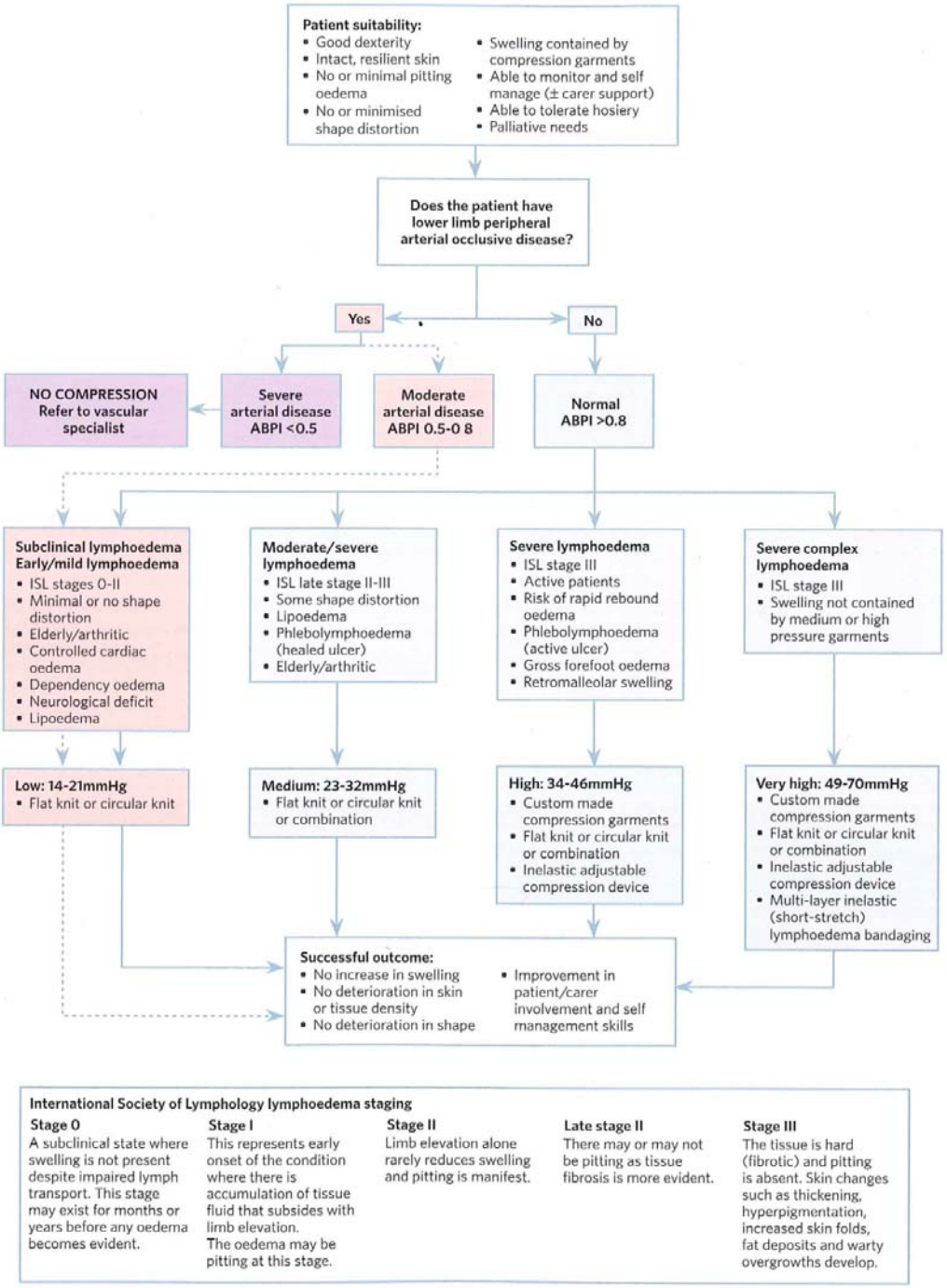
Table 6 Compression garment choices for upper limb lymphoedema

Indications	Compression garment classification	Recommendations	Notes
■ Prophylaxis ■ Mild lymphoedema ■ ISL stage I-II ■ No shape distortion ■ Maintenance ■ Palliation	LOW 14-18mmHg	Circular or flat knit Ready to wear*	Application aids may be required by less dextrous and elderly patients
■ Moderate lymphoedema ■ ISL late stage II-III ■ Some shape distortion	MEDIUM 20-25mmHg	Circular or flat knit Ready to wear or custom made*	Garments can be made that incorporate pads to treat areas of thickened tissue Silk inserts can be used at the inner elbow if irritation and trauma occur
■ Severe lymphoedema ■ ISL stage III ■ Major shape distortion	HIGH 25-30mmHg	Circular or flat knit Custom made*	Such high pressure is required only in exceptional cases

NB The compression applied by knitted armsleeves is graduated. The compression applied at the proximal end of the garment is 50-80% of that applied at the wrist.
*All upper limb styles including gloves and gauntlets and inelastic adjustable compression devices.

Source: Lymphoedema Framework (2006). Reprinted with permission

Figure 7 Compression garment algorithm for lower limb lymphoedema



Source: Doherty, et al. (2006).

GPP The Lymphoedema Framework[3] indicates compression ranges (Table 6 and Figure 7) for lower and upper limb lymphoedema, but clinical judgement based on thorough assessment is essential to establish the appropriate compression level for the individual person.

3.10 Garment prescription

Garment manufacturers and suppliers can provide specific product information as garments are available in a wide variety of styles, colours and attachments. The ability of a person or their carer to don and doff the compression garment needs to be considered when choosing the appropriate product. Donning aids are discussed later in this chapter.

People with lymphoedema may require lifelong compression garments. When garments are worn daily, each person should have at least two effective and appropriate garments per affected body part at any given time.[3,4,7]

When prescribing garments for people with complex presentations, advice from experienced lymphoedema clinicians is recommended to ensure the appropriate garment selection.[3]

GPP The clinician should consider heat and humidity when prescribing compression garments for people who live in warmer climates. Heat and humidity may influence the style and material selected for the garment e.g. use of a cotton liner under a garment.

GPP Each person requires appropriate and well-fitting garments determined by clinical assessment.

3.11 Garment prescription by body region

3.11.1 Limb lymphoedema

Compression garments are most commonly designed to manage upper or lower limb lymphoedema. Challenges with limb prescription include:

- ill-fitting garments—inappropriate prescription, measurement and fitting of a compression garment may cause tissue trauma,[7] exacerbate swelling and lead to permanent tissue damage.[4]
- limb shape distortion—the use of circular knit garments should only be considered for lymphoedematous limbs without shape distortion. When used for people with severe limb shape distortion, these garments may be ill-fitting and cause pain, skin damage and potentially tourniquet of the limb.[7,27] Custom made flat knit garments are the most appropriate alternative.[7,27]
- severe skin conditions such as eczema and lymphorrhoea which may require bandaging as a first line of treatment.[7]

3.11.2 Midline lymphoedema

Midline lymphoedema includes lymphoedema of the head/neck, breast, trunk and genital regions. When applying compression garments for midline lymphoedema consider the following:

- Head and neck lymphoedema
  - Localised low pressure can be applied to lymphoedema of the head and neck; however compression should not be applied to the neck in isolation.[3]
  - Low density foam pads may be used under garments for localised pressure.[3]

GPP Interim compression for the head and neck region should be trialled with tubular or short-stretch bandage to determine tolerance for garment wear before prescribing a garment for this region.

- Breast lymphoedema
  - Medium levels of compression, 25–30mmHg, are suggested.[3]

GPP Suitable compression may include firm fitting bras, sports bras, custom made vests or support singlets/corsets. High or low density foam inserts may be used to decrease fibrosis.

- Trunk lymphoedema
  - Medium levels of compression, 25mmHg or higher, are suggested.[7]

GPP Custom made or RTW options such as leotards or bodice style are available depending on body shape and the stage of lymphoedema.

- Genital lymphoedema
  - This is frequently combined with severe leg lymphoedema and is a challenging region of the body to compress.[7]
  - Lower limb compression in the absence of genital compression may precipitate or exacerbate swelling in the genital area. Therefore compression may be required for both body regions and could be applied in the form of pantyhose. Bike shorts and shaped padding can be used for women. Bike shorts and scrotal supports can be used for men.[3,7]

GPP Absorbent pads or clinician made foam chip bags can be inserted into a commercially available body support garment for women and men to increase localised pressure.

3.12 Co-morbidities

3.12.1 Allergies and skin sensitivity

Some people may be, or may become, allergic to the components of compression garments such as latex, elastane and dyes.[39] Cotton liners or cotton-rich compression garments may benefit these people.[3,7]

3.12.2 Arthritis

In people with arthritis, garments with lower compression, up to 23–32mmHg, are generally better tolerated.[7] If a person is unable to don a garment of this pressure, a garment of lower compression level, 14–21mmHg, or two lower pressure garments worn one on top of the other may be used.[7] Layered garments can be easier to apply to achieve the required pressure.[5]

3.12.3 Cardiac disease

Low compression levels can be used for people with stable cardiac disease. These people should be monitored closely for any change in symptoms e.g. breathlessness that may indicate further disease progression or intolerance to compression.[7]

3.12.4 Lipoedema

People with lipoedema often have difficulty tolerating compression due to tenderness of the tissue. However, lower compression levels may be better tolerated in this population.[7]

3.12.5 Neurological deficit

Low compression levels and careful monitoring are required to prevent skin damage in this cohort.[7] Self or carer monitoring of circulation needs to be taught and conducted regularly as normal warning mechanisms including pain may be impaired.[7]

3.12.6 Palliative conditions

Garments with lower levels of compression or alternative compression, including shaped elastic tubular bandages or bike pants, may be better tolerated by people with palliative conditions.[7] Examples of lower compression can include tubular knitted padding products or multiple layers of tubular bandage.

3.12.7 Venous leg ulcers

The Australian Wound Management Association and The New Zealand Wound Care Society[6] guidelines state that there is insufficient evidence for determining the best levels of compression to assist healing of wounds. It is suggested that 'higher pressure is better than lower pressure and some pressure is better than no pressure'.[6(p55)]

GPP In cases of lymphoedema with large and/or unhealed ulcers, bandaging is the preferred application of compression due to practicalities of maintaining wound dressings.

A compression garment with 40mmHg pressure is recommended in people with a healed ulcer and lymphoedema, however medium pressures of 23–32mmHg for the lower limb may be sufficient to prevent ulcer recurrence.[7]

3.13 Garment measuring

Measurement for compression garments should take place in the following circumstances:

- when the limb volume is stable
- when no or minimal pitting oedema is present
- immediately after removal of bandages
- early in the morning when swelling is less severe.[3,5,7]

It is important to follow the measurement instructions provided by each supplier of compression garments.

If used as an initial treatment, compression bandaging should be continued until the person has received the prescribed garments.[3,7] Compression bandaging is advisable before garment measuring if soft pitting oedema is present.[7]

3.14 Garment wearing regimen

3.14.1 Application/frequency

Compression garment wearing regimens will vary according to the severity of a person's lymphoedema and the treatment approach taken. People must have a clear understanding of the wearing regimen and implications.

The following regimens are recommended:

- for people following intensive therapy—garments should be worn 23 out of 24 hours until the limb volume has stabilised[3]
- for people with very mild/subjective symptoms
  - daily garment wear may be considered.[40] In a population-based morbidity trial (n=196), Stout Gergich et al. (2008) provided participants with sub-clinical arm lymphoedema (defined as greater than 3 per cent increase from pre-operative measurements) with compression garments 20–30mmHg which were worn daily for an average of 4.4 weeks. Following the intervention, there was a significant volume reduction ($p<0.001$), which was maintained at follow up (average of 4.8 months). Once reduction was achieved the women wore the garment only for strenuous physical activities.[40]
  - intermittent garment wear may be required for activities which exacerbate symptoms—for example, for heavy physical activities, exercise and repetitive activities[3]
- for people with severe lymphoedema—indefinite night time bandaging/garment wear may be required in combination with daytime garment wear.[7]

GPP People who have undergone treatment for stage I (early) lymphoedema, particularly of the upper limb, may not require lifelong use of compression garments.

GPP Daytime garment wear may be recommended for people waiting long periods of time for intensive therapy and for those who do not require intensive treatment.

GPP Compression garments should maintain the volume reduction achieved in the initial management phase.

GPP People who have completed intensive therapy may require day and night time compression until stable limb volumes have been achieved. Garments worn at night should be lower in compression level than day time garments. Once stability has been achieved, night time compression may no longer be necessary. However, to establish this, a trial of weaning night time compression should be undertaken.

GPP Limb volumes may take up to 6–12 months to stabilise.

GPP Maximum clinical benefit from compression garments will be achieved by:

- prescribing a wearing regimen in partnership with the person
  - using clinical findings and reasoning
  - considering individual characteristics
- wearing the garment according to the prescribed regimen
- long term adherence.

3.14.2 Air and land-based travel

The need for compression for air travel has been discussed since 1996 when Casley-Smith[41] published the results of a questionnaire sent to 1020 people with lymphoedema.

- Of the 749 responses received, sustained exacerbation of existing lymphoedema was reported after the flight by
  - 23 arm lymphoedema subjects
  - 44 leg lymphoedema subjects.
- 490 respondents identified a trigger to the development of their lymphoedema and of these, 27 attributed lymphoedema to flight and nine attributed it to a long bus or car trip.[41]

Casely-Smith[41] suggested the lowered cabin pressure when flying was a possible cause for the exacerbation and thus compression may reduce or prevent this risk.

Graham[42] investigated the relationship of flying and lymphoedema via a questionnaire sent to 293 breast cancer survivors. Of the 287 responses, there were no reports of permanent swelling after air travel. Nine women reported temporary swelling and of these, six reported coexisting possible risk factors. The author concluded that domestic air travel less than 4.5 hours is a low risk for the development or exacerbation of lymphoedema.[42]

The National Lymphedema Network[43] states in their position paper that there is little evidence regarding the risk of flying on the development or exacerbation of lymphoedema.[43] People with diagnosed lymphoedema should wear their usual compression garment/s when flying, but should also adhere to common venous thromboembolism prophylaxis.[44]

GPP People with established lymphoedema should wear compression garments as per their usual regimen when travelling by air or land.

GPP People at risk for lymphoedema need to discuss their case with an experienced lymphoedema clinician. If garment wear seems appropriate when travelling by air it should include a gauntlet for the ‘at risk’ arm. The appropriate garment should be worn in a simulated test situation such as watching a movie and sitting for a prolonged time prior to the flight to ensure a good fit. The prescribed garment should be worn for the duration of the flight and for a period before and after the flight.

3.14.3 Donning and doffing

The ability to don and doff the compression garment by a person or their carer needs to be considered when choosing the appropriate product as there are critical implications for incorrect donning/doffing and wearing of garments.[7]

Tissue damage or trauma may occur during incorrect application of the garment at points of high compression where the fabric is doubled up, wrinkled, rolled down or folded over.[7] To avoid these problems, people with lymphoedema and/or their carers need to be educated in correct donning/doffing and wearing of garments.[3] Appropriate care will also maintain the longevity of the garments.

Impaired strength and dexterity associated with the ageing process and arthritis may make it difficult for people to independently don and doff compression garments.[7]

Donning and doffing aids are available for easier application of compression garments.[3,4]

3.14.4 Care of garments

Suppliers' product information regarding the daily care of garments should be adhered to. People should be educated to wash the garments regularly, preferably daily, to maintain hygiene and garment tension.[4,35]

Care should be exercised when applying oil-based moisturisers and other skin care products as these may affect the longevity of the garment fabric.[35] Options to reduce this risk may include:

- changing the skin care routine by using water-based lotions prior to the application of the garment
- using oil-based lotion/cream at night if a garment is not clinically required
- applying a cotton liner under garments when oil-based products are required.

3.14.5 Garment replacement

When garments are worn daily, people require at least two appropriate garments per affected body part, which should be replaced at least every six months.[3,4,7]

Garments may need to be replaced more frequently in cases of heavy wear such as very active or obese people.[3,7,35]

GPP Garments may need to be replaced more frequently when changes in limb size or body weight occur causing the garment to become ill-fitting.

3.15 Training requirements

Clinicians need to be highly skilled in the assessment of lymphoedema and appropriately trained in the prescription, measurement and fitting of compression garments.[3,4,7]

GPP All clinicians prescribing initial and changed compression garments are recommended to have level one lymphoedema training with additional continuing professional development in lymphoedema as outlined by the National Lymphoedema Practitioner Register (www.lymphoedema.org.au). This

professional development will assist the clinician with complex problem solving and/or the ability to respond to changes in clinical presentation throughout the treatment course.

A trained clinician should check the fit of newly prescribed compression garments and provide education on garment care to garment wearers and their carers.[3,7]

Advice and assistance of an experienced clinician is required for those with severe complex lymphoedema or lymphoedema of the trunk.[7]

GPP Clinical judgement and discussion with an experienced clinician is required to determine the appropriate timeframes for review.

3.16 Summary of recommendations

There are no recommendations from RCTs or systematic reviews for this chapter. The reason for this is that existing studies did not specifically address compression garments and did not provide robust methodologies or statistical analyses.

4. Intermittent pneumatic compression

Intermittent pneumatic compression (IPC) is applied using an electrically driven air compression pump attached to an inflatable plastic sleeve and fitted over the person's limb. The sleeve inflates and deflates cyclically over a set period. Sleeves can be single or multi-chambered. In multi-chambered sleeves, the chambers inflate sequentially in a distal to proximal direction creating a peristaltic massaging effect along the length of the limb towards the limb root.[3] In a single compartment sleeve, compression is applied to all points simultaneously.[45]

4.1 Aims

The aims of IPC include:

- reducing limb size[46]
- increasing speed of lymph flow.[19,47]

4.2 Mechanism of action

There is debate in the literature over the exact mechanism of action of IPC. This may be due to variance in the types of IPC products available and how they are used.[47]

The three most commonly accepted mechanisms of action for IPC are that it:

- mimics a muscular contraction with compression and relaxation of the lymphatic vessels, thereby facilitating movement of fluid out of the extracellular tissue and into the lymph vessels[47]
- decreases filtration of blood out of the capillaries and reduces lymph formation[47]
- reduces the fluid in a lymphoedematous limb but does not have the ability to remove large protein molecules, thereby creating a high protein environment in the extracellular tissues.[19,47]

4.3 Common indications

IPC is indicated for use during the:

- intensive phase of lymphoedema treatment—IPC has a synergistic effect with intensive treatment programs[48] and is a useful adjunct[17]
- long term maintenance of limb volume reduction[49] through self-administered home programs.[17]

4.4 Effectiveness

Although there is no strong evidence to support the use of IPC as a primary treatment in the management of lymphoedema, there continues to be considerable international debate about its efficacy. Regardless, IPC continues to be used in combination with other modalities for some people with lymphoedema in both the intensive therapy and long term management phases.[3]

One moderate quality pseudo-randomised controlled trial (n=47) compared IPC for two hours at 60mmHg—as part of a combined treatment program consisting of arm exercises, elevation, hygiene and skin care—with 20 minutes of low level laser therapy in combination with arm exercises, elevation, hygiene and skin care.[50] The trial found both programs were effective in reducing breast cancer-related lymphoedema (BCRL) at six months post intervention. However, low level laser therapy demonstrated better volume reduction than IPC at 12 months ($p<0.02$).[50]

Szolnoky et al. conducted a randomised controlled trial (RCT) (n=27) comparing daily IPC for 30 minutes at 50mmHg—in addition to 30 minutes of manual lymphatic drainage (MLD), skin care, compression bandaging and exercises with 60 minutes of MLD, skin care, compression bandaging and exercises over a two week period.[48] Significant reductions in BCRL ($p<0.05$) were noted in the IPC group when compared with the MLD group at the end of the two week therapy program. This significant reduction was maintained up to two months post treatment.[48]

Szuba et.al. conducted a RCT examining IPC across the initial treatment phase (n=23) and during the longer term management phase (n=25) in subjects with BCRL.[49] The treatment group received 10 days of daily IPC, for 30 minutes at 40–50mmHg, combined with MLD for 30–60 minutes and compression bandaging. The control group received daily MLD for 30–60 minutes and compression bandaging. The treatment group, with IPC, was shown to have significant limb volume reduction ($p<0.05$) compared to the control group. Following this initial treatment phase, all subjects wore a class II garment in place of bandaging and performed self massage for a further 30 days. The results, at 30 days post treatment, were not significantly different between the two groups. In the second stage of this RCT (a crossover trial), two groups of subjects participated in a self-management phase consisting of wearing a class II garment and performing self massage for two months. In addition, one group applied one hour of IPC daily for one month prior to swapping with the second group who also applied IPC for one month. One month of this self-management phase in combination with IPC demonstrated a significant difference in volume reduction ($p<0.05$). The group undergoing self-management without IPC experienced a slight increase in limb volume.[49]

Recommendation

IPC can be effective as part of a combined lymphoedema treatment program for reducing BCRL in the short term, up to two months post treatment.[48,49]

In addition to short term limb volume reduction, anecdotal evidence suggests IPC may be beneficial in reducing subjective symptoms including pain, heaviness, paraesthesia, tightness and weakness.[46,48,50]

4.5 Contraindications

General contraindications for compression include:

- severe arterial insufficiency*
- uncontrolled heart failure
- severe peripheral neuropathy.[3,5,6]

*Prior to commencing lower limb compression, a comprehensive vascular assessment is recommended to rule out any underlying arterial insufficiency.[7]

Vascular assessment may involve a review of subjective symptoms, palpation of pulses and/or measurement of ankle brachial pressure index (ABPI). However, palpation of pulses can be unreliable and the use of an ABPI is considered to be a more reliable predictor of arterial status.[8] The ABPI should be performed by a trained health professional and repeated as clinically indicated and as per local guidelines. An ABPI between 0.8 and 1.2 is usually considered indicative of good arterial flow in the absence of other clinical indicators for arterial disease.[6] An ABPI below or above this range requires further assessment as it may indicate that compression is not appropriate. People using compression should be taught to monitor their limb/s for signs of ischaemia, including altered sensation, colour or pain.[7]

Lymphoedema Framework[3] list the following additional contraindications specific to IPC:

- untreated non-pitting chronic lymphoedema
- known or suspected deep vein thrombosis
- pulmonary embolism
- thrombophlebitis
- acute inflammation of the skin (e.g. cellulitis or erysipelas)
- pulmonary oedema
- ischaemic vascular disease
- active metastatic disease affecting the oedematous region
- oedema at the root of the affected limb or truncal oedema.[3]

4.6 Caution

Though not contraindicated, caution is advised when compression is used with people who have the conditions listed below:

- an ABPI less than 0.8 or greater than 1.2 [6]
- high arterial blood pressure[5]
- cardiac arrhythmia or cardiac stenosis[5]
- controlled heart failure[3]
- scleroderma[5]
- chronic polyarthritis[5]
- complex regional pain syndrome[5]

- malignant lymphoedema[3]
- acute cellulitis/erysipelas[3]
- diabetes mellitus[3]
- paralysis[3]
- sensory deficit[3]
- fragile or damaged skin.[3]

Clinical reasoning and careful monitoring is recommended when these complications arise, necessitating changes to the way IPC may be applied. For example, with controlled heart failure it is important to consider the haemodynamic effects of compression as fluid is shifted from the limb to the trunk and alters the circulating fluid volume in the body. Light compression may be tolerated with careful monitoring.[7] For patients with cellulitis, compression may be applied after the commencement of antibiotics and as tolerated by the person.[9]

In addition, the following good practice points (GPP) are advised:

GPP Medical advice should be sought prior to using compression for people with a low platelet count <75 x 10^9/L due to the potential for tissue trauma.

GPP If the person undergoing lymphoedema treatment is also undergoing chemotherapy, the clinician must protect themselves by adhering to cytotoxic precautions.

Assessment and clinical reasoning are required with everyone to determine the appropriate compression. Where compression is required for people with any of the above clinical conditions, advice should be sought from an advanced lymphoedema practitioner to assist with clinical reasoning.

Although there was limited reporting of adverse effects in the literature surveyed, careful surveillance of physical and subjective symptoms is required before and during IPC treatment.[49]

GPP Education including indications and treatment regimen should always occur before commencement of IPC. This will assist the person to commit to and prepare for IPC use.

GPP Extreme limb deformity may impede correct use of IPC and therefore other treatment modalities should be considered.

GPP People using IPC should be educated about monitoring and precautions to encourage self-reporting of any pain and changes in circulation whilst using IPC so adjustments to intensity and cycle settings can be made as necessary.

4.7 Intermittent pneumatic compression use in lymphoedema treatment

IPC can be used across the treatment spectrum from intensive therapy through to the long term phase.[17] However, IPC is not commonly used within Queensland Health. This may be due to the limited evidence supporting its long term effectiveness, access to IPC devices, costs associated and the treatment time required when using IPC in the clinical setting.

4.7.1 Intermittent pneumatic compression products

There are several IPC products on the market with a variety of features:

- limb IPC with single and multi-chambered sleeves and sequential and non-sequential functions[47]
- highly specialised automated trunk IPC that enables clearance in the ipsilateral and contralateral quadrants prior to commencement of limb treatment.[17]

When considering IPC use for lymphoedema treatment, it is important to determine which features are required in order to provide safe and effective intervention[17].

A RCT by Pilch et al. (n=57) investigated the effect of compression cycle times (90 seconds compression, 90 seconds interval versus 45 seconds compression, 15 seconds interval) and the number of compression chambers (single versus three chamber sleeves) on BCRL to determine the effects on the movement of lymph fluid.[47] All treatment groups demonstrated a significant reduction in oedema ($p<0.01$) after IPC treatment. However, no significant difference in volume reduction was found between cycle times ($p=0.52$) and number of chambers ($p=0.51$) used. Pilch et al. (2009) concluded that IPC was effective in reducing limb volume oedema in BCRL irrespective of the number of chambers and cycle rates used.[47]

Recommendation

IPC can reduce limb volume in BCRL irrespective of the number of chambers and the cycle time used.[47]

GPP The therapist should adjust the duration and pressure intensity of IPC in order to target therapeutic goals.

GPP When IPC devices are used with multiple individuals, infection control principles need to be maintained.

4.7.2 Treatment program

Preparation for the use of IPC is extremely important to prevent complications. Trunk clearance before commencing IPC is essential to facilitate lymph flow through alternate pathways and minimise volume and pressure within the trunk region.[17]

If the trunk and proximal limb have not been adequately prepared, adjacent body quadrants may become oedematous resulting in further complications. Adverse outcomes may include:

- genital oedema and congestion or formation of a fibrotic ring in the non-compressed proximal area[2,17]
- pain in the back, chest, shoulder or breast[17]
- worsening of existing neuropathic pain of the fingers.[17]

The use of modern IPC devices that clear the trunk and proximal areas while applying low pressure is one option for treatment when the limb is at risk of developing fibrosis.[17] During IPC treatment, fluid is removed from the interstitial spaces leaving behind a higher concentration of protein. The resultant increase in tissue oncotic pressure causes more fluid to be drawn in to the interstitial spaces further increasing oedema within the limb.[17,30] Following IPC, the application of either compression bandages or garments is necessary to maintain limb volume reduction[30] and to prevent rebound swelling.[3]

The Lymphoedema Framework[3] advises that IPC compression levels of 30–60mmHg should be used, as tolerated, and adjusted in response to treatment. Lower pressures (e.g. less than 30mmHg) are advised when using IPC for people with palliative conditions.[3]

There is potential for lymphatic vessel injury when sustained high pressures are applied to the skin. It is important to closely monitor the amount and duration of pressure applied.[17] The duration and frequency of IPC varies within the literature. One study applied IPC two hours daily at 60mmHg, five days per week for four weeks in combination with daily exercises, with no reported adverse effects.[50] Another study investigated the application of 30 minutes of IPC daily for 10 days at 40–50mmHg in addition to MLD and compression bandaging with no reported adverse effects.[49]

The amount of pressure applied to the surface area of a lymphoedematous limb along with the duration of pressure applied from IPC devices can affect personal comfort.[17] During IPC, compression is delivered cyclically, allowing periodic compression of the tissues to expel lymph fluid and the periodic release of compression to allow for refilling of the lymphatic vessels.[47] As compression is not sustained, higher levels of pressure are more likely to be tolerated for shorter durations.[17]

People may choose to use IPC at home as part of a self-management program. Mayrovitz[17] indicates maintaining limb volume reduction in the long term may be a challenge due to the following difficulties:

- performing self massage to required body parts and distal extremities
- application of self bandaging
- emotional stressors due to the time taken to complete daily treatment
- overuse injuries of the affected and unaffected limb.[17]

The home use of IPC can be an effective self-management approach to increase a person's adherence by reducing the physical and emotional burden as outlined above.[17] Daily one hour use of IPC at 40–50mmHg is considered to be effective at continuing to reduce mean volume reduction as part of a self-management program.[49]

GPP IPC should be used with other modalities and not as a stand-alone treatment in order to enhance its effectiveness.

GPP IPC may be used as an alternative treatment when constant compression, such as lymphoedema compression bandaging or garments is poorly tolerated.

GPP IPC should only be used after the person's trunk has been prepared with MLD or use of modern IPC devices that clear the trunk.

GPP Bandaging of toes/fingers may be considered prior to commencement of IPC to avoid pooling of fluid in the digits.

GPP With close monitoring, IPC may be used 30–120 minutes daily or as tolerated.

GPP The treatment duration and compression intensity of IPC should be individually prescribed to meet the person's clinical needs.

GPP IPC can be applied if there is no or minimal oedema at the proximal root of the limb or adjacent trunk.

GPP If there is no limb volume reduction during the first week of intensive therapy, treatment should be re-evaluated to determine the cause of this unexpected result and to modify the treatment program accordingly.

4.8 Training requirements

Within Queensland Health, there is a limited number of lymphoedema clinicians with access to and experience with IPC.

GPP All clinicians prescribing IPC are recommended to have level one lymphoedema training with additional continuing professional development in lymphoedema as outlined by the National Lymphoedema Practitioner Register (www.lymphoedema.org.au). This professional development will assist the clinician with complex problem solving and/or the ability to respond to changes in clinical presentation throughout the treatment course.

GPP Clinicians without level one or two training can deliver IPC if they have access to a level one or level two trained clinician to assess and monitor the treatment program.

4.9 Summary of recommendations

IPC, as part of a combined treatment program, has been shown to be effective in the short term, up two months, for people with BCRL irrespective of the number of chambers or cycle times used. Due to limited research regarding the longer term benefits of IPC use, clinicians should consider whether there are additional clinical benefits to be gained over existing treatment regimens prior to incorporating IPC into clinical practice within Queensland Health.

Refer to Table 7 for a summary of the evidence used to develop these recommendations for IPC.

Table 7 Summary of evidence for recommendations for intermittent pneumatic compression

Level of evidence	Author	Year	Design	Country	N	Treatment	Control	Randomisation	Blinding	Follow up	Result	Limitations	Outcomes
II low risk of bias	Pilch	2009	Experimental study/RCT	Poland	n=57 BCRL	IPC 30–50mmHg five times per week for five weeks (total of 25, 60 minute sessions). Four groups with different cycles and different sleeves: 1. 1:1 cycle of compression (90s:90s) with single chamber sleeve (n=17) 2. 1:1 cycle of compression (90s:90s) with three chamber sleeve (n=nine) 3. 3:1 cycle of compression (45s:15s) with single chamber sleeve (n=11) 4. 3:1 cycle of compression (45s:15s) with three chamber sleeve (n=20)	Unaffected arm as baseline measure	Poorly addressed	Not reported	Five weeks	Primary outcome addressed arm volume reduction. Outcome tool used water displacement volumetry. Significant difference in oedema in all groups after treatment $p<0.05$. No significant difference in mean oedema reduction between cycles or sleeve groups.	Small sample size. Limited description of baseline characteristics of participants and poorly described randomisation.	When comparing the efficacy of IPC there was no significant difference between the number of sleeve chambers and cycle times. However, the IPC cycle 45s:15s, when combined with a three chamber sleeve was more effective in reducing oedema volume compared with the three other groups assessed. IPC is effective in reducing upper limb oedema in women with BCRL irrespective of the compression sleeve type and cycle rates used.

II low risk of bias	Szolnoky	2009	RCT	Hungary	n= 27 female unilateral BCRL (greater than 2 months post-surgery or adjuvant treatment). Nil exclusions during or at end of study.	n=14 IPC 30 minutes MLD 30 minutes IPC (Lympha Mat 50mmHg 12 cell multi-chamber) plus skin care, bandaging and exercises five days per week over two weeks'	n=13 MLD 60 minutes plus skin care, bandaging and exercises five days per week over two weeks'	Not reported	Not reported	Limb volume calculated at baseline, beginning of treatment, end of treatment, one month and two months	Primary outcome addressed mean volume reduction (limb volume using tape measures every four centimetres then percentage volume calculated) Mean volume reductions for MLD group at treatment completion, one month and two months after treatment respectively: 3.06%, 2.9% and 3.6% ($p<0.05$). In IPC+MLD, mean volume reductions at treatment completion, one month and two months after treatment respectively: 7.93%, 9.02% and 9.62% ($p<0.05$). Mean limb volume reduction was statistically significant in and between both groups at end of treatment, one month and two months. IPC group had statistically greater limb volume reduction than MLD group alone.	Results need to be interpreted with caution due to: • small sample size • lack of detail regarding randomisation • raw scores not being clearly presented	IPC with MLD results in significant limb volume reduction in combination with skin care, bandaging and exercises when compared to MLD alone in the short term (1–2 months post treatment)

II high risk of bias	Szuba	2002	RCT Study One	USA	n=23 unilateral BCRL greater than 20% difference. greater than 12 weeks post-surgery, radiation therapy or both.	n=12 IPC (30 minutes at 40–50mmHg) plus MLD (30–60minutes Vodder) and compression bandaging (comprilan left overnight) daily for 10 days then garment (class II Medi USA during day) and self applied MLD further 30 days.	N=11 MLD (30–60 minutes Vodder) plus compression bandaging (comprilan left overnight) daily for 10 days then garment (class II Medi USA during day) and self applied MLD further 30 days	Not reported	Not reported	10 days and 40 days	Primary outcome addressed reduction in volume. Outcome tool utilised water displacement volumetry. At 10 days of using IPC with MLD and bandaging, volume reduction was 45.3% compared to MLD and bandaging alone at 26% ($p<0.05$). At 40 days of IPC with MLD and bandaging, volume reduction was 30.3% compared to MLD and bandaging alone at 27.1% ($p>0.05$).	Small sample size and flaws in methodology. Limited raw data displayed.	After cessation of treatment, there was significant limb volume reduction in the IPC group at 10 days which was not sustained at 40 days.
II high risk of bias			RCT with treatment Study Two, crossover		n=25 BCRL greater than 12 weeks post-surgery, radiation therapy or both	n=13 IPC (sequential 40–50mmHg) one hour daily for one month plus continued maintenance (self-massage and class II garment) followed by one month of self massage and class II garment only	n=12 Maintenance (self-massage and class II garment) for one month followed by one month of IPC (sequential 40–50mmHg) one hour per day plus continued maintenance (self-massage and class II garment)	Process not reported. Subjects were randomised into either group	Not reported	Quantitative assessment at time of enrolment and at one month (prior to crossover) then again two months	Primary outcome addressed reduction in volume. Outcome tool utilised water displacement volumetry. Maintenance phase without IPC resulted in mean volume increase of 32.7mL (3.3%) at one month. Self-administered IPC plus self massage and garment resulted in mean volume reduction of 89.5ml (9%) $p<0.05$. At the end of two months, there was no recorded difference between order of treatment.	Caution needs to be given when interpreting this study, due to design flaws and no 'washout time' mentioned between cross over interventions.	IPC combined with self-massage and garment in the maintenance phase continues to reduce lymphoedema in the majority of patients.

Appendices

Appendix 1 Overview of the guideline

This guideline aims to:

- provide practical, evidence-based recommendations for the use of compression therapy for the treatment of established lymphoedema in adults
- provide a current and contemporary educational resource for clinicians new to lymphoedema within Queensland Health
- enhance the practice of compression therapy within Queensland Health
- apply the allied health clinical governance framework to address the high cost, high risk and high volume allied health service delivery.[51]

For the purposes of this guideline, compression therapy includes the use of compression bandaging, compression garments and intermittent pneumatic compression. This methodology will be used to support the development of a statewide funding model for compression garments.

The recommendations should be implemented subject to clinical reasoning by the clinician and with consideration for each person's individual factors.

Background

Queensland Health identified the need to develop and promote evidence-based practice for compression therapy in chronic disease (lymphoedema). The Allied Health Workforce Advice and Coordination Unit endorsed a business case to develop the guideline.

A statewide expert working group (EWG) was established which consisted of:

- four representatives from occupational therapy, two representatives from physiotherapy and one representative from nursing
- two consumer representatives from the Lymphoedema Association of Queensland
- clinical librarian.

Refer to Appendix 2 for details.

Scope of the guideline

This guideline is intended for use by occupational therapists, physiotherapists and registered nurses with lymphoedema training. In particular, the target audience is 'new' lymphoedema trained clinicians practising in the area of lymphoedema treatment.

This guideline does not replace the need for any clinician providing lymphoedema therapy to complete an appropriate lymphoedema training course.

Funding

Phase one of this project was funded by Allied Health Workforce Advice and Coordination Unit, Queensland Health. Phase two of the project was supported by the facilities of the EWG (Cairns, Princess Alexandra, Royal Brisbane and Women's and The Townsville Hospitals) through the contribution of their time.

Development of the guideline

A project team and multidisciplinary EWG were formed to develop this CPG—which was guided by the National Health and Medical Research Council's (NHMRC) handbook series on preparing clinical practice guidelines and Scottish Intercollegiate Guideline Network's[52] (SIGN) Guideline Developers Handbook.

The guideline takes into account the following key documents:

- Clinical practice guideline: for the management of delirium in older people
- Clinical practice guideline: for the prevention of venous thromboembolism in patients admitted to Australian hospitals
- The ADAPTE process: resource toolkit for guideline adaptation
- Coeliac disease: recognition and assessment of coeliac disease.

Authorship of the CPG was by the EWG, including critical appraisal of the evidence. The importance of involving people with lymphoedema and their clinical care was reflected through consumer involvement during the development of this guideline.

Literature search

The aim of the literature search was to identify relevant evidence to answer the clinical questions identified by the EWG (see Appendix 4). Databases utilised in the literature search included:

- The Cochrane Database of Systematic Reviews (Wiley Interscience)
- Medline (Ovid)
- Embase (Ovid)
- CINAHL Plus with Full Text (EBSCO)
- PEDro
- OT Seeker.

A search of the literature with levels of evidence of randomised controlled trial (RCT) and above was undertaken from 2000 to 2011. The development of this guideline occurred over four years. The literature search for phase one was undertaken in May 2010 and for phase two in July 2011 (see Appendix 5).

The systematic reviews (SRs) identified in the search did not specifically address the primary intent of this CPG so source articles were appraised instead of SRs. Evidence was critically appraised utilising SIGN[52] recommended tools—specifically the methodology checklist 2 for RCTs (see Appendix 6). All SIGN methodology checklists are available on request to the authors (see Appendix 2). Source articles were also evaluated using the NHMRC levels of evidence (Table 8).

Table 8 NHMRC evidence hierarchy

Level	Intervention	Diagnosis	Prediction and prognosis	Aetiology and risk factors	Screening and Intervention
I	A systematic review of Level II studies	A systematic review of Level II studies	A systematic review of Level II studies	A systematic review of Level II studies	A systematic review of Level II studies
II	A randomised controlled trial	A study of test accuracy with an independent, blinded comparison with a valid reference standard, among consecutive patients with a defined clinical presentation	A prospective cohort study	A prospective cohort study	A randomised controlled trial
III-1	A pseudo randomised controlled trial (i.e. alternate allocation or some other method)	A study of test accuracy with: an independent, blinded comparison with a valid reference standard, among consecutive patients with a defined clinical presentation	All or none of the people with the risk factor(s) experience the outcome	All or none of the people with the risk factor(s) experience the outcome	A pseudo randomised controlled trial (i.e. alternate allocation or some other method)
III-2	A comparative study with concurrent controls: • non-randomised experimental trial • cohort study • case control study • interrupted time series with a control group	A comparison with reference standard that does not meet the criteria for Level II and Level III-1 evidence	Analysis of prognostic factors amongst persons in a single arm of a randomised control trial	A retrospective cohort study	A comparative study with concurrent controls: • non-randomised experimental trial • cohort study • case control

III-3	A comparative study without concurrent controls: • historical control study • two or more single arm study • interrupted time series without a parallel control group	Diagnostic case—control study	A retrospective cohort study	A case control study	A comparative study without concurrent controls: • historical control study • two or more single arm study
IV	Case series with either post-test or pre-test/post-test outcomes	Study of diagnostic yield (no reference standard)	Case series or cohort study of persons at different stages of disease	A cross sectional study or case series	Case series

Source: National Health and Medical Research Council (2009).

Bibliographies and/or references of identified reports, articles, guidelines and expert clinician recommended texts were reviewed to identify relevant literature. Internet searches were also conducted to identify guidelines and reports. Websites used included:

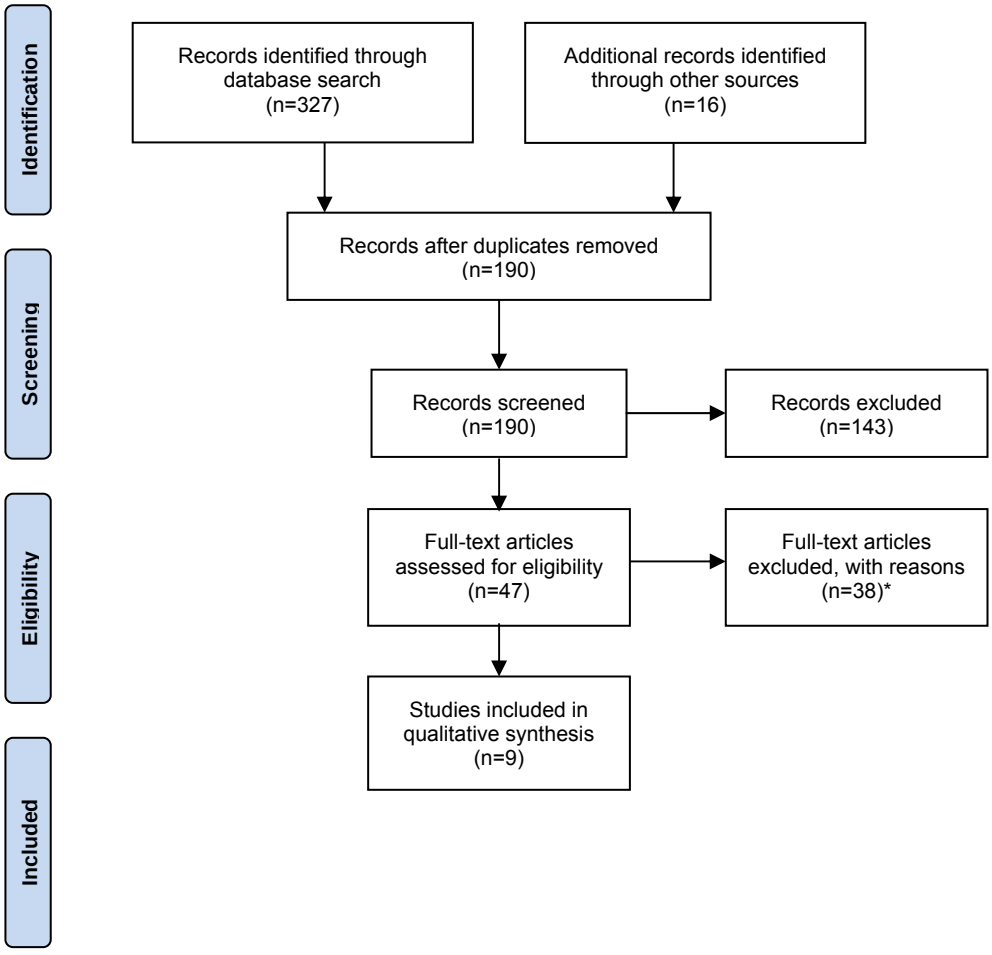
- National Institute of Health and Clinical Excellence (www.nice.org.uk)
- NHS Evidence (http://www.evidence.nhs.uk)
- National Health and Medical Research Council (NHMRC) (www.nhmrc.gov.au)
- New Zealand Guideline Development Group (NZGG) (www.nzgg.org.nz)
- NHS Health Information Resources (www.library.nhs.uk)
- Scottish Intercollegiate Guideline Network (SIGN) (www.sign.ac.uk)
- Guidelines and Audit Implementation Network (GAIN) (http://gain-ni.org)
- Institute for Clinical Systems Improvement (ICSI) (http://www.icsi.org)
- National Guideline Clearinghouse (NGC) (www.guideline.gov)
- Guidelines International Network (G-I-N) (www.g-i-n.net)
- National Breast and Ovarian Cancer Centre (NBOCC) (http://canceraustralia.gov.au)
- Cancer Care Ontario Practice Guideline Initiative (www.cancercare.on.ca)
- American Society of Clinical Oncology (www.asco.org)
- National Cancer Institute (www.cancer.gov)
- National Comprehensive Cancer Network (www.nccn.org)
- European Society of Lymphology (http://www.eurolymphology.org)
- European Wound Management Association (www.ewma.org)
- Australasian Lymphology Association (http://lymphoedema.org.au).

The review of websites identified a further three CPGs, one evidence summary report, two Australian Government funded reviews, eight international consensus documents and two Australian consensus documents (see Appendix 7).

All evidence retrieved was screened for inclusion. The inclusion criteria were as follows:

- levels of evidence of RCT or greater
- year 2000 and onwards to ensure contemporary evidence
- relevant to lymphoedema treatment not oedema management
- specific to compression therapy in the treatment of lymphoedema.

Figure 8 PRISMA 2009 Flow Diagram



Source: Moher, Liberati, Tetzlaff, Altman (2009).

Refer to Appendix 8 for excluded studies.

Recommendation and good practice point development

The evidence used to make recommendations in this CPG was limited to RCTs, as the SRs identified in the search did not specifically address the primary intent of this CPG. Source articles were appraised.

To review the reliability of the appraisal process, the evidence was independently reviewed by the clinical librarian. Three articles were randomly nominated reviewed by two members of the EWG. The SIGN appraisal was applied by both of the assessors. The findings were as follows:

- same level of assessed evidence
- same level of assessed bias
- correlations existed between the assessors for methodology and applicability.

As per the NHMRC recommendations for the development of guidelines, clinical practice recommendations were developed by clinical experts based on high quality (level II) critically appraised evidence.[52] The good practice points (GPPs) in this guideline reflect the consensus opinion of the EWG where there was limited high quality evidence available.[52]

Updating the guideline

Review and update of this CPG should occur earlier than the recommended three yearly plan in the event of the following:

- publication of any new SRs or new major RCTs that could change the recommendations in this guideline
- the emergence of any major safety concerns relevant to this guideline.

Appendix 2 Expert working group

Committee member qualifications	Role and location	Setting of practice	Types of population	Participation in guideline development
Sue Laracy B.OccThy (Hons)	Director of Occupational Therapy Royal Brisbane and Women's Hospital	Non clinical	Not applicable	Chair of expert working group (EWG). Guideline development. Author: summary chapter and Appendix 1
Amanda Purcell B.OccThy, PhD	Team Leader Consultant, Lymphoedema Service Occupational Therapy Princess Alexandra Hospital	Cancer related lymphoedema assessment and treatment	Public outpatient service: cancer related lymphoedema for urban and rural populations.	Member of EWG. Guideline development. Author: bandaging chapter.
Hildegard Reul-Hirche Dip Phty	Senior Consultant–Lymphoedema, Physiotherapy Department Royal Brisbane and Women's Hospital	Cancer and non-cancer related lymphoedema assessment and treatment Member of Multidisciplinary Lymphoedema Assessment Clinic	Public outpatient service: cancer and non-cancer related lymphoedema for urban, rural and remote populations.	Member of EWG. Guideline development. Co-author: garment chapter.
Leonie Naumann B.Phty	Team Leader Cancer Care, Physiotherapy Department Royal Brisbane and Women's Hospital	Cancer related lymphoedema assessment and treatment	Public outpatient service: cancer related lymphoedema for urban, rural and remote populations.	Member of EWG. Guideline development. Co-author: garment chapter.
Susan Doherty B.OccThy	Occupational Therapist–Vascular The Townsville Hospital	Vascular assessment and treatment	Public outpatient vascular service for regional, rural, Indigenous Australian populations and telehealth to remote areas.	Member of EWG. Guideline development. Co-author: intermittent pneumatic compression (IPC) chapter.
Jo-Anne Sobb B.OccThy	Deputy Director Occupational Therapy Cairns Hospital	Assessment and treatment of acute inpatient and outpatient trauma, vascular and lymphoedema caseloads	Public inpatient and outpatient service for regional, rural and remote populations in far north Queensland.	Member of EWG. Guideline development. Co-author: IPC chapter.

Committee member qualifications	Role and location	Setting of practice	Types of population	Participation in guideline development
Lars Eriksson	Librarian Herston Health Sciences Library, University of Queensland	Non clinical	Not applicable	Member of EWG. Literature appraisal.
Nerida Smith	Consumer representative President of Lymphoedema Association of Qld (LAQ)	Not applicable	Not applicable	Member of EWG. Consumer representative.
Leila Bourke	Consumer representative Executive member of LAQ	Not applicable	Not applicable	Member of EWG. Consumer representative.
Kerrie Coleman	Nurse Practitioner Complex Wound Management, Skin Integrity Services Royal Brisbane and Women's Hospital	Management of acute and chronic wounds within a tertiary hospital setting	Public inpatient and outpatient service.	Member of EWG. Clinical consultation.

Appendix 3 Expert working group conflict of interest declarations

1. Amanda Purcell
   - Support received for oedema training courses from Biomet Australia, Haddenham Australia, Reis Surgical and Orthopaedic, Smith and Nephew Australia (donation of compression garment samples)
   - Support received for oedema training courses from Smith and Nephew Australia (donation of compression bandages)
2. Hildegard Reul-Hirche
   - Support received for lymphoedema management courses from Smith and Nephew Australia (donation of compression bandages)
   - Payment received from Smith and Nephew Australia for development and presentation of workshop in 2012.

The other members of the expert working group did not report any competing interests.

Appendix 4 Clinical questions identified by the expert working group

To assist the development of good practice points, a checklist of clinical questions was developed by the expert working group to focus on the purpose and the target audience of the clinical practice guideline. The checklist questions are as follows:

1. Is this treatment effective?
2. At what stage would I use this type of compression treatment?
3. What compression level is most effective?
4. What regimen is most effective?
5. What are the contraindications to this treatment?
6. Are there any side effects or precautions for this treatment?
7. What length of time will treatment need to be conducted for?
8. What resources are required?
9. What type of training is required?
10. What kind of results should I expect?
11. How long do treatment effects last?
12. How frequently does treatment need to occur?

Appendix 5 Literature search strategies

MEDLINE SEARCH (2000–2011)

Conducted: 6 July 2011

Database(s): Ovid MEDLINE(R)

Search strategy

#	Searches	Results
1	exp Lymphedema/	8007
2	exp Elephantiasis/	2253
3	(Lymph?dema or elephantiasis).mp. [mp=protocol supplementary concept, rare disease supplementary concept, title, original title, abstract, name of substance word, subject heading word, unique identifier]	9024
4	1 or 2 or 3	9024
5	exp Physical Therapy Modalities/	103614
6	exp Bandages/	17536
7	exp Intermittent Pneumatic Compression Devices/	284
8	exp Compression Bandages/	717
9	"physical therapy".mp.	28088
10	bandag*.mp. [mp=protocol supplementary concept, rare disease supplementary concept, title, original title, abstract, name of substance word, subject heading word, unique identifier]	15310
11	(hosiery or hose or garment).mp. [mp=protocol supplementary concept, rare disease supplementary concept, title, original title, abstract, name of substance word, subject heading word, unique identifier]	1495
12	compression.mp. [mp=protocol supplementary concept, rare disease supplementary concept, title, original title, abstract, name of substance word, subject heading word, unique identifier]	68952
13	"manual lymphatic drainage".mp.	99
14	"complex physical therapy".mp.	22
15	"decongestive therapy".mp.	52
16	flexitouch.mp. [mp=protocol supplementary concept, rare disease supplementary concept, title, original title, abstract, name of substance word, subject heading word, unique identifier]	3
17	5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16	193464
18	4 and 17	989
19	randomised controlled trial.pt.	310029
20	controlled clinical trial.pt.	82729
21	randomised.ab.	216360
22	placebo.ab.	125831
23	clinical trials as topic.sh.	155042
24	randomly.ab.	156530
25	trial.ti.	92627

#	Searches	Results
26	19 or 20 or 21 or 22 or 23 or 24 or 25	720091
27	exp animals/not humans.sh.	3607004
28	"systematic review".tw. or meta-analysis.pt.	45601
29	26 or 28	750173
30	29 not 27	694214
31	18 and 30	106
32	31	106
33	limit 32 to (english language and yr="2000–2011")	74

COCHRANE LIBRARY (2000–2011)

Conducted: 12 July 2011

(Bandag* OR “complex physical therapy” OR “Physical Therapy” OR “pneumatic compression” OR “manual lymphatic drainage” OR “decongestive therapy” OR flexitouch OR compression OR multilayer OR hosiery OR hose OR garment) AND (lymphedema OR lymphoedema)

EMBASE SEARCH (2000–2011)

Conducted: 11 July 2011

#	Searches	Results
1	exp lymphedema/	10228
2	exp elephantiasis/	1760
3	(Lymph?dema or elephantiasis).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	10334
4	1 or 2 or 3	11062
5	exp physiotherapy/	41044
6	exp bandage/	9160
7	exp intermittent pneumatic compression device/	362
8	compression/or compression garment/or compression bandage/	13222
9	"physical therapy".mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	10770
10	bandag*.mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	12270
11	(hosiery or hose or garment).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	2987
12	compression.mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	90097
13	"manual lymphatic drainage".mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	163

#	Searches	Results
14	"complex physical therapy".mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	35
15	"decongestive therapy".mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	124
16	flexitouch.mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	7
17	5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16	145345
18	4 and 17	1480
19	limit 18 to (clinical trial or randomised controlled trial or controlled clinical trial or multicenter study or phase 1 clinical trial or phase 2 clinical trial or phase 3 clinical trial or phase 4 clinical trial)	158
20	randomised.ab.	266254
21	placebo.ab.	149384
22	randomly.ab.	188549
23	trial.ti.	112255
24	randomised.ab.	54792
25	20 or 21 or 22 or 23 or 24	600692
26	"systematic review".tw.	28566
27	meta-analysis.tw.	35884
28	26 or 27	57020
29	25 or 28	637318
30	18 and 29	96
31	19 or 30	191
32	31	191
33	limit 32 to yr="2000–2011"	144
34	33	144
35	limit 34 to english language	126

CINAHL EBSCOhost

Date Limit: 2000-2011

Date Searched: 12-7-11

	Search Strategy:	Results
S17	S11 and S14 and S15 Limiters - Published Date from: 20000101-20111231; English Language (43)	43
S16	S11 and S14 and S15	49
S15	S12 or S13	1312
S14	TX Bandag* OR “complex physical therapy” OR “Physical Therapy” OR “pneumatic compression” OR “manual lymphatic drainage” OR “decongestive therapy” OR flexitouch OR compression OR multilayer OR hosiery OR hose OR garment	56558
S13	(MM "Elephantiasis") OR (MM "Lymphedema")	927

S12	lymphedema or lymphoedema	1296
S11	S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8 or S9 or S10	120758
S10	(MM "Quantitative Studies") OR (MM "Systematic Review") or meta-analysis or systematic	37757
S9	(MM "Placebos")	519
S8	AB placebo* OR TI placebo*	17571
S7	AB random* allocat* (4298)	4298
S6	(MM "Random Assignment")	87
S5	TI randomi* control* trial* OR AB randomi* control* trial* (29683)	29683
S4	AB ((singl* n1 blind*) or (singl* n1 mask*)) or AB ((doubl* n1 blind*) or (doubl* n1 mask*)) or AB ((tripl* n1 blind*) or (tripl* n1 mask*)) or AB ((trebl* n1 blind*) or (trebl* n1 mask*)) (11019)	11019
S3	TI clinic* n1 trial* OR AB clinic* n1 trial* (23706)	23760
S2	PT Clinical trial	41087
S1	(MM "Clinical Trials")	5743

Appendix 6 Methodology checklist for randomised controlled trials

SIGN	**Methodology Checklist 2: Controlled Trials**		
Study identification (Include author, title, year of publication, journal title, pages)			
Guideline topic:		Key Question No:	
Checklist completed by:			
Section 1: INTERNAL VALIDITY			
In a well conducted RCT study…		**In this study this criterion is:**	
1.1	The study addresses an appropriate and clearly focused question.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.2	The assignment of subjects to treatment groups is randomised	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.3	*An adequate concealment method is used*	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.4	Subjects and investigators are kept 'blind' about treatment allocation	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.5	The treatment and control groups are similar at the start of the trial	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.6	The only difference between groups is the treatment under investigation	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.7	All relevant outcomes are measured in a standard, valid and reliable way	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.8	What percentage of the individuals or clusters recruited into each treatment arm of the study dropped out before the study was completed?		
1.9	*All the subjects are analysed in the groups to which they were randomly allocated (often referred to as intention to treat analysis)*	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.10	Where the study is carried out at more than one site, results are comparable for all sites	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable

Section 2: OVERALL ASSESSMENT OF THE STUDY				
2.1	*How well was the study done to minimise bias?* Code ++, +, or –			
2.2	If coded as +, or – what is the likely direction in which bias might affect the study results?			
2.3	Taking into account clinical considerations, your evaluation of the methodology used and the statistical power of the study, are you certain that the overall effect is due to the study intervention?			
2.4	Are the results of this study directly applicable to the patient group targeted by this guideline?			
Section 3: description OF THE STUDY (The following information is required to complete evidence tables facilitating cross-study comparisons. Please complete all sections for which information is available). PLEASE PRINT CLEARLY				
3.1	*Do we know who the study was funded by?*		□ Academic Institution □ Healthcare Industry □ Government □ NGO □ Public funds □ Other	
3.2	*How many centres are patients recruited from?*			
3.3	*From which countries are patients selected? (Select all those involved. Note additional countries after "Other")*		□ Scotland □ UK □ USA □ Canada □ Australia □ New Zealand □ France □ Germany □ Italy □ Netherlands □ Scandinavia □ Spain □ Other:	
3.4	*What is the social setting (i.e. type of environment in which they live) of patients in the study?*		□ Urban □ Rural □ Mixed	
3.5	*What criteria are used to decide who should be INCLUDED in the study?*			
3.6	What criteria are used to decide who should be EXCLUDED from the study?			
3.7	*What intervention or risk factor is investigated in the study? (Include dosage where appropriate)*			
3.8	*What comparisons are made in the study (i.e. what alternative treatments are used to compare the intervention with). Include dosage where appropriate.*			
3.9	*What methods were used to randomise patients, blind patients or investigators and to conceal the randomisation process from investigators?*			
3.10	*How long did the active phase of the study last?*			
3.11	*How long were patients followed up for, during and after the study?*			
3.12	*List the key characteristics of the patient population. Note if there are any significant differences between different arms of the trial.*			
3.13	*Record the basic data for each arm of the study. If there are more than four arms, note data for subsequent arms at the bottom of the page.*			
	Arm 1: Treatment: Sample size: No. analysed With outcome:	Arm 2: Treatment: Sample size: No. analysed With outcome:	Arm 3: Treatment: Sample size: No. analysed With outcome:	Arm 4: Treatment: Sample size: No. analysed With outcome:

	Without outcome:	Without outcome Primary outcome?	Without outcome Primary outcome?	Without outcome Primary outcome?
3.14	*Record the basic data for each IMPORTANT outcome in the study. If there are more than four, not data for additional outcomes at the bottom of the page.*			
	Outcome 1: Value: Measure: P value Upper CI Lower CI Primary outcome?	Outcome 2: Value: Measure: P value Upper CI Lower CI Primary outcome?	Outcome 3: Value: Measure: P value Upper CI Lower CI Primary outcome?	Outcome 4: Value: Measure: P value Upper CI Lower CI Primary outcome?
3.15	Notes. Summarise the author's conclusions. Add any comments on your own assessment of the study and the extent to which it answers your question. *{Much of this is likely to be contributed by GDG members).*			

Appendix 7 Documents identified from websites

	Title	Publisher	Country/ language	Publish Date	End of search date	Comments
Clinical practice guidelines						
1	Guidelines for the Diagnosis, Assessment and Management of Lymphoedema	Clinical Resource Efficiency Support Team	Northern Island/ English	2008	2007	Clinical practice guideline. Well referenced, use of evidence tables, comprehensive management of lymphoedema.
2	European Society of Lymphology: EBM guidelines on the Diagnosis and Treatment of Lymphedema	Societa Italiana di Linfangiologi a	Italy/ English	2006	no referenc e list	Document is referenced in 'Guidelines for the Diagnosis, Assessment and Management of Lymphoedema'
3	Clinical practice guidelines for the care and treatment of breast cancer: 11. Lymphoedema	Canadian Medical Association	Canada/E nglish	2001	2000	Information and recommendations for patients and clinicians on lymphoedema measurement and management.
Evidence summary report						
1	The Treatment of Lymphedema Related to Breast Cancer Evidence Summary Report #13-1	Cancer Care Ontario Program	Canadian/ English	2003	2002	Systematic review of evidence for treatment.
Australian Government funded reviews						
1	Review of current practices and future directions in the diagnosis, prevention and treatment of lymphoedema in Australia	Commonwea lth of Australia	Australia/ English	2006	2003	Outline of recent Australian initiatives, discussion of the burden of disease of lymphoedema in Australia. Impression of the current clinical management of lymphoedema and an overview of the best available evidence pertaining to the prevention, diagnosis and treatment of lymphoedema.
2	Review of research evidence on secondary lymphoedema: incidence, prevention, risk factors and treatment	National Breast and Ovarian Cancer Centre	Australia/ English	2008	2007	Describes the prevalence, incidence and nature of secondary lymphoedema following treatment for cancer. Identifies risk factors associated with the development of secondary lymphoedema and provides an overview of the evidence for strategies for prevention and treatment of secondary lymphoedema.

International consensus documents						
1	Lymphoedema Framework: International consensus: best practice for the management of lymphoedema	Medical Education Partnership Ltd	UK/English	2006	2006 (from reference list)	Consensus document, in guideline format. Good algorithms for treatment, clear, concise explanations of treatment. Comprehensive management of lymphoedema.
2	European Wound Management Association (EWMA) focus document: lymphoedema bandaging in practice	Medical Education Partnership Ltd	UK/English	2005	2005	Practical consensus document. Guidance on bandaging for upper and lower limbs, head and neck, breast and genitalia
3	Lymphoedema Framework: compression hosiery in lymphoedema	Medical Education Partnership Ltd	UK/English	2006	2006	Compilation of evidence review and guideline for the use of hosiery for lower limb lymphoedema, including trunk and genitalia.
4	Consensus document on the management of cellulitis in lymphoedema	British Lymphology Society and the Lymphoedema Support Network	UK/English	2005	N/A	Consensus document on cellulitis management.
5	The diagnosis and treatment of peripheral lymphedema: 2009 consensus document of the international society of lymphology	International Society of Lymphology	International/English	2009	2008	ISL consensus document on staging, diagnosis, assessment, treatment (non-operative and operative).
6	Consensus statement: indications for compression therapy in venous and lymphatic disease.	International Angiology	European/ English	2008	2007	International Compression Club consensus on the review of published literature on the use of compression treatments in the management of venous and lymphatic diseases.
7	Classification of compression bandages: practical aspects	American Society for Dermatologic Surgery	European/ English	2008	2007	A consensus document on the standardisation of the classification of compression bandages.
8	Best practice in managing scrotal oedema	British Journal of Community Nursing	Britain/English	2007	2007	Classification, clinical presentation and management of scrotal oedema
Australian consensus documents						
1	Australasian Lymphology Association position statement on the management of cellulitis in lymphoedema	Australasian Lymphology Association	Australia/ English	2008	2006	Australian perspective and nationally consistent principles on the management of cellulitis in lymphoedema.
2	Setting a national standard for measurement of lymphoedematous limbs	Australasian Lymphology Association	Australia/ English	2004	N/A	Protocol of circumferential measurement of arms and legs for lymphoedema.

Appendix 8 Excluded studies

Reference	Reason for exclusion
"The diagnosis and treatment of peripheral lymphedema: 2009 Consensus Document of the International Society of Lymphology." Lymphology 42 (2): 51–60.	Not a randomised study.
Andersen, L., I. Hojris, et al. (2000). "Treatment of breast-cancer-related lymphedema with or without manual lymphatic drainage: A randomized study." Acta Oncologica 39 (3): 399–405.	Not specifically on compression. Focus on MLD and not compression garments.
Bernas, M., M. Witte, et al. (2005). "Massage therapy in the treatment of lymphedema. Rationale, results, and applications." IEEE Engineering in Medicine & Biology Magazine 24(2): 58-68.	Not on compression therapy.
Box, R. C., H. M. Reul-Hirche, et al. (2002). "Physiotherapy after breast cancer surgery: Results of a randomised controlled study to minimise lymphoedema." Breast Cancer Research and Treatment 75 (1): 51–64.	Not on compression therapy. Study is focussed on an early intervention and exercise protocol.
Carmeli, E. and R. Bartoletti (2011). "Retrospective trial of complete decongestive physical therapy for lower extremity secondary lymphedema in melanoma patients." Supportive Care in Cancer 19 (1): 141–147.	Not a randomised study. Retrospective Study of CDT of lower extremity.
Chandrakaladharan, B. S., M. J. Paul, et al. (2009). "Randomized control trial to evaluate the influence of class II compression stockings in preventing the development of lymphoedema in breast carcinoma patients." Annals of Oncology Conference: IMPAKT Breast Cancer Conference Brussels Belgium. Conference Start: 20090507 Conference End: 20090509. Conference Publication: (var.pagings). 20: ii69.	Research abstract. Focussed on at risk patients.
Damstra, R. J., E. R. Brouwer, et al. (2008). "Controlled, comparative study of relation between volume changes and interface pressure under short-stretch bandages in leg lymphedema patients." Dermatologic Surgery 34(6): 773–778; discussion 778–779.	Not a randomised study. Experimental, controlled comparative study on the short term effects of short stretch bandages on leg volume in both healthy and lymphoedematous legs
De Godoy, J. M. P., L. M. O. Azoubel, et al. (2010). "Intensive treatment of leg lymphedema." Indian Journal of Dermatology 55 (2): 144–147.	Not a randomised study. Prospective quasi-randomised study.
Devoogdt, N., M. Van Kampen, et al. (2010). "Different physical treatment modalities for lymphoedema developing after axillary lymph node dissection for breast cancer: A review." European Journal of Obstetrics Gynecology and Reproductive Biology 149 (1): 3–9.	Systematic Review on low level evidence. Bandaging and compression sleeve recommendations are based on single studies and IPC based on 3 studies. These studies have been individually reviewed for this guideline.
Irdesel, J. and S. Kahraman Celiktas (2007) "[Effectiveness of exercise and compression garments in the treatment of breast cancer related lymphedema]." Turkiye Fiziksel Tip ve Rehabilitasyon Dergisi, 16–21.	Non-English, unable to translate.

Jackson, B. L. (2007). "Does literature recommend the use of physical therapy as an intervention for cancer survivors following radical mastectomy?" Rehabilitation Oncology 25(4): 3–7.	Not a randomised study. Literature review focussed on exercise for lymphoedema.
Johansson, K., K. Tibe, et al. (2005). "Low intensity resistance exercise for breast cancer patients with arm lymphedema with or without compression sleeve." Lymphology 38 (4): 167–180.	Not a randomised study. Patients randomly asked to take part in the study.
Karadibak, D., T. Yavuzsen, et al. (2008). "Prospective trial of intensive decongestive physiotherapy for upper extremity lymphedema." Journal of Surgical Oncology 97 (7): 572–577.	Not specifically on compression. Study focus is primarily on Kinesiophobia.
Karki, A., H. Anttila, et al. (2009). "Lymphoedema therapy in breast cancer patients – a systematic review on effectiveness and a survey of current practices and costs in Finland." Acta Oncologica 48(6): 850–859, 852p.	Systematic review of low level evidence. Based on fourteen studies of which twelve trials are considered to have a high risk of bias. Studies reviewed individually for this guideline.
Karki, A., R. Simonen, et al. (2001). "Efficacy of physical therapy methods and exercise after a breast cancer option: a systematic review." Critical Reviews in Physical & Rehabilitation Medicine 13(2–3): 159–190.	Systematic review of low level evidence. Four studies on elastic sleeve therapy included but methodology was considered poor. Studies reviewed individually for this guideline.
Kasseroller, R. G. and E. Brenner (2010). "A prospective randomised study of alginate-drenched low stretch bandages as an alternative to conventional lymphologic compression bandaging." Supportive Care in Cancer 18 (3): 343–350.	Does not address short stretch bandaging.
Kasseroller, R. G. and G. N. Schrauzer (2000). "Treatment of secondary lymphedema of the arm with physical decongestive therapy and sodium selenite: a review." American journal of therapeutics 7 (4): 273–279.	Not a randomised study. Review rather than study. Refers to German RCT on the effects of sodium selenite in the reduction of LE with CDT.
Kligman, L., R. K. S. Wong, et al. (2004). "The treatment of lymphedema related to breast cancer: A systematic review and evidence summary." Supportive Care in Cancer 12 (6): 421–431.	Systematic review of low level evidence. Studies reviewed individually for this guideline.
Liao, S. F., M. S. Huang, et al. (2004). "Complex decongestive physiotherapy for patients with chronic cancer-associated lymphedema." Journal of the Formosan Medical Association 103 (5): 344–348.	Not a randomised study.
Maiya, A. G., E. Olivia et al. (2008). "Effect of low energy laser therapy in the management of post-mastectomy lymphoedema." Physiotherapy Singapore 11(1): 2–5.	Not on established lymphoedema.
Martin, M. L., M. A. Hernandez, et al. (2011). "Manual lymphatic drainage therapy in patients with breast cancer related lymphoedema." BMC Cancer 11(94).	Research Protocol.
Matheny, C. and A. Snider (2011). "Complex Decongestive Physical Therapy for the Treatment of Breast Cancer-Related Lymphedema: A Systematic Review." Journal of Women's Health Physical Therapy 35(1): 25–25.	Research Poster

McNeely, M. L., D. J. Magee, et al. (2004). "The addition of manual lymph drainage to compression therapy for breast cancer related lymphedema: A randomized controlled trial." Breast Cancer Research and Treatment 86 (2): 95–106.	Not specifically on compression. Primary focus is on MLD.
Mondry, T. E., R. H. Riffenburgh, et al. (2004). "Prospective trial of complete decongestive therapy for upper extremity lymphedema after breast cancer therapy." Cancer Journal 10 (1): 42–48.	Not a randomised study.
Moseley, A. L., C. J. Carati, et al. (2007). "A systematic review of common conservative therapies for arm lymphoedema secondary to breast cancer treatment." Annals of Oncology 18 (4): 639–646.	Systematic review of low level evidence. Studies reviewed individually for this guideline.
Moseley, A. L., M. Esplin, et al. (2007). Endermologie (with and without compression bandaging)–a new treatment option for secondary arm lymphedema." Lymphology 40 (3): 129–137.	Not a randomised study. Two trials of Endermologie for lymphoedema.
Preston, N. J., K. Seers, et al. (2004). "Physical therapies for reducing and controlling lymphoedema of the limbs." Cochrane Database of Systematic Reviews(4).	Systematic review of low level evidence. Results based on three studies which have been reviewed as a part of this guideline.
Rinehart-Ayres, M. E., K. Fish, et al. (2007). "Systematic review of the use of compression pumps for upper extremity lymphedema following treatment for breast cancer." Rehabilitation Oncology 25(1): 25–25.	Research abstract of a systematic review.
Rinehart-Ayres, M., K. Fish, et al. (2010). "Use of compression pumps for treatment of upper extremity lymphedema following treatment for breast cancer: a systematic review." Rehabilitation Oncology 28(1): 10–18.	Systematic review based on low level evidence. Based on three studies, two of which had been cited as having methodological flaws. Studies reviewed individually for this guideline.
Sitzia, J., L. Sobrido, et al. (2002). "Manual lymphatic drainage compared with simple lymphatic drainage in the treatment of post-mastectomy lymphoedema: a pilot randomised trial." Physiotherapy 88(2): 99–107.	Not primarily on compression. Focus is on massage.
Stout Gergich, N. L., L. A. Pfalzer, et al. (2008). "Preoperative assessment enables the early diagnosis and successful treatment of lymphedema." Cancer 112 (12): 2809–2819.	Not a randomised study.
Swedish Council on Technology Assessment in Health, C. (2005) "Manual lymph drainage combined with compression therapy for arm lymphedema following breast cancer treatment – early assessment briefs (Alert) (Structured abstract)." Stockholm: Swedish Council on Technology Assessment in Health Care (SBU).	HTA is based on low level evidence. The three studies used have been reviewed individually as a part of this guideline.
Torres Lacomba, M., M. J. Yuste Sánchez, et al. (2010). "Effectiveness of early physiotherapy to prevent lymphoedema after surgery for breast cancer: randomised, single blinded, clinical trial." BMJ: British Medical Journal (Overseas & Retired Doctors Edition) 340: b5396–b5396.	Not on compression therapy.

Vignes, S., R. Porcher, et al. (2006). "Predictive factors of response to intensive decongestive physiotherapy in upper limb lymphedema after breast cancer treatment: A cohort study." Breast Cancer Research and Treatment 98 (1): 1–6.	Not a randomised study. Cohort study looking for predictors of response to CDT.
Wigg, J. (2009). "A pilot randomised control trial to compare a new intermittent pneumatic compression device and 12-chamber garment with current best practice in the management of limb lymphoedema." European Journal of Lymphology and Related Problems 20 (58): 16–23.	Unable to obtain the study.
Wilburn, O., P. Wilburn, et al. (2006). "A pilot, prospective evaluation of a novel alternative for maintenance therapy of breast cancer-associated lymphedema [ISRCTN76522412]." BMC Cancer 6(84).	Small Pilot study, randomisation is unclear.
Williams, A. F., A. Vadgama, et al. (2002). "A randomized controlled crossover study of manual lymphatic drainage therapy in women with breast cancer-related lymphoedema." European Journal of Cancer Care 11(4): 254–261.	Not specifically on compression. Primary focus of the study is on MLD.
Wozniewski, M., R. Jasinski, et al. (2001). "Complex physical therapy for lymphoedema of the limbs." Physiotherapy 87 (5): 252–256.	Not a randomised study. Experimental study of CPT in women with lymphoedema.

Abbreviations

ABPI	Ankle brachial pressure index
BCRL	Breast cancer-related lymphoedema
CPG	Clinical practice guideline
EWG	Expert working group
GPP	Good practice point
IPC	Intermittent pneumatic compression
LCB	Lymphoedema compression bandaging
MLD	Manual lymphatic drainage
mmHg	Millimetres of mercury
NHMRC	National Health and Medical Research Council
RCT	Randomised controlled trial
RTW	Ready to wear
SIGN	Scottish Intercollegiate Guideline Network
SR	Systematic review
SSI	Static stiffness index

Glossary

Ankle brachial pressure index	A ratio of ankle systolic blood pressure to arm systolic blood pressure that is conducted to determine arterial insufficiency in the lower limbs.
Cellulitis	A bacterial infection that presents as an acute, diffuse, spreading condition with swelling, pain and inflammation of the dermis and underlying subcutaneous tissues of the skin.
Chronic venous insufficiency	Chronic inadequate drainage of venous blood and venous hypertension (increased hydrostatic pressure in the veins of the lower limb).
Clinical practice guideline	Systematically developed statements to assist clinicians with decisions about appropriate health care for specific circumstances. Content of a guideline is based on a systematic review of clinical evidence.
Clinician	For the purposes of this clinical practice guideline (CPG), a clinician is a health professional from one of the allied health or nursing disciplines, as distinguished from a medical practitioner.
Consumer	A person or group of people who are the final users of products and or services generated within a social system.
Complex lymphoedema treatment	Involves a combination of education, skin care, manual lymphatic drainage (MLD), exercise, compression bandaging, compression garments and occasionally intermittent pneumatic compression. For the purposes of this CPG complex lymphoedema treatment is referred to as intensive therapy.
Compression	The act of pressing, squeezing, or otherwise applying pressure to an organ, tissue or body area so that they occupy a smaller volume of space.
Compression garments	Firm fitting garments that are designed to provide compression to a limb or body part, usually for long term lymphoedema management.
Dependency oedema	Fluid accumulation in the tissues which is influenced by gravity. Occurs when a limb is in a dependent position for a prolonged period of time.
Education	Verbal and written information often given to consumers about their condition as part of their overall treatment program.
Exercise	Specific exercises designed to enhance the efficiency of the muscle pump and increase lymph circulation.
Expert working group	Group of experts who have authored this CPG.
Fibrosis	Thickening and scarring of connective tissue.
Good practice point	Created in the absence of empirical evidence to inform relevant clinical practice.
Heart failure	Inability of the heart to pump enough blood to avoid congestion of the tissues. Fluid overload occurs particularly in the feet and lungs.
Holistic	The consideration of the complete person, physically and psychosocially, in the treatment of a condition.
Hyperpigmentation	The discoloration of the skin associated with venous disease. It commonly occurs in the lower legs.

Initial management	The first phase of lymphoedema management which may involve a variety of treatment approaches depending on the severity of the condition.
Intensive therapy	A phase of lymphoedema treatment where a combination of modalities are used frequently, sometimes daily. These modalities may include education, skin care, MLD, exercise, compression bandaging, compression garments and/or intermittent pneumatic compression. This is also referred to as complex lymphoedema treatment.
Intermittent pneumatic compression	A form of compression therapy that utilises an electrical air compression pump.
Lipoedema	Excess accumulation of subcutaneous fat, usually distributed on lower extremities starting from ankles to hips. Feet are usually spared.
Long term management	A phase of lymphoedema treatment where the main aim is to maintain limb volume often involving compression garments and self-management strategies.
Low platelet count	A decreased number of platelets in the blood. For the purposes of this document, a low platelet count is defined as $<75 \times 10^9$/L of blood.
Lymphoedema compression bandaging	A specialised bandaging technique used to treat lymphoedema. Lymphoedema compression bandaging utilises short stretch bandages applied in multiple layers in combination with other products.
Lymphorrhoea	The leakage of lymph through the skin in the context of severe lymphatic obstruction or overload.
Manual lymphatic drainage	A specific form of massage to stimulate the lymphatic system.
'New' lymphoedema trained clinician	Clinician who has completed lymphoedema training and is new to lymphoedema clinical practice.
Palpation	To examine by touching the skin and applying pressure to the underlying tissue.
Pitting oedema	Well defined impressions in the soft tissue formed after applying pressure on the swollen area for at least ten seconds. Pitting indicates the presence of excess interstitial fluid.
Primary lymphoedema	Results from congenital abnormality or malformation of the lymphatic system.
Randomised controlled trial	A research study where a group of patients is randomised into an experimental group and a control group. These groups are followed up for the variables/outcomes of interest.
Recommendation	Clinical practice recommendations developed by clinical experts based on high quality (level II) critically appraised evidence.
Secondary lymphoedema	Results from an acquired functional deficiency e.g. obstruction or damage of the lymphatic system.
Self lymphatic drainage	Self-administered modified version of MLD.
Skin care	A skin care regimen involving meticulous hygiene, regular moisturising, protection of skin and early identification and management of skin infections.

Systematic review	A literature review focussed on a single question that tries to identify, appraise, select and synthesise all high quality evidence relevant to the question.
Transition phase	A phase of lymphoedema treatment which occurs between the intensive and long term management phases.
Venous thromboembolism	A thrombus in the venous system. It includes deep vein thrombosis and pulmonary embolism.

Bibliography

Lymphoedema Framework. Best practice for the management of lymphoedema. International consensus. London: MEP Ltd; 2006.

The diagnosis and treatment of peripheral lymphedema. 2009 Consensus Document of the International Society of Lymphology. Lymphology 2009;42(2):51-60.

The diagnosis and treatment of peripheral lymphedema: 2013 Consensus Document of the International Society of Lymphology. Lymphology 2013;46(1):1-11.

Allied Health Workforce Advice and Coordination Unit. An Allied Health Clinical Governance Framework in Queensland Health Discussion Paper. Brisbane: Queensland Government; 2010.

Andersen L, Hojris I, Erlandsen M, Andersen J. Treatment of breast-cancer-related lymphedema with or without manual lymphatic drainage--a randomized study. Acta Oncologica 2000;39(3):399-405.

Asmussen PD, Strossenreuther RH. Compression Therapy. In: Földi M, Földi E, editors. Földi's textbook of lymphology for physicians and lymphedema therapists. 2nd ed. München, Germany: Elsevier, Urban & Fischer Verlag; 2006. p. 563-627.

Australasian Lymphology Association. Position Statement: The Management of Cellulitis in Lymphoedema. 2012; Available from: www.lymphoedema.org.au

Badger CMA, Peacock JL, Mortimer PS. A randomized, controlled, parallel-group clinical trial comparing multilayer bandaging followed by hosiery versus hosiery alone in the treatment of patients with lymphedema of the limb. Cancer 2000;88(12):2832-7.

Cameron J. Skin care for patients with chronic leg ulcers. Journal of Wound Care 1998;7(9):459-62.

Carati C, Gannon B, Piller N. Principles of anatomy and physiology in relation to compression of the upper limb and thorax. In: Lymphoedema Framework, editor. Template for practice: Compression hosiery in upper body lymphoedema. London: MEP Ltd; 2009. p. 6-15.

Casley-Smith JR, Casley-Smith JR. Lymphedema initiated by aircraft flights. Aviation Space and Environmental Medicine 1996;67(1):52-6.

Clark M. Compression bandages: principles and definitions. In: European Wound Management Association, editor. Understanding Compression Therapy. London: MEP Ltd; 2003. p. 5-7.

Clark M, Krimmel G. Lymphoedema and the construction and classification of compression hosiery. In: Lymphoedema Framework, editor. Template for practice: compression hosiery in lymphoedema. London: MEP Ltd; 2006. p. 2-4.

Clinical Epidemiology and Health Service Evaluation Unit, Melbourne Health. Clinical Practice Guidelines for the Management of Delirium in Older People. In collaboration with the Delirium Clinical Guidelines Expert Working Group. 2006. Available from: http://paweb.sth.health.qld.gov.au/projects/steadi/documents/dem_clin_gline_dem.pdf

Clinical Resource Efficiency Support Team. Guidelines for the diagnosis, assessment and management of lymphoedema. CREST; 2008; Available from: http://www.gain-ni.org/Guidelines/CrestGuidelines.pdf.

Damstra RJ, Partsch H. Compression therapy in breast cancer-related lymphedema: A randomized, controlled comparative study of relation between volume and interface pressure changes. Journal of Vascular Surgery 2009;49(5):1256-63.

Didem K, Ufuk YS, Serdar S, Zumre A. The comparison of two different physiotherapy methods in treatment of lymphedema after breast surgery. Breast Cancer Research and Treatment 2005;93(1):49-54.

Doherty D, Morgan P, Moffatt C. Role of hosiery in lower limb lymphoedema. In: Template for practice: Compression hosiery in lymphoedema London: Medical Education Partnership; 2006. Available from: http://www.woundsinternational.com/pdf/content_177.pdf.

Földi E, Junger M, Partsch H. The Science of Lymphoedema Bandaging. In: European Wound Management Association, editor. Focus Document: Lymphoedema Bandaging in Practice London: MEP Ltd; 2005. p. 2-4.

Földi M, Földi E. Lymphostatic Diseases. In: Földi M, Földi E, editors. Földi's textbook of lymphology for physicians and lymphedema therapists. 2nd ed. München, Germany: Elsevier, Urban & Fischer Verlag; 2006.

Földi M, Földi E, Strössenreuther RHK, Kubik S. Földi's textbook of lymphology for physicians and lymphedema therapists. München, Germany: Elsevier, Urban & Fischer Verlag; 2006.

Gavish I, Brenner B. Air travel and the risk of thromboembolism. Internal and Emergency Medicine 2011;6(2):113-6.

Graham PH. Compression prophylaxis may increase the potential for flight-associated lymphoedema after breast cancer treatment. Breast 2002;11(1):66-71.

Gultig O. Lymphoedema bandaging for the head, breast and genitalia. In: European Wound Management Association, editor. Lymphoedema Bandaging in Practice. London: MEP Ltd.; 2005. Available from: http://www.woundsinternational.com/pdf/content_179.pdf.

Haghighat S, Lotfi-Tokaldany M, Yunesian M, Akbari ME, Nazemi F, Weiss J. Comparing two treatment methods for post mastectomy lymphedema: complex decongestive therapy alone and in combination with intermittent pneumatic compression. Lymphology 2010;43(1):25-33.

Irdesel J, Kahraman C. Effectiveness of exercise and compression garments in the treatment of breast cancer related lymphedema. Turkiye Fiziksel Tip ve Rehabilitasyon Dergisi, 2007;53:16-21.

Kasseroller RG, Brenner E. A prospective randomised study of alginate-drenched low stretch bandages as an alternative to conventional lymphologic compression bandaging. Supportive Care in Cancer 2010;18(3):343-50.

Khan NA, Rahim SA, Anand SS, Simel DL, Panju A. Does the clinical examination predict lower extremity peripheral arterial disease? JAMA 2006;295(5):536-46.

Kozanoglu E, Basaran S, Paydas S, Sarpel T. Efficacy of pneumatic compression and low-level laser therapy in the treatment of postmastectomy lymphoedema: a randomized controlled trial. Clinical Rehabilitation 2009;23(2):117-24.

Mayrovitz HN. The standard of care for lymphedema: current concepts and physiological considerations. Lymphatic Research and Biology 2009;7(2):101-8.

Moffatt C. Compression hosiery in lymphoedema. In: Template for practice: compression hosiery in lymphoedema. London: MEP Ltd; 2006. Available from: http://www.woundsinternational.com/pdf/content_177.pdf.

Moffatt C, Morgan P, Doherty D. The Lymphoedema Framework: a consensus on lymphoedema bandaging. In: European Wound Management Association, editor. Lymphoedema Bandaging in Practice. London: MEP Ltd; 2005. p. 5-9.

Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Medicine 2009;6(7):e1000097.

Mortimer PS. Managing lymphoedema. Clinical and Experimental Dermatology 1995;20(2):98-106.

National Health and Medical Research Council. NHMRC levels of evidence and grades for recommendations for developers of guidelines. 2009. Available from: http://www.nhmrc.gov.au/_files_nhmrc/file/guidelines/evidence_statement_form.pdf

National Health and Medical Research Council's National Institute of Clinical Studies. Clinical Practice Guideline for the Prevention of Venous Thromboembolism (Deep Vein Thrombosis and Pulmonary Embolism) in Patients Admitted to Australian Hospitals. In collaboration with a 16 member multidisciplinary committee of experts. 2009. Available from: http://www.nhmrc.gov.au/guidelines/publications/cp115

National institute for health care and excellence. Recognition and Assessment of Coeliac disease. 2009. Available from: http://guidance.nice.org.uk/CG86

National Lymphoedema Network. Position Statement of the National Lymphedema Network: Lymphedema Risk Reduction Practices. 2012. Available from: www.lymphnet.org

Partsch H. The static stiffness index: a simple method to assess the elastic property of compression material in vivo. Dermatologic Surgery 2005;31(6):625-30.

Partsch H, Clark M, Mosti G, Steinlechner E, Schuren J, Abel M, et al. Classification of compression bandages: practical aspects. Dermatologic Surgery 2008;34(5):600-9.

Partsch H, Flour M, Smith PC, International Compression Club. Indications for compression therapy in venous and lymphatic disease consensus based on experimental data and scientific evidence. Under the auspices of the IUP. International Angiology 2008;27(3):193-219.

Partsch H, Junger M. Evidence for the use of compression hosiery in lymphoedema. In: Lymphoedema Framework, editor. Template for practice: Compression hosiery in upper body lymphoedema. London: MEP Ltd.; 2006.

Pilch U, Wozniewski M, Szuba A. Influence of compression cycle time and number of sleeve chambers on upper extremity lymphedema volume reduction during intermittent pneumatic compression. Lymphology 2009;42(1):26-35.

Regnard C, Allport S, Stephenson L. ABC of palliative care. Mouth care, skin care, and lymphoedema. BMJ (Clinical Research Ed.) 1997;315(7114):1002-5.

Schuren J, Mohr K. Pascal's law and the dynamics of compression therapy: a study on healthy volunteers. International Angiology 2010;29(5):431-5.

Scottish Intercollegiate Guideline Network. SIGN 50: A Guideline Developer's Handbook. 2008; Available from: http://www.sign.ac.uk/pdf/sign50.pdf

Stout Gergich NL, Pfalzer LA, McGarvey C, Springer B, Gerber LH, Soballe P. Preoperative assessment enables the early diagnosis and successful treatment of lymphedema. Cancer 2008;112(12):2809-19.

Swedborg I. Effectiveness of combined methods of physiotherapy for post-mastectomy lymphoedema. Scandinavian Journal of Rehabilitation Medicine 1980;12(2):77-85.

Szolnoky G, Lakatos B, Keskeny T, Varga E, Varga M, Dobozy A, et al. Intermittent pneumatic compression acts synergistically with manual lymphatic drainage in complex decongestive physiotherapy for breast cancer treatment-related lymphedema. Lymphology 2009;42(4):188-94.

Szuba A, Achalu R, Rockson SG. Decongestive lymphatic therapy for patients with breast carcinoma-associated lymphedema. A randomized, prospective study of a role for adjunctive intermittent pneumatic compression. Cancer 2002;95(11):2260-7.

The ADAPTE Collaboration. The ADAPTE Process: Resource Toolkit for Guideline Adaptation. 2007; Available from: www.adapte.org.

The Australian Wound Management Association, The New Zealand Wound Care Society. Australian and New Zealand clinical practice guideline for prevention and management of venous leg ulcers. Cambridge Publishing; 2011; Available from: http://www.awma.com.au/publications/2011_awma_vlug.pdf.

Todd J. Containment in the management of lymphoedema. In: R. Twycross, Jones K, Todd J, editors. Lymphoedema. Melbourne: Ausmed; 2003. p. 165 -202.

Tsai HJ, Hung HC, Yang JL, Huang CS, Tsauo JY. Could Kinesiotape replace the bandage in decongestive lymphatic therapy for breast-cancer-related lymphedema? A pilot study. Supportive Care in Cancer 2009;17(11):1353-60.

Vanscheidt, W., Ukat, A., & Partsch, H. Dose-response of compression therapy for chronic venous edema--higher pressures are associated with greater volume reduction: two randomized clinical studies. Journal of Vascular Surgery 2009; 49(2): 395-402.

Williams A, Keller M. Practical guidance on lymphoedema bandaging of the upper and lower limbs. In: European Wound Management Association, editor. Focus Document: Lymphoedema Bandaging in Practice London: MEP Ltd.; 2005. p. 10-4. Available from: http://www.woundsinternational.com/clinical-guidelines/lymphoedema-bandaging-in-practice.

Williams AF, Williams AE. 'Putting the pressure on': a study of compression sleeves used in breast cancer-related lymphoedema. Journal of Tissue Viability 1999; 9(3):89-94.

Zelikovski A, Manoach M, Giler S, Urca I. Lympha-press A new pneumatic device for the treatment of lymphedema of the limbs. Lymphology 1980; 13(2):68-73.

References

[1] Földi M, Földi E. Lymphostatic Diseases. In: Földi M, Földi E, editors. Földi's textbook of lymphology for physicians and lymphedema therapists. 2nd ed. München, Germany: Elsevier, Urban & Fischer Verlag; 2006.

[2] The diagnosis and treatment of peripheral lymphedema. 2009 Consensus Document of the International Society of Lymphology. Lymphology 2009;42(2):51-60.

[3] Lymphoedema Framework. Best practice for the management of lymphoedema. International consensus. London: MEP Ltd; 2006.

[4] Clinical Resource Efficiency Support Team. Guidelines for the diagnosis, assessment and management of lymphoedema. CREST; 2008; Available from: http://www.gain-ni.org/Guidelines/CrestGuidelines.pdf.

[5] Asmussen PD, Strossenreuther RH. Compression Therapy. In: Földi M, Földi E, editors. Földi's textbook of lymphology for physicians and lymphedema therapists. 2nd ed. München, Germany: Elsevier, Urban & Fischer Verlag; 2006. p. 563-627.

[6] The Australian Wound Management Association, The New Zealand Wound Care Society. Australian and New Zealand clinical practice guideline for prevention and management of venous leg ulcers. Cambridge Publishing; 2011; Available from: http://www.awma.com.au/publications/2011_awma_vlug.pdf.

[7] Doherty D, Morgan P, Moffatt C. Role of hosiery in lower limb lymphoedema. In: Template for practice: Compression hosiery in lymphoedema. London: Medical Education Partnership; 2006. Available from: http://www.woundsinternational.com/pdf/content_177.pdf.

[8] Khan NA, Rahim SA, Anand SS, Simel DL, Panju A. Does the clinical examination predict lower extremity peripheral arterial disease? JAMA 2006;295(5):536-46.

[9] Australasian Lymphology Association. Position Statement: The Management of Cellulitis in Lymphoedema. 2012; Available from: www.lymphoedema.org.au.

[10] Moffatt C, Morgan P, Doherty D. Lymphoedema bandaging in practice. In: European Wound Management Association, editor. London: MEP Ltd. (2005a). p. 1. Available from http://www.woundsinternational.com/clinical-guidelines/lymphoedema-bandaging-in-practice

[11] Williams A, Keller M. Practical guidance on lymphoedema bandaging of the upper and lower limbs. In: European Wound Management Association, editor. Focus Document: Lymphoedema Bandaging in Practice. London: MEP Ltd.; 2005. p. 10-4. Available from: http://www.woundsinternational.com/clinical-guidelines/lymphoedema-bandaging-in-practice.

[12] Moffatt C, Morgan P, Doherty D. The Lymphoedema Framework: a consensus on lymphoedema bandaging. In: European Wound Management Association, editor. Lymphoedema Bandaging in Practice. London: MEP Ltd; 2005. p. 5-9.

[13] Földi E, Junger M, Partsch H. The Science of Lymphoedema Bandaging. In: European Wound Management Association, editor. Focus Document: Lymphoedema Bandaging in Practice London: MEP Ltd; 2005. p. 2-4.

[14] Badger CMA, Peacock JL, Mortimer PS. A randomized, controlled, parallel-group clinical trial comparing multilayer bandaging followed by hosiery versus hosiery alone in the treatment of patients with lymphedema of the limb. Cancer 2000;88(12):2832-7.

[15] Tsai HJ, Hung HC, Yang JL, Huang CS, Tsauo JY. Could Kinesio tape replace the bandage in decongestive lymphatic therapy for breast-cancer-related lymphedema? A pilot study. Supportive Care in Cancer 2009;17(11):1353-60.

[16] Didem K, Ufuk YS, Serdar S, Zumre A. The comparison of two different physiotherapy methods in treatment of lymphedema after breast surgery. Breast Cancer Research and Treatment 2005;93(1):49-54.

[17] Mayrovitz HN. The standard of care for lymphedema: current concepts and physiological considerations. Lymphatic Research and Biology 2009;7(2):101-8.

[18] Partsch H. The static stiffness index: a simple method to assess the elastic property of compression material in vivo. Dermatologic Surgery 2005;31(6):625-30.

[19] Partsch H, Clark M, Mosti G, Steinlechner E, Schuren J, Abel M, et al. Classification of compression bandages: practical aspects. Dermatologic Surgery 2008;34(5):600-9.

[20] Schuren J, Mohr K. Pascal's law and the dynamics of compression therapy: a study on healthy volunteers. International Angiology 2010;29(5):431-5.
[21] Kasseroller RG, Brenner E. A prospective randomised study of alginate-drenched low stretch bandages as an alternative to conventional lymphologic compression bandaging. Supportive Care in Cancer 2010;18(3):343-50.
[22] Clark M. Compression bandages: principles and definitions. In: European Wound Management Association, editor. Understanding Compression Therapy. London: MEP Ltd; 2003. p. 5-7.
[23] Damstra RJ, Partsch H. Compression therapy in breast cancer-related lymphedema: A randomized, controlled comparative study of relation between volume and interface pressure changes. Journal of Vascular Surgery 2009;49(5):1256-63.
[24] Vanscheidt W, Ukat A, Partsch H. Dose-response of compression therapy for chronic venous edema—higher pressures are associated with greater volume reduction: Two randomized clinical studies. Journal of Vascular Surgery 2009;49(2):395-402.
[25] Barbenel JC, Socklingham S, Queen D. In vivo and laboratory evaluation of elastic bandages. Care, Science and Practice 1990;8(2):72-4.
[26] Gultig O. Lymphoedema bandaging for the head, breast and genitalia. In: European Wound Management Association, editor. Lymphoedema Bandaging in Practice. London: MEP Ltd.; 2005. Available from: http://www.woundsinternational.com/pdf/content_179.pdf.
[27] Partsch H, Junger M. Evidence for the use of compression hosiery in lymphoedema. In: Lymphoedema Framework, editor. Template for practice: Compression hosiery in upper body lymphoedema. London: MEP Ltd.; 2006.
[28] Todd J. Containment in the management of lymphoedema. In: R. Twycross, Jones K, Todd J, editors. Lymphoedema. Melbourne: Ausmed; 2003. p. 165 -202.
[29] Carati C, Gannon B, Piller N. Principles of anatomy and physiology in relation to compression of the upper limb and thorax. In: Lymphoedema Framework, editor. Template for practice: Compression hosiery in upper body lymphoedema. London: MEP Ltd; 2009. p. 6-15.
[30] Partsch H, Flour M, Smith PC, International Compression Club. Indications for compression therapy in venous and lymphatic disease consensus based on experimental data and scientific evidence. Under the auspices of the IUP. International Angiology 2008;27(3):193-219.
[31] Regnard C, Allport S, Stephenson L. ABC of palliative care. Mouth care, skin care, and lymphoedema. BMJ (Clinical Research Ed.) 1997;315(7114):1002-5.
[32] Andersen L, Hojris I, Erlandsen M, Andersen J. Treatment of breast-cancer-related lymphedema with or without manual lymphatic drainage--a randomized study. Acta Oncologica 2000;39(3):399-405.
[33] Irdesel J, Kahraman C. Effectiveness of exercise and compression garments in the treatment of breast cancer related lymphedema. Turkiye Fiziksel Tip ve Rehabilitasyon Dergisi, 2007;53:16-21.
[34] Moffatt C. Compression hosiery in lymphoedema. In: Template for practice: compression hosiery in lymphoedema. London: MEP Ltd; 2006. Available from: http://www.woundsinternational.com/pdf/content_177.pdf.
[35] Clark M, Krimmel G. Lymphoedema and the construction and classification of compression hosiery. In: Lymphoedema Framework, editor. Template for practice: compression hosiery in lymphoedema. London: MEP Ltd; 2006. p. 2-4.
[36] Swedborg I. Effectiveness of combined methods of physiotherapy for post-mastectomy lymphoedema. Scandinavian Journal of Rehabilitation Medicine 1980;12(2):77-85.
[37] Mortimer PS. Managing lymphoedema. Clinical and Experimental Dermatology 1995;20(2):98-106.
[38] Williams AF, Williams AE. 'Putting the pressure on': a study of compression sleeves used in breast cancer-related lymphoedema. J Tissue Viability 1999;9(3):89-94.
[39] Cameron J. Skin care for patients with chronic leg ulcers. Journal of Wound Care 1998;7(9):459-62.

[40] Stout Gergich NL, Pfalzer LA, McGarvey C, Springer B, Gerber LH, Soballe P. Preoperative assessment enables the early diagnosis and successful treatment of lymphedema. Cancer 2008;112(12):2809-19.
[41] Casley-Smith JR, Casley-Smith JR. Lymphedema initiated by aircraft flights. Aviation Space and Environmental Medicine 1996;67(1):52-6.
[42] Graham PH. Compression prophylaxis may increase the potential for flight-associated lymphoedema after breast cancer treatment. Breast 2002;11(1):66-71.
[43] National Lymphoedema Network. Position Statement of the National Lymphedema Network: Lymphedema Risk Reduction Practices. 2012; Available from: www.lymphnet.org.
[44] Gavish I, Brenner B. Air travel and the risk of thromboembolism. Internal and Emergency Medicine 2011;6(2):113-6.
[45] Zelikovski A, Manoach M, Giler S, Urca I. Lympha-press A new pneumatic device for the treatment of lymphedema of the limbs. Lymphology 1980;13(2):68-73.
[46] Haghighat S, Lotfi-Tokaldany M, Yunesian M, Akbari ME, Nazemi F, Weiss J. Comparing two treatment methods for post mastectomy lymphedema: complex decongestive therapy alone and in combination with intermittent pneumatic compression. Lymphology 2010;43(1):25-33.
[47] Pilch U, Wozniewski M, Szuba A. Influence of compression cycle time and number of sleeve chambers on upper extremity lymphedema volume reduction during intermittent pneumatic compression. Lymphology 2009;42(1):26-35.
[48] Szolnoky G, Lakatos B, Keskeny T, Varga E, Varga M, Dobozy A, et al. Intermittent pneumatic compression acts synergistically with manual lymphatic drainage in complex decongestive physiotherapy for breast cancer treatment-related lymphedema. Lymphology 2009;42(4):188-94.
[49] Szuba A, Achalu R, Rockson SG. Decongestive lymphatic therapy for patients with breast carcinoma-associated lymphedema. A randomized, prospective study of a role for adjunctive intermittent pneumatic compression. Cancer 2002;95(11):2260-7.
[50] Kozanoglu E, Basaran S, Paydas S, Sarpel T. Efficacy of pneumatic compression and low-level laser therapy in the treatment of postmastectomy lymphoedema: a randomized controlled trial. Clinical Rehabilitation 2009;23(2):117-24.
[51] Allied Health Workforce Advice and Coordination Unit. An Allied Health Clinical Governance Framework in Queensland Health Discussion Paper. Brisbane: Queensland Government; 2010.
[52] Scottish Intercollegiate Guideline Network. SIGN 50: A Guideline Developer's Handbook. 2008; Available from: http://www.sign.ac.uk/pdf/sign50.pdf.