EWMA FOCUS DOCUMENT

LYMPHOEDEMA
bandaging in practice

- The science of lymphoedema bandaging
- The Lymphoedema Framework: a consensus on lymphoedema bandaging
- Practical guidance on lymphoedema bandaging of the upper and lower limbs
- Lymphoedema bandaging for the head, breast and genitalia

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Lymphoedema bandaging in practice

CJ Moffatt

In producing a focus document, the European Wound Management Association (EWMA) has chosen the challenging topic of lymphoedema management. Much of the inspiration for and development of the key treatment programme for this condition, known as decongestive lymphatic therapy, comes from Germany. This involves a combination of skin care, manual lymphatic drainage, inelastic multi-layer compression bandaging and exercise. Although this programme of care is well established, there is little understanding of how the different treatment components work or how to optimise the effects. For this reason EWMA has launched its first focus document with the intention of gaining a European perspective on decongestive lymphatic therapy. Although all elements of this treatment, including assessment and diagnosis, are of equal importance the focus here is on compression bandaging. By reducing the remit, the intention is to broaden awareness of the principles of multi-layer compression bandaging and to widen the scope for specialist and generalist practitioners caring for patients with lymphoedema.

One of the key factors in developing a pan-European perspective lies in the development of a common language and clear definitions of the terms used. In the absence of international consensus we have adopted the following terms in this document to promote understanding:

Elastic	**Long-stretch**	
Incorporates material that exerts pressure when applied with stretch	Extensibility >100%	
Inelastic	**Short-stretch**	**Non-stretch**
Exerts pressure that increases when movement causes calf muscle to contract	Extensibility <100%	Extensibility approximately zero (e.g. zinc paste bandage, Unna boot)

Extensibility is the ability of a bandage to increase in length in response to an applied force
Adapted from Stacey M *et al*. Consensus document (in preparation)

The first paper in this focus document, by Földi, Jünger and Partsch, examines the scientific principles underpinning inelastic multi-layer compression bandaging and the effects of compression on lymphoedema. Much of the evidence on how compression works is based on research into venous disease, which has been extrapolated to lymphoedema. In addition, many studies report on the use of decongestive lymphatic therapy as a whole and it is therefore difficult to determine the precise role played by compression.

The second paper describes an important UK initiative by the Lymphoedema Framework. This paper takes a revolutionary step forward and presents a clearly defined programme of care called 'standard intensive therapy'. This can be modified according to the patient's health status and ability to undertake standard treatment. In addition, this article clarifies how these programmes of care should be used during the long-term management of this condition.

In the third paper Williams and Keller present a rationale for using inelastic multi-layer compression bandaging and offer advice on its application to the arms and lower limbs. The final paper by Gültig addresses the more complex issues involved in lymphoedema bandaging for the head, breast and genitalia. It also examines the important psychological issues facing these patients and the need for them to be involved in their own care.

Although patients with complex problems such as genital oedema require specialist care, others will be cared for in general healthcare settings or at home. The need for effective training and maintenance of skills is the key to improving standards. Increasing awareness of this common condition highlights the need for better understanding of how compression works in lymphoedema. This in turn will lead to better clinical outcomes and more cost-effective treatments.

The European Wound Management Association (EWMA) has chosen to launch a new educational initiative. This will take the form of a focus document. The key objective is to focus on a particular topic area to promote better understanding and provide clear clinical guidance. This document focuses on lymphoedema bandaging in Europe and is intended to form part of an educational campaign that will facilitate consensus in lymphoedema practice across Europe.

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The science of lymphoedema bandaging

E Földi[1], M Jünger[2], H Partsch[3]

Lymphoedema occurs when there is a fault in the lymphatic system resulting in the accumulation of fluid in the tissues. Treatment is life-long and requires maintenance therapy to reduce oedema and to prevent further complications. This paper discusses the possible mode of action underpinning high pressure compression bandaging.

INTRODUCTION

Primary lymphoedema is caused by congenital disease or a primary abnormality of the lymphatics, while secondary lymphoedema results from various insults to the lymphatic system, such as malignancy, trauma, surgery or irradiation[1]. An accurate medical diagnosis is essential to provide appropriate and effective treatment. Decongestive lymphatic therapy (DLT), based on the treatment described by Winiwarter in the 19th century[2], is the basis of successful management of this chronic condition. This is a regimen of centrifugally applied mild massage (manual lymphatic drainage), compression therapy and remedial exercises (physiotherapy), in combination with appropriate skin care. Although this approach has been used for over a century and is clearly successful, the mechanisms of action of each component remain poorly understood.

STRUCTURE AND FUNCTION OF THE LYMPHATIC SYSTEM

The basic function of the lymphatic system is to remove fluid from the interstitial tissues and return it to the venous circulation. Lymph enters blind protrusions of the lymph capillary network and is transported into valve-bearing lymph collectors that can be divided into three sections:

- *The superficial (subcutaneous or prefascial) system* drains the cutis and subcutis.
- *The deep (subfascial) system* drains lymph from the deeper structures such as the joints, synovia, nerves and muscles.
- *The visceral lymph system* consists of collectors (a subgroup of the deep lymph collectors), which run parallel to the blood vessels of the organs.

The superficial and deep systems are linked by perforating vessels, most of which move lymph from the deep system to the superficial system. The segment of the collector between two valves is called a lymphangion, which spontaneously contracts like a small heart. The valve sinuses fill with lymph, causing the proximal valves to open and the distal valves to close thus preventing retrograde flow. Contraction of the lymphangion is enhanced by movement, arterial pulsation, respiration, massage and compression[3].

PATHOPHYSIOLOGY OF LYMPHOEDEMA

Morphological and functional damage to the initial lymphatics and lymph collectors lead to stagnation of the lymphatic load, resulting in an accumulation of protein, hyaluronan, water and cell debris in the interstitial tissues and hypertension in those lymph vessels that still function[3]. This causes swelling of the limbs or in some cases the trunk, genitalia or distal anatomical structures such as the toes. The impaired transport of immune cells promotes chronic inflammation (such as recurrent cellulitis/erysipelas and venous ulceration) and may lead to tissue changes that result in fibrosclerosis (thickening of the skin) and the deposition of fat, further compromising lymph flow.

EFFECTS OF COMPRESSION

Several studies have shown an impressive reduction in swelling as a result of compression[4,5], but few have tried to elucidate the mechanism of action for this improvement. The following mechanisms may explain how compression reduces volume in a lymphoedematous limb:

- 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 patients with veno-lymphatic dysfunction
- breakdown of fibrosclerotic tissue.

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Reduction in capillary filtration

Starling's hypothesis states that the exchange of water and small molecules is governed mainly by the transcapillary hydrostatic and colloid osmotic pressures. External compression increases the interstitial pressure and prevents fluid from filtering out of the capillary network[6-8]. The role of capillary reabsorption is still a matter of debate[8]. Compression removes more water than protein from the tissue, increasing oncotic tissue pressure and reinforcing the need for sustained compression[9]. In chronic lymphoedema, therefore, success depends on continued compression.

Shift of fluid into non-compressed parts of the body

Oedematous fluid may be shifted into non-compressed distal and proximal parts of the body. Bandaging the fingers and toes and, as far as possible, using compression devices to cover proximal, non-oedematous areas of an extremity should prevent this. Manual lymphatic drainage is especially important in patients with proximal lymphoedema.

Increase in lymphatic reabsorption and stimulation of lymphatic transport

Decongestive lymphatic therapy reduces microlymphatic hypertension and improves microlymphatic dynamics in patients with lymphoedema of the lower limbs. It has been shown that microlymphatic pressure can be nearly normalised with at least two weeks of intensive manual lymphatic drainage and multi-layer short-stretch bandaging[10]. In this study a reduction in the maximum dispersion of a fluorescent dye indicated that drainage from the superficial lymph capillaries had improved.

Olszewski cannulated superficial lymph collectors in lymphoedematous and healthy human legs[11]. Using a pressure recorder, flow meter and test tube to collect lymph, the influence of an elastic bandage and contracting calf muscle (exercise) on lymph pressure and flow were measured. The results showed that both compression bandaging and exercise stimulated the movement of stagnating lymph through the lymph collector in lymphoedema patients, in which the lymphatic trunks are filled, but not in healthy individuals, in which they are empty. This supports the conclusion that compression is likely to be more effective when the intrinsic pump fails than when it is functioning normally[12].

Lymphoscintigraphy has been used to demonstrate an immediate increase in lymph drainage after manual lymphatic drainage[13] and the initiation of intermittent pneumatic compression devices[9,14]. If compression bandaging is continued (using interface pressure 40–60mmHg), the dynamics of the cutaneous lymphatic circulation remain improved[15]. However, lymphoscintigraphy has shown that several weeks of compression therapy improve disturbed lymph drainage only in some cases and not in patients with severe, indurated lymphoedema[16].

Improvement in the venous pump in patients with veno-lymphatic dysfunction

In cases with accompanying venous insufficiency compression therapy reduces venous reflux and promotes venous return. Inelastic, short-stretch bandages applied with tension to deliver a high pressure can reduce ambulatory venous hypertension[17], resulting in a reduction in capillary hypertension[18] and consequent reduction in the lymphatic load.

Subfascial lymph transport is decreased in patients with deep vein thrombosis and post-thrombotic syndrome[19], but this can be improved by the application of inelastic bandages[20].

Breakdown of fibrosclerotic tissue

Although the mode of action at the molecular level is not clear, compression also helps to break down fibrosclerosis. In patients with venous leg ulceration compression accelerates blood flow in the microcirculation, favours white cell detachment from the endothelium and prevents further adhesion of the neutrophils. In lipodermosclerotic areas where skin perfusion may be reduced due to the strain associated with high tissue pressure, compression therapy can increase this gradient and improve blood flow. This leads to softened skin.

In a clinical trial the quantitative expression of the genes encoding CD14, interferon-γ receptor (IFNγR), tumour necrosis factor-alpha (TNF-α), very late antigen-4 (VLA-4), TNF receptor-1 (TNFR1) and CD44 was examined in patients with peripheral leg lymphoedema to investigate the

FOCUS ON PRACTICE

The effects of compression bandaging on lymphoedema include:

- reduced capillary fluid filtration due to enhanced tissue pressure
- reduced microlymphatic hypertension
- promotion of rhythmic lymph pulsation
- softening of fibrotic tissue, improving the function of local lymphatics

potential role of gene expression in the inflammatory response[21]. The findings suggest that pro-inflammatory cytokines and receptors for growth factors are upregulated in patients with primary and secondary lymphoedema and become downregulated after decongestive lymphatic therapy using a combination of skin care, manual lymphatic drainage, compression therapy and remedial exercises. It seems reasonable to assume that the development of fibrosclerosis in these patients is triggered by the dysregulation of these molecular mechanisms.

INELASTIC BANDAGES

Compression therapy for lymphoedema is based mainly on the use of inelastic, short-stretch bandages, which has been clinically endorsed by only one randomised controlled trial that showed a consistently greater volume reduction in lymphoedematous arms with short-stretch multi-layer bandages compared to hosiery[22].

Short-stretch materials have the specific advantage of exerting high pressure peaks intermittently during walking (a massage effect) and low resting pressures, which patients prefer at night. Expertly applied short-stretch multi-layer bandages have been shown to produce an interface pressure on the lower leg of 50–60mmHg in a supine and 70–80mmHg in a standing position[23]. Even if they are loosely applied, as may be the case with inexperienced practitioners, a pressure of 30mmHg in a supine and more than 40mmHg in a standing position may be achieved[23]. It must be noted that optimal pressures have yet to be determined. Bandaging should always be adapted to the individual, considering the circumference of the limb, the consistency of the tissue and the mobility of the patient. It is essential that the patient's age, diagnosis and other conditions such as peripheral neuropathy and diabetes also be considered prior to bandage application. Alternative forms of multi-layer compression systems can be used in combination with adhesive or cohesive bandages to make them more rigid and produce higher working pressures.

CONCLUSION

Inelastic multi-layer high compression bandaging and the long-term use of compression is clearly effective as one component of decongestive lymphatic therapy. The focus must now be on gaining a better understanding of the properties of the materials used and establishing the optimum pressures in treating lymphoedema.

REFERENCES

1. Browse NL, Stewart G. Lymphoedema: pathophysiology and classification. *J Cardiovasc Surg* (Torino) 1985; 26(2): 91-106.
2. Winiwarter A. *Die chirurgischen Krankheiten der Haut und des Zellgewebes.* Stuttgart: Verlag Ferdinand Enke, 1892.
3. Földi M, Földi E, Kubik S (eds). *Textbook of Lymphology for Physicians and Lymphedema Therapists.* San Francisco, CA: Urban & Fischer, 2003.
4. Badger C, Preston N, Seers K, Mortimer P. Physical therapies for reducing and controlling lymphoedema of the limbs. Cochrane Database Syst Rev 2004; 4: CD003141.
5. McNeely ML, Magee DJ, Lees AW, et al. The addition of manual lymph drainage to compression therapy for breast cancer related lymphoedema: a randomized controlled trial. *Breast Cancer Res Treat* 2004; 86(2): 95-106.
6. Bates DO, Levick JR, Mortimer PS. Subcutaneous interstitial fluid pressure and arm volume in lymphoedema. *Int J Microcirc Clin Exp* 1992; 11(4): 359–73.
7. Partsch H. Understanding the pathophysiological effects of compression. In: EWMA Position Document. *Understanding compression therapy*. London: MEP Ltd, 2003; 2-4.
8. Levick JR. *An Introduction to Cardiovascular Physiology*. London: Arnold, 2003.
9. Partsch H, Mostbeck A, Leitner G. [Experimental studies on the efficacy of pressure wave massage (Lymphapress) in lymphedema]. *Z Lymphol* 1981; 5(1): 35-39.
10. Franzeck UK, Spiegel I, Fischer M et al. Combined physical therapy for lymphedema evaluated by fluorescence microlymphography and lymph capillary pressure measurements. *J Vasc Res* 1997; 34(4): 306–11.
11. Olszewski WG. Lymph pressure and flow in limbs. In: Olszewski WG (ed). *Lymph Stasis: pathophysiology, diagnosis and treatment.* Boca Raton, FL: CRC Press, 1991.
12. Levick JR, McHale N. The physiology of lymph production and propulsion. In: Browse N, Burnand K, Mortimer P (eds). *Diseases of the Lymphatics*. London: Hodder Arnold, 2003; 44-64.
13. Leduc O, Bourgeois P, Leduc A. Manual lymphatic drainage: Scintigraphic demonstration of its efficacy on colloidal protein resorption. In: Partsch H (ed). *Progress in Lymphology XI*. Amsterdam: Excerpta Medica, 1988; 551-54.
14. Leduc A, Bastin R, Bourgeois P. Lymphatic reabsorption of proteins and pressotherapies. In: Partsch H (ed). *Progress in Lymphology XI*. Amsterdam: Excerpta Medica, 1988; 591-92.
15. Casley-Smith JR. Changes in the microcirculation at the superficial and deeper levels in lymphoedema: the effects and results of massage, compression, exercise and benzopyrones on these levels during treatment. *Clin Hemorheol Microcirc* 2000; 23(2-4): 335–43.
16. Földi E, Földi M, Weissleder H. Conservative treatment of lymphoedema of the limbs. *Angiology* 1985; 36(3): 171–80.
17. Partsch H. [Improving the venous pumping function in chronic venous insufficiency by compression as dependent on pressure and material]. *Vasa* 1984; 13(1): 58-64.
18. Jünger, Steins A, Hahn M, Hafner HM. Microcirculatory dysfunction in chronic venous insufficiency (CVI). *Microcirculation* 2000; 7(6 Pt 2): S3-12.
19. Lofferer O, Mostbeck A, Partsch H. [Nuclear medicine diagnosis of lymphatic transport disorders of the lower extremities]. *Vasa* 1972; 1(2): 94-102.
20. Haid H, Lofferer O, Mostbeck A, Partsch H. [Lymph kinetics in the postthrombotic syndrome under compression bandages]. *Med Klin* 1968; 63(19): 754-57.
21. Földi E, Sauerwald A, Hennig B. Effect of complex decongestive physiotherapy on gene expression for the inflammatory response in peripheral lymphedema. *Lymphology* 2000; 33(1): 19–23.
22. Badger CM, 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): 2832-37.
23. Partsch H. The use of pressure change on standing as a surrogate measure of the stiffness of a compression bandage. *Europ J Vasc Endovasc Surg* (in print).

The Lymphoedema Framework: a consensus on lymphoedema bandaging

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The Lymphoedema Framework project in the UK is a research project that involves a partnership between specialist practitioners, general clinicians, patient groups (Lymphoedema Support Network), healthcare organisations, and the wound care and compression industry. The aim of the project is to establish national provision of lymphoedema services with access to specialist practitioners and improved community services. The recommendations presented here seek to provide clear guidelines for managing the complex needs of patients with lymphoedema who require bandaging.

INTRODUCTION

A recent systematic review of physical therapies in lymphoedema has highlighted the paucity of empirical evidence to support treatment decisions[1]. This led the Lymphoedema Framework project in the UK to adopt a rigorous consensus approach in defining current best practice[2]. The methodology involved a systematic review of physical therapies, together with a review of the literature and other national (Dutch[3] and German[4]) and international lymphoedema guidelines[5]. In the absence of robust evidence the recommendations within this article have drawn on research from a number of key areas[6,7].

PROGRAMMES OF CARE

There are no internationally agreed criteria for patients requiring lymphoedema treatment. Throughout Europe reference is made to decongestive lymphatic therapy as a treatment programme; however, this is a broad term encompassing a number of treatment modalities and is open to different interpretations. For this reason, the Lymphoedema Framework project in the UK has developed detailed programmes of care, which clearly define treatment options. The main programme of care is called 'standard intensive therapy' and modified versions of this have been developed. Figure 1 shows the different programmes of care available for certain groups of patients, based on their health status and ability to undertake standard intensive therapy.

In the UK where lymphoedema services are sparse, decisions on treatment are frequently based on the degree of severity. The emphasis has therefore been on providing intensive treatment for severe, complex cases rather than being able to offer earlier intervention for patients with milder degrees of swelling, thus preventing long-term deterioration.

A comprehensive assessment that defines the type and severity of lymphoedema, as well as social and psychological factors that influence treatment, is required for all patients[8]. This process will also define whether specialist intervention is needed or whether care can be delivered within a general healthcare setting. Appropriate training will be required for all practitioners who deliver care to this patient group[9].

RECOMMENDATIONS FOR THE CHOICE OF BANDAGING

A systematic review has shown that bandaging and hosiery, when used in combination, are more effective at reducing and maintaining limb volume reduction over six months than using hosiery alone[10]. However there is little research on the many different combinations of bandages or different bandage application techniques.

While it is recognised that multi-layer lymphoedema bandaging is most often applied during intensive treatment it may also be used as part of a long-term management programme in certain groups of patients who are unable to wear hosiery. Multi-layer bandaging can also be used effectively to aid symptom control in patients with cancer-related lymphoedema and frail patients with complex medical problems[11,12]. It is essential that practitioners understand how application techniques can affect the performance of the bandage systems recommended for these individual groups. Lymphoedema multi-layer bandage systems usually involve the use of inelastic bandages (e.g. short-stretch). These provide low resting pressures when the patient is at rest and high working pressures during exercise when the muscles are engaged[13]. Inelastic multi-layer bandaging is central to the standard intensive therapy programme presented here. For patients with lymphoedema and venous ulceration or in immobile patients the recommendations offer the option of using either inelastic or elastic multi-layer bandage systems.

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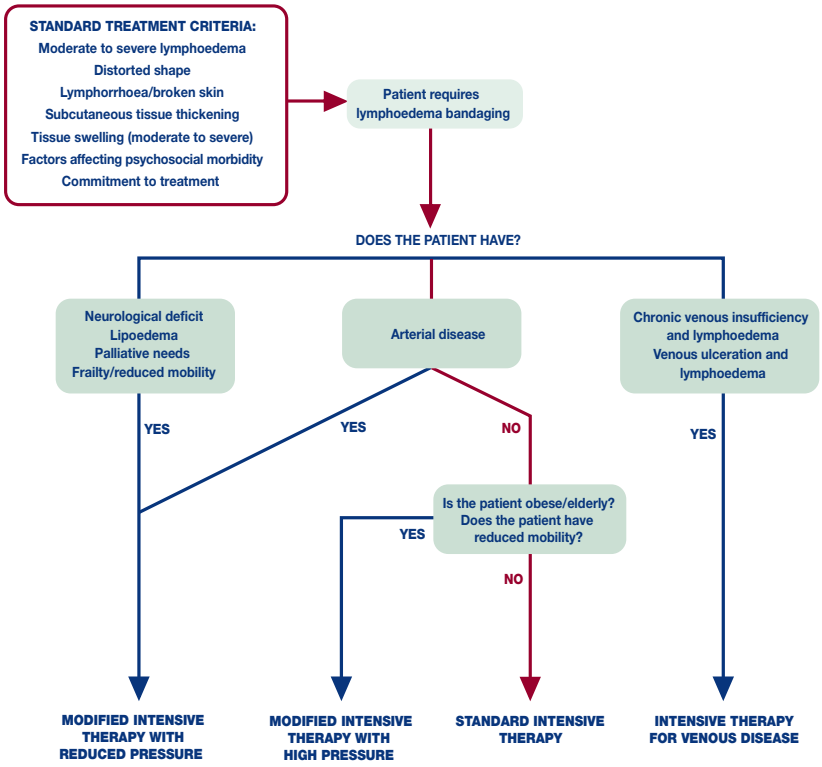

FIGURE 1 Treatment options for patients with moderate to severe lymphoedema. The different programmes of care are:

- **Standard intensive therapy:** skin care, manual lymphatic drainage, exercise and inelastic multi-layer bandaging undertaken daily by a trained specialist practitioner over 2–4 weeks.
- **Modified intensive therapy with high pressure:** skin care, exercise and inelastic multi-layer bandaging undertaken 3 times weekly for patients unable to commit to standard intensive therapy.
- **Modified intensive therapy with reduced pressure:** skin care, exercise and inelastic multi-layer bandaging undertaken 3 times weekly by a trained practitioner over 2–4 weeks.
- **Intensive therapy for venous disease:** skin care, exercise and inelastic or elastic multi-layer bandaging undertaken 1–3 times weekly by a trained practitioner.

NOTE: These are recommended programmes of care. The frequency of bandaging changes will vary according to the severity of lymphoedema, wound status and local treatment facilities.

TREATMENT OPTIONS

Standard intensive therapy (high compression >45mmHg)

This regimen is recommended for patients who meet the standard criteria for treatment (Fig 1) and who are able to undergo a daily intensive treatment programme. Patients in this group may also have swelling involving the root of the limb. Patients need to be reasonably mobile in order to participate in exercise programmes designed to enhance the effects of bandaging.

The bandaging regimen recommended frequently requires the use of different density foams to reduce fibrosis and correct limb distortion – individual foam templates may be required for each individual patient. Inelastic bandages of varying sizes are used in combination and application techniques are adapted for specific clinical problem areas such as forefoot oedema. Due to the resource implications, patients must be carefully selected. Manual lymphatic drainage (MLD) is an integral component and should be performed by an appropriately trained practitioner. A trained lymphoedema specialist is required to deliver and monitor all aspects of treatment efficacy.

Modified intensive therapy (high compression >45mmHg)

There are a number of patient groups who require a modified version of intensive treatment, such as the elderly, obese or those who have poor mobility, but who are able to tolerate high levels of compression. These patients do not suffer from arterial occlusive disease and, in the case of leg oedema, have an ankle-brachial pressure index (ABPI) recorded by Doppler ultrasound of >0.8. Concurrent medical or mobility problems prevent them from undertaking a full intensive treatment programme and a modified version involves an adapted exercise programme (e.g. graded walking or hydrotherapy and a range of motion exercises for the extremities).

Inelastic multi-layer bandaging is recommended for these patients. Cohesive or adhesive inelastic bandages may be required to prevent slippage. In this regimen patients may only be seen three times a week, although in the first week of treatment, when oedema reduction is at its greatest, more frequent applications may be necessary. An individual exercise programme can be devised following a full assessment of the patient's functional status. This may require a physiotherapy assessment and advice on which exercises can be performed within the limited capability of the patient.

NOTE: All pressures given for treatment options are the recorded resting (supine) pressure at application.

PATIENT CRITERIA

- Patients with moderate to severe lymphoedema may be selected for standard intensive therapy
- Moderate to severe lymphoedema can be classified using a combination of ISL[5] stages (stage II and III) and excess volume as follows:
  - moderate lymphoedema: 20–40% excess limb volume
  - severe lymphoedema: >40% excess limb volume
- Other classification systems are available[3,4]

Modified intensive therapy (reduced compression 15–25mmHg)

A number of patients require a period of intensive treatment, but can only tolerate a lower level of compression (15–25mmHg). This includes patients with a mild degree of concurrent arterial occlusive disease. The pressure recommendations for this group are drawn from the International Leg Ulcer Advisory Board recommended treatment pathway. This states that patients with a reduced ABPI of 0.5–0.8 should not receive compression exceeding 25mmHg[7]. Difficulty may be experienced when measuring the ABPI in patients with lymphoedema due to the problem of insonating pulses and because a higher cuff pressure is needed to occlude the artery. If arterial involvement is suspected, specialist referral should be made before introducing compression.

Other patients requiring reduced compression include those who are frail and elderly and for whom active engagement in treatment is difficult. Particular care should be taken in patients with a neurological deficit, who have difficulty recognising complications. Lower levels of compression according to tolerance that do not compromise the arterial status of the patient can be used safely and the use of inelastic materials provides a safe resting pressure level in these patients. While the outcome of successful treatment for this category is similar to the other groups receiving intensive treatment, it is likely that resolution of the lymphoedema will be more complex and take longer.

Patients with lipoedema find it difficult to tolerate compression due to the pain caused by this treatment, although the mechanisms for this remain unclear. Low levels of compression may be recommended for these patients.

Reduced compression with inelastic multi-layer bandaging can also be used effectively as a palliative treatment for patients with cancer, and in non-cancer patients where their medical status prevents more aggressive reduction of swelling. The aim in these groups is to reduce unpleasant symptoms such as pain, heaviness or lymphorrhoea. Bandaging may be used for several weeks or as part of a longer-term maintenance programme to control the swelling.

Intensive therapy for lymphoedema with venous disease (35–45mmHg)

Patients who have had a previous deep vein thrombosis and have post-thrombotic syndrome are at risk of developing lymphoedema with intractable venous ulceration[14,15]. Recommendations on compression bandaging for the management of venous leg ulceration have been described[7,16].

These patients have different clinical problems compared to patients with venous ulceration alone and require modification of the multi-layer bandage systems. Oedema of the toes and forefoot leads to changes in the superficial lymphatics and secondary skin changes[17]. Mycosis between the toes and secondary bacterial infection are common, leading to further deterioration of the condition. Toe bandaging is required to reduce the risk of infection and to treat or prevent lymphorrhoea. If limb distortion is present specialist intervention is required with the use of foams to correct the altered limb shape. In severe cases where there is a large degree of limb distortion, oedema and fibrosis, fit patients may benefit from a period of standard intensive therapy to bring about a rapid resolution of their condition.

Traditional bandaging for venous ulceration is applied below the knee. However, if swelling extends to the thigh, full-length bandaging is necessary. Where swelling extends to the rest of the limb, genitalia or trunk, specialist intervention is required to provide the most appropriate treatment. Poor bandaging technique or inappropriate choice of bandages may cause swelling around the foot, knee and thigh. Particular care should be given to the choice of appropriate primary wound contact dressings to reduce the risk of tissue trauma, manage levels of exudate and reduce the risk of contact dermatitis. Many patients with venous ulceration have poor mobility and are unable to elevate their legs[18]. Intermittent pneumatic compression may be particularly useful for this group[19,20]. Control of the pain associated with venous ulceration is an important priority as it affects up to 80% of patients[21]. The programmes of care described raise a number of training issues that must be addressed to improve patient care. Access to a specialist practitioner to provide advice on how to modify treatments for individual patients[22] is essential.

KEY ISSUES FOR LYMPHOEDEMA TREATMENT

- Sustained high compression
- Meticulous skin hygiene
- Prevention of infection
- Manual lymphatic drainage and/or self massage
- Exercise programmes
- Patient support and education on their condition and self-management strategies
- Exclusion of arterial disease by Doppler ultrasound or pulse oximetry

General considerations

The care pathway (Fig 2) encourages practitioners to continuously document and evaluate the treatment they are providing and to consider whether patients require more intensive phases of

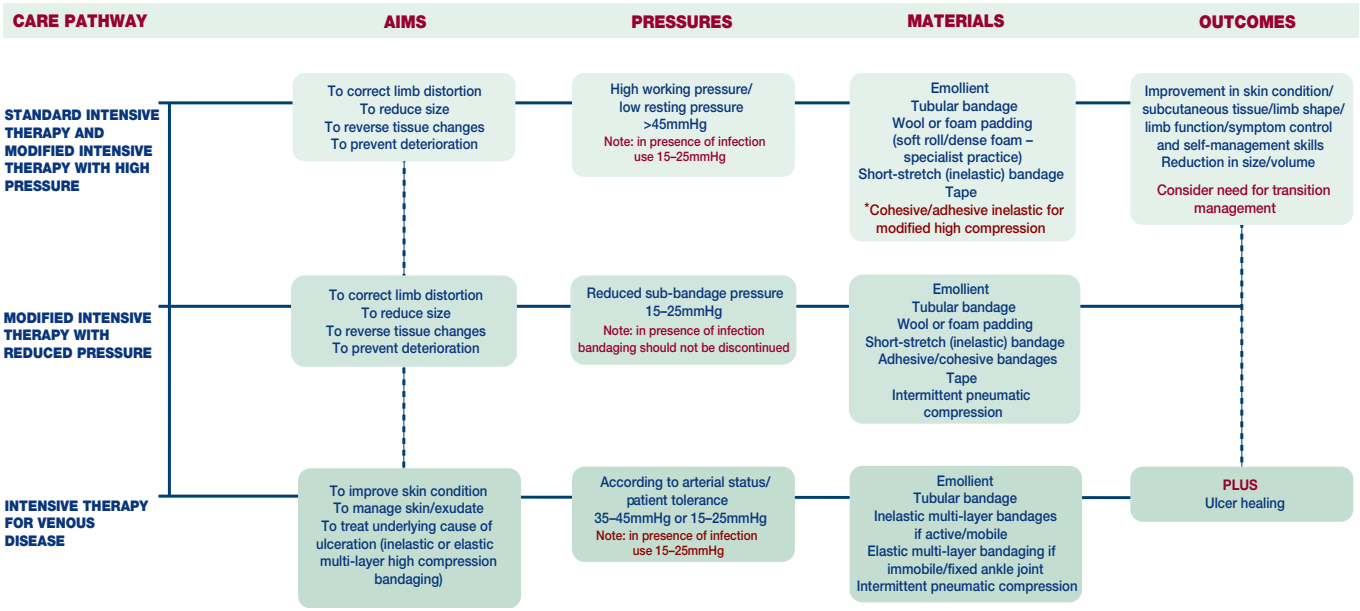

FIGURE 2 The different care pathways for patients with moderate or severe lymphoedema.

treatment or adaptations to their regimen. Lymphoedema can make it easier to develop skin infections (cellulitis) or infection of the lymph vessels/system (lymphangitis)[23]. It is proposed that effective treatment with a reduction of oedema may lead to lessening of these events, although the evidence to support this is weak[24]. During periods of acute infection all patients should receive reduced compression (15–25mmHg) and medical supervision may be required. Bandaging should not be discontinued unless the patient is unable to tolerate any pressure, and should be recommenced when the acute phase of infection has resolved.

TRANSITION TO LONG-TERM MANAGEMENT

These recommendations introduce the concept of a transition phase of treatment between the intensive phase and long-term management (Fig 3). This phase is particularly important in patients who are identified as having potential problems with rapid rebound swelling, when multi-layer bandaging is discontinued.

Transition management

The aim of the transition phase is to consolidate within three months the effects of the intensive phase of treatment and to evaluate long-term maintenance strategies. The management of this phase can be more effectively undertaken by a specialist practitioner. To prevent rebound swelling a combination of hosiery and bandaging may be required to contain the oedema and prevent deterioration.

Patients should be actively engaged wherever possible in all stages of their treatment. This requires comprehensive education and the integration of self-management programmes to promote control of their lymphoedema, including the use of self massage.

If swelling is not controlled within three months further intensive treatment should be considered or the use of adjuncts to therapy such as intermittent pneumatic compression. However, it may be that the optimum level of improvement has been attained.

Long-term management

The majority of patients will be able to manage their lymphoedema using a combination of good skin hygiene, exercise and hosiery. Long-term bandaging may be required for a small group of patients. This includes those with fragile skin who cannot or are unable to have hosiery safely applied and removed without trauma. Patients with cognitive impairment may benefit from bandaging that cannot be tampered with or rolled down. The bandage pressure required relates

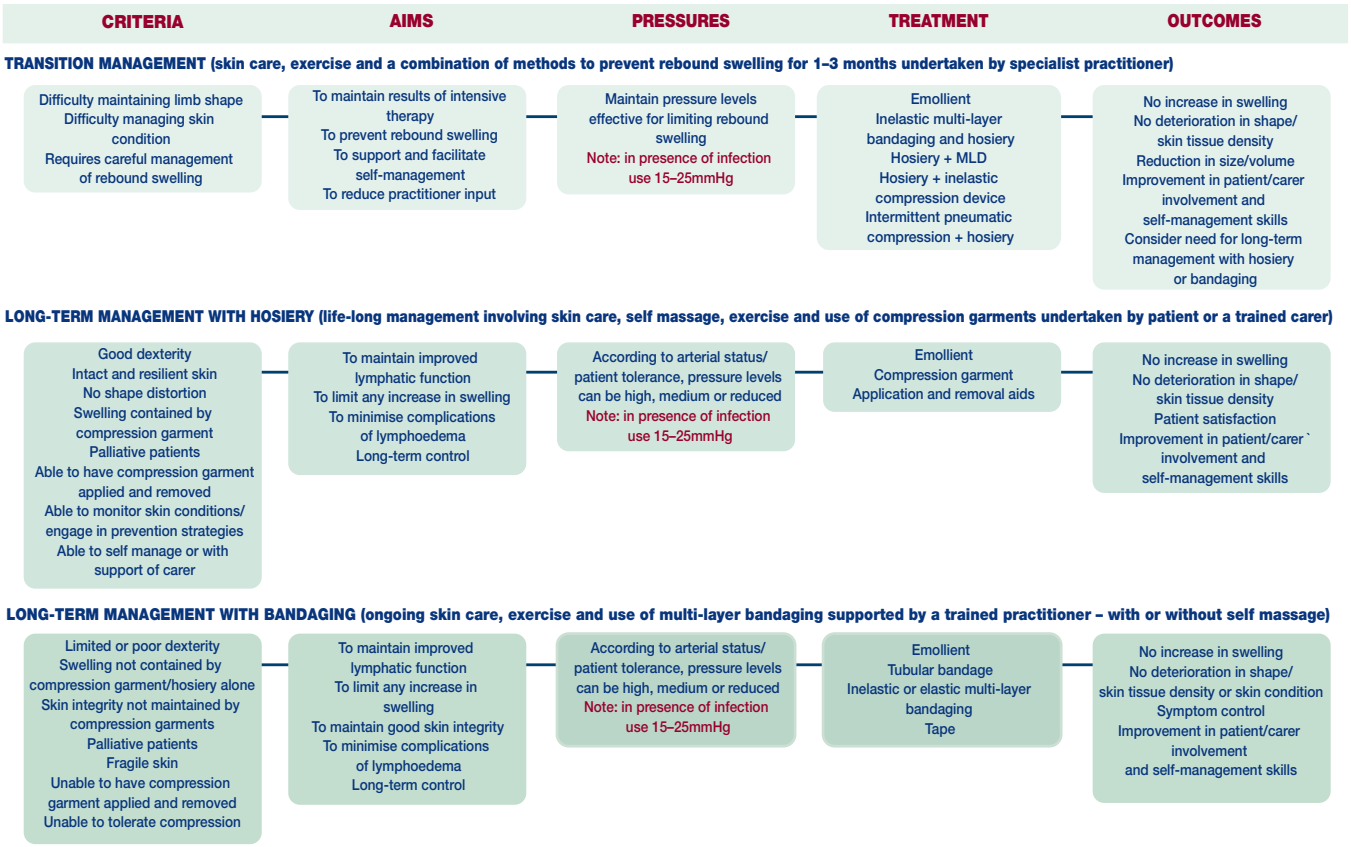

FIGURE 3 Care pathways for patients in the transition phase of treatment or long-term management with either hosiery or bandaging.

to the patient's arterial status and tolerance of compression. Particular care should be taken in maintaining skin integrity and promoting as much movement and function as possible.

CONCLUSION

Inelastic multi-layer bandaging continues to play a major role in the treatment of lymphoedema. Future research must seek to evaluate which of the many systems available are the most clinically and/or cost effective. This will enable future recommendations to be based on empirical research as well as the important knowledge gained from expert practitioners.

REFERENCES

1. Badger C, Preston N, Seers K, Mortimer P. Physical therapies for reducing and controlling lymphoedema of the limbs. Cochrane Database Syst Rev 2004; 4: CD003141.
2. Murphy MK, Black NA, Lamping DL, et al. Consensus development methods, and their use in clinical guideline development. *Health Technol Assess* 1998; 2(3): 1-88.
3. Summary of the National Guidelines for Lymphedema in the Netherlands. Available from www.lymfoedeem.nl
4. Diagnostik und Therapie der Gliedmaßenlymphödeme. AWMF-Reg. No. 058/001. Available from www.leitlinien.net
5. International Society of Lymphology. The diagnosis and treatment of peripheral lymphedema. Consensus document of the ISL. *Lymphology* 2003; 36 (2): 84-91.
6. Partsch H. Understanding the pathophysiological effects of compression. In: EWMA Position Document. *Understanding compression therapy*. London: MEP, 2003; 2-4.
7. Marston W, Vowden K. Compression therapy: a guide to safe practice. In: EWMA Position Document. *Understanding compression therapy*. London: MEP Ltd, 2003; 11-17.
8. Twycross R, Jenns K, Todd J (Eds). *Lymphoedema*. Oxford: Radcliffe Medical Press, 2000.
9. Morgan PA, Moody M, Franks PJ, et al. Assessing community nurses' level of knowledge of lymphoedema. *Br J Nurs* 2005; 14(1): 8-13.
10. Badger CM, Peacock JL, Mortimer PS. A randomised, 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; 15(88): 2832-37.
11. National Institute of Clinical Excellence. Improving supportive and palliative care for adults with cancer. London: NICE, 2004. Available from www.nice.org.uk.
12. Mortimer PS, Levick JR. Chronic peripheral oedema: the critical role of the lymphatic system. *Clin Med* 2004; 4(5): 448-53.
13. Partsch H. The Static Stiffness Index (SSI). A simple method to assess the elastic property of compression material in vivo. *Derm Surg* 2005; 31(6): 625-30.
14. Brautigam P, Földi E, Schaiper I, et al. Analysis of lymphatic drainage in various forms of leg edema using two compartment lymphoscintigraphy. *Lymphology* 1998; 31(2): 43-55.
15. Walker N, Rodgers A, Birchall N, et al. Leg ulceration as a long-term complication of deep vein thrombosis. *J Vasc Surgery* 2003; 38(6): 1331-35.
16. Cullum NA, Nelson EA, Fletcher AW, Sheldon TA. Compression for venous leg ulcers. Cochrane Database Syst Rev 2001; 2: CD000265.
17. Tiwari A, Cheng KS, Button M, et al. Differential diagnosis, investigation, and current treatment of lower limb lymphedema. *Arch Surgery* 2003; 138(2): 152-61.
18. Franks PJ, Moffatt CJ, Connolly M, et al. Factors associated with healing leg ulceration with high compression. *Age Ageing* 1995; 24(5): 407-10.
19. Vowden K. The use of intermittent pneumatic compression in venous ulceration. *Br J Nurs* 2001; 10(8): 491-509.
20. Alpagut U, Dayioglu E. Importance and advantages of intermittent external pneumatic compression therapy in venous stasis ulceration. *Angiology* 2005; 56(1): 19-23.
21. Franks PJ, Moffatt CJ. Who suffers most from leg ulceration? *J Wound Care* 1998; 7(8): 383-85.
22. Dodds SR. Shared community-hospital care of leg ulcers using an electronic record and telemedicine. *Int J Lower Extremity Wounds* 2002; 1(4): 260-70.
23. Földi M, Földi E, Kubik S (Eds). *Textbook of lymphology for physicians and lymphedema therapists*. San Francisco: Urban & Fisher, 2003.
24. Ko DS, Lerner R, Klose G, et al. Effective treatment of lymphedema of the extremities. *Arch Surg* 1998; 133(4): 452-58.

Practical guidance on lymphoedema bandaging of the upper and lower limbs

AF Williams[1], M Keller[2]

Inelastic multi-layer bandaging, when used within the context of a combined treatment approach for lymphoedema, can help to reduce excess limb volume. This paper offers a rationale for and explains the techniques used in the practical application of inelastic multi-layer bandaging.

INTRODUCTION

Multi-layer bandaging of the upper and lower limbs using inelastic bandages has become widely accepted as part of the decongestive lymphatic therapy (DLT) programme. Compression bandaging is indicated to reduce limb volume, improve limb shape, enhance or protect the condition of the skin and tissues, and manage symptoms such as lymphorrhoea. Central to the efficacy of any bandaging system is an ability to combine the scientific theory with the skilled art of bandage application after assessment of individual patient need and circumstance.

EVIDENCE BASE

There is significant experience and expert opinion to support the efficacy of inelastic bandaging systems in reducing limb volume in lymphoedema. However, there is little robust data to explain the effect of bandages on a lymphoedematous limb or inform practical bandage application. The evidence on how bandaging should be combined with interventions such as manual lymphatic drainage or intermittent sequential pressure therapy in different types of oedema is also limited.

Various studies have shown the effects of the combined decongestive lymphatic therapy programme[1-4] but do not isolate the independent effects of bandaging. However, a randomised controlled study over 24 weeks reported a greater reduction in limb volume with bandaging followed by hosiery than with hosiery alone[5]. Compression bandaging with inelastic bandages has also been shown to be an effective treatment for lymphoedema related to breast cancer[6,7].

EFFECTIVE BANDAGING

An effective multi-layer bandaging system will provide adequate pressure to reduce swelling while allowing for natural movement without causing tissue damage, allergy or altered sensation. The three fundamental principles that determine the choice of bandaging materials are:

- protection of the skin and tissue to prevent friction, tissue necrosis or a deterioration in the condition of the skin
- correction of limb shape distortion before the application of pressure bandages to achieve an even, cross-sectional distribution of sub-bandage pressure
- provision of appropriate support to the tissues, incorporating a decreasing pressure gradient from distal to proximal points.

Pressure profile

Limb shape is often altered in lymphoedema due to oedema distribution, fatty changes and fibrosclerosis. Little is known about what constitutes the optimum pressure gradient or suitable ambulatory sub-bandage pressures required to reduce lymphoedema. There is evidence that multi-layer compression bandaging is more likely to produce a graduated pressure profile in lymphoedema than single-layer bandaging[8]. Factors that influence the pressure profile are listed in Table 1[9].

A modified Laplace equation is often used to predict sub-bandage pressures. Although there are criticisms regarding accuracy[10], this equation highlights the issues that need to be considered when bandaging a limb[9,10]. These are:

- the tension of the fabric during application
- the radius of the surface of the limb
- the number of bandage layers.

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TABLE 1
Factors that influence pressure profile[9]

Intrinsic/patient factors:
Type of oedema, such as low or high-protein oedema
Limb shape
Limb circumference, particularly radius
Skin and tissue condition, such as presence of fibrosis
Patient characteristics, such as concordance, mobility and physical activity
Extrinsic factors:
Experience of practitioner
Type of padding
Type and condition of bandage
Bandage width
Number of layers and extent of overlap
Method of application and tension applied
Time since application

TABLE 2
Contraindications to high compression

Acute infection with local and/or systemic symptoms
Untreated deep venous thrombosis
Untreated cardiac failure or hypertension[11]
Untreated genital oedema
Proven arterial insufficiency (ABPI <0.5–0.8)[13,15]

LAPLACE'S LAW[10]

P = (TN x 4630) ÷ CW

P = sub-bandage pressure (mmHg)
T = bandage tension (kgf)
N = number of layers
C = limb circumference (cm)
W = bandage width (cm)

A poorly graduated pressure profile may compromise venous and lymphatic flow, preventing fluid from moving proximally and increasing venous and lymphatic hypertension. This may present as a new or persistent oedema of the hand, foot or digits, or increased shape distortion.

ASSESSMENT

A comprehensive assessment involving an accurate medical diagnosis and identification of any contraindications is a prerequisite for the safe initiation of multi-layer bandaging[11,12] (see Table 2). The programmes of care described by Moffatt *et al* (pp5–9) suggest that levels of compression should be modified according to the type of oedema, associated pathology and patient need[13]. It is essential that clinicians are aware of contraindications to high levels of compression and know when it is safe to apply bandaging.

Patients require verbal and written instructions before and during the bandaging period, including practical information on exercise and care of the bandaged limb. Advice on recognising potential problems such as signs of ischaemia, including changes in skin temperature or colour and altered sensations, should be given along with details on whom to contact if a problem arises.

PROTECTION OF THE SKIN

Tissue changes such as papillomatosis (multiple benign epidermal tumours), lymphangiectasia (excessive dilatation of the lymphatics), hyperkeratosis (thickening of the epidermis), lymphorrhoea (leakage of lymph from the skin) and increased skin folds are known complications of lymphoedema[14]. Many of these conditions improve or resolve as a result of effective compression.

General skin considerations

The skin should be carefully examined before each bandage application, particularly between digits and at joints, skin folds and creases. Appropriate emollients should be used to moisturise dry skin (sometimes a consequence of bandaging). This must be monitored carefully to prevent maceration. Sharp debridement should be avoided when managing areas of hyperkeratosis because of the increased risk of infection due to compromised immunocompetence.

Ulcers and other wounds require particular attention. Clinicians must choose an appropriate protective dressing according to the characteristics of the wound, taking into account issues such as exudate, pain and allergy[15,16].

A reduction in oedema usually enhances wound healing by stabilising homeostasis, facilitating the delivery of nutrients, growth factors and lymphocytes to the cells and speeding up the removal of waste products. This minimises the inflammatory process[14] and reduces the risk of infection.

MULTI-LAYER BANDAGING MATERIALS

Multi-layer bandaging systems commonly combine the use of a tubular bandage lining, digit bandages, padding materials and several layers of inelastic bandages applied to the whole limb. Daily bandaging, used in the 2–4 week 'standard intensive phase' of decongestive lymphatic therapy[13] may incorporate 3–4 layers of inelastic bandages and requires significant concordance with treatment. Alternative systems can be used for different patient groups[13].

Tubular bandage lining

After using an emollient a cotton or cotton-viscose tubular bandage is applied next to the skin. This protects the skin and absorbs perspiration and excess moisture. The bandage should be long enough to allow it to be folded back over the padding layer at both the hand and foot (to prevent fraying) and the groin or axilla (to prevent chafing of sensitive skin).

Digit bandages

To reduce or prevent swelling of the digits in the hand or foot, a 4–5cm wide retention bandage, secured without pressure at the wrist or foot, should be applied in several layers along the length of each digit, starting distally and finishing proximally. If the toes are small the bandage can be folded to 2–2.5cm in width. A thin strip of undercast padding may be used to protect the base of the digit, and in a small foot with short toes the bandage may be started at the ankle to minimise slippage.

Padding

The padding layer is used to:

- *Protect the skin and tissue* – to reduce the risk of pressure damage, preventing chafing and shearing. Vulnerable pressure points such as the Achilles' tendon, dorsum of the foot, tibialis anterior tendon and the malleoli may require extra protection.
- *Reshape the limb* – to a cylindrical shape in cross-section and a conical shape along the length of the limb. This provides a smooth surface for the application of bandages and allows an even distribution of cross-sectional sub-bandage pressures, with a decreasing pressure gradient from distal to proximal points.

The unique shape of each limb requires careful assessment and practitioners need to familiarise themselves with a variety of padding products. These include polyester undercast padding and polyurethane foam.

Polyester undercast padding is available in various widths and can be applied in layers along the length of the limb. It is a versatile material that can be cut, folded and shaped to fill in skinfolds or fissures and secure other padding materials. It is also used to protect vulnerable areas where the skin is easily irritated, such as the popliteal and cubital fossa.

Polyurethane foam is available in different widths, thicknesses and densities, and as bandages, sheets or individual pads. Hypoallergenic foam should always be used and the edges of any foam piece should be bevelled to prevent friction. Polyurethane foam is available as:

- *Low to medium-density foam* – this is used as a spiral bandage or cut into various shapes to fill in gaps or protect specific areas. Larger foam pieces can be used to encase the limb.
- *Higher density foam rubber pads* – these are used to provide localised pressure and/or soften fibrosis. For example the area around the malleoli is particularly vulnerable to oedema and a shaped foam insert will encourage reshaping of the ankle.
- *Foam chip bags* – these are made up of low-density foam pieces contained in a tubular bandage and can be used to bulk out areas such as the palm of the hand or in the management of fibrosis. Using a low-density foam chip bag in the palm will give the hand a more rounded shape in cross-section, increasing pressure on the dorsum of the hand and reducing pressure on the ulnar or radial border[8].

Inelastic bandage layer

Inelastic bandages are applied in one or more layers and provide a rigid casing around the limb that creates resistance (Box 1). Movement of the limb from the horizontal to dependent position or during muscular activity alters the limb geometry[17], increasing sub-bandage pressure as the tissues work against the resistance of the casing. The force produced is directed back into the limb, exerting an effect on the tissues and influencing venous and lymphatic haemodynamics[11,12].

At rest and during muscle diastole the pressure reduces, allowing the lymphatics to refill. The increase in pressure when standing up from the supine position and during walking is much higher with inelastic bandages compared with elastic bandages[9,11]. It is generally suggested that inelastic bandages produce low resting pressures and are less likely to compromise arterial flow, although the pressure produced by several layers of inelastic bandages may be significantly high immediately after application[11,18].

Due to the rapid, high volume reduction during the first 1–2 weeks[6,7,19], inelastic bandages need to be reapplied daily in this decongestive phase as the oedema dissipates and limb shape modifies. Studies have shown that sub-bandage pressure may reduce considerably in the first three hours after application[20] and clinical experience suggests that oedema reduction is greatest in the first week[19]. This supports the use of daily bandaging in that period according to the recommendations of 'standard intensive therapy'[13]. Less frequent bandaging may be indicated in some groups[13] but ongoing evaluation of progress is imperative.

Bandages are commonly applied to the whole limb and any partial bandage must extend beyond the area of swelling and incorporate the knee or elbow joint to prevent proximal displacement of fluid into the joint.

The hand should be bandaged with fingers splayed and the patient should then be asked to make a fist and pronate the forearm, with elbow slightly flexed as the arm is bandaged. This

BOX 1 INELASTIC BANDAGES

Materials:

- Constructed of crimped cotton yarns (examples include Rosidal® K, Comprilan®)
- Cohesive inelastic bandages are available (examples include Rosidal® Haft, Actico).
- Most types are available in 4cm, 6cm, 8cm, 10cm and 12cm widths

CAUTIONARY NOTES

- Pressure reduces with time
- Very high pressures may be achieved over vulnerable pressure points
- Pressures will be higher where there is a modest circumference
- Below-knee bandaging should be used with caution after careful assessment of the extent and cause of the lymphoedema as inappropriate use can cause swelling of the knee
- Significant moving and handling issues are associated with bandaging a heavy limb

reduces the risk of an overly tight bandage and allows for a better range of movement at the elbow. Feet and ankles should be bandaged with the ankle in dorsiflexion. The leg can be bandaged with the patient in a sitting or standing position. If standing, the heel should be supported on a rolled bandage to slightly flex the knee.

A combination of spiral and figure-of-eight techniques is normally used to build up layers but the effect of bandage width, overlap and layering must be continuously assessed. To avoid torquing the soft tissue, consecutive spiral bandages should be applied clockwise then counter-clockwise, although alternate layering with a figure-of-eight and a spiral will produce a more even distribution of pressure and is less likely to distort the position of the muscles.

INDICATION-SPECIFIC CONCERNS

Management of skin sacs and lobes

Large pendulous skin sacs or lobes may occur on the lower abdomen or legs, often around the knee, particularly in patients who are obese and immobile. These require specialised interventions. Individual lobes may need to be bandaged separately before being incorporated into the main bandaging system. The weight of the lobes can be supported using bulked padding underneath them, which should be secured in place by retention bandages before pressure is applied. Cohesive bandages can also be used and may be more comfortable for patients.

It is important to ensure that skin sacs or lobes are not bandaged too tightly at the root as this can create a tourniquet effect. Maceration may develop under these heavy, oedematous areas and persistent infection is common. Meticulous skin care is therefore of paramount importance.

Management of fibrosclerotic areas

Tissue affected by fibrosclerosis is firm, often non-pitting and therefore more resistant to pressure[14,21]. Like scar tissue it responds to high pressure over prolonged periods of time so various materials and products can be used over the skin to facilitate softening by creating localised friction. Commercially available foam pads or fibrosis pads constructed from small pieces of dense foam sandwiched between adhesive tape may be used with caution for short periods over fibrotic areas. These should be used only by experienced practitioners as excessive friction over several hours may lead to skin damage. Manual lymphatic drainage may also be indicated in the management of fibrosis.

Bandaging joints

A joint bandage needs to provide adequate pressure to enable reshaping but reduce the potential for shearing and friction. Where possible, the ankle and foot bandage should allow

FOCUS ON PRACTICE

- Inelastic bandages should be applied at full stretch (lock-out point) with uniform tension over the limb.
- Simple application, bandaging from distal to proximal points using a spiral method, may be adequate but experienced practitioners use a range of different techniques to create the required rigidity and pressure.
- It should be remembered that a bandage applied in a figure-of-eight may produce about 1.5–2 times the pressure than when the same bandage is applied as a spiral with a 50% overlap[22].
- Range of movement should be assessed after bandaging.
- Adequate layering is required on the dorsum of the foot or hand to prevent distal oedema. However, the foot should not be so bulky that shoes cannot be worn as normal gait is crucial to establishing an effective calf and foot muscle-pump action.
- Patients should be encouraged to play an active role in the development and evaluation of the bandage system.
- A cohesive system may stay in place longer (reduced slippage).
- Some patients may appreciate the option of removing the final layer of bandage.

BOX 2 TIPS TO REDUCE SLIPPAGE

- Use foam to pad as this is more likely to stay in place than undercast padding
- Incorporate small strips of foam between the layers of inelastic bandages at the thigh to act as a brake[23]
- Apply a cohesive bandage in one or more layers, and particularly as the final layer
- Use pantyhose over the bandage or suspenders attached at the proximal end of the bandages to avoid changing the pressure gradient

supportive footwear to be worn to normalise gait and maximise the effect of the foot and calf pump. Knees and elbows should be bandaged to ensure support, flexibility and normal movement.

Reducing slippage

As oedema reduces, particularly in the early stages of bandaging, slippage is common and can result in a tourniquet effect and significant discomfort. This is also likely to occur in obese patients with poorly shaped, short limbs. See Box 2 for tips to reduce slippage.

TRANSITION AND MAINTENANCE PHASES

Decisions on treatment length, frequency, follow-up and relevant outcome measures vary according to patient need. Appropriate compression hosiery plays an important role in the long-term control of lymphoedema and should be available immediately after bandaging. Flat-knit styles or double layers may be indicated to provide adequate containment and prevent the accumulation of fluid, but a comprehensive discussion of this aspect of care is beyond the scope of this paper. Patients who are at risk of rebound swelling may need regular maintenance manual lymphatic drainage and bandaging. Where possible, they should be taught self-bandaging and self-massage skills to increase independence and maintain improvements in their condition.

CONCLUSION

Inelastic multi-layer bandaging is one important aspect of the decongestive lymphatic therapy programme. The transport of interstitial fluid into the lymphatics relies on intermittent changes in tissue pressure brought about by movement and local massage, and is enhanced by compression therapy. There is considerable scope for research aimed at improving understanding of the sub-bandage pressure profile and the optimum pressures required to manage lymphoedema. Likewise, little is known about the effect of different materials on the lymphoedematous limb. The selection of materials may be influenced by cost, availability, wash- and reusability and personal preference, but more information is required to base decisions on relevant and scientific rationale. Although lymphoedema management requires specialist skills, as the provision of care becomes more widespread, opportunities should be explored to maximise care outcomes and ensure that treatment is widely accessible to those who require it.

REFERENCES

1. Mondry TE, Riffenburgh RH, Johnstone PA. Prospective trial of complete decongestive therapy for upper extremity lymphedema after breast cancer therapy. *Cancer J* 2004; 10(1): 42-48; discussion 17-19.
2. Szuba A, Cooke JP, Yousuf S, Rockson SG. Decongestive lymphatic therapy for patients with cancer-related or primary lymphedema. *Am J Med* 2000; 109(4): 296-300.
3. Ko DS, Lerner R, Klose G, Cosimi AB. Effective treatment of lymphedema of the extremities. *Arch Surg* 1998; 133(4): 452-58.
4. Sitzia J, Sobrido L. Measurement of health-related quality of life of patients receiving conservative treatment for limb lymphoedema using the Nottingham Health Profile. *Qual Life Res* 1997; 6(5): 373-84.
5. Badger CM, 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): 2832-37.
6. McNeely ML, Magee DJ, Lees AW, et al. The addition of manual lymph drainage to compression therapy for breast cancer related lymphedema: a randomized controlled trial. *Breast Cancer Res Treat* 2004; 86(2): 95-106.
7. Johansson K, Albertsson M, Ingvar C, Ekdahl C. Effects of compression bandaging with or without manual lymph drainage treatment in patients with postoperative arm lymphedema. *Lymphology* 1999; 32(3): 103-10.
8. Badger CM. A study of the efficacy of multi-layer bandaging and elastic hosiery in the treatment of lymphoedema and their effects on the swollen limb. PhD Thesis. London: Institute of Cancer Research, 1997.
9. Partsch H, Clark M, Bassez S, et al. Measurement of lower leg compression in vivo: Recommendations for the performance of measurements of interface pressure and stiffness: A consensus statement. *Derm Surg* (in print).
10. Melhuish JM, Clark M, Williams R, Harding KG. The physics of sub-bandage pressure measurement. *J Wound Care* 2000; 9(7): 308-10.
11. Partsch H. Understanding the pathophysiological effects of compression. In: EWMA Position Document. *Understanding compression therapy*. London: MEP Ltd, 2003; 2-5.
12. Mortimer PS, Levick JR. Chronic peripheral oedema: the critical role of the lymphatic system. *Clin Med* 2004; 4(5): 448-53.
13. Moffatt C, Morgan P, Doherty D. The Lymphoedema Framework: a consensus on lymphoedema bandaging. In: EWMA Focus Document: *Lymphoedema bandaging in practice*. London: MEP Ltd, 2005; 5-9.
14. Földi M, Földi E, Kubik S (eds). *Textbook of Lymphology for Physicians and Lymphedema Therapists*. San Francisco, CA: Urban & Fischer, 2003.
15. Marston W, Vowden K. Compression therapy: a guide to safe practice. In: EWMA Position Document. *Understanding compression therapy*. London: MEP Ltd, 2003; 11-17.
16. Macdonald JM, Sims N, Mayrovitz HN. Lymphedema, lipedema, and the open wound: the role of compression therapy. *Surg Clin North Am* 2003; 83(3): 639-58.
17. Thomas S, Nelson A. Types of compression bandage. *J Wound Care* 1998; 7(8 Suppl): SI 5-10.
18. Clark M. Compression bandages: principles and definitions. In: EWMA Position Document. *Understanding compression therapy*. London: MEP Ltd, 2003; 5-7.
19. Leduc O, Leduc A, Bourgeois P, Belgrado JP. The physical treatment of upper limb edema. *Cancer* 1998; 83(12 Suppl American): 2835-39.
20. Larsen AM, Futtrup I. Watch the pressure - it drops! *EWMA Journal* 2004; 4(2): 8-12.
21. Földi E, Jünger M, Partsch H. Science of lymphoedema bandaging. In: EWMA Focus Document. *Lymphoedema bandaging in practice*. London: MEP Ltd, 2005; 2-4.
22. Barbenel JC, Socklingham S, Queen D. *In vivo* and laboratory evaluation of elastic bandages. *Care, Science and Practice* 1990; 8(2): 72-74.
23. Strössenreuter RHK. Practical instructions for therapists - general requirements for compression bandages. In: Földi M, Földi E, Kubik S (eds). *Textbook of Lymphology for Physicians and Lymphedema Therapists*. San Francisco, CA: Urban & Fischer, 2003; 564-67.

Lymphoedema bandaging for the head, breast and genitalia

O Gültig

Anatomical areas such as the head, breast and genitalia are difficult to bandage. Patients often have to learn how to self-bandage and need a high level of support from practitioners. It is of paramount importance that the practitioner gains practical experience and has a sound theoretical understanding of wound care, skin care and the materials used for compression therapy. In the absence of literature and robust data surrounding the topic, this paper offers practical guidance on the compression techniques used.

INTRODUCTION

Compression bandaging can be used as part of decongestive lymphatic therapy to manage lymphoedema in awkward anatomical areas such as the head, breast and genitalia. In Germany most of these patients are initially decongested in specialised lymphology clinics as it may be necessary for them to receive several treatments each day if the condition is particularly severe. In most other European countries they are traditionally treated as outpatients[1]. Although effective bandaging of these areas can be difficult, patients often need to be able to apply or reapply the bandages so practitioners have a vital role in providing reliable support. This requires a sophisticated level of sensitivity and sound knowledge of the pathophysiology of lymphoedema and associated disease processes.

BANDAGING THE HEAD AND FACIAL AREA

Pronounced head, neck, facial and cervical lymphoedema is a common complication of cancer of the ear, nose and throat. Oedema can also develop in other areas, particularly in the floor of the mouth and the cheeks. Surgery and subsequent radiotherapy are usually contributing factors as secondary tissue changes in the irradiated field can cause radiation dermatitis and radiogenic fibrosis.

A feeling of constriction due to the oedema and possibly fibrosclerosis in the irradiated field can result in compromised mobility throughout the cervical spine region and in the pectoral girdle. Very often the sheer number of problems associated with the disease and its treatment lead to severe depression and psychosocial isolation[2].

Compression therapy has the potential to significantly reduce oedema. In addition, the micromassage effect of the foam padding may help to soften any radiogenic fibrosis that may be present[3]. The compression dressing technique described below is relatively easy for patients to manage and is generally comfortable and well tolerated.

PRACTICAL APPLICATION Bandaging the head and facial area

- To prevent or minimise the risk of chronic lymphoedema, compression therapy should begin as soon as possible after surgery or on identification of the first signs of lymphoedematous swelling.
- Compression therapy in the head and facial region must be applied gently and low pressures must be used to prevent paraesthesia or bruising in irradiated regions.
- The neck itself must never be involved in the compression process.
- A knitted tubular bandage is cut into a strip 12–16cm wide, folded in half and then placed in position before the insertion of the foam padding layer (Fig 1).
- To prevent chafing and capillary damage the edges of all pieces of foam are trimmed at an angle of 45 degrees.
- The padding is placed within the tubular bandage. To ensure that hygiene is maintained the piece of foam is always covered by a tubular bandage.
- It is possible to increase localised pressure by placing several layers of foam on top of one another[4,5].
- Depending on how pronounced the facial oedema is, the floor of the mouth, the lower jaw, large areas of the cheeks and the upper lip as far as the cheekbone can also be gently compressed (Fig 2).
- Custom-made compression hosiery with hook-and-loop fasteners can be used in the maintenance phase of treatment (Fig 3).

FIGURE 1

FIGURE 2

FIGURE 3

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FIGURE 4 Secondary lymphoedema of the left breast and arm.

COMPRESSION OF THE BREASTS

Cancer is the most common condition associated with lymphoedema of the breast. Breast conservation surgery is being performed with increasing frequency and often involves partial or total removal of the axillary lymph nodes[3,6]. Radiotherapy is also an increasingly integral part of treatment with the result that, in addition to the more familiar secondary arm lymphoedemas, secondary lymphoedemas of the breast are becoming more common[3,6] (Fig 4). Ongoing manual lymphatic drainage, which stimulates the lymphatic anastomoses that lead to the healthy axillary lymph nodes on the unoperated side of the body and to the inguinal lymph nodes on the same side of the body, remains the mainstay of treatment. However, it may be useful to provide mild compression of the lymphoedematous and often fibrotic breast.

PRACTICAL APPLICATION Compression of the breast

- A soft piece of thick foam (1.5–2.5cm) should be cut into a cup shape and the interior surface pared down to create a corrugated surface. Alternatively, a commercially available foam pad can be used (Fig 5). In addition to increasing the degree of compression, this helps to provide a micromassage effect that gently squeezes the fibrosis (Fig 6). A properly fitted support bra is imperative to secure the foam padding in place.
- The foam padding must be inserted in such a way as to reach underneath the armpit and to overlap the edges of the bra cup, as it is here in particular that lymph drainage can be impeded by a tourniquet effect (Fig 7). Care must also be taken to protect and pad under the shoulder straps.
- To protect the skin and enhance comfort, the interior surface of the foam should be covered with wide strips of a thin, non-occlusive fixing tape.

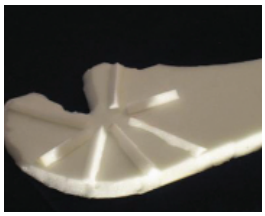

FIGURE 5

FIGURE 6

FIGURE 7

ETHICAL CONSIDERATIONS

- Clinicians are obliged to inform boys with primary genital lymphoedema that long-term compression and elevated temperatures in the testicles can result in fertility problems
- Written consent to treatment is required
- The provision of counselling and appropriate advice on sexual health is mandatory

BANDAGING THE GENITALIA

All patients with genital lymphoedema should be treated at a specialised lymphology clinic in the first phase of decongestive lymphatic therapy. If this is not possible they should be treated as outpatients at least once or twice daily for several weeks. Manual lymphatic drainage is an important part of treatment for genital lymphoedema.

Males

Therapy should begin with a low level of compression and, depending on the severity of the condition and response to treatment, be increased in consultation with the patient. It is essential that patients (or their carers/parents) learn self-bandaging skills because excess fluid can rapidly accumulate in the external genitalia if treatment is interrupted.

Maintenance therapy will be required in many cases, and commercially available scrotal and penile dressings may be used to enable a return to normal life. After successful decongestion, in consultation with the lymphologist, it may be advisable to surgically remove superfluous scrotal skin to reduce the risk of infection and oedema reformation in the flaccid tissue.

Females

The treatment of genital lymphoedema in females is more complex. A custom-made anatomically contoured foam panel at least 1cm thick can usually be used to apply adequate pressure in the oedematous, and possibly also fibrotic, region of the mons pubis and the labia. This should be covered with a tubular bandage and removable panty liner to keep the foam clean by preventing it from coming into direct contact with the skin. The gusset of the foam panel should be trimmed so that it does not impede walking.

Compression is achieved through the use of a tailored pair of compression shorts or flat-knit compression hosiery into which the foam panel is inserted. The pressure can be increased by

Pictures supplied courtesy of: Lymphologic®; Dr. med. R. Stroßenreuther; Sana Derm Bad Mergentheim, Dipl Phys T Künzel.

PRACTICAL APPLICATION Bandaging the male genitalia

- For mild to moderate lymphoedema, inelastic gauze (short-stretch) bandages usually provide adequate local pressure. These must be applied with gentle to moderate stretching force and with respect for the limits of their elasticity.
- The dressing is applied in stages (Figs 8–10) and usually only the foremost part of the penile dressing is detachable to allow for urination.
- In pronounced lymphoedema, the penis and scrotum are also padded with pieces of foam 3–4cm thick, which are applied cylindrically. These should be lined with soft surgical tape to enable even the highest pressures exerted by the inelastic gauze (short-stretch) bandage layer to be evenly distributed.
- In the scrotal region, cohesive bandages are used because they prevent slippage and pinching of the skin.
- Even the most severely congested mons pubis can be included in treatment through the use of an anatomically contoured piece of foam at least 2cm thick, with fenestrations over the hypogastrium (Fig 10), or a pair of compression shorts.

FIGURE 8 First stage of scrotal dressing with cohesive bandage

FIGURE 9 Protective tubular bandage

FIGURE 10 Foam padding and anatomically contoured panel

layering several foam panels. Extra foam cubes or self-adhesive strips can be attached to the inside of the first foam layer in the area of the mons pubis to aid the softening of fibrotic tissue.

In the maintenance and optimisation phase, commercially available compression stockings with local padding enable the patient to resume daily activities.

Wound care

The lymph system plays an important role in the body's immune response so patients with lymphoedema are vulnerable to infection. Those with head, breast and genital lymphoedema are often further compromised as a result of disease, surgery and/or radiotherapy so scrupulous skin care is essential to reduce the risk of infection[3].

Before beginning the first phase of treatment, a strict hygiene routine must be introduced. This is particularly important in patients with lymphoedema of the genitalia as they are at increased risk of erysipelas. Cellulitis and fungal infections are common in this patient group, especially in men with scrotal oedema. Special consideration should also be given to the lymphocysts and lymphocutaneous fistulas that are common in this part of the body, both before and during decongestive lymphatic therapy. Laser therapy can be used to treat these complications. Women with recurrent vulval carcinoma who have had inguinal node dissection may have a fungating lesion in the groin requiring complex management[7].

An ongoing reduction in oedema is essential to prevent additional wound healing disorders and the often fatal infections associated with them[3,4,8].

CONCLUSION

Self-treatment acquires a high priority and the patient must be familiar with and efficient in self-bandaging techniques[1]. Practitioners have a professional responsibility to ensure they are equipped with appropriate technical skills and knowledge of the available products and materials to offer guidance in achieving effective compression in these complex anatomical areas.

REFERENCES

1. Gültig O. Short-term care for lymphedema pays off. *Eur Hosp* 2001; 10(1): 8.1.
2. Bräuer B, Koscielny S, Sonnefeld U. Einfluß der manuellen Lymphdrainage auf die Lebensqualität von Patienten mit Kopf-Hals-Tumoren. In: *Lymphologie gegen Ende des 20. Jahrhunderts: Lymphologica 99*. Lippert BM, Rathcke IO, Werner JA (Hrsg.). Aachen: Shaker, 1999; 128-31.
3. Földi M, Földi E, Kubik S (eds). *Textbook of Lymphology for Physicians and Lymphedema Therapists*. San Francisco, CA: Urban & Fischer, 2003.
4. Partsch H. Understanding the pathophysiological effects of compression. In: EWMA Position Document. *Understanding compression therapy*. London: MEP Ltd, 2003; 2-4.
5. Clark M. Compression bandages: principles and definitions. In: EWMA Position Document. *Understanding compression therapy*. London: MEP Ltd, 2003; 5-7.
6. Truong PT, Olivotto IA, Whelan TJ, et al. Steering Committee on Clinical Practice Guidelines for the Care and Treatment of Breast Cancer. Clinical practice guidelines for the care and teatment of breast cancer: 16 Locoregional post-mastectomy radiotherapy. *CMAJ* 2004; 170(8): 1263-73.
7. Grocott P. Assessment of fungating malignant wounds. *J Wound Care* 1995; 4(7): 333-36.
8. MacDonald JM, Sims N, Mayrovitz HN. Lymphedema, lipedema and the open wound: the role of compression therapy. *Surg Clin N Am* 2003; 83(3): 639-58.