

Compression

made
easy

Introduction

Compression therapy using either bandages or hosiery is fundamental to venous ulcer healing and oedema control. While it is important to use the highest level of compression possible, quality of life is a vital issue and patient needs should be taken into account. The choice of bandage or hosiery system therefore requires selection on an individual basis. A good knowledge of the different systems available and how patients can be supported would enable practitioners to choose effective treatments that are properly matched to patient needs.

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UNDERSTANDING COMPRESSION THERAPY

Compression applies graduated pressure to the leg with the highest pressure at the ankle, gradually reducing towards the knee. Compression increases venous blood flow up the leg allowing fluid to drain from the tissues into the venous and lymphatic system, thereby reducing oedema (Moffatt et al, 2007).

Chronic venous hypertension (see Box 1) and oedema cause changes in the skin, tissue and shape of the leg with a high risk of ulceration. When worn consistently, compression helps to reverse or control these changes.

ROLE OF COMPRESSION BANDAGING

Compression bandages come in a variety of forms; either as inelastic (short-stretch) systems, elastic (long-stretch) systems and, more recently, as combinations of both materials. In the UK, working pressures are generally in the region of 40mmHg at the ankle, but the pressure depends on the circumference of the ankle (Moffatt et al, 2007). Wear time is usually up to 7 days but this is guided by many patient-related factors such as exudate strikethrough and the rate of oedema reduction, which may result in bandages becoming loose.

Bandaging is most often used to treat active ulceration. For some patients, bandages are used as ongoing maintenance, for those unable to tolerate hosiery or those with complex conditions such as lymphoedema, especially when the legs are large and have many skin folds. In these patients, full-leg bandaging may be required to control oedema and maintain the shape of the leg.

Box 1: Understanding venous hypertension

Blood returns to the heart via the veins and the blood is pushed upwards from the feet by the action of the calf muscle pump and a smaller pump in the foot. The pumps are activated when standing, walking or flexing the ankle joint. As the venous blood is pushed upwards, valves within the veins close to prevent backflow. If the valves are damaged they are unable to close and venous blood pools on the lower leg with a number of consequences:

- Veins swell to accommodate the extra volume of blood
- Swollen veins are visible as thread veins or ankle flare
- Chronically swollen veins are visible as varicose veins
- Fluid leaks from the swollen veins causing tissue oedema
- Red cells leak from the swollen veins and cause discolouration of the tissue (hyperpigmentation/haemosiderin staining)
- Tissue and skin are compromised by the congestion in the circulation and skin changes occur (varicose eczema, dry, flaky skin)
- The swelling and skin changes make the leg vulnerable to damage (e.g. ulceration).

Prior to compression therapy, patients must have a clear diagnosis and any comorbidities identified especially if it impacts on the safe use of compression. Individuals with significant arterial disease may suffer harm because externally applied high pressures could further reduce arterial flow (Gohel and Poskitt, 2013). A vascular assessment, including a Doppler ultrasound recording of the ankle brachial pressure index (ABPI), is essential to ascertain the extent of any compromised arterial flow (Gohel and Poskitt, 2013).

ROLE OF COMPRESSION HOSIERY

Compression hosiery is most commonly used post-ulcer healing to control oedema and reduce venous hypertension, both of which help prevent ulcer recurrence. Hosiery can also be used for active ulceration although it can be difficult to apply over some dressings especially if they are bulky and the pressure exerted by the hosiery needs to be enough to control oedema. Compression hosiery may also be used when there are early signs of venous insufficiency to help prevent the development of an ulcer.

Compression hosiery comes ready-to-wear or made-to-measure as below-knee and full-leg garments. In the UK, the most common classification systems are British Standard and German RAL standard or European class, which offers similar pressure ranges (Table 1). Hosiery delivers pressures in the range of 14 to >49mmHg and it is important to know the different pressure levels delivered by different systems. For instance, if a 'Class II' garment is applied, the practitioner would need to know whether this means up to 24mmHg or up to 32mmHg depending on whether this is British Standard or RAL Standard (Dowsett, 2011); this may be clinically relevant to the vascular status of

the patient and also relevant in terms of what the patient is able to tolerate and apply.

Many manufacturers have introduced hosiery kits where there is an inner layer (liner) delivering approximately 10mmHg to the limb. A higher pressure stocking is then applied over the top to increase the pressure to the limb. The inner layer helps the stronger outer layer to be applied more easily as it provides a smoother surface than skin.

Circular or flat knit hosiery?

Hosiery can be constructed in two ways: by a flat- or a circular knitting technique. In the UK both types are used, while in some parts of Europe, such as the Netherlands and Germany, hosiery is predominantly flat-knit. Flat-knit hosiery is made by knitting a flat piece of fabric on a loom and sewing the edges together to create a garment with a seam. The fabric tends to be relatively thick and stiff, which lets it lie across skin folds without cutting in to the skin. Circular-knit hosiery is knitted using circular needles to produce a seamless tube. The fabric tends to be finer and results in a more cosmetically-acceptable garment. It is suitable where there is no or minimal limb distortion. Flat-knit is usually used for made-to-measure garments as it can be more readily adapted to limb shape changes (Lymphoedema Framework, 2006).

BANDAGING AND HOSIERY: PRESSURE APPLIED

In general, hosiery exerts less external pressure than compression bandaging. This is important to remember when switching the patient from bandaging to hosiery once the ulcer has healed.

Bandaging will have reduced the oedema, facilitating ulcer healing; if the hosiery then exerts a much lower pressure, the oedema may increase and the leg is at high risk of breaking down again. The class of compression hosiery is mostly selected according to the capacity of the patient to apply it. Hosiery is also available in a 2-layer kit with the inner and outer layer combined designed to give pressures of 30–40mmHg at the ankle, although this will depend on the ankle circumference. The larger the circumference, the lower the pressure applied.

Generally the stiffer the fabric, the more effective it is in controlling oedema. Stiffness is calculated by measuring the pressure difference for each 1cm that the circumference of the limb increases. Stiffer, inelastic materials will resist being stretched (for example as oedema increases when a person is standing) and therefore the interface pressure will be higher than more elastic materials that do stretch (Partsch, 2005). Compression hosiery comprising inelastic, stiffer materials will be more effective at reducing oedema, but may be more difficult to apply.

EVIDENCE BASE FOR COMPRESSION

There is a wealth of evidence to support the use of compression therapy for active ulceration, prevention of recurrence and oedema control. Research tends to focus on comparing bandage systems and equivalence evaluation of new bandages

Table 1: Classification of hosiery

Class	British Standard mmHg	German RAL Standard mmHg	European Class mmHg
I	14–17	18–21	18–21
II	18–24	23–32	23–32
III	25–35	34–46	34–46
IV		>49	

In general, British Standard hosiery is used for the management of venous hypertension and European class or RAL Standard hosiery are used in the management of lymphoedema. RAL refers to a specific external testing method. The mmHg ranges refer to the pressures applied at the ankle (Wounds UK BPS, 2008)

to existing ones. Compression hosiery research includes comparisons with bandages, but more commonly is on classes of hosiery and evaluation of tolerance issues. Some key studies are presented here.

Bandage vs. bandage

Harrison et al (2012) concluded in a large multicentre trial that there were very similar costs of 4-layer and inelastic (short-stretch) bandage systems and that it was the care setting and skills of staff applying the therapy that made the difference to patient outcomes including healing rates and pain.

Lazareth et al (2012) compared a new 2-layer bandage system to a 4-layer system in 186 patients in 3 countries. Both systems afforded similar efficacy with complete wound closure achieved in 44% of patients in the 2-layer bandage group and 39% in the 4-layer bandage group. However, the 2-layer system was assessed as being easier to apply ($P=0.038$), especially in the group in France which had a marked difference in the ease of application for the 2-layer system ($P=0.001$).

Hosiery vs. bandage

Ashby et al (2014) compared a 2-layer hosiery system to a 4-layer bandage in a study involving 457 patients with venous leg ulcers who were able to receive high compression. Both systems were found to be equally effective in terms of ulcer healing. However, more patients changed from hosiery to an alternative treatment compared to those in bandaging – 38.3% hosiery (90 patients) vs 27.0% bandage (70 patients) ($P=0.02$) – mainly due to deterioration in the ulcer, discomfort or non-adherence. Post-healing, the people who wore hosiery had lower recurrence rates and the group that tolerated hosiery for ulcer treatment demonstrated greater cost-efficiency than those who did not.

Finlayson et al (2012) compared a multilayer bandage to Class III hosiery in terms of healing and quality of life of 103 patients. There was no statistical difference for healing, but there was a difference between time to healing ($P=0.018$) in favour of bandaging. There were no differences in pain or quality of life measurements between each group.

Hosiery vs. hosiery

Compression hosiery can be used in active ulceration, but lower levels of compression compared to high compression bandages may not be as effective. There may also be practical issues when

Table 2: Factors in compression therapy choices

Patient factor	Bandaging	Hosiery	Comments
Active ulceration	Suitable	Less common but use of leg ulcer hosiery kits is increasing	When using hosiery the pressure must be sufficient to control oedema and venous backflow
Healed ulceration	Suitable but resource intensive	Suitable especially if self-caring (or help available)	Bandaging as maintenance therapy has resource implications but may be necessary for oedema control and for patients with deep skinfolds
Oedema control	Suitable	Suitable if the external pressures can be tolerated	Pressure levels must be sufficient and inelastic systems may need to be applied more often until the oedema is controlled
Ability to self-care	Less common	Suitable	Some patients may be able to apply bandaging but hosiery is more usual. Some patients may be suitable for a wrap system of compression that they can apply and adjust
Not suitable for full compression	Bandage systems can be modified and reduced compression kits are available	Lower classification and less stiff fabrics can be used	Reduced compression levels can be facilitated by types and layer modifications according to manufacturer's instructions. Some systems are made for reduced compression. Class of compression hosiery can be reduced

dressings are being used because they may become dislodged when applying and removing hosiery and bulky dressings may impact on the pressure profiles.

The key function of hosiery is prevention of recurrence; the higher the pressure applied the more beneficial the effect. However, in practice, there is a trade-off between hosiery pressure, the tolerance of the patient to therapy and recurrence rates. For instance Nelson et al (2006) found that patients in Class III hosiery had the longest time between healing and recurrence compared to those in Class II, but that the non-concordance rate in Class III was 42%. Clarke-Moloney et al (2012) compared Classes I and II and found no statistical difference in time to recurrence, but more people in Class I developed recurrence; unsurprisingly people who did not wear the hosiery were much more likely to suffer recurrence.

COMPRESSION SELECTION: HOSIERY OR BANDAGING?

Assessing venous leg ulcers is more than a clinical diagnosis. It involves a holistic approach that takes into account all of the physical and psychological factors that may impact on healing. It is vital that patients are able to make choices and the variety of compression systems available makes this more likely. However it is important that practitioners are skilled in a variety of systems and understand the underlying principles of the therapy to make sure it is properly matched to the patient (Table 2). Patient lifestyle factors and preferences should therefore be taken into account as well as clinical considerations (Figure 1).

Hosiery has a variety of types, shades and colours including socks, and is a more 'normal' garment for patients and less bulky than bandages. Many patients experience more control because hosiery can be removed and reapplied as part of a self-management programme. However the practitioner must still offer support and encouragement because patients may forget to reapply the therapy or may go for periods of time without it, causing increasing oedema and risk of skin breakdown (Van Hecke et al, 2011).

Patients with oedema, especially if complicated by being overweight, will have an altered leg shape making it difficult to

ascertain where the knee joint is and they may have large skin folds especially around the ankle and knee. When applying a bandage system, padding is used to even out the shape of the limb and help ensure a graduated shape. This is much more difficult with compression hosiery as the use of padding is not practical and achieving an even pressure is more challenging.

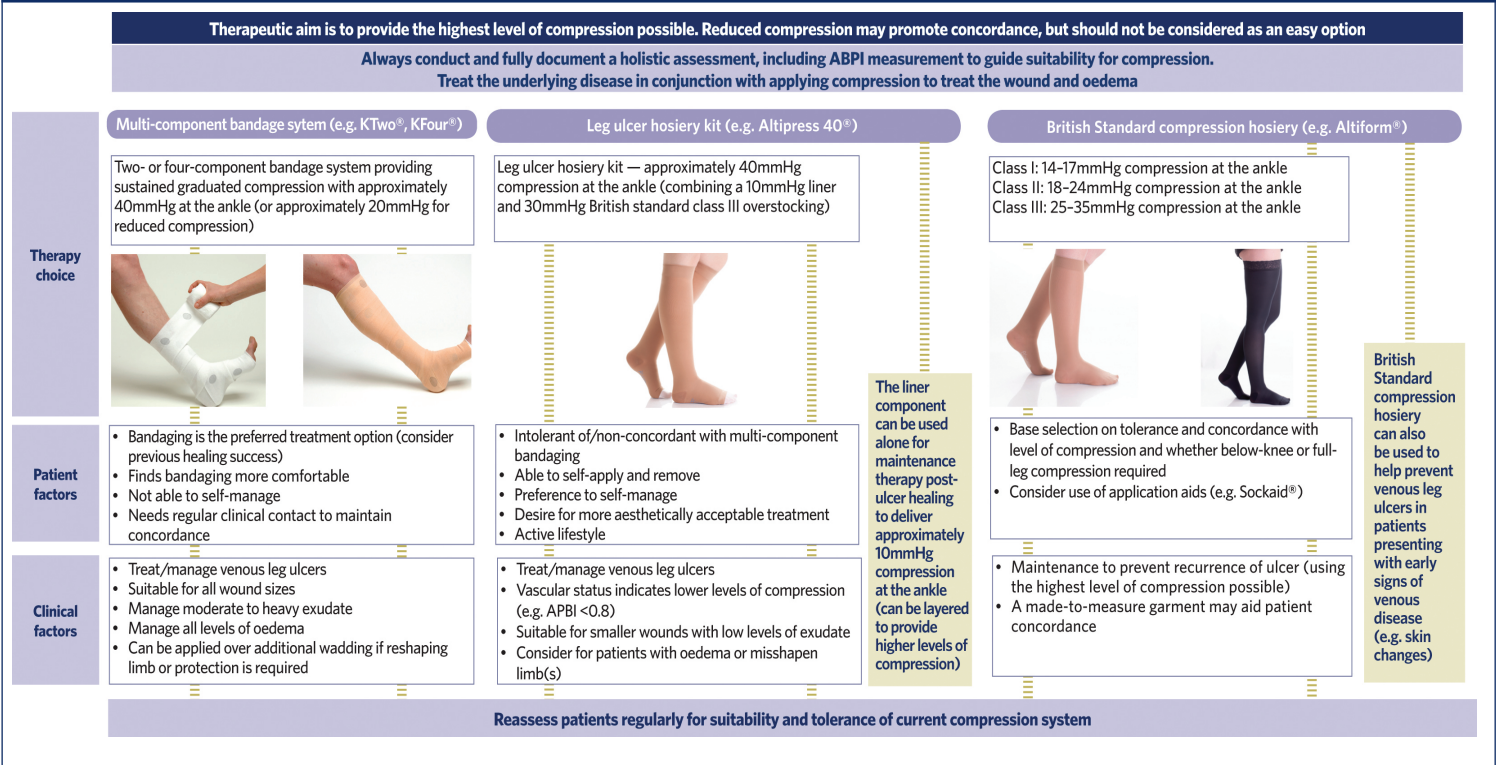
Compression bandages need to be applied according to the manufacturer's instructions and relative to the size and shape of the limb and clinical presentation otherwise the treatment may not be effective and may cause damage; for example, if the bandage is applied too loosely, it will not provide sufficient pressure, too tight and it may lead to tissue injury. Bandages can also be bulky, complicating footwear choices and, if inexpertly applied, can impede mobility affecting ankle movement and calf muscle pump action. Mobility, and at the very least flexing the ankle joint, facilitates the squeezing action of the calf muscle pump, which is very important for venous return. Impeded mobility and ill-fitting footwear will also add to the risk of falls.

PATIENT CONCORDANCE AND COMPRESSION THERAPY

Compression therapy is demanding of patients. It can be bulky, hot, increase pain and carries a risk of damage to patients' limbs if not used appropriately. In the case of compression hosiery there can be real problems for people because it can be difficult to apply and remove. The limb must be measured accurately to ensure a good fit and hosiery application aids should be offered. Patients may have good reason to adjust or remove a bandage or hosiery and this highlights the importance of being empathetic and responsive to patients' needs (Taverner et al, 2014). We would not wear something that is causing us pain or discomfort or is too difficult to manage and we must recognise this right in patients too.

Some barriers to compression therapy are psychologically based and some physical; often the two combined. The psychological impact of ulceration frequently includes the consequences of pain, exudate and malodour (González-Consuegra and Verdú, 2011). Compression therapy can increase pain for patients, but

Figure 1: Selecting the right compression for the right patient



mostly this is because the system chosen is not suitable for the patient or pain is poorly assessed and managed. Many patients find the right therapy reduces pain especially when oedema reduces and the wound begins to heal. A consequence of oedema and wound size reduction is decreased exudate, which reduces the risk of damage to periwound skin, decreases pain and skin irritation and also extends the time between bandage changes. A healing ulcer should help patients feel more in control and comfortable.

Physical barriers are often related to dexterity and obesity (Finlayson et al, 2010). Many patients with oedema and leg ulceration have other conditions such as osteo- or rheumatoid arthritis that affect strength and movement in the hands (Carpentier et al, 2011). This may result in considerable difficulty applying compression hosiery even with the use of the many aids available to assist. For an increasing number of people obesity presents practical problems in walking, doing ankle exercises and elevating the legs, all of which are important for venous return and oedema reduction (Padberg et al, 2004). Obesity may make it difficult to bend down, making hosiery application and removal difficult or impossible even with the use of aids.

PATIENT CHOICE AND THE ROLE OF EDUCATION

While the treatment of ulcers requires the clinician to select appropriate compression, this in isolation will not ensure healing in every instance. How treatments are accepted and adhered to by individuals needs careful consideration (Miller et al, 2011). This is reliant on patient knowledge and understanding of the long-term effects of venous disease and the role of compression in the prevention and treatment of venous leg ulcers.

When discussing treatment options with patients, it is important to take into account their health needs and lifestyle (Moffatt, 2004). In addition, leg elevation, foot exercises, and general health advice such as optimal sleep, diet and fluid intake all need to be part of the holistic assessment and the consequent treatment plan agreed between the nurse and patient.

As well as spending time discussing causes and treatment options with the patient, it is helpful for them to have written information to take away to read at their leisure and share with relatives and carers. Questions about treatment options at follow-up appointments should be encouraged.

Patient attitudes to and beliefs about compression often influence concordance (Moffatt, 2004). These beliefs frequently revolve around the ulcer being untreatable, particularly if the ulcer has been present for many years and there have been previous episodes of failed treatment, creating a spiral of hopelessness and helplessness (Green and Jester, 2009).

Patients who are unable to visualise or conceptualise a future where they will experience an improvement in their condition may find it difficult to engage with the therapy that is being suggested. By empathising with the patient and negotiating the objectives with a degree of sensitivity can help to establish what is achievable for them. Small, easily achievable successes in the early stages of the professional relationship do much to build up patient trust in the clinician's professional and technical capability and foster a sense of hope for the patient (Van Hecke et al, 2011).

However, it is important to discuss the long-term implications of leg ulcer deterioration. If not addressed, patients may be left with a false view that their clinical condition should be tolerated

Box 2: Compression do's and don'ts

- ✓ DO explain the consequences of venous and arterial disease in plain terms. Be prepared to repeat the information several times and check the patient's understanding
- ✓ DO enlist the help of family and friends to reinforce key messages about prevention and treatment of leg ulcers
- ✓ DO provide patients with sufficient information for them to understand the rationale for treatment
- ✓ DO acknowledge the physical and psychological issues that patients experience with venous leg ulcers
- ✗ DON'T be afraid to be honest about the consequences of not managing a leg ulcer effectively
- ✗ DON'T start with full compression if you feel that it is appropriate to gradually build up to full compression
- ✓ DO expect the relationship between the patient and nurse to take time to develop; it will influence how well the patient receives advice and their confidence in the treatment
- ✓ DO measure and record lower limb measurements so the appropriate compression bandaging or hosiery is selected. Consider repeating the circumferential measurements weekly during early compression therapy to give patients direct feedback on how the treatment is progressing
- ✓ DO consider pain as an influencing factor in completing the Doppler assessment and determining whether compression therapy is accepted and tolerated
- ✓ DO be flexible while keeping the treatment goal in mind. Practitioners need to be prepared to negotiate with patients to find solutions that encourage concordance with compression. For example, this may mean understanding how compression fits with daily living activities
- ✓ DO reassess patients regularly for suitability and tolerability of the compression therapy system and concordance with treatment. This should identify any potential problems that may affect healing or recurrence such as pain, signs of pressure damage or impact on circulation and slippage
- ✓ DO identify how much patients want to be involved in their care; effective communication between healthcare providers and patients can lessen the economic burden of non-concordance and improve outcomes for patients (Wounds International, 2012).
- ✓ DO emphasise the importance of continuing compression after the ulcer has healed. Ideally the patient should be referred to a healed ulcer service to support ongoing health promotion to prevent recurrence.

rather than it being a serious medical condition that requires life-long treatment to avoid ulcer recurrence and development of life-limiting complications. As a long-term condition, the degree to which a patient wishes to be involved will have important implications for adoption of self-care regimens (Moffatt, 2004). Some patients become experts as they learn to cope with their condition. Their insights and perspectives are crucial in developing better care and improving patient-clinician partnerships (Box 2).

PRACTICAL SOLUTIONS TO OPTIMISE CONCORDANCE

- Be honest about the consequences of non-treatment of the leg ulcer. Without accurate knowledge of the condition, patients may not see compression as worthwhile and choose not to undergo treatment. It is important to provide information on the benefits of treatment as well as the consequences of not accepting treatment so that patients can make an informed decision.

- Develop a therapeutic relationship with the patient and accept that this takes time. Trust and a rapport need to be built early on for the patient to feel confident in the practitioner's ability and the treatment provided (Green and Jester, 2009).
- Identify 'hooks' to motivate the patient. One of the practitioner's skills is to explore aspects of daily living that can be improved by effective compression, e.g. walking the dog. Another goal might be resizing a limb so that the patient can return to hosiery if the purpose of bandaging is oedema reduction. Keep goals short-term and manageable.
- Think about what you say. Avoid terms such as 'tight' or 'restrictive', which can demotivate patients before compression has even started. Terms such as 'supportive' or 'firm' may encourage greater acceptance.
- Some compression is better than no compression. A staged introduction may improve concordance for some patients who find high levels of compression difficult to tolerate. For example, 4-layer compression can be built up over a period of 4–6 weeks, with layers 1+2+3 applied in the first 2 weeks and layer 1+2+4 applied in the next couple of weeks, and then full compression to allow the patient to get used to it. This is of particular benefit for patients whose pain levels may be a factor in the adoption of compression, or those patients for whom the shifting of fluid back to the central venous system might need to be gradual due to a degree of organ failure. Similarly in terms of 2-layer systems, a reduced compression version can be used as a gentle introduction before full compression.
- Enlist family and friends to help motivate the patient to take better care of their legs. Practitioners often only have limited access to patients even if they visit them on a daily basis. Engaging the patient's social contacts early and providing education often helps to reinforce self-care regimens.
- Bulky compression bandages that restrict footwear choice may be less acceptable to patients. Low-profile compression systems (e.g. UrgoKTwo®) may be less bulky than 4-layer systems, are cooler and allow patients to wear normal footwear and clothing. This may help improve mobilisation, self-image and ability to self-manage (Greaves et al, 2014).
- Offer practical solutions. For example, patients who find wearing compression bandaging in bed problematic, suggest a simple stocking over the top to prevent bandages sticking to bed linen. A light dusting of talcum powder on the top cohesive layer of some bandaging systems can also reduce the 'stickiness' of the bandages against clothing or bed linen.
- Tell patients what to expect. For example, in the early stages of oedema reduction, particularly in patients who have not received compression before, make sure the patient is aware that slippage is to be expected.
- For patients who have had a previous bad experience with compression, take time to listen and explore reasons why they are reluctant to accept compression.

SUMMARY

Compression as a therapy only works if it is worn consistently. To facilitate this, patients need to have choice and know that if they cannot tolerate one type of bandage or hosiery there are others they can try. The range of compression makes this feasible but practitioners need to have competencies for different systems and a thorough knowledge of the principles of compression.

Case study: The importance of compression choice in a non-concordant patient

Background

An 80-year-old female with poorly-controlled diabetes, atrial fibrillation and hypertension presented with three ulcers on her left leg. The ulcers were painful, highly exuding and each measured 1cm x 1cm. The gaiter area was macerated and hyperkeratosis was present (Figure 1). She had been dressing the wounds herself at home for 2 months. The lady was generally anxious and was known to be non-concordant with treatment.

The ABPI was 0.8 and she was considered suitable for compression therapy. The patient had been treated with 4-layer compression bandages previously, but found them to be bulky and uncomfortable. A 2-layer system was suggested, but the patient refused. The wound was therefore dressed with a hydro-desloughing dressing and absorbent foam. However, the patient removed the dressings at home and applied gauze, which stuck to the wound, resulting in very painful dressing changes. After 3 weeks the wound became infected and the patient agreed to try a 2-layer reduced compression system (UrgoKTwo®) with a silver dressing applied to the wound until the infection had resolved (Figure 2).

Treatment

The patient tolerated the bandages well and became more relaxed and happier over time. She was able to go on holiday with her daughter who could safely change the 2-layer system using the printed pressure indicators. The ulcers had completely healed at 10 weeks (Figure 3). A week later the patient was fitted with made-to-measure Class II, below-knee, compression stockings (Altiform®, Urgo). The patient was happy to trust the nurses' explanation and was pleasantly surprised with the ease of application and comfort of the stockings. The patient currently returns to the surgery for INR tests and continues to wear her stockings with no further ulcer recurrence.

Outcome

This was a particularly difficult patient to manage due to her comorbidities, poor concordance and distrust of the nurses. The pain and embarrassment associated with her leg ulcers had caused her to become depressed and socially isolated. Once she had agreed to reduced compression therapy, her wounds healed in 10 weeks. During this time, the patient became completely concordant with treatment and is able to wear her normal shoes and attend regular organised day trips, improving her quality of life.



Figure 1



Figure 2



Figure 3

Patients in bandages with a healed ulcer might be anxious about switching to hosiery, especially if they have already experienced ulcer recurrence. However for many patients the switch to hosiery after healing can be liberating in terms of self-management, comfort and body image factors. Practitioners need to be committed to supporting and encouraging patients to continue whatever compression therapy is working for them.

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