Comfortable and effective

A flat-knit garment that promotes adherence

Clinical benefits of JOBST Confidence

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Foreword

Professor Christine Moffatt CBE,
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Never has there been a greater awareness within the field of wound care and chronic oedema of the role of self-management and the vital aspect that adherence to compression plays in helping people live well with a stable condition. Achieving this will improve people's quality of life, reduce their feelings of stigma and allow them to feel a degree of self-control in what often seems to be a spiralling condition of deterioration and relapse requiring more intensive intervention. This renders the patient powerless and helpless, rather than empowered to manage their condition.

As well as presenting huge challenges, the COVID-19 pandemic has provided us with opportunities to consider the importance of 'supported self-management'. This requires that we provide the support and compression devices people need to function in healthcare systems where self-management is increasingly seen as a way to reduce costs, rather than an opportunity to improve patient wellbeing and reduce risk of complications such as cellulitis.

In writing this foreword, I want us to reflect on just how challenging and deep the issues of self-management really are and the danger of advocating simple solutions that fail to take into account the complex situations that patients face day to day.

First, we must ask the question: do we agree on what self-management with chronic oedema really looks like? The answer is definitely no. The international guidelines on chronic oedema and lymphoedema refer to self-management, but provide little or no guidance on what it requires and how to assess the readiness and ability of people to adhere to long-term treatments such as compression therapy.

The International Lymphoedema Framework has begun to explore the concept of self-efficacy, a term used to understand how ready and able people feel to continue with treatment. Self-efficacy is complex, and is influenced by many factors such as motivation, personal beliefs and access to the internal and external resources that the individual needs to succeed. Patients often do not understand or believe in the treatments offered to them and, if these solutions 'fail', are unable to adhere to them. We should not underestimate the issues of fit, comfort and managing heat. These are just some of many examples that could be cited. Our obsession is on controlling limb volume—and that is the correct focus for health professionals—but it may not be the dominant issue for a patient in relation to compression.

The sad reality of the lymphoedema model of care is that it is what I term a 'failed acute-illness model'. We offer intensive treatments requiring a huge patient and health-care commitment, followed by a maintenance phase during which many patients slowly deteriorate. Surely our goal must be to embrace a model of stable chronic-illness management, in which people are able to control their condition while having access to professional care when they need it.

We are in an era in which compression products are being produced with technologies that were not available a decade ago. The JOBST® Confidence range of flat-knit garments has been developed, using new technology, to address the real-life challenges faced by people who wear compression. The case reports published in this supplement demonstrate how this range has enabled people to overcome some of their struggles with lymphoedema and compression therapy.

The holy grail for demonstrating performance efficacy is the large randomised controlled trial (RCT). I fully support the need for RCTs but, as far as lymphoedema is concerned, the reality is more complex: we lack an agreed terminology, investment and international standards to assess the outcome required in large studies to answer some of these complex issues. Surely what matters more is retaining a truly patient-centred focus, whereby an individualised approach can increase understanding of how to use compression more effectively. Let us be clear: compression therapy is the most transformational treatment we have for lymphoedema and, with well-designed products and excellent professional knowledge and skills, the day-to-day challenges that patients face in relation to compression can be overcome.

I am so pleased to see the development in products such as JOBST Confidence. We need to work together to gather an increasing evidence base on its role in patient treatment and affect on outcomes.

A flat-knit garment that inspires confidence and aids adherence

Compression garments play a vital role in the maintenance phase of lymphoedema management, but good outcomes are largely dependent on patient adherence. This is more likely to be achieved if garments are comfortable, do not restrict movement and support the ability to undertake activities of daily living. This article describes how a garment was developed, using innovative technology, to achieve these objectives.

Justine Whitaker, Director and Nurse Consultant, Northern Lymphology

Living with lymphoedema can be extremely challenging. Just as lymphoedema can present as mild, moderate or severe, the psychological impact can also vary. It is paramount, therefore, that we consider individual patient needs, both physical and psychological, when supporting patients in self-management. This is true even when it comes to selecting—and indeed developing—compression garments, as this can help promote adherence to treatment and therefore improve outcomes.

This article explores innovations in the design of compression garments. It describes how technology in garment manufacture has developed in response to patient feedback, which prioritised comfort during wear and facilitation of limb movement, with the ultimate aim being to increase adherence.

What are chronic oedema and lymphoedema?

Oedema (swelling in the tissue) can be acute or chronic in origin. To manage the oedema successfully, it is vital to be able to differentiate between these two states.

Acute oedema is swelling that accumulates as a result of a 'central-in-origin' problem such as acute heart failure or acute renal failure.

Chronic oedema is an umbrella term for conditions, such as lymphoedema, lymphovenous oedema and dependency oedema, that are associated with a failure of the lymphatic system (*Table 1*). It is vital, therefore, to be able to identify lymph stasis, as it is indicative of an impairment in the lymphatic system (Whitaker, 2012).

Table 1. Different types of non-acute swelling described as chronic oedema

Lymphoedema (primary and secondary)
Venous oedema
Chronic swelling due to immobility
Oedema related to advanced cancer
Chronic swelling related to obesity
Chronic swelling associated with rare vascular malformations such as Klippel-Trenaunay syndrome

Source: Moffatt et al, 2019

Both primary lymphoedema and secondary lymphoedema constitute chronic swelling that has been present for ≥3 months. They can affect most body parts, such as the upper and lower limbs, digits, genitals, head, face and torso (Moffatt et al, 2019).

Primary lymphoedema has been described as an intrinsic developmental fault of either the anatomy or function of the lymphatic systemic (Ho et al, 2018). Primary lymphoedema and its associated lymphatic malformations can now be more readily classified through genetics. The phenotype—the physical characteristics of the genotype (an individual's collection of genes)—gives us a better understanding of the disease and thus which treatment regimen will be more appropriate for an individual patient (Ho et al, 2018).

Secondary lymphoedema occurs following damage to the superficial and/or deep lymphatic system (Reich-Schupke and Stücker, 2019), often due to cancer and venous disease (Keeley et al, 2019).

In the LIMPRINT study cohort of 8140 patients from nine specialist lymphoedema services in four countries, 17.5% had primary lymphoedema and 82.5% had secondary lymphoedema (Keeley et al, 2019).

Classification and staging

Both primary and secondary lymphoedema can progress in severity as a result of a deterioration in the affected area, an underlying cause or other comorbidities (heart failure, obesity, endocrine dysfunction, vascular disease and hypertension) or a failure to control the accumulated oedema. The different stages of lymphoedema have been classified by the International Society of Lymphology (ISL) (2016), based on their appearance and the results of skin palpation. These stages, which are numbered, can be broadly classified as mild, moderate and severe (*Table 2*).

Although a patient might continue to present in one stage for most of the time—for example, their thigh and knee area may remain in stage I—it is possible that some isolated areas, such as the ankle and foot, may cross into a higher stage (such as, stage II). Therefore, careful differential diagnosis is needed to ensure accurate documentation. Further investigation with imagery may be required to give a full and accurate diagnosis, which will affect the choice of treatment. In addition, assessment to identify comorbidities such as heart failure, obesity, endocrine dysfunction, vascular disease and hypertension should be undertaken, as these will affect treatment decisions (ISL, 2016).

Another system for classifying lymphoedema, from the British Lymphology Society (BLS), is available. Unlike the ILS classification, the BLS system involves a holistic assessment and classifies patients into four groups (BLS, 2001):

- People at risk
- People with mild, uncomplicated oedema
- People with moderate to severe OR complicated oedema regardless of severity
- People with oedema and advanced malignancy.

The BLS and ILS classifications are complementary, and one should not be used in preference to the other.

Psychological assessment can be performed using a quality-of-life tool that is relevant to the patient and service environment.

Management

A patient-focused management plan, with both short- and long-term components, will need to be developed; its content will depend on whether the individual is presenting with mild, moderate or severe oedema. Patients assessed as having ISL late stage II and stage III lymphoedema usually enter the decongestive phase for treatment, which is also referred to in the literature as complex decongestive therapy (CDT) (Ezzo et al, 2015) or decongestive lymphoedema therapy (DLT) (Gordon and Mortimer, 2018). DLT is an intensive phase, where the focus is on (Crane, 2009):

- Volume reduction
- Reshaping the limb
- Improving the condition of the skin, limb function and mobility, as well as other symptoms, such as adjacent joint pain caused by the weight of the limb.

DLT comprises a number of treatment modalities, including skin care, wound management, lymphatic massage (also known as manual lymphatic drainage (MLD)), weight management and compression therapy, generally in the form of multilayer bandages (MLLB). A combination of these treatments is generally applied daily or 2–3 times weekly for 1–4 weeks in total as an 'intensive' block of care.

Other options for compression in the DLT phase are the use of an adjustable compression wrap system, intermittent pneumatic compression devices and compression garments, depending on the patient's

Table 2. International Society of Lymphology (ISL) classification of the different stages of lymphoedema

Stage	Description	Severity
Stage 0/ latent stage	Latent or subclinical condition, where the oedema is not yet evident, despite impaired transport of lymph, subtle alterations in the characteristics and composition tissue fluid, and changes in subjective symptoms. This can last for months or years before overt oedema occurs (stages I–III)	Mild
Stage I	Early accumulation of fluid with a relatively high protein content (compared with venous oedema, for example), which subsides with limb elevation. Pitting may occur. An increase in various types of proliferating cells can also occur	
Stage II	Limb elevation alone rarely reduces the oedema and pitting is manifest. Later in stage II, the limb may not pit as excess subcutaneous fat forms and fibrosis occurs	Moderate
Stage III	Encompasses lymphostatic elephantiasis, where pitting can be absent and trophic skin changes such as acanthosis can occur	Severe

Source: International Society of Lymphology (2016)

comorbidities, access to treatment and ability to tolerate compression. When the DLT phase is complete, the maintenance phase (also known as phase 2) begins. This is a long-term phase that aims to maintain the results of DLT.

Providing patient education during DLT can help empower patients to take control of their condition and self-manage during the maintenance phase. In this next phase, compression is nearly always applied by a round-knit elastic or flat-knit compression garment, sleeve or stocking, which is sometimes supplemented with an adjustable compression wrap system and/or night-time compression (Whitaker, 2016).

Patients who initially present with mild, stage I or early stage II lymphoedema can go straight to the maintenance phase without the need for DLT, although some of these patients will benefit from 'top-up' sessions of MLD and occasional MLLB, depending on individual need and service provision. The main aim of the maintenance phase is self-care. Skin care, regular exercise, self-massage, a healthy diet and weight reduction if necessary are key aspects that will support compression during maintenance care. Again, provision of patient education and ongoing support is hugely important.

The most important intervention in managing lymphoedema is compression, which is central to both DLT and maintenance, as noted in a recent consensus document (Rabe et al, 2018). The consensus document cites several studies demonstrating that, even in patients with the mildest symptoms of lymphoedema, use of medical compression garments improved quality of life (Rabe et al, 2018).

Medical compression garments

The differences between elastic round-knit and flat-knit garments are outlined in *Table 3*. Both are capable of delivering the same interface pressure onto the skin surface, but their knit alters their stiffness and the pressure applied during wear.

Compression and stiffness

Compression garments are classified into different compression classes—for example, classes I, II, III and IV. Each class is associated with the application of a specific range of pressure. For example, class II is in the range of 20–30 mmHg or 23–32 mmHg, measured at the ankle, with a decreasing pressure gradient from distal to proximal, depending on individual company standards and the dynamometer, such as the HOSY, used to determine the product pressures. Compression classes are used to classify a garment's compression range and resting pressure gradients (Neumann et al, 2016). Different standards and definitions of compression classes exist in different countries. The German brand JOBST is developing its products in accordance with the RAL GZ387/ 1:2008.

Measuring the pressure applied by a garment is different to measuring its stiffness. The stiffness of a product is measured by calculating its static stiffness index (SSI), which is the difference between the interface pressures measured at the B1 point of the limb when the individual is lying down and standing up (Partsch, 2005).

The knitting process

Compression garments consist of two types of yarn: the body yarn and a covered elastic inlay yarn. The garment is manufactured by knitting the inlay yarn (B) into the course

Table 3. Differences between round-knit and flat-knit compression garments

Characteristic	Round knit	Flat knit
Fabric	Thin, elastic and sheer. Fine yarn. Cosmetically pleasing	Thicker, heavier, opaque yarn
Construction	Cylindrical garment; knitted in one continuous circular knit	Flat knit produced on a knitting machine. The edges are sewn together, creating a seam
Compression class	1–3	1–4
Seam	None	Positioned on the back of garment
Style	Off the shelf. Occasionally, made-to-measure option	Made to measure. Occasionally, off the shelf
Options	Open or closed toe, grip top, gauntlet (armsleeve)	Multiple options including zips, digits and functional zones
Resting pressure	High	Low
Working pressure	Low	High
Stiffness	Lower, due to elastic content and weave of knit	Higher, due to weave of knit, strength of over-knit elastic and flat machine knit

of the body yarn (A) (*Figure 1*). Both the yarns and the knitting structure can have a crucial impact on the material properties of the manufactured fabric, such as its thickness and elasticity. By varying the knitting structure and properties of the yarn, different material properties can be achieved, which can be tailored to meet therapeutic needs. In short, the properties of the material will determine the garment's therapeutic dose.

The initial stretch of the garment will define the resting pressure, while the knitting structure and thickness of the yarns will provide the stiffness. Thus, when considering what is required for the patient, the two key factors are the garment's compression class and its stiffness.

Selecting a garment

Factors to consider when selecting compression garments are therefore:

- The patient's ISL and BLS stage or classification and how their oedema responds under compression
- The desired compression pressure (class in mmHg)
- Stiffness or elasticity of the garment
- Limb size and shape (for both off-the-shelf and made-to-measure garments)
- How the garment responds to the skin and tissue on application and over time
- Aims of treatment and expectations of the product's performance
- Patient access to garments
- Tolerability, comfort and ability to don and doff, from a patient perspective

The last point is important. The health professional might consider that a strong stiff garment is required to achieve the treatment goals, but if the patient finds it uncomfortable and is unable to apply or take it off or tolerate it for any length of time, it may be necessary to consider a trade-off between comfort/ease of use and the level of compression. Other factors influencing adherence are discussed below.

Adherence to treatment

Educating patients on the benefits of compression therapy will help promote adherence to it. Unfortunately, robust research on whether provision of education actually meets patient needs is lacking. However, research that has been conducted indicates there is scope for improvement. In 2013, Deng et al found that 76% of patients with primary or secondary lymphoedema sourced their information from websites, with only 55% receiving it from healthcare providers (Deng et al, 2013). In 2018, Ostby et al found that

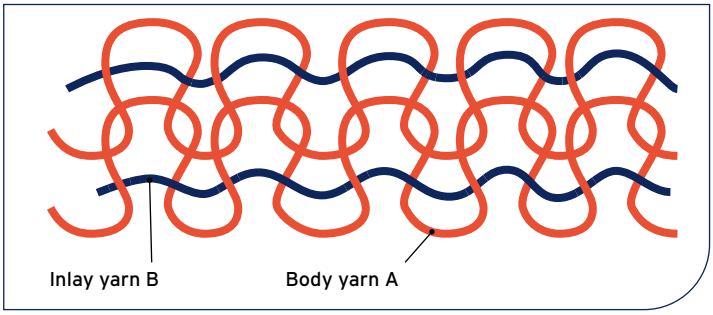

Figure 1. Inlay and body yarns (knitting process)

lack of education, lack of understanding by others (people in general) and decreased self-efficacy (an individual's belief in their ability to succeed in specific situations or to accomplish a task) can contribute to poor adherence to a lymphoedema management plan (Ostby et al, 2018).

Education is not the only factor to consider when helping patients to self-manage: psychological support and advice on coping skills should also be offered (Armer et al, 2011).

Nevertheless, supporting patients effectively involves offering them education that will help them tailor their individual plan over time to help them cope with their chronic disease (Ostby et al, 2018).

Tolerability is another important factor affecting adherence, which needs to be borne in mind during selection. A 2009 study investigating the adverse effects of compression therapy on limb lymphoedema concluded that a poor choice of garment and therapeutic material was often the overriding reason for non-adherence (Vignes and Arrault, 2009). Adverse events identified by the investigators included rubbing and pain at the joints, such as the wrist and digits. Education provided to health professionals and patients on the management of lymphoedema should therefore include garment selection (Vignes and Arrault, 2009). The wrong choice of garment on the wrong type of oedema, such as elastic round-knit garments on skin folds, can result in constriction marks (Reich-Schupke and Stücker, 2019).

The level of pressure exerted by a compression garment can also affect the patient's ability to wear it. An extensive literature search of randomised controlled trials (RCTs) and prospective studies that have evaluated the use of compression stockings in patients with chronic venous disease or for the prevention and treatment of post-thrombotic syndrome found that, although adherence was good, approximately two-thirds of the total sample was less likely to wear garments that apply higher degrees of

pressure (Kankham et al, 2018). The review discussed compression in terms of 'pressure levels' only and did not differentiate between flat knit and elastic round knit.

Next-generation garments

The choice of compression therapy is, of course, determined by the selection available on the market. Although a huge array of products is available, there is still a need for innovation. Fortunately, technologies now entering the arena are offering options for increasing comfort, fit and movement, which should improve outcomes.

Such developments are inspired by company-funded market research on what improvements patients and health professionals want to see. Essity undertook market research in four countries (Germany, France, US and China) to optimise the development of new products in its JOBST range. Of the patients included in the market research, over 80% were found to have mild to moderate lymphoedema (JOBST Internal Market Research, 2014/2015) and were thus in the maintenance phase of management, for which compression garments are the most important aspect (Rabe et al, 2018).

The patients involved in the JOBST market research reported that wearing compression garments constrained their everyday lives, resulting in poor adherence. This supports published evidence that some patients do not wear compression, possibly due to the level of compression applied (*Table 4*) (Moffatt et al, 2003; Kankham et al, 2018). Adverse experiences reported by the market-research participants in relation to wearing compression garments included:

- Pins and needles
- Pressure around the wrist when wearing armsleeves, with the garment digging in, which got worse throughout the day
- Skin becoming hot and sweaty under the garment, causing some to use cool packs on warm days
- Difficulty with donning and doffing.

Participants wanted to be free of physical discomfort and pain when wearing compression garments and to be able to lead independent lives in which their ability to undertake daily activities, socialise and work were not compromised. Despite the discomfort experienced when wearing compression garments, they were still committed to the concept of a treatment regimen for their lymphoedema. Compression garments are the key to long-term management; investment in technology that can address the above factors will help enable people to self-care, maintain independence and achieve a near-normal lifestyle (Muldoon, 2019).

In response to these market-research results and following a needs analysis as well as body scans of lymphoedema patients, Essity sought to develop the next generation of made-to-measure flat-knit compression garments. The manufacture of flat-knit and round-knit garments is based on the premise that the limb, at the point of measurement, is in essence a perfect circle. Of course, arms and legs are very rarely exactly circular. Essity therefore developed JOBST Confidence, which is constructed to precisely fit the real anatomical shape of each individual patient's limb, thereby providing both comfort and facilitating a greater degree of movement for the wearer. These improvements are due to the knitting process used to make the garment and the yarn technology. The Contour Fit technology allows for the addition or reduction in stitches at four positions; this is in contrast to other flat-knit garments, where the stitches can only be added or reduced at one position. This innovative knitting process results in unique Contour Points (*Figure 2*), which show where the garment has been tailored to conform to the individual body shapes (*Figure 3*).

Table 4. Instances of non-adherence to compression garments for lymphoedema reported in the literature

Reference	Design	Outcome
Moffat et al (2003)	Questionnaire-based survey of 228 patients with lymphoedema	Subset of 201 patients (24%) reported that they had received compression garments, but never worn them (the reasons for this were not specified)
Kankam et al (2018)	Literature search of randomised controlled trials (RCTs) and prospective studies on patients prescribed compression stockings for chronic venous disease or to prevent or treat post-thrombotic syndrome	Two-thirds (66.2%) of the total sample was adherent to the compression therapy, although patients were more likely to wear stockings applying lower levels of compression (≤25 mmHG)*
		Factors that contributed to an unwillingness to wear the prescribed compression garments included: pain, discomfort, difficulty with donning stockings, tightness, feeling hot under the garment, perceived ineffectiveness of the garment, skin irritation, cost and lack of cosmetic appeal of the garment

* The authors did not differentiate between flat-knit and elastic round-knit garments in the literature review

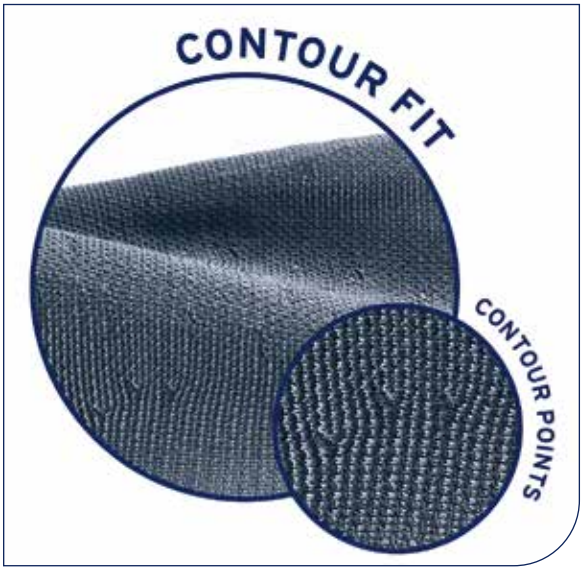

Figure 2. The Contour Points in JOBST Confidence

Due to its built-in moisture management technology, JOBST Confidence also benefits from advances in temperature control and moisture wicking. It uses a high-performance double-layer fabric of interlinked yarns. The inner layer is mainly made of hydrophobic yarns and therefore pushes the moisture onto the outside surface of the garment. In contrast, the outer layer is mainly made of hydrophilic yarns, which also pull moisture to the outside surface. This push-pull effect efficiently wicks moisture away from the skin towards the garment's outer layer (*Figure 4*). In this way, it is designed to keep the skin dry and reduce the build-up of heat under the garment, thereby improving patient comfort during wear.

Not only is the technology used designed to produce a more comfortable and flexible garment, but it also ensures the knitting construction delivers the correct level of therapeutic compression and stiffness. Created with supple yarns, a double-layered knitting construction is used to promote comfort during wear. The firm support achieved by the yarns and knit technology adapts to the patient's body size to deliver the optimal compression level required (*Figure 5*). The flexible nature of the garment and its innovative knit are intended to make donning and doffing easier for the patient.

Conclusion

There is no doubt that the use of compression garments is still the best option for the long-term management of mild to moderate lymphoedema. However, good outcomes are largely reliant on the provision of

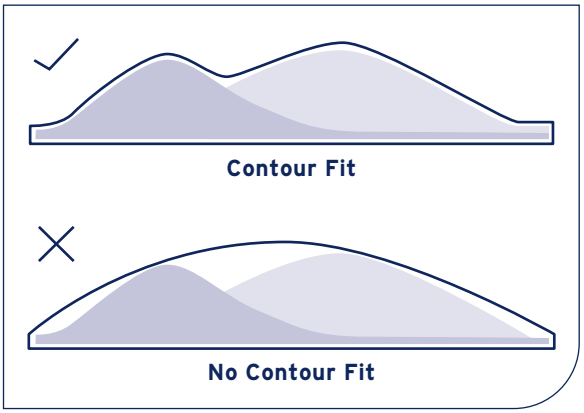

Figure 3. Illustration of how the Contour Fit technology accommodates the limb shape

education on lymphoedema to both patients and health professionals. This can be used to support self-management regimens, help patients set self-management goals and establish a daily routine for both the short and long term. This must be combined with the provision of appropriate therapeutic treatment options to patients, including innovative technologies where possible. Industry has a responsibility to listen to patients' and professionals' expressions of their needs and to consider the requirement for innovation, for all patients, from an ethical and economic perspective.

This supplement describes how this led to the development of a compression garment for patients with mild to moderate lymphoedema, where the focus is on better fit and comfort, to promote adherence. The rest of this document comprises case reports describing the outcomes achieved using the garment in clinical practice.

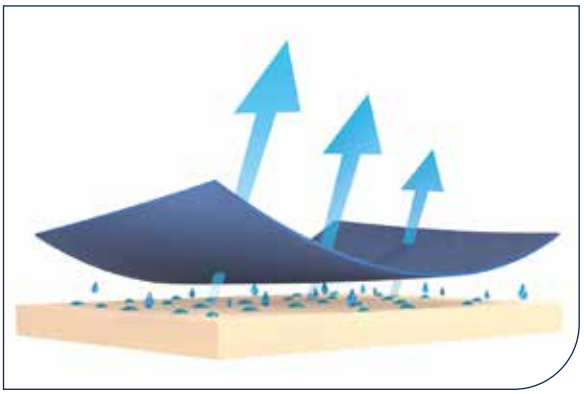

Figure 4. The hydrophobic inner layer pushes moisture onto the outer surface of the garment, while the hydrophilic outer layer pulls any moisture away. This push-pull effect wicks moisture away from the skin

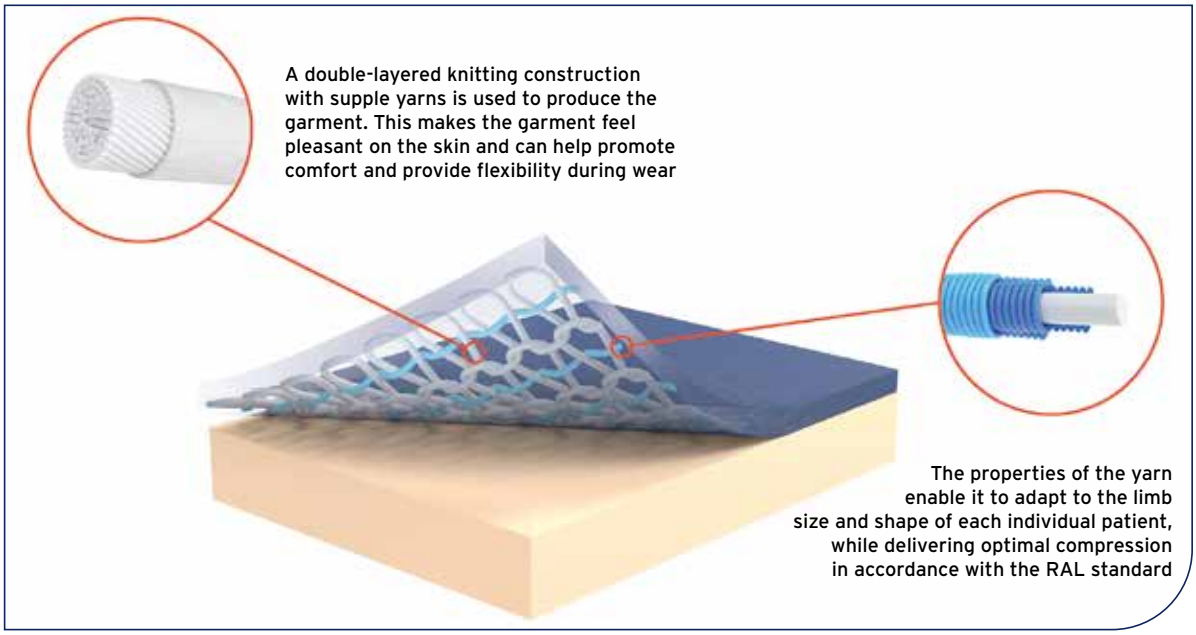

Figure 5. The garment's yarns and knit technology adapt to the limb size to increase comfort while delivering the optimal compression

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Using JOBST Confidence to support adherence

Two lymphoedema nurse consultants, **Denise Hardy** and **Justine Whitaker**, tried JOBST Confidence on patients with mild or moderate lymphoedema who had previously used a variety of compression garments. These case reports describe their patients' experiences with this garment. The patients preferred it to their previous garments, not only finding it more comfortable but also more effective in reducing limb size

In all of the cases described below, lymphoedema was graded in accordance with the International Society of Lymphology (ISL) standards (ISL, 2016). Patient parameters assessed included limb volume (where circumferential measurements, taken every 4 cm up the limb, were entered into a computer program that calculates the distal, proximal and overall limb volume and then compares the difference between the two limbs) and the condition of the skin (where palpation was used to assess its shape, texture, sensation and presence of pitting). Patients' self-reported perceptions of JOBST Confidence were based on:

- Satisfaction with its overall fit and shape
- Overall wearing comfort
- Its ability to remain in place during daily activities
- Allowance to take part in any exercise (such as walking, cycling, yoga and other sports)
- Ease of donning
- Breathability in terms of managing build-up of heat and sweating.

Case reports 1–6, Denise Hardy, Lymphoedema Nurse Consultant, Kendal Lymphology Centre, UK

Case 1: patient who leads a very active life

A 58-year-old woman developed secondary lymphoedema in her left arm 7 years ago following breast cancer treatment involving wide local excision, axillary node clearance and radiotherapy. Her lymphoedema was graded as stage II. She was generally well and did not require any medication.

Previous experiences of compression

The patient had started wearing compression products 6 years previously. In an attempt to find the 'optimal fit', she had tried various compression garments over the years and was currently wearing a flat-knit compression class (CCL) 2 garment. She was extremely adherent, wearing the garment all day, every day, as otherwise her arm felt uncomfortable and heavy. She was very active, and perhaps because of this found many compression garments uncomfortable around the elbow flexure. She also commented that they wore out quickly.

Treatment objectives

The patient was prescribed a made-to-measure CCL 2 JOBST Confidence armsleeve (CG1) with a functional elbow zone for her left arm. Treatment objectives were to determine whether the armsleeve maintained support throughout the day, as the patient thought that other sleeves had slackened during wearing time, and if the elbow functional zone increased comfort at the elbow. The patient wore the armsleeve for 12 hours everyday throughout the follow-up period.

Initial assessment

The consistency and condition of the patient's skin was normal, although on palpation, the forearm tissues were slightly firmer below the elbow (*Figure 1*). The patient also experienced tension throughout the limb when she did not wear a garment. The volume measurement for the left arm was 2204 ml, with an excess volume of 13.4% compared with the right arm (*Table 1*).

Figure 1. Case 1: the patient's arms at the start of the follow-up period

Figure 2. Case 1: the patient's left arm at the end of the follow-up period

Interim assessment

The patient was assessed on day 6 of treatment. She reported that she had been wearing the garment for 12 hours each day. The condition and consistency of her skin were still normal, and the tissue above the elbow had softened slightly. She did not feel any tension building up, as she no longer removed the armsleeve during the day. The volume measurement for her left arm had reduced to 2167 ml, with the excess volume decreasing to 11%.

Final assessment

This took place on day 26. The condition and consistency of the patient's skin remained normal, and the forearm had softened considerably, feeling almost back to normal both above and below the elbow (*Figure 2*). The patient still did not experience any tension in the limb. The volume measurement for her left arm had reduced to 2104 ml, with the excess volume decreasing to 8%.

Patient perspective

The patient was 'very satisfied' with the overall fit and shape of the armsleeve. She rated its overall wearing comfort as 'very comfortable', its ability to remain in place during daily activities and exercise as 'very good' and its breathability as 'very good'. She found it 'somewhere in between easy [and] difficult' to don the sleeve', as it was less elastic than the previous garment she had worn, although this became easier over time. She stated that, compared with her previous garment, the armsleeve performed better for all parameters assessed except ease of donning, for which it was 'slightly worse'. Asked what the garment's biggest benefit was, she replied that, once in place, it was easier to wear and improved the tissue texture and volume measurements. She said she was 'really, really pleased with the sleeve in all categories… it's extremely comfortable; stays in place (never moves throughout the day!); allowed me to do all my usual activities and exercises with no problem at all and I've never had to remove it because of heat or sweat. Love it.'

Conclusion

After approximately 4 weeks of treatment, the volume measurement for the left arm had reduced by 100 ml, with the excess volume reducing from 13.4% to 8%. This was a great result for this patient whose limb volume had remained stable when wearing her previous garments.

Case 2: active patient still struggling to accept her condition

A 64-year-old woman developed breast cancer-related lymphoedema in her left arm immediately after a mastectomy, axillary node clearance, chemoradiation and breast reconstruction in 2015. She last underwent surgery for adhesion division in 2018. Her lymphoedema was graded as stage II. The patient had been fit, well and very healthy until the cancer diagnosis in 2015. She found the subsequent onset of lymphoedema difficult to deal with psychologically; in particular, it was a constant reminder of her breast cancer. She was not prescribed any medication.

Table 1. Case 1: change in limb volume recorded during the follow-up period

Appointment date	26.08.2020 Start of follow-up	01.09.2020 Interim follow-up	21.09.2020 End of follow-up
Limb volume*	Right arm: 1946 ml Left arm: 2204 ml Excess volume:** 259 ml (13.4%)	Right arm: 1946 ml Left arm: 2167 ml Excess volume:** 221 ml (11%)	Right arm: 1948 ml Left arm: 2104 ml Excess volume:** 156 ml (8%)

*Referenced measurement point on limb: 10/18 cm (from nail bed to the dorsum (10 cm) and the wrist (18 cm))
** Left versus right arm

Previous experiences of compression

The patient had started wearing compression therapy 2 years previously. Her experience with compression therapy had not been easy, as she had not found a product that controlled her lymphoedema. She said she hated wearing compression garments, as they were a constant reminder of the underlying diagnosis, and admitted to leaving them off on occasion. She had tried different compression sleeves, and was desperate to find one that was comfortable enough to wear for as much of the day as possible. The psychological impact of the lymphoedema on this patient, and her denial of it, added to her struggle with compression, which involved issues relating to cosmesis, embarrassment and fit. Most recently, she had been wearing a flat-knit CCL 2 garment. She was recommended a daily wear time of at least 8–10 hours a day, but wore it for 6 hours daily. However, she was gradually coming round to the fact that her swelling worsened when she did not wear compression.

Treatment objectives

The patient was prescribed a made-to-measure CCL 2 JOBST Confidence armsleeve (CG1) with a functional elbow zone for her left arm. The aim was to enable her to wear a compression garment for longer each day. Other objectives were to increase comfort during wear and achieve clinical effectiveness. The patient's adherence to the armsleeve was very good, as she wore it for approximately 10 hours every day.

Initial assessment

The condition and consistency of the patient's skin were normal, but some fibrosis was detected on palpation above and below the elbow on the outer aspect of the forearm (*Figure 3*). The patient also complained about shoulder and clavicle discomfort, which had been present since April 2020, although no abnormality was detected. She had an occasional ache in the forearm and hand swelling. Her arm felt heavy, particularly at the end of the day. The volume measurement for her left arm was 2538 ml, with an excess volume of 65%—a difference of over 1 litre *(Table 2)*.

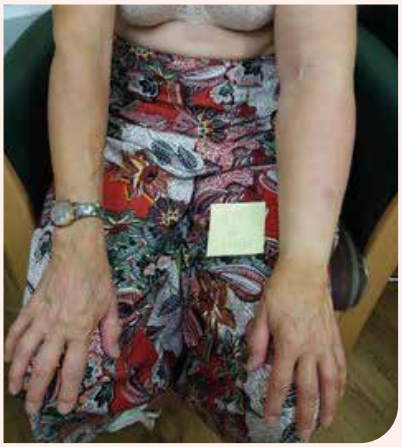

Figure 3. Case 2: the patient's arms at the start of the follow-up period

Figure 4. Case 2: the patient's left arm at the end of the follow-up period

Interim assessment

On day 7, the condition and consistency of the skin were still normal. The fibrotic tissue on the forearm felt firm on palpation, and her arm continued to feel heavy. The limb volume reduced to 2501 ml, with an excess volume of 59%.

Final assessment

At the end of the follow-up period (day 24), the condition and consistency of her skin remained normal and the fibrotic tissue was much softer in both the upper and lower arm (*Figure 4*). Discussion with the patient indicated there was a slight improvement in the shoulder and clavicle discomfort, and a somewhat more noticeable improvement in the forearm ache. At no point during the follow-up period did hand swelling become a problem. The patient's left arm had notably reduced in size: the excess limb volume was 46% and the difference between the volume measurements for the two arms was 719 ml. This was an extremely positive outcome and demonstrated to the patient that adhering to compression therapy can help improve lymphoedema.

Patient perspective

The patient was 'very satisfied' with the overall fit and

Table 2. Case 2: change in limb volume recorded during the follow-up period

Appointment date	07.09.2020 Start of follow-up	14.09.2020 Interim follow-up	01.10.2020 End of follow-up
Limb volume*	Right arm: 1535 ml Left arm: 2538 ml Excess volume:** 1003 ml (65%)	Right arm: 1575 ml Left arm: 2501 ml Excess volume:** 928 ml (59%)	Right arm: 1554 ml Left arm: 2273 ml Excess volume:** 719 ml (46%)

*Referenced measurement point on limb: 11/21 cm (from nail bed to the dorsum (11 cm) and the wrist (21 cm))
** Left versus right arm

shape of the armsleeve. She rated its overall wearing comfort as 'comfortable', its ability to remain in place during daily activities and exercise as 'good' and its breathability as 'good'. At first she found the armsleeve hard to don, but this became easier with time, resulting in her rating this as 'very easy' at the end of the follow-up period. She stated that the armsleeve was better than her previous garment for all the parameters assessed except breathability, for which it was 'equal'. She commented that, 'I have come to like the garment more and more over time… It is now easier to apply; sits well on the limb and doesn't slip, even when using the arm (which I do a lot). I would say of all the garments I have used; this is the best so far.'

Conclusion

The garment's treatment objectives were achieved and the patient appeared to gain confidence in putting it on. Both the patient and specialist were delighted with the reduction in volume achieved, as the limb measurements previously had remained relatively stable. The tissues were much softer, too. Psychologically, the patient appeared more positive about wearing a compression garment. The reduction achieved in the limb size also reduced her fear and uncertainty about the underlying cause of the lymphoedema. This was a great improvement overall.

Case 3: lymphoedema secondary to cellulitis and obesity

A 61-year-old gentleman had stage II lymphoedema in his lower right leg. The lymphoedema was secondary to recurrent cellulitis, which had started in 2015, and subsequent obesity. As the patient's lymphoedematous limb got bigger after each infection, his mobility worsened and his obesity increased, creating a vicious circle. The patient also had hypothyroidism, for which he took thyroxine. His medications were prophylactic antibiotics (penicillin V) to prevent recurrent cellulitis (British Lymphology Society (BLS), 2016).

Previous experiences of compression

The patient had only started wearing compression therapy in the previous 2 months. He was referred late to the lymphoedema clinic, and so had not received appropriate treatment before this, despite having had leg swelling for over 6 years. Following his referral, he underwent intensive decongestive lymphatic therapy (DLT) and subsequent fitting for a flat-knit CCL 3 garment. He became accustomed to the garment, finding it comfortable, supportive and reassuring, and knowing that it would maintain and optimise the new limb shape and size. Despite wearing the compression post-treatment, he experienced some rebound/regression of swelling, which is common in such patients. His adherence to compression therapy had been good.

Treatment objectives

The patient was prescribed a made-to-measure CCL 3 JOBST Confidence knee-high stocking (AD) with a closed toe, a functional ankle zone and a SoftFit border for his right leg. The treatment objectives were to compare the JOBST Confidence garment with the previous compression garment he had worn in terms of their ability to maintain the limb shape and size, comfort, fit and breathability, and to evaluate any improvement in the texture (softening) of the tissues. The patient wore the stocking for approximately 14 hours every day during the follow-up period. His adherence to it was very good, even though he worked as a chef and so had to stand for much of the day in a hot kitchen.

Initial assessment

The condition and consistency of the patient's skin were normal. The tissue was firm and indurated in places, but there were no other symptoms of the lymphoedema *(Figure 5*). The volume measurement for the patient's right leg was 13781 ml, with an excess volume of 25% when compared with the left leg, which was 11034 ml (*Table 3*).

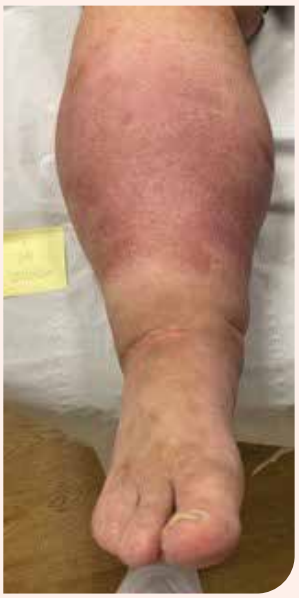

Figure 5. Case 3: the patient's right leg at the start of the follow-up period

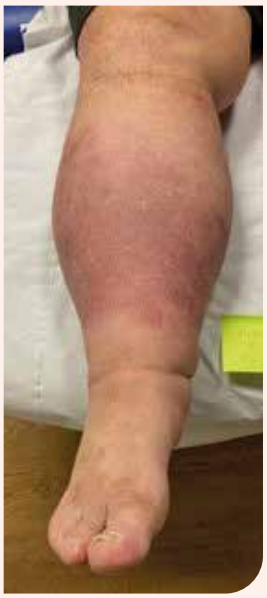

Figure 6. Case 3: the patient's right leg at the end of the follow-up period

Table 3. Case 3: change in limb volume recorded during the follow-up period

Appointment date	02.10.2020 Start of follow-up	12.10.2020 Interim follow-up	23.10.2020 End of follow-up
Limb volume*	Right leg: 13781 ml Left leg: 11034 ml Excess volume:** 2747 ml (25%)	Right leg: 13566 ml Left leg: 11033 ml Excess volume:** 2532 ml (22%)	Right leg: 12859 ml Left leg: 10997 ml Excess volume:** 1861 ml (17%)

*Referenced measurement point on limb: 10/11 cm (from nail bed to the dorsum (10 cm) and from the floor to above the ankle (11 cm))
** Right versus left leg

Interim assessment

On day 10, the consistency and condition of the skin were still normal, and the tissue had remained firm and indurated in places, although the patient noted a possible improvement. The volume measurement for the right leg had reduced to 13566 ml, with the excess volume falling to 22%.

Final assessment

After 3 weeks of treatment (day 21), the consistency and condition of the skin remained normal and the tissue around the ankle and calf had improved greatly and was much softer and more supple (*Figure 6*). The right leg had reduced considerably in size, with the volume measurement reducing to 12859 ml, resulting in the excess volume falling to 17%.

Patient perspective

The patient was 'very satisfied' with the overall fit and shape of the stocking. He rated its overall wearing comfort as 'very comfortable', its ability to remain in place during daily activities and exercise as 'very good' and its breathability as 'very good'. He found it 'difficult' to don the garment as it was firmer than the ones he had worn before, but he stated that its flexibility and freedom of movement, which were both aided by the ankle functional zone, were 'acceptable'. He said that, compared with the previous garment used, the stocking performed better for all the parameters assessed except ease of donning and flexibility/freedom of movement aided by the ankle functional zone, for which it was 'worse' and 'equal', respectively. Overall, the patient was 'very satisfied' with the stocking. Asked what its biggest benefit was, he replied that it 'appeared to stay in place so much better—no slippage. Snug and secure.' When describing his experience of wearing the garment, he said, 'Fantastic. Love it. Comfortable and effective.'

Conclusion

Both treatment objectives were achieved. There had been an initial rebound after transitioning to compression post-DLT but, following use of JOBST Confidence garment, the limb measurements reduced, such that the leg was even smaller than it had been after completing intensive treatment. Its shape had improved, and there was obvious softening of the tissues around the ankle and calf.

Case 4: patient with atypical Klippel-Trenaunay syndrome

This case report describes a 36-year-old woman who was born with congenital primary lymphoedema (atypical Klippel-Trenaunay syndrome including vascular anomalies) in her right leg. Apart from intermittent episodes of irritable bowel, she was fit and well. The lymphoedema (graded as stage II) in her lower right leg has been her main problem over the years. She had experienced frequent recurrent episodes of cellulitis, lymphorrhoea (particularly in the digits) and thrombosis. To reduce the lymphorrhoea in her digits, she wore a toe glove, interspersed with toe bandaging, under a compression garment. She was prescribed blood thinners (rivaroxaban) to prevent thrombosis and prophylactic antibiotics (phenoxymethylpenicillin) to reduce the risk of cellulitis (BLS, 2016).

Previous experiences of compression

The patient had started compression therapy 9 years previously. Wearing compression garments was a part of her everyday life and she viewed them as an essential component of her daily clothing. She had tried numerous garments over the years, but settled with a flat-knit (closed toe) over a fine toecap to control the toe leakage, which had proved troublesome on occasion. Her biggest problem was ankle flexure, which tended to become sore and uncomfortable by the end of her working day, due to rubbing of the garment. The patient also had raised blood vessels, which could become irritated and sore. Before the start of the case report, she had been wearing a flat-knit CCL 3 garment. Her adherence to compression therapy was very good as she knew that not wearing a compression garment for any length of time would result in the leg swelling, causing discomfort and an increase in associated symptoms.

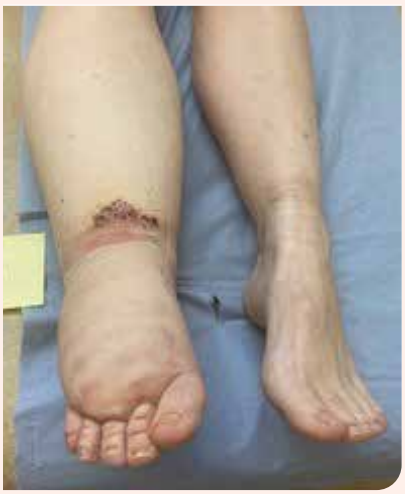

Figure 7. Case 4: the patient's legs at the start of the follow-up period

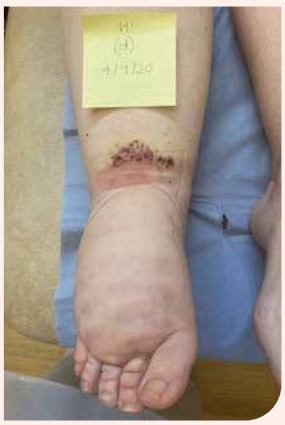

Figure 8. Case 4: vascular anomalies on the patient's right leg, particularly the lower shin, at the start of the follow-up period

Treatment objectives

The patient was prescribed a made-to-measure CCL 3 JOBST Confidence knee-high stocking (AD) with a closed toe and a SoftFit border for her right leg. The treatment objectives were to ascertain if the shape and size of the leg could be maintained or improved and the discomfort at the ankle flexure and the vascular anomalies reduced. The patient wore the stocking for approximately 14 hours everyday for almost 4 weeks (26 days), making her adherence to it as very good.

Initial assessment

The consistency of the skin was normal (*Figure 7*), but there were various vascular anomalies on the limb, particularly on the lower shin (*Figure 8*), and the toes leaked occasionally. The tissues felt firm on palpation and pitting was only just detectable. The patient reported that the leg always felt heavy, but was not painful. As well as the leakage, blood blisters occurred on the toes. The volume measurement for the patient's right leg was 9414 ml, with an excess volume of 30.6% compared with the leg left (*Table 4*).

Interim assessment

On day 11, various vascular anomalies around the ankle had reduced (flattened), but the toes continued to leak occasionally. There was no change in the nature of the tissue, and the leg continued to feel heavy. The volume measurement for the right leg had reduced slightly to 9314 ml, with the excess volume now being 29.2%.

Final assessment

At the end of the follow-up period (day 26), the numerous vascular anomalies had visibly reduced *(Figures 9 and 10)* and the lymphorrhea had greatly improved, enhancing her comfort. The tissues had softened significantly and pitting was barely achievable. There was also a notable improvement in the blood blisters, which were visibly smaller, and the leakage from the toes had reduced significantly. The leg was feeling less heavy and the soreness in the ankle crease was better. The volume measurement for the right leg reduced to 8873 ml, resulting in the excess volume falling to 27.4%.

Patient perspective

The patient was 'very satisfied' with the overall fit and shape of the stocking. She rated its overall wearing comfort as 'very comfortable', its ability to remain in place during daily activities and exercise as 'very good' and its breathability as 'very good'. She found the stocking 'very easy' to don. She stated that, compared with the previous garments she had used, it performed 'better' for all the parameters assessed except ease of donning, for which it was 'equal'. Overall, the patient was 'very satisfied' with the JOBST Confidence garment. Asked about her experience of wearing the stocking, she replied, 'I have noticed a distinct improvement in my lower leg: the ankle particularly is better defined, the tissues softer and, more importantly, the vascular changes have flattened well. Even the toe leakage is better, although it has not stopped completely.' She also mentioned that the toe area did not appear to fit snugly due to a small gap between the large toe and the second toe, which made the garment appear a little baggy. However, this improved after the garment was washed.

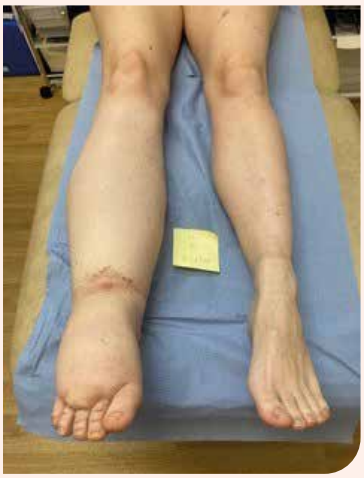

Figure 9. Case 4: the patient's legs at the end of the follow-up period

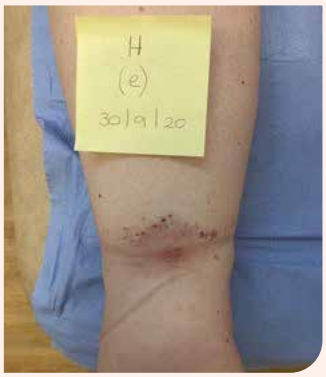

Figure 10. Case 4: vascular anomalies on the patient's right leg at the end of follow-up period; the visible improvement is remarkable (compare with Figure 8)

Table 4. Case 4: change in limb volume recorded during the follow-up period

Appointment date	04.09.2020 Start of follow-up	15.09.2020 Interim follow-up	30.09.2020 End of follow-up
Limb volume*	Right leg: 9414 ml Left leg: 7210 ml Excess volume:** 2204 ml (30.6%)	Right leg: 9314 ml Left leg: 7210 ml Excess volume:** 2104 ml (29.2%)**	Right leg: 8873 ml Left leg: 6966 ml Excess volume:** 1907 ml (27.4%)

*Referenced measurement point on limb: 9/10 cm (from nail bed to the foot (9 cm) and from the floor to the ankle (10 cm))
** Right versus left leg

Conclusion

All the treatment objectives were met beyond expectation: the shape and size of the leg improved and the limb volume reduced; the patient reported that the discomfort at the ankle flexure had reduced and there was less obvious friction; the vascular anomalies had flattened and reduced (*Figures 8 and 10*), resulting in improved cosmesis and a reduced risk of infection. Although the toe area did not fit as well as it should have, the lymphorrhoea has definitely lessened. Interestingly, the patient mentioned that she had lost weight. Her leg was more comfortable since she started wearing the stocking and she was therefore walking more than usual. Altogether, these were great results to achieve over such a short period of time.

Case 5: patient with late-onset primary lymphoedema

This case report describes a 79-year-old woman whose lymphoedema became apparent, over 30 years previously, after she had tripped and stumbled into some waves on the beach. Lymphograms of her leg, undertaken at that time, indicated that an underlying primary lymphoedema had been exacerbated by the stumble. Unfortunately, there was no lymphoedema service in the area where she lived, so she did not receive appropriate treatment. In 2006, 15 years later, she moved to the Lake District, where she attended a lymphoedema clinic and received decongestive lymphatic therapy (DLT) with multi-layer lymphoedema bandaging (MLLB), manual lymphatic drainage (MLD), skin care and exercise. Once the limb had reduced in size, it was fitted with a CCL 3 made-to-measure, flat-knit, high-compression garment. Over the next few years, lymphoedematous 'adipose' tissues became increasingly evident, despite her adherence to her compression therapy and the other elements of self-care. Following assessment by the surgical team, the adipose tissue was successfully removed with liposuction. The patient remained fit and active until 2018 when she was diagnosed with breast cancer, for which she required surgery and radiotherapy. She recovered well and has had no problems since. She is not on any medication.

Previous experiences of compression

The lymphoedema was classified as stage II. Following the liposuction, the patient had been wearing a flat-knit CCL 3 garment. Wearing compression garments has become a normal part of her everyday life, and she wore her stocking for as much of the day as possible. Although she never experienced any significant issues with her garments, she did have some discomfort behind the knee and around the ankle on occasion, despite trying products.

Treatment objectives

The patient was prescribed a made-to-measure CCL 3 JOBST Confidence thigh-high stocking (AG) with an open toe, a functional ankle zone and a SoftFit border for her right leg. The treatment objective was to see if it would be more comfortable behind the knee and at the ankle than previous garments she had tried, all of which tended to wrinkle in these areas. The patient wore the new garment for approximately 12–14 hours every day for the follow-up period, and so her adherence to it was very good.

Initial assessment

The consistency and condition of the skin were normal. The tissue was a little firm, but not fibrous (*Figure 11*). The patient had no other symptoms relating to the lymphoedema. The volume measurement for her right leg was 7963 ml, with an excess volume of 17% when compared with the left leg (*Table 5*).

Interim assessment

On day 7, the consistency and condition of the skin were still normal, and the tissues now felt slightly firm. The volume measurement for the right leg had reduced to 7612 ml, with the excess volume now being 12%.

Final assessment

At the end of the follow-up period on day 17, both the therapist and patient observed that the tissue felt much softer (*Figure 12*). The excess limb volume between the legs had reduced to 10.5% at week 2.5, a reduction of 436 ml when compared with baseline. This was amazing considering the patient had previously been in established

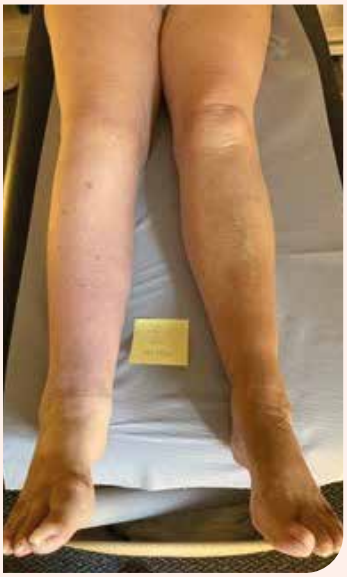

Figure 11. Case 5: the patient's legs at the start of the follow-up period

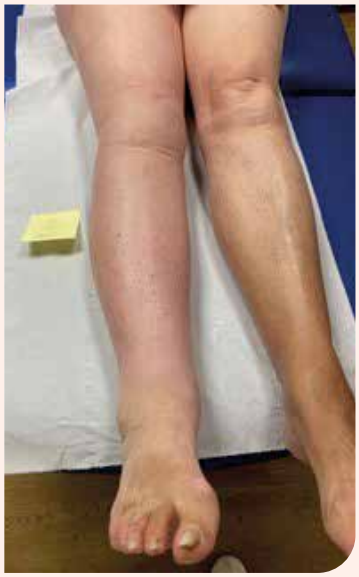

Figure 12. Case 5: the patient's legs at the end of the follow-up period

and equivalent compression for some time. Her activity levels had remained unchanged.

Patient perspective

The patient was 'very satisfied' with the overall fit and shape of the garment. She rated its overall wearing comfort as 'very comfortable', its ability to remain in place during daily activities and exercise as 'good' and 'very good', respectively, and its breathability as 'very good'. She found the garment 'very easy' to don, noting that the ankle functional zone was a 'good' aid to facilitate this. She stated that, compared with the previous garment used, it performed 'better' in all but two categories (ability to remain in place and enable her to take part in any exercise), for which it was 'equal'. Overall, she was 'very satisfied' with the stocking. She commented that, 'the garment was comfortable, particularly around the knee and ankle areas, which I had previously struggled with when using other garments'.

Conclusion

The treatment objective was achieved. The patient did comment that the garment's grip top could be more 'grippy', as she experienced slight slippage over the day, but to her surprise this did not cause friction behind the knee. She concluded saying, 'I would be more than happy to use the garment again as part of my maintenance programme…one of the better products I have tried over the years'.

Case 6: patient with stable, long-standing breast cancer-related lymphoedema

A 63-year-old woman developed secondary lymphoedema in her right upper arm 21 years ago following breast cancer treatment involving a right mastectomy and axillary node clearance only. This patient had stage II lymphoedema. Her body mass index (BMI) was within the normal range. She was extremely fit, well and active, and took no medication apart from calcium and vitamin D supplements.

Previous experiences of compression

The patient had worn compression products since she first developed the lymphoedema. She had tried a variety of compression armsleeves (both circular and flat-knitted) with the aim of finding one that would be flexible enough to wear at both work and during recreation and social events. She generally found compression garments comfortable, supportive and protective, and at the start of this case report was favouring a made-to-measure flat-knit CCL 2 garment. The patient understood the importance of compression within a self-management programme. Her adherence to compression therapy was good, and she wore her armsleeve every day for at least 12 hours.

Treatment objectives

The patient was willing to try new compression garments and so accepted the opportunity to evaluate a JOBST Confidence product. She was prescribed a made-to-measure CCL 2 JOBST Confidence armsleeve (CG1) with

Table 5. Case 5: change in limb volume recorded during the follow-up period

Appointment date	15.09.2020 Start of follow-up	22.09.2020 Interim follow-up	02.10.2020 End of follow-up
Limb volume*	Right leg: 7963 ml Left leg: 6817 ml Excess volume:** 1147 ml (17%)	Right leg: 7612 ml Left leg: 6823 ml Excess volume:** 790 ml (12%)	Right leg: 7511 ml Left leg: 6799 ml Excess volume:** 711 ml (10.5%)

*Referenced measurement point on limb: 9 cm (to the dorsum, from the second nail bed); 9 cm (from the floor to the ankle)
** Right versus left leg

a functional elbow zone and a SoftFit border for her right arm. The objectives were to evaluate the elbow functional zone and assess whether the SoftFit border felt as occlusive as had the borders of her previous compression garments. The patient wore the armsleeve for 12–14 hours every day during the 3-week follow-up period.

Initial assessment

The consistency and condition of the patient's skin were normal, although the tissues in her forearm were particularly firm and rubbery (*Figure 13*). Her arm felt heavy, especially at the end of the day. The volume measurement for her right arm was 1938 ml, with an excess volume of 12% when compared with the left arm (*Table 6*).

Interim assessment

On day 7, the consistency and condition of the skin remained normal. The forearm tissue had softened considerably, although it was still firmer than elsewhere on the limb. Her arm also still felt heavy, especially at the end of the day. The volume measurement for the right arm had reduced to 1904 ml, with the excess volume falling to 9.7%.

Final assessment

After 3 weeks of treatment (day 21), the consistency and condition of the patient's skin were still normal, and the forearm tissue had continued to soften (*Figure 14*), although it was still firmer than the rest of the limb and the arm continued to feel heavy, again particularly at the end of the day. The limb volume measurement had reduced to 1841 ml, with the excess volume decreasing to 6%.

Patient perspective

The patient was 'very satisfied' with the overall fit and shape of the garment. She rated its overall wearing comfort as 'comfortable', its ability to stay in place during daily activities and exercise as 'good', and its breathability as 'very good', but found it 'difficult' to don the sleeve as the material was not as stretchy as the previous garments she had tried. Overall, the patient was 'satisfied' with the garment. She commented that, although she did not find it easy to get the elbow functional zone in the correct place, she liked the lack of a seam at the wrist area, which stopped it from digging in. She said the garment's biggest benefit was that it softened the firm tissues of the lower arm.

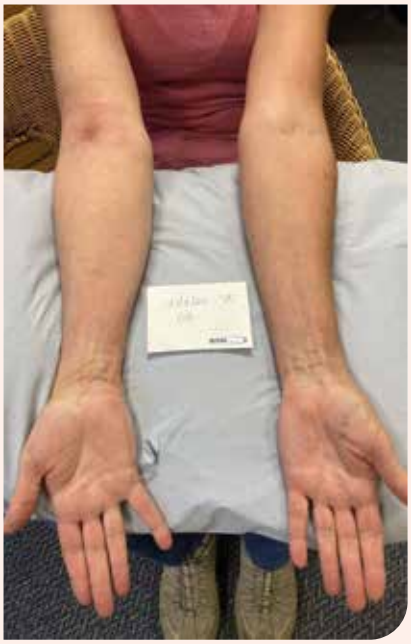

Figure 13. Case 6: the patient's arms at the start of the follow-up period

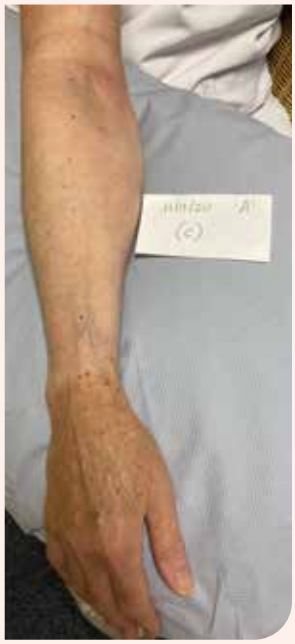

Figure 14. Case 6: the patient's right arm at the end of the follow-up period

Conclusion

The garment exceeded expectations, even though it did not meet one of the treatment objectives. The patient continued to wear the armsleeve after the 3-week follow-up period, and now believes it is the best armsleeve she has ever used to self-manage her condition. Praise indeed.

Table 6. Case 6: change in limb volume recorded during the follow-up period

Appointment date	21.08.2020 Start of follow-up	28.08.2020 Interim follow-up	11.09.2020 End of follow-up
Limb volume*	Right arm: 1938 ml Left arm: 1736 ml Excess volume:** 202 ml (12%)	Right arm: 1904 ml Left arm: 1736 ml Excess volume:** 168 ml (9.7%)	Right arm: 1841 ml Left arm: 1736 ml Excess volume:** 105 ml (6%)

* Referenced measurement point on limb: 12/21 cm (from nail bed to the dorsum (12cm) and the wrist (21 cm))
** Right versus left arm

Case reports 7–8, Justine Whitaker, Director and Nurse Consultant, Northern Lymphology, Forest of Bowland, Lancashire

Case 7: lymphoedema exacerbated by a fall with consequent metal rod insertion into femur

A 73-year-old woman developed secondary lymphoedema following a road traffic accident in 2016, when she sustained soft tissue damage in her left leg requiring multiple skin grafts. In August 2020, the patient broke her femur in a fall and underwent surgery during which a metal rod was inserted into the full length of the bone. The lymphoedema was graded as stage II. The patient had hypertension, which was well controlled with medication (simvastatin, ramipril, co-codamol and calcium), but no other comorbidities.

Previous experiences of compression

The patient started compression therapy in 2016. She wore round-knit garments, but these had dug in at the knee, were uncomfortable and occasionally slipped at the top thigh. She found it hard to put on the garments over her foot and ankle. She did manage to do this on her own, but her husband had to pull off the garment at the end of the day. Despite this, her adherence to compression therapy was very good.

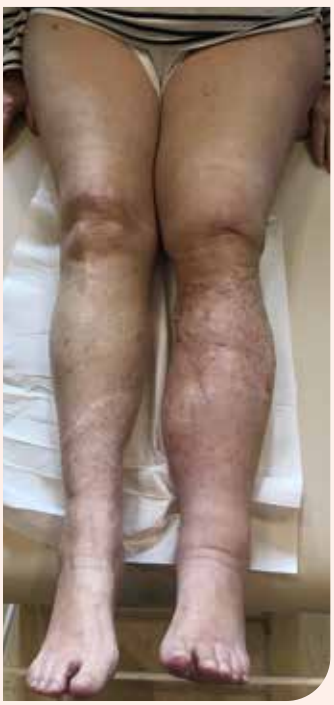

Figure 15. Case 7: the patient's legs at the start of the follow-up period

Figure 16. Case 7: the patient's left leg with the JOBST Confidence stocking in place at the interim assessment: the patient was not wearing the garment as instructed

Treatment objectives

As the patient's lymphoedema got much worse due to her recent accident, she was about to change from a round-knit CCL 2 garment to a flat-knit compression garment. She was therefore prescribed a made-to-measure, flat knit, CCL 2 JOBST Confidence thigh-high stocking (AG) with a closed toe and a functional ankle and knee zone for her left leg. The treatment objectives were: to ease or eliminate the discomfort at the knee; gain or maintain a better control of oedema; prevent cellulitis and deterioration of the underlying tissues; and improve the outer appearance of the leg. The patient wore the stocking for approximately 11 hours per day for 3 weeks, making her adherence to it very good.

Initial assessment

Scar tissue was present on the left leg. The condition of the skin was normal, but its consistency was generally soft, except around the scarring, where it was hard. There was fibrosis on the lower leg, which felt congested during palpation, whereas the thigh issue felt doughy. The area around the knee was very painful, which had been aggravated by the round-knit garment (*Figure 15*). The volume measurement for the left leg was 9057 ml, with an excess volume of 20% compared with the right leg (*Table 7*). *Figure 16* shows the new garment in place.

Interim assessment

This took place on day 10. The condition of the skin had become normal, and its consistency was soft. There was no change in the areas around the scars. The fibrosis was still present, and the tissue in the thigh remained doughy, although this was less pronounced. The knee area was still painful, but this might have been because the patient was not applying the garment correctly, in the way demonstrated to her at the consultation. The volume measurement for the left leg had reduced to 8297 ml, with the excess volume decreasing to 9.7%.

Final assessment

This took place on day 20. The consistency of the skin remained soft, and the areas around the scars were much softer and had a better colour. Similarly, the amount of fibrosis had reduced and was softer. The thigh tissue was also less doughy (*Figures 17 and 18*). The knee pain had

Figure 17. Case 7: the JOBST Confidence stocking in place at the end of the follow-up period

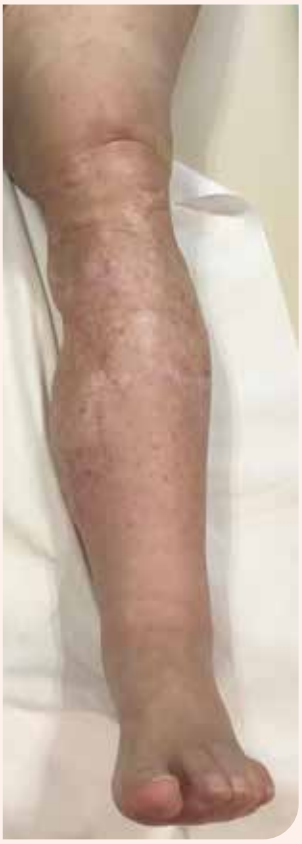

Figure 18. Case 7: the patient's left leg at the end of the follow-up period

improved but was not completely resolved. The volume measurement for the left leg had reduced still further to 7943 ml, with an excess volume of 4%. This good result was not expected, as the patient had been managing well in the maintenance phase of treatment for 18 months, with occasional top-up MLD. It is also remarkable because, from the first to the interim appointments, the patient did not apply the garment as instructed, failing to pull it up properly (*Figure 16*). Despite this, the overall condition of the leg improved.

Patient perspective

The patient was 'satisfied' with the overall fit and shape of the garment. She rated its overall wearing comfort as 'acceptable', its ability to remain in place during daily activities as 'good', its flexibility and freedom of movement, aided by the ankle functional zone, as 'very good', and its breathability as 'very good'. She found it 'difficult' to don, but reported that this was 'good' when aided by the ankle functional zone. She stated that, compared with the previous garment used, it performed better in terms of its overall fit and shape, but was 'equal' for all the remaining categories, including ease of donning. Overall, the patient was 'very satisfied' with the garment. Asked what its biggest benefits were, she replied the reduction in limb volume and the slight improvement in her knee pain. She also said that the colour and appearance of her leg looked much better, that she had avoided infection and was not taking as many pain killers as before. However, she noted that the garment slipped at the top, although this was probably due to the immense reduction in limb volume (1114 ml) achieved by the end of the follow-up period.

Conclusion

The treatment objectives were achieved in a way that exceeded expectation: the oedema was greatly reduced, there were no occurrences of cellulitis, the texture of the subcutaneous skin improved and the colour and shape of the leg improved. Overall, this was a remarkable outcome for a 3-week follow-up.

Case 8: active young patient with primary lymphoedema

A 25-year-old woman had primary lymphoedema caused by congenital hypoplasia in her right leg. The first sign of an onset of her lymphoedema occurred when she was 12, when she experienced a swelling in her foot, which then resolved. The main onset came later when she was 17. Her lymphoedema is graded as stage II. She had two episodes of cellulitis in April and June 2020 when the UK was in lockdown

Table 7. Case 7: change in limb volume recorded during the follow-up period

Appointment date	02.10.2020 Start of follow-up	12.10.2020 Interim follow-up	22.10.2020 End of follow-up
Limb volume*	Right leg: 7562 ml Left leg: 9057 ml Excess volume:** 1495 ml (20%)	Right leg: 7562 ml Left leg: 8297 ml Excess volume:** 735 ml (9.7%)	Right leg: 7640 ml Left leg: 7943 ml Excess volume:** 303 ml (4%)

*Referenced measurement point on limb: 10 cm (from the floor to above the ankle)
** Left versus right leg

due to the COVID-19 pandemic, but was unable to get an appointment to discuss a prescription for long-term prophylactic antibiotics due to the disruption in outpatient appointments and GP services at that time.

Previous experiences of compression

The patient had started wearing compression therapy 7 years previously. She found they could dig in around the toes and top/groin area. She also complained that they became baggy at the back of the knee, moved during exercise and did not stay in place when she was running, resulting in her always having to pull them up. Despite this, her adherence to compression therapy was very good.

Treatment objectives

She was wearing a flat-knit CCL 4 garment before switching to a made-to-measure CCL 3 JOBST Confidence thigh-high stocking (AG) with an open toe for her right leg. The treatment objectives, determined by the specialist and patient, were to ascertain whether the garment would fit better, feel more comfortable, stay in place during exercise, maintain the current level of oedema and reduce the risk of cellulitis. The patient wore the stocking for approximately 12–13 hours every day for the 3-week follow-up, making her adherence to it very good. Her risk of cellulitis remained high during the follow-up period, but she did not receive any prophylactic medication for this, for the reasons described above.

Initial assessment

The condition of the skin was normal, but its consistency was doughy due to fibrosis, which was present in the distal and proximal areas of the right leg (*Figure 19*). The patient experienced tension in the calf towards the end of the day and the leg sometimes felt numb when not moved for a while. She also had ongoing lateral foot pain. In addition, the top of the previous thigh stocking had pulled and pinched her, causing discomfort. The volume measurement in the right leg was 15544 ml, with an excess volume of 30% when compared with the leg left (*Table 8*).

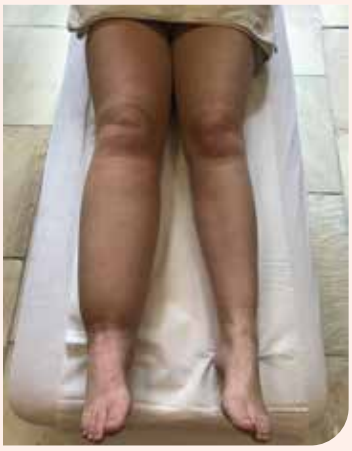

Figure 19. Case 8: the patient's legs at the start of the follow-up period

Figure 20. Case 8: the patient's legs at the end of the follow-up period

Interim assessment

This took on place on day 10. There was no change in the consistency and condition of the skin, and the fibrosis was still present in the distal and proximal areas of the leg. However, the only lymphoedema-related pain that the patient had experienced during this week was the tension in the calf at the end of the day. The volume measurement for the right leg had reduced to 15042 ml, with the excess volume now being 25.8%.

Final assessment

This took place on day 21. The fibrosis was slightly softer (*Figure 20*), and the volume measurement for the right leg was 14837 ml, with the excess volume reducing to 24.3%. Otherwise, the patient remained the same as at day 10.

Patient perspective

The patient was 'very satisfied' with the overall fit and shape of the garment. She rated its overall wearing comfort as 'very comfortable', its ability to remain in place during daily activities and exercise as 'good', and its breathability as 'very good', saying that the garment cooled her leg on a hot day. She found the garment 'very easy' to don. She stated that, compared with the previous garment used, it performed 'better' in all categories. Overall, the patient was 'very satisfied' with the new garment. Asked what its biggest benefits were, she replied, 'The fit of it, the comfort and [it's] a lot lighter than previous garments'. In addition, the garment helped improve her quality of life, as her foot was not painful anymore. She said her experience with the garment was 'just very positive'. She did experience some garment slippage at the top, but this was due to reduction of oedema in the thigh.

Conclusion

The treatment objectives were achieved: the garment fitted well, felt comfortable and stayed in place, apart from slight slippage at top due to the limb volume reduction, the oedema reduced and there were no episodes of cellulitis.

All of these patients gave consent for their case reports and images to be published

Table 8. Case 8: change in limb volume recorded during the follow-up period

Appointment date	15.09.2020 Start of follow-up period	25.09.2020 Interim follow-up	06.10.2020 End of follow-up period
Limb volume*	Right leg: 15544 ml Left leg: 11961 ml Excess volume:** 3583 ml (30%)	Right leg: 15042 ml Left leg: 11961 ml Excess volume:** 3081 ml (25.8%)	Right leg: 14837 ml Left leg: 11933 ml Excess volume:** 2904 ml (24.3%)

*Referenced measurement point on limb: 11 cm (from the floor to above the ankle)
** Right versus left leg

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British Lymphology Society. Consensus document on the management of cellulitis in lymphoedema. 2016. https://tinyurl.com/yysazau3 (accessed 8 January 2021)

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