# Getting the pressure right: how do we know?

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The lymphatic system is a low-flow, low-pressure system, with the latter generally remaining in single figures, but occasionally rising to 40–50 mmHg when blocked. These low pressures – coupled with the delicate nature of even the collecting lymphatics, their location, and the relatively few muscular and structural elements in their walls – mean that the lymphatic system is very sensitive to external pressures, even more so than the venous system.

The fundamentals of lymphoedema management involve bandaging and compression garments; it is widely accepted that applied pressure can reduce the outflow from the vascular system (thus, reducing lymphatic load), increase interstitial tissue pressures, and increase lymph flow. There may also be a benefit in the breakdown of fibrosclerotic tissues (Partsch and Moffatt, 2012).

However, we also know that constant pressure is not good, as it may prevent fluid flow through the interstitium and along the lymphatics. Furthermore, pressure variation is positive as it allows fluids to move from the interstitial spaces into the lymphatics and along them. We also know that pressure gradients under the garment or bandage, and in areas proximal to it, are essential.

We know that external pressure changes with the radius of the limb and the position of it, whether elevated, dependant, or supine. Generally speaking, for a large radius, the pressure at every point is lower than when there is a small radius. This type of pressure variation is equalised by the use of padding to increase the apparent radius and thus the pressure in these areas (Schuren, 2012). Pressure also becomes an issue in relation to elasticised clothing (i.e. underwear and bras with narrow bands of elastic fabric that can cause high local area pressure, particularly in small radius areas such as the shoulder in medial groin).

We know that there are varying compressions recommended for a range of acute and chronic conditions ranging from 'mild' (<20 mmHg) to 'very strong' (>60 mmHg). But how do we know that the pressure we need for an individual patient is the pressure (or the range of pressure) that we deliver?

Knowing this is important, especially for those patients who are immobile through age or under palliative orders or who suffer muscular weakness or dystrophy. This question may be of less importance for those patients who can vary the pressure under their garment or bandage through isotonic or isometric movement.

So how do we know the pressure? All lymphoedema garment manufacturers' provide charts for achieving various pressures for various circumferences. Use of these charts in conjunction with careful measurement of the limb's circumference, in standardised postures, is critical.

But how accurate is this process? I recall a small study we undertook some years ago looking at the pressure under a sleeve. Only one patient had a pressure within the expected range; none had what would be regarded as a reasonable pressure gradient. Bad news, then.

Do we have a solution? Yes, maybe, but currently it is not an easy one and requires more thought and research.

The 'solution' is undergarment pressure monitoring, perhaps making use of memory fabrics that change colour based on tension. Right now, we have fabrics that are temperature sensitive (see ***http://freshscience.org.au/2011/a-smart-bandage-reveals-healing***). But temperature changes are mainly an issue with bandages, less so for garments, but nevertheless perhaps just as important!

Professor John Arkwright, (Commonwealth Scientific and Industrial Research Organisation, Melbourne) has been developing a flexible pressure sensor based on fibre optics that is proving to be accurate in measuring under bandage pressure. Preliminary evidence suggests that clinicians tend to apply bandages with a pressure that is too high, and we know what that means for lymphatic drainage.

You can imagine it then; a tight bandage with all its consequences, including elevated temperature. So how can we really expect to get the best outcome for that patient?

Further development and research into undergarment pressure (and temperature) are essential. We cannot always depend on what garment manufacturers' charts' suggest in relation to pressure, and when we are bandaging, we really have nothing other than the experience of a good therapist to determine what is optimal.

We need more objectivity to get better outcomes. Maybe the answer is in the indicators from the fabrics themselves? Or maybe it is from small implanted sensors? Whatever the answer is, we need to find it quickly. JL

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Partsch H, Moffatt C (2012) Chapter 2: An overview of the science behind compression bandaging for lymphoedema and Chronic Oedema. In: Moffatt C, Partsch H (eds) ***Best Practice for the Management of Lymphoedema. Compression Therapy: A position document on compression bandaging.*** 2nd edn. International Lymphoedema Framework, London: 12–23

Schuren J (2012) Chapter 3: Optimising compression bandaging. In: Moffatt C, Partsch H (eds) ***Best Practice for the Management of Lymphoedema. Compression Therapy: A position document on compression bandaging.*** 2nd edn. International Lymphoedema Framework, London: 24–31