Intermittent sequential compression therapy in lower limb disorders

When venous disorders of the leg fail to respond to traditional graduated compression bandaging or hosiery, intermittent sequential compression therapy can be a useful alternative treatment, helping to reduce oedema and promote healing.

Although the use of graduated compression bandages and hosiery remains the treatment of choice in the management of venous disorders of the lower limb, this method is not always acceptable to patients. Older patients often find the effective level of compression required is greater than they can tolerate (Pflug, 1975), while many people are unable to apply compression stockings, either through lack of strength or dexterity.

A growing body of work supports the use of pneumatic compression therapy as an additional or alternative treatment in the management of lymphoedema and disorders of the lower limb. The aim is to push or drain excess fluid from the interstitial spaces back into the venous and lymphatic vessels. Intermittent compression garments have been widely accepted for the prophylaxis of deep-vein thrombosis, and have broad applicability in both elective and emergency situations (Ligenfritz and Meier, 1994).

This article describes the current use of intermittent sequential compression therapy (ISCT), its clinical applications and the therapeutic and prophylactic effects.

History

Much of the early pioneering work on the use of pneumotherapy to reduce limb oedema in the UK was carried out during the 1970s at the Derbyshire Royal Infirmary by the parent company of Centromed, with the assistance of the superintendent physiotherapist.

The early equipment was cumbersome to use because of the size of the compressed air cylinders. These were quickly superseded by a pneumatic system driven by a compressor, which supplied air to a single cell limb garment with a pressure range of 20mmHg to 140mmHg. This type of single cell system is still in use today in some hospital units.

The main disadvantage of the single cell system is the lack of control over dispersion of fluid. As a result, a three-cell graduated sequential compression (GSC) garment was developed – the Flowtron (Huntleigh Diagnostics). The main criticism of the GSC system, however, is that it produces high pressures (60-70mmHg), which could result in damage to already compromised vessels.

Further refinement saw the development of multiple, five- and 10-chamber, single and double-limb intermittent sequential compression (ISC) garments (the Minor and Major; Centromed). These have a variable pressure cycle and time component which allows either a light or firm massage of the limb, depending on the causative factor.

How ISCT works

There is growing evidence to suggest that multi-cell garments operating on the principle of intermittent compression help to promote the healing of leg ulcers, and combat damage to the subcutaneous tissue associated with venous hypertension and secondary lymphoedema (Moody and Slade, 1993; Moody and Sergeant, 1995).

Using this form of compression the first cell or chamber inflates, then the second. Air is transferred from the first cell to the third, from the second to the fourth and so on, creating a ‘peristaltic’ action which milks blood from the compressed vessel, starting at the distal end and moving proximally (Kamm, 1982). This is in contrast to single-cell compression, which merely collapses the proximal veins.

The effect of this massage is to reduce the size of an oedematous limb by draining away excess tissue
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Literature search
Unlike many aspects of tissue viability and wound care, there is a dearth of quality literature and research on the use of pneumatic compression. Most of the work undertaken refers to small groups of patients and earlier models of equipment. Certain general principles can be applied, however, and these should be used to form the basis for further study.

Clinical applications
The patient may present with a chronic swollen limb or limb for two main reasons: as a general vascular disorder or as an accompanying sign of another, often more serious, condition.

The chronic swollen leg of venous or lymphatic origin is so common that it represents not only a medical but also a social and economic problem (Pflug, 1975). Many patients are unable to use normal footwear because of oedema.

A retrospective study from 1974 to 1988 (Lippmann et al, 1994) examined the biomedical and socio-economic rationale of oedema control and found compression to be inexpensive and adaptable for use in middle-aged and older ambulatory patients. The author’s experience (Moody and Sergeant, 1995) supports the view that patients find using the ISCT equipment easy and very relaxing.

ISCT has been used in the treatment of a range of clinical conditions:

Leg ulcers A small number of studies (Zelikowski et al, 1978; Hazarika and Wright, 1981; Cokeridge Smith et al, 1990) have been conducted to examine sequential therapy in the treatment of venous and other ulcers (Moody and Slade, 1993). Their findings appear positive, and merit further work, suggesting that sequential therapy may be a functional substitute for the ailing calf pump mechanism in patients with chronic venous insufficiency and oedema (Lippmann et al, 1994).

A significant difference in oxygen tension in leg ulcers of venous origin and ulcer healing rates (Hills et al, 1972) has also been shown.

Prophylaxis Reference has already been made to the application of mechanical compression in the prevention of deep-vein thrombosis and its therapeuetic effect upon the vasculature of the lower limb. The studies are again relatively small (Pflug, 1975; Hills et al, 1972; Nicholaides et al, 1980), thus providing an opportunity for further research.

If venous hypertension is not correctly managed, it will result in a change in the physiological status of local capillaries and veins, causing enlargement of the endothelial pores, capillary leakage and localised oedema.

Lipodermatosclerosis Extravasation into the interstitial spaces of larger protein and lipid molecules can cause fibrotic changes in the affected limb, commonly referred to as lipodermatosclerosis. The tissues become rigid and hard and patients frequently complain of the limb being heavy, tender and painful. Constriction of the tissues around the ankle may give rise to the familiar ‘Champagne bottle’ appearance.

A combination of ISCT and support bandages or hosiery can dramatically improve the condition of the affected limb(s). Anecdotal evidence suggests that by ‘breaking down’ the hard fibrotic tissue with gentle massage, the limb is reduced in size, tissue perfusion improves and ulcers, even those that have been present for longer than five years, heal. Patients can restart therapy at any time if they consider the limb to be showing signs of deterioration. Thus ulceration can usually be prevented (Moody and Sergeant, 1995).

Ulcers that are difficult to heal Leg and foot ulcers in patients with diabetes or rheumatoid arthritis are widely considered to be resistant to treatment. Such ulcers are commonly attributed to vasculitis, but little is known of other potential aetiological factors (McRorie et al, 1994). Hence, despite good local wound management, many of these wounds fail to heal. The older patient is especially at risk of many podiatric conditions which may threaten the viability of the limb (Morse, 1993). Even when meticulous foot care (Small and Barnes, 1994), combined with rest, elevation and appropriate medication are employed, there remains a high risk of amputation. Despite the dearth of scientific evidence to support the practice of offering ISCT to patients in this high-risk group, the anecdotal and case history evidence is beginning to show a positive outcome for those able to take up this option.

Lymphoedema The interstitial fluid is derived from blood filtrate and should contain essential nutrients to sustain cellular activity. Waste products such as urea and carbon dioxide, along with excess fluid, are transported back to the circulatory...
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Box 1. Case study

Mrs Smith, aged 73 years, had a history of lymphoedema spanning 40 years. She had used a graduated compression system for approximately 20 years and specially measured support stockings. She attended her GP, complaining that her left leg was increasing in size. She was experiencing reduced mobility and fear of tissue ulceration. After an initial assessment and obtaining limb measurements, Mrs Smith commenced on ISCT twice a day for six months. She diligently recorded her limb measurements before and after treatment. At the end of this period her limbs ‘reduced significantly in size’ and a new fitted compression stocking had to be made.

System via a complex network of vessels and nodes, collectively termed the lymphatic system. Changes in interstitial pressure caused by respiration and muscle activity facilitate drainage while the lymph nodes filter toxins and other potentially harmful substances from the circulating lymph. Any reduction of function can predispose the person to an increased risk of infection.

Lymphoedema occurs when there is an excessive accumulation of lymph in the tissues, causing thickening fibrotic changes and enlargement of the limb. Treatment is primarily by massage and support garments. Some patients have been treated by the use of a single or graduated compression garments, but the benefits of this form of treatment remain a subject for debate.

The author’s recent experience of using ISCT in 10- and five-chamber garments have demonstrated a positive outcome for some patients (Box 1) and work is ongoing in this specialised area of tissue viability.

Additional therapeutic benefits. A review of the literature suggests that a reduction in movement in the dorsovolar plane occurs in the ankle joint adjacent to chronic ulceration. The longer the period of ulceration the greater the restriction of movement (Helliwell and Chessbrough, 1994). However, patients receiving ISCT may experience improved ankle movements after six to 10 weeks.

In the author’s experience, none of the patients who have mentioned improved ankle movement have received manual massage and other possible regimens such as additional resting and physiotherapy have not taken place. The improvement has therefore been attributed to ISCT, because this was the only common treatment provided. However, there is a need critically to evaluate this potential therapeutic value.

Gentle but firm massage of the skin and subcutaneous tissues with the fingers and a little bland oil in a centripetal direction, combined with passive movements of the ankle joint has five effects:

- Dispersal of oedema through the tissues
- Softening of the subcutaneous tissues
- Break-up of some of the fibrin deposited in the tissues
- Softening of the skin, reducing hyperkeratosis
- Encouragement of ankle movements (Browse et al, 1988)

Treatment regimen

The dearth of clinical evidence to support recommendations about treatment frequency, cycle time and pressure requires the practitioner to exercise his or her clinical judgement in consultation with the patient. Guidelines are provided by the equipment manufacturers and are based on the accumulated views of numerous practitioners over a period of several years.

In the author’s experience, patients who receive therapy twice daily for 30 minutes to one hour per session appear to achieve optimum limb status within the shortest time, especially in the case of patients with lymphoedema, lipodermatosclerosis, venous insufficiency or vascular ulcers. Positive results have also been achieved for patients treated twice daily for 30 minutes to one hour three times a week, over a longer period of time.

Conclusion

The adaptable and inexpensive nature of ISCT means that it can be used in a number of clinical situations for the management of lymphoedema or disorders of the lower limb. The acceptable nature of this form of treatment also promotes its use among patients. However, despite the fact that there is a growing body of evidence in support of the therapeutic effects of this treatment method, further research and clinical evaluation of its effectiveness is required.

References (continued)


A video and booklet providing an introduction to sequential compression can be obtained from Centromed, Unit B, St John’s Cour, Ashford Business Park, Swington, Ashford, Kent TN24 9J.