

The use of intermittent pneumatic compression of the thigh with the WoundExpress™ to affect arterial and venous blood flow proximal to a chronic wound sites

Authors: Morris, R.J., Ridgway B.S., Woodcock J.P.
Department of Medical Physics and Clinical Engineering,
University Hospital of Wales, Heath Park, Cardiff, CF14 4XW.

OBJECTIVE:

Intermittent pneumatic compression (IPC) of the lower limbs has been shown to have beneficial effects in patients with chronic ulceration. There is evidence that the technique can improve the symptoms of arterial insufficiency and reduce oedema and pain. Intermittent compression below diastolic pressure compresses the veins in the limb, and expels venous blood proximally, but is also known to cause arterial hyperaemia, with several physiological mechanisms proposed.

It is plausible that some haemodynamic effects would also be present distal to a pneumatic cuff. Therefore, if thigh-only IPC was applied to a limb, it may cause blood flow changes in the calf. A suitable thigh-only compression regime could then, based on existing evidence, promote healing in calf wounds, without compressing the wound directly, or interfering with any dressings that had been applied to that wound.

DESIGN:

The distal venous and arterial effects of a prototype 3-chamber sequential IPC system (Huntleigh WoundExpress™) were tested in 20 healthy volunteers (10 male, 10 female), and 14 patients with ulcers of various aetiologies (9 male, 5 female) using the 8 MHz flat transducer of a continuous-wave Doppler ultrasound system. The mean age of the volunteers was 31 years, and the mean age of the patients was 71 years. The type of ulcer was determined by the normal assessment procedure of the clinic, with 3

venous, 5 arterial, 2 mixed, 2 diabetic and 2 systemic lupus erythematosus. Two different sequential compression cycles were tested at 60 mmHg in the healthy volunteers, with 2-minute resting intervals between each 2-minute period of intermittent compression instituted after preliminary results, to optimise the induction of hyperaemia. Only the most haemodynamically successful cycle was applied to the ulcer patients.

RESULTS:

The prototype WoundExpress™ produced significant hyperaemic responses in the distal arterial flow of both test groups during the rest phases. If a hypothetical baseline flow is drawn between the average response of the first 3 minutes (before compression) and the final 30 seconds (after the final hyperemic response), then the average percentage change in flow, based on the area under the curve, and assuming no change in arterial diameter, would be -1.20% for the healthy

volunteers for the most successful cycle, and +4.76% for the patients. In only 7 patients was a signal detectable in the dorsalis pedis artery, most likely because of severe calcification or distal vessel occlusion. The peak venous velocity on deflation of the first and second chambers of the cuff was also greater in the patients with ulceration than in the healthy volunteers (11.6 cm s⁻¹ versus 8.3 cm s⁻¹, P=0.1).

CONCLUSION:

The results of this preliminary investigation are consistent with four propositions:

1. An intermittent pneumatic compression cuff and compression cycle can be designed that has a positive effect on both arterial and venous blood flow in the lower limb.
2. Intermittent pneumatic compression of the proximal lower limb (thigh) can have positive effects on the blood flow in the distal lower limb (calf).
3. Compression sequences designed to prevent venous reflux in the presence of valvular incompetence can be used without reducing overall arterial flow.
4. The haemodynamic response to intermittent pneumatic compression of patients with vascular disease can be equal or greater than that of healthy volunteers.

Existing IPC systems aimed at treating chronic ulceration using calf, foot/calf, or calf/thigh garments, intend to compress the site of the wound. While this research only indicates the haemodynamic potential of a thigh-only approach, it does give some justification for continuing to evaluate using specific sequences of compression in the thigh to promote healing of wounds caused by chronic venous, arterial and other disease. A long-term trial of the effects of a device such as the Huntleigh WoundExpress™ on the healing of chronic wounds should be conducted in combination with standard treatments, and as there should be no negative haemodynamic effects it would not pose any risk to the recruited patients' progress.



Further advice and information regarding the WoundExpress can be found online at:

www.woundexpress.com

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35 Portmanmoor Road, Cardiff, CF24 5HN, United Kingdom
T: +44 (0)29 20485885 sales@huntleigh-diagnostics.co.uk
www.huntleigh-diagnostics.com

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