

COMPRESSING ISCHEMIC LIMBS AND WHY IT'S BENEFICIAL

THE MISCONCEPTION

Is it true that arterial occlusive disease is an absolute contraindication for intermittent pneumatic compression (IPC)?

THE ANSWER

Not at all!

Unfortunately, many medical professionals are under the impression that applying even a small external pressure to an ischemic limb with reduced distal arterial pressures may serve to reduce or completely stop the already-compromised blood flow. This article presents strong evidence that, contrary to popular belief, IPC can bring life-changing benefits to those who cannot undergo revascularization.

HISTORY

Part of the reason this dogma exists is because, for many who consider it, applying IPC to ischemic limbs seems counterintuitive and likely dangerous. Also contributing to this myth are the literature reviews written by investigators as far back as 1934 who showed a poor understanding of the physiological mechanisms. Though these measured acute effects of compression on increased blood flow in ischemic limbs and relief of symptoms, the assessments made about IPC therapy were muddled due to the use of a great variety of compression schemes and devices. This lack of clarity resulted in literature that only served to

feed misgivings about IPC as a treatment modality.

PHYSIOLOGICAL AND OPTIMIZATION STUDIES | ACI MEDICAL

To demystify the true value of IPC, our goal was to determine the physiological mechanisms of action, to optimize IPC design for maximal acute effect, and to determine if there is a clinical benefit to patients with lower extremity ischemic disease.

We started with physiological studies¹ with compression applied to the dependent limb, which showed these acute mechanisms:

- ▶ Increased arterial-venous pressure gradient
- ▶ Reduced peripheral resistance
- ▶ Abolition of the veno-arteriolar reflex

Further studies² concerned optimization:

- ▶ **Pressure: at least 120 mmHg**

This high pressure is required to empty the veins in the dependent limb, which temporarily reduces venous pressure to near zero and increases the arterial-to-venous pressure gradient and therefore, flow. Reducing venous pressure also serves to temporarily abolish the veno-arteriolar reflex, which allows for arteriolar dilation.

- ▶ **Timing: 3 second pulses followed by 17 seconds of low pressure**

An essential requirement for an arterial pump is the ability to quickly reach inflation and deflation pressures with rise times of 0.25 to 0.30 seconds and fall times under 0.5 seconds. This rapid squeeze and release creates blood velocities that apply shear stress to the endothelium which releases nitric oxide and further supports the large acute vasodilatory effect in the arterioles.

- ▶ **Compressed tissues: foot, ankle and calf regions**

In order to maximize blood flow through the major arteries and to the toes where ischemic disease often presents, we found that a circumferential foot bladder including the ankle should be compressed first, followed one second later by compression of the calf with a relatively large asymmetrical bladder.

RANDOMIZED CONTROLLED TRIALS | ACI MEDICAL

INTERMITTENT CLAUDICATION

Once the arterial IPC device was optimized, three randomized controlled trials³ were performed on patients with intermittent claudication. Not only did these trials yield significantly increased walking distances of two to three times, but also sustained “permanent” improvements begged the question, “What long term mechanisms might be at work?”

LIMB SALVAGE DUE TO ARTERIOGENESIS

Further studies⁴ showed that arteriogenesis (the opening of collaterals) was responsible for improved ABI's, PVR's, toe pressures and popliteal flow. A recently published study from 2010⁵ reported a **94% limb salvage rate** at 3.5 years in patients who were unable to undergo revascularization procedures.

ARTERIAL ASSIST DEVICE, NOT LYMPHEDEMA PUMP

Today, it is widely-known that IPC devices are designed for prophylaxis against deep vein thrombosis (DVT) and for treatment of lymphedema. However, the understanding behind these devices does not coincide with our exploration of IPC to treat severe forms of arterial disease. Lymphedema and DVT devices do not apply enough pressure to the dependent limb to adequately empty the veins, nor do they apply and release pressure rapidly enough to stimulate release of nitric oxide (NO). While such devices will not significantly improve blood flow in the ischemic limb, it is difficult to say whether they would be harmful without further study.

 ***Think before you contraindicate.***

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