Compression Pump Studies – Arterial Disease

Intermittent pneumatic compression for the treatment of lower extremity arterial disease: a systematic review
By Nicos Labropoulos, Carl Wierks and Brian Suffoletto
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Abstract: This study aimed to identify the role of intermittent pneumatic compression in treating peripheral arterial disease and to investigate the types of treatment programs that are most effective. Data was sourced from English-language articles which were identified by a computer search using MEDLINE from 1996 to 2001, followed by extensive bibliography review. Studies were included if they contained pertinent material involving a compression device and arterial flow dynamics in lower limbs. A total of 26 English-language studies were identified that met the inclusion criteria. The diverse patient criteria and methods used in the studies provided an opportunity to examine the effectiveness of each, but made it difficult to compare one study with another. To assist in focusing on overall trends in improvement, patient type and treatment type disparities must be identified. In conclusion, it is evident that an intermittent pneumatic compression program appears promising and may be used in patients with severe peripheral arterial disease who are not candidates for revascularization using surgery or percutaneous angioplasty. It is now the goal to establish randomized, prospective, controlled trials to clarify the most beneficial regimen for treating such disease.

Acute Effects of Intermittent Pneumatic Compression on Popliteal Artery Blood Flow
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ABSTRACT: Objectives: To investigate the immediate effects of intermittent pneumatic foot and calf compression (IPFCC) on popliteal artery blood flow in symptom-free volunteers and to determine the reproducibility of color flow duplex imaging in the popliteal artery.
Design: Cohort study.
Setting: A university associated tertiary care hospital.
Patients: Forty lower limbs of 30 symptomfree volunteers who had at least 5 color flow duplex imaging measurements taken at each of the above time points on 3 different days.
Interventions: Popliteal artery blood flow was measured in the sitting position before, during, and after the application of OPFCC using color flow duplex imaging. The interobserver, intraobserver, and between occasion within-subject variability of the popliteal artery blood flow were evaluated in 5 symptomfree volunteers who had at least 5 color flow duplex imaging measurements taken at each of the above time points on 3 different days.
Main Outcome Measures: The arterial diameter, peak systolic, end diastolic, and reverse-flow velocities were measured, as well as the duration of forward flow during diastole before, during, and after IPFCC. The same variables were measured in 5 separate volunteers by 3 different observers, on 3 separate days, at 3 separate times to determine reproducibility.
Results: Including all types of variability, the popliteal artery blood flow varied from 8% to 39% with a mean value of 19%. Since the diameter of the artery was obtained with less than 5% variability, the time average mean velocity was responsible for the high variation in flow. During application of the IPFCC, the popliteal artery blood flow increased significantly in all subjects (P.<.001). The mean increase in the flow was 2.4 times the baseline values. The diameter of the arteries remained unchanged while the time average velocity increased significantly (P.<.001). This velocity increase was due to marked elevation in the peak systolic and end diastolic velocities and diminution of the reverse-flow component, as well as a prolongation of the forward flow during diastole. After cessation of the pump, flow returned to baseline levels (P = .41).
Conclusions: Ultrasound-derived popliteal artery blood flow measurements show moderate variability. The application of IPFCC greatly enhances popliteal artery blood flow. The flow increase is due to a dramatic drop in the peripheral vascular resistance as the peak systolic and end diastolic flow velocities increase and the reverse-flow component diminishes. Its role in the treatment of lower extremity occlusive arterial disease needs to be determined.
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Augmentation of Blood Flow in Limbs with Occlusive Arterial Disease by Intermittent Calf Compression

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**Abstract:** Purpose: This study was designed to investigate the effect of intermittent calf compression on popliteal arterial blood flow and to see how flow is influenced by position of the subject and by arterial blood pressure at the ankle.

**Methods:** Volume flow in the popliteal artery of subjects in the sitting and prone positions was measured with duplex ultrasonography before inflation and immediately after deflation of a pneumatic cuff placed around the calf. Eleven legs of control subjects and 41 legs of patients with symptoms (32% patients with diabetes) with decreased ankle pressure were studied. Cuffs were inflated for 2 seconds at pressures ranging from 20 to 120 mm Hg.

**Results:** An increase in arterial blood flow of two to eight times (mean 4.4 ± 2.0) was found on deflation of the cuff in seated control subjects. Little change in flow was observed when the subjects were in the prone position. In seated patients with arterial obstruction, the mean increase in arterial flow was 3.2± 1.6 times the resting flow. Little correlation was found between the maximum increase in flow and the ankle/brachial index.

**Conclusions:** An increased arteriovenous pressure gradient accounts for some but not all of the flow increase, much of which must be attributable to transient vasodilatation. Because the increase in flow does not depend on an increased inflow pressure and was not adversely affected by a low resting ankle-brachial pressure index or a low toe-pressure, intermittent external limb compression may deserve investigation as soon as a possible adjunct to the nonoperative treatment of patients with severe arterial insufficiency.


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**Abstract:** Background. The aim of this retrospective observational study was to review the use of an intermittent pneumatic compression device on nonhealing wounds in patients with critical limb ischemia at Mayo Clinic Rochester.

**Methods:** The setting was a community and referral multidisciplinary wound care clinic. The authors analyzed 107 patients, median age 73, with critical limb ischemia and active ulcers started using a compression device between 1998 and 2000; 101 patients had lower extremity ulcers, and 25% had a history of amputation and 64% had diabetes. Of all the wounds, 64% were multifactorial in etiology, and 60% had associated transcutaneous oxygen tension levels below 20 mmHg. Patients were typically asked to use the device at home on the affected limb(s) for 6 hours daily. The main outcome criterion was complete wound healing with limb preservation.

**Results:** The median follow-up after initiation of treatment was 6 months. Complete wound healing with limb preservation was achieved by 40% of patients with TCPO2le vels below 20 mmHg; by 48% with osteomyelitis or active wound infection; by 46% with diabetes patients discontinued the device because of pain experienced with its use.

**Conclusion:** Patients with critical limb ischemia and nonhealing wounds at high risk of amputation can achieve complete wound healing and limb preservation by using an intermittent pneumatic compression device.