INVITED COMMENTARY

The Compression Paradox of Deep Veins May Not be a Paradox

Christopher R. Lattimer [a,b,c]

[a] Josef Pflug Vascular Laboratory, Ealing Hospital, Middlesex, UK
[b] Department of Surgery and Cancer, Imperial College, London, UK
[c] West London Vascular and Interventional Centre, Northwick Park Hospital, Harrow, UK

D. Rastel and B. Lun should be congratulated for their evidence as to why low strength 18–23 mmHg medical compression stockings (MCS) do not significantly compress or occlude deep calf veins in the standing position.[1] This is contrary to the results of compression specialists who claim, using standing MRI, that low strength compression stockings alone can significantly compress or occlude the deep veins of the calf.[2]

The authors used ultrasound through a transparency of a hybrid (elastic + non-elastic) pneumatic pressure device in nine standing patients (all limbs classified $C_{1\text{-}3}$). Pressures of 43.1 ± 16.2 mmHg (mean, SD) were required to occlude deep veins. They went on to examine seven standing patients, bearing equal weight, first wearing a 20–36 mmHg MCS and then without a MCS. There was no significant difference in diameter change with the stocking. Additionally, six patients were examined without compression with the leg: (i) off-loaded, (ii) bearing equal weight, and then (iii) bearing full weight. Deep venous diameters reduced significantly ($p = .009$) from off-loading to equal weight bearing by 11.8% (range 0–54%). From equal weight bearing to full weight bearing all deep veins collapsed completely. They concluded that the observed deep vein diameter reductions under compression in the standing position are caused by the isometric muscle tension necessary for weight bearing and not by the compression effect of the stocking.

The deep veins of the calf are surrounded by muscles that form the pumping chamber. It is not surprising that any pressure changes in this compartment would have a significant effect on venous diameter. This was acknowledged recently in an attempt to explain the "paradox" effect of MCS on deep *versus* superficial veins.[3] However, weight bearing requires powerful isometric muscle contractions. Furthermore, a transfer of body weight from one leg to the other, which occurs in walking and standing, is the most efficient natural pumping mechanism recognised to date.[4]

If the hypothesis that a MCS compresses deep veins independently of the systolic and diastolic activities of the calf pump is correct, then a real paradox arises: how can collapsed veins result in better pumping with an improved ejection fraction?[2,5]

The work presented by the authors supports that a MCS does not significantly compress the deep veins of the calf alone and that any effects observed are from muscle pumping activity. There is no paradox.

REFERENCES

1 Rastel D, Lun B. Lower limb deep vein diameters beneath medical compression stockings in the standing position. *Eur J Vasc Endovasc Surg* 2019;**57**:276–82.
2 Partsch H, Mosti G, Uhl JF. Unexpected venous diameter reduction by compression stocking of deep, but not of superficial veins. *Veins Lymphat* 2012;**1**:e3.
3 Uhl JF, Benigni JP, Cornu-Thenard A, Fournier J, Blin E. Relationship between medical compression and intramuscular pressure as an explanation of a compression paradox. *Phlebology* 2015;**30**:331–8.
4 Lattimer CR, Franceschi C, Kalodiki E. Optimizing calf muscle pump function. *Phlebology* 2018;**33**:353–60.
5 Mosti G, Partsch H. Is low compression pressure able to improve venous pumping function in patients with venous insufficiency? *Phlebology* 2010;**25**:145–50.

DOI of original article: https://doi.org/10.1016/j.ejvs.2018.07.040
E-mail address: c.lattimer09@imperial.ac.uk (Christopher R. Lattimer).

https://doi.org/10.1016/j.ejvs.2018.08.027