Relationship between Compression and Intramuscular Pressure

Compression paradox

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No conflict of interest to declare

International Compression Club

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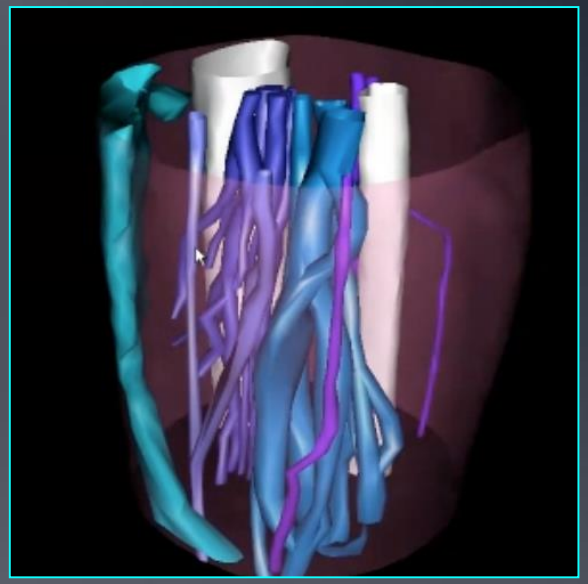
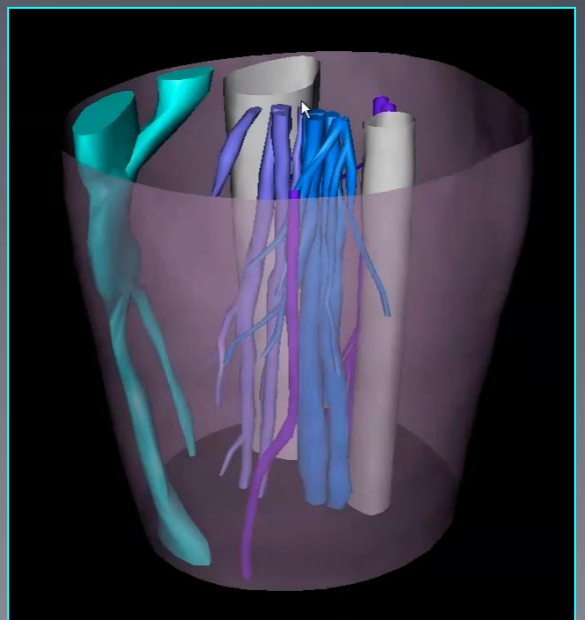
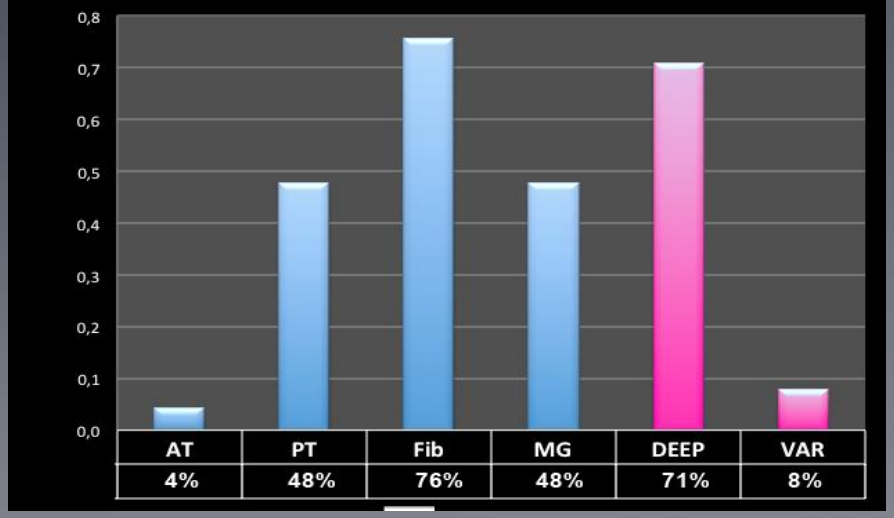
Background : paradox of compression

Partsch et al , Uhl et al showed by MRI and 3D venous quantification* that, in the standing position a MCS of 22 mm Hg significantly reduced the caliber of deep calf veins but, paradoxically did not affect superficial varicose veins.





Reduction of vein volume (%) due to compression



Partsch H, Mosti G, Mosti F. Int Angiol. 2010 Oct;29(5):408-10.

OBJECTIVES

- ✓ To solve this paradox by measuring the pressure in the muscular compartment (IMP) under a stiff compression device with several interface pressures (IP)
- ✓ To compare these results with the literature assessing the efficacy of both elastic & inelastic devices.

MATERIAL & METHODS

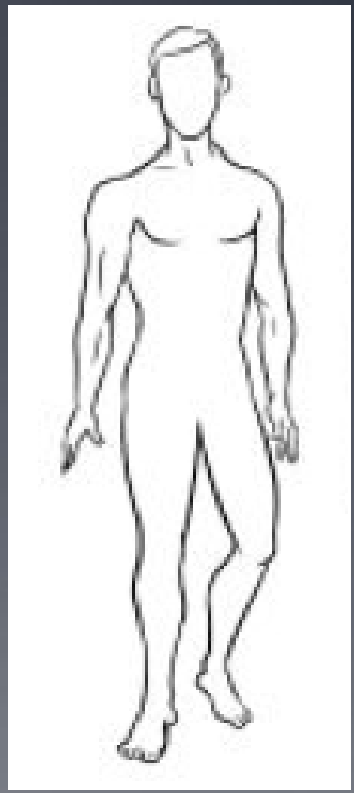
In 10 legs of healthy adults we studied:

- The intra-muscular pressure (IMP) of the medial gastrocnemius measured with a 21 G needle connected to a manometer (Stryker® quick pressure monitor)

MATERIAL & METHODS

- In prone (at rest) and standing positions

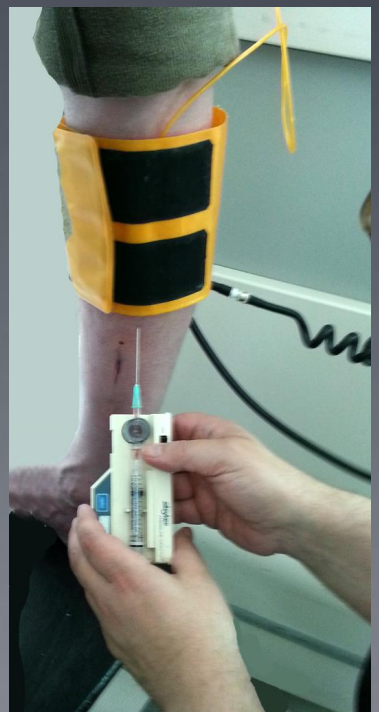
- In standing position, the weight of the body was on the other leg, the tip of the foot of the studied leg lightly resting on the ground..



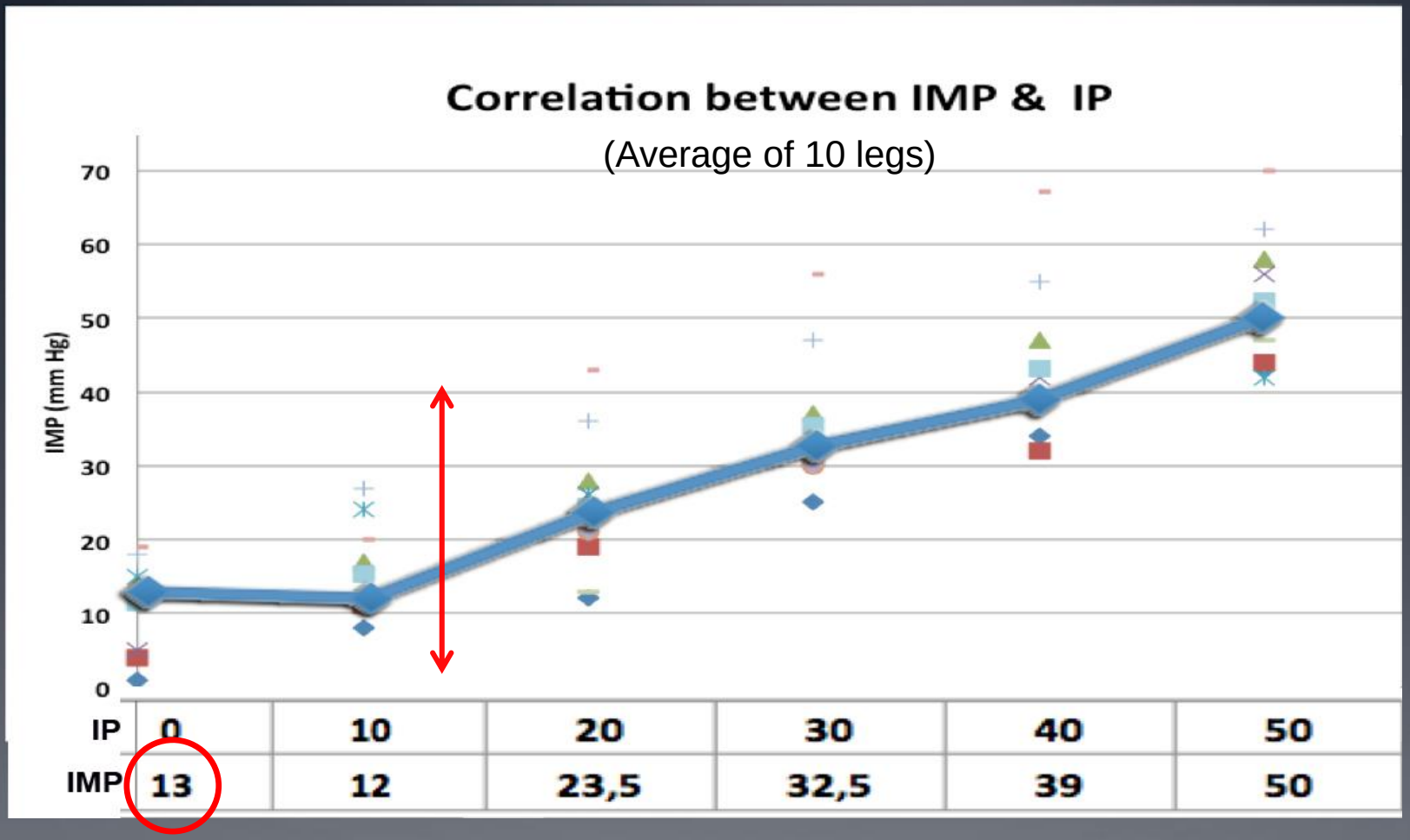
MATERIAL & METHODS

-The external pressure was exerted by a blood pressure cuff inflated at 0, 10, 20, 30, 40 and 50 mmHg and verified by a probe*

* *The Interface pressure (IP) was checked with a Kikuhime® device (small probe)*



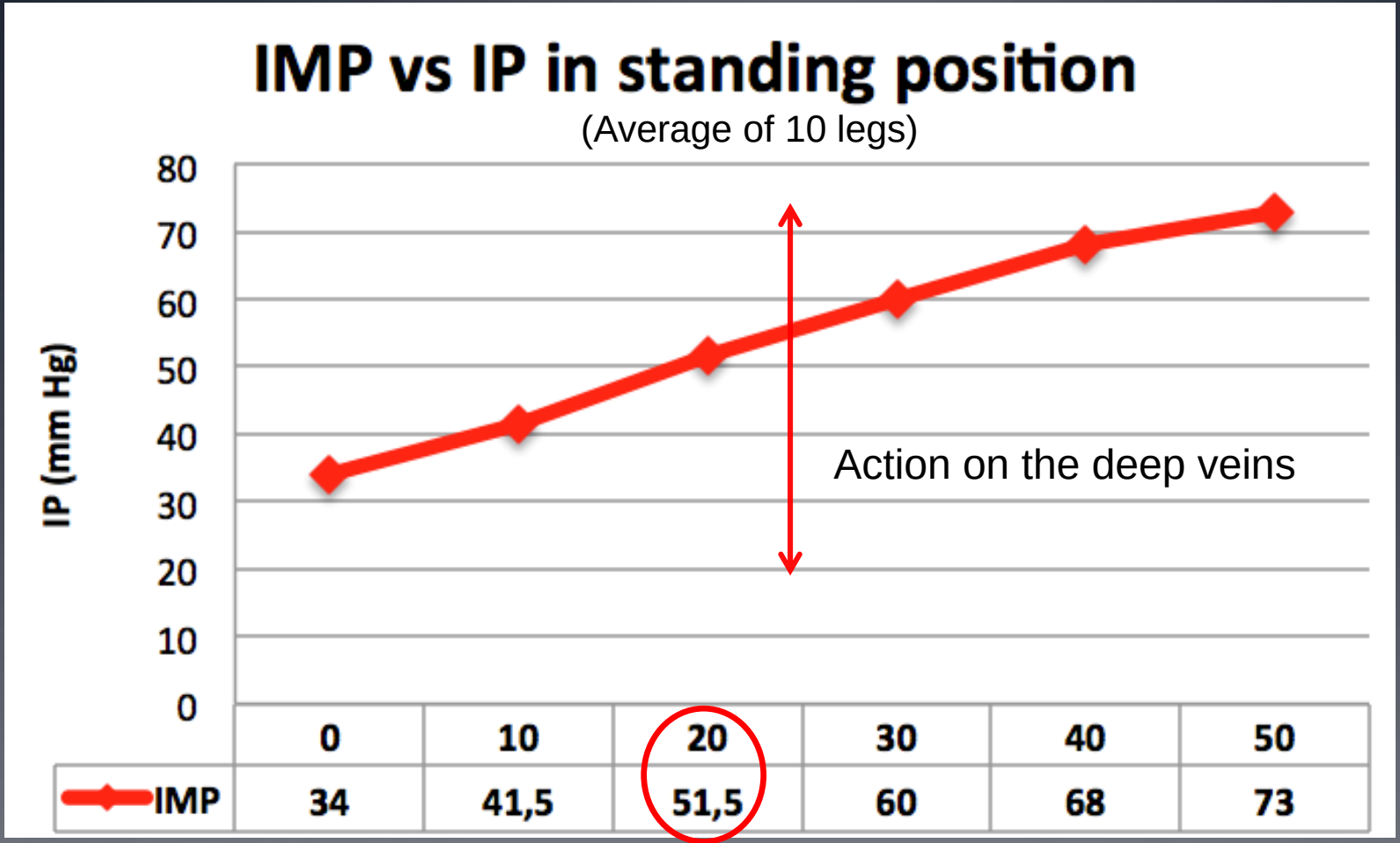
RESULTS at rest (lying)



IP	0	10	20	30	40	50
IMP	13	12	23,5	32,5	39	50

In ventral lying position, an IP < 20 mmHg (red arrow) did not significantly change IMP (median pressure = 13 mmHg with no IP).
On the contrary, a perfect linear correlation with the IMP (r=0.92) was observed from an IP of 20 mmHg to 50 mmHg.

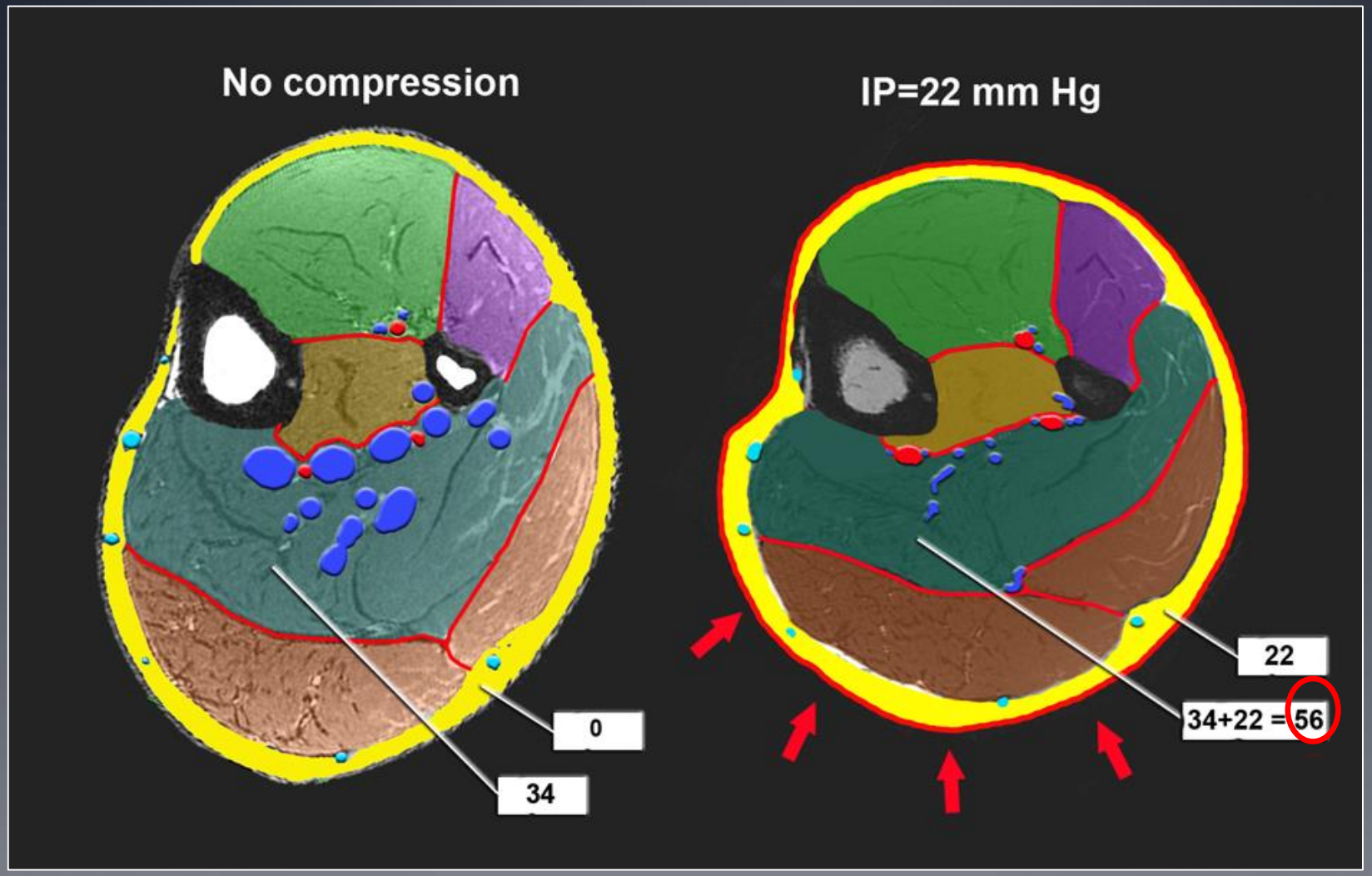
RESULTS



	0	10	20	30	40	50
IMP	34	41,5	51,5	60	68	73

In standing position with a stiff cuff, the IP is added to the baseline

Possible explanation of the paradox..



In standing position, 60 mmHg is required to fight against the intra venous hydrostatic Pressure and so to flattens the veins…

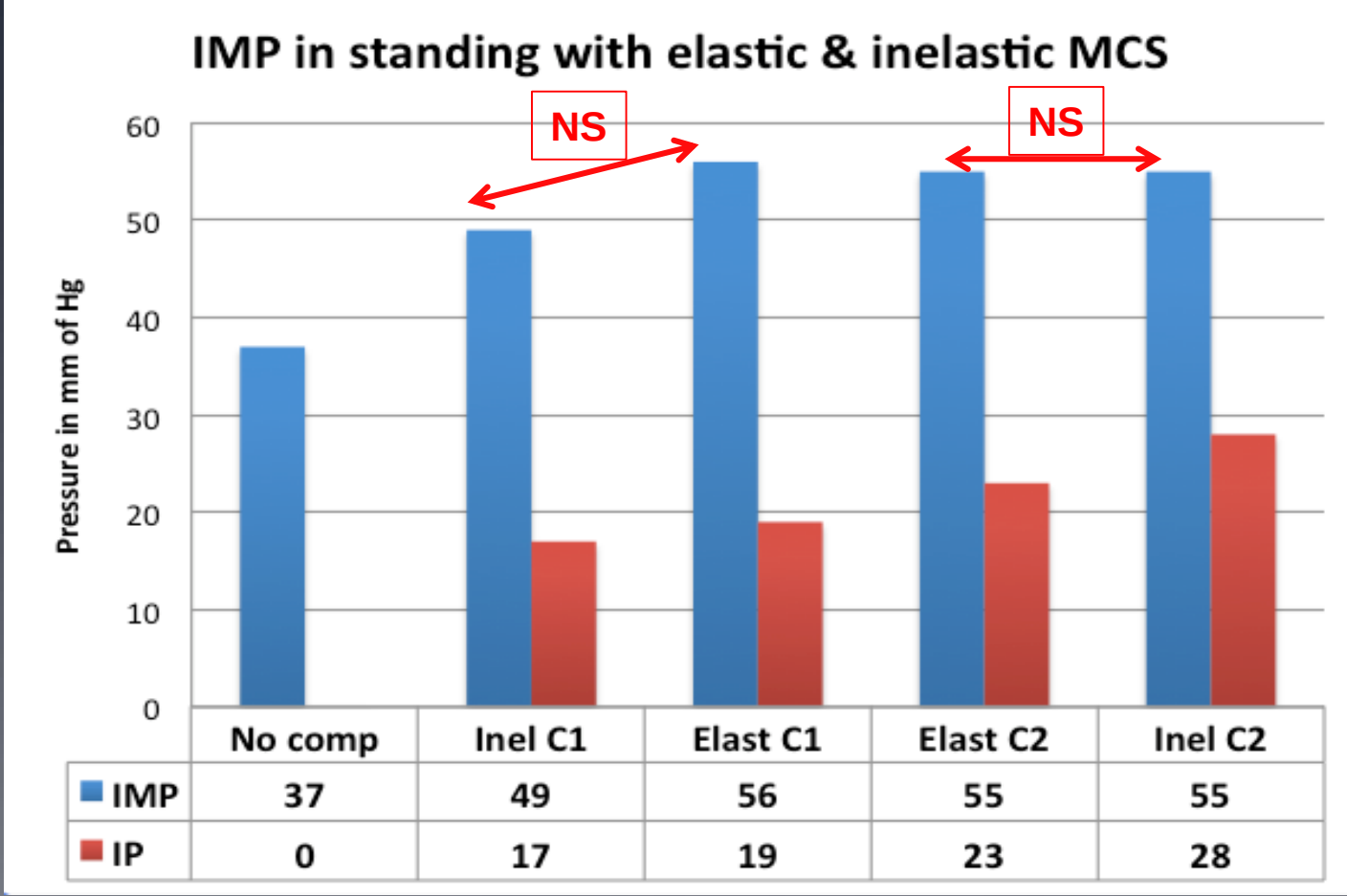
DISCUSSION

Confirmation of our results by Murthy

NASA grant Ann of vasc Surg 1994; 8 ,543-48

Elastic vs inelastic during static muscular contraction

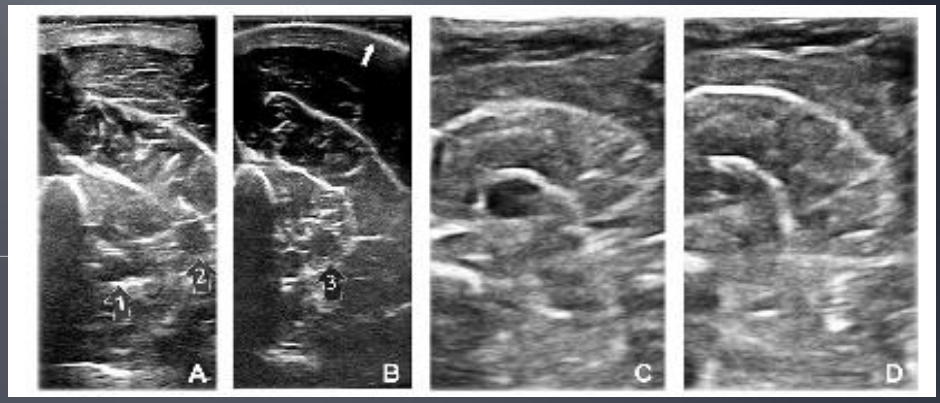
Murthy et al. (Ann of vasc Surg 1994; 8 ,543-8)



	No comp	Inel C1	Elast C1	Elast C2	Inel C2
IMP	37	49	56	55	55
IP	0	17	19	23	28

No significative difference was shown regarding the IMP for similar IPs

DISCUSSION



D. Rastel and B. Lun* challenge our results

. Isometric muscle contraction

Weaknesses of their study :

. Study of slices vs. study of segment volume

. Difficulties in performing measurements always in the same place

* Eur J Vasc Endovasc Surg. 2019 Mar 25.

Conclusion (1)

In the standing position, compression stockings with an IP of ± 20 mm Hg produce an IMP around 55 mm Hg in the medial GM (IP + IMP with no CS = 20+35) Increasing the IMP by 40%.

Conclusion (2)

This level of pressure is enough to flatten the deep compartment and MUSCULAR veins.

But the same IPs are too low in the subcutaneaous tissues to compress the superficial compartment in standing position (about 70 mm Hg is needed)

This is a relevant explanation for the « compression paradox » and for our 3D anatomical results.

Conclusion (3)

The effects of compression on the superficial veins could be due to the action on the deep system ++

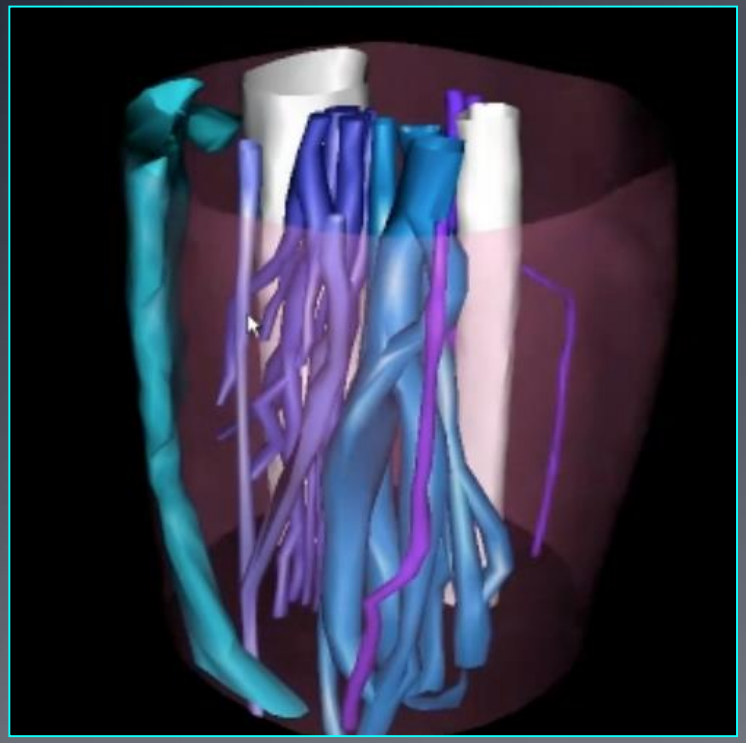
The increase of the IMP acting on the muscular veins has a direct effet on the calf pump function.

This is supporting the idea that compression should be focused on the CALF muscles, and that degressivity is not mandatory[1].

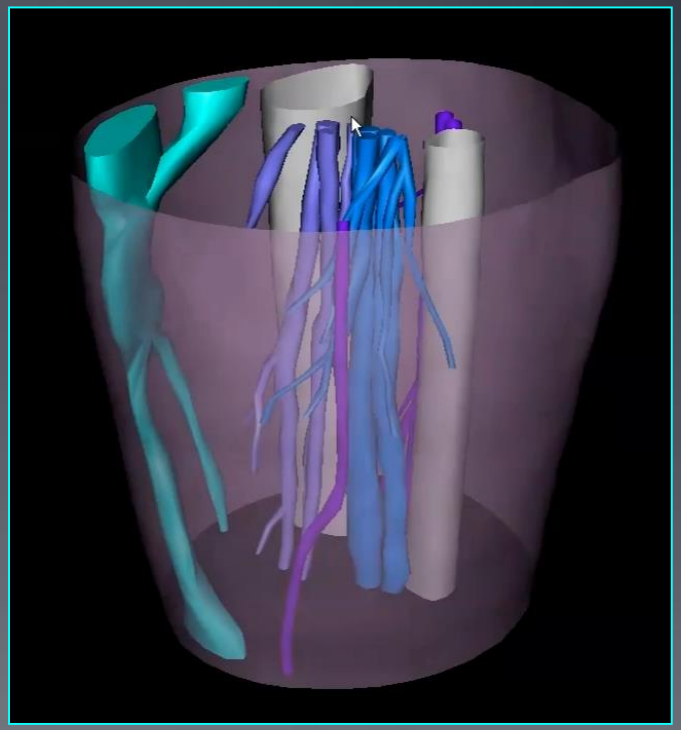
It makes sense that higher IMP (inelastic CS) are more efficient on the calf pump[2].

1- Mosti, Partsch EJVES. 2012 Sep;44(3):332-6 *2- Mosti G. Phlebology. 2012 Feb;27(1):1-4.*

Thank you for your attention



No compression standing
IM pressure= 34 mm Hg



IP 22 mm Hg standing
IMP= 34+22= 56 mm Hg