Medical Compression: Effects on Leg Blood Flow

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Medical Compression Bandaging

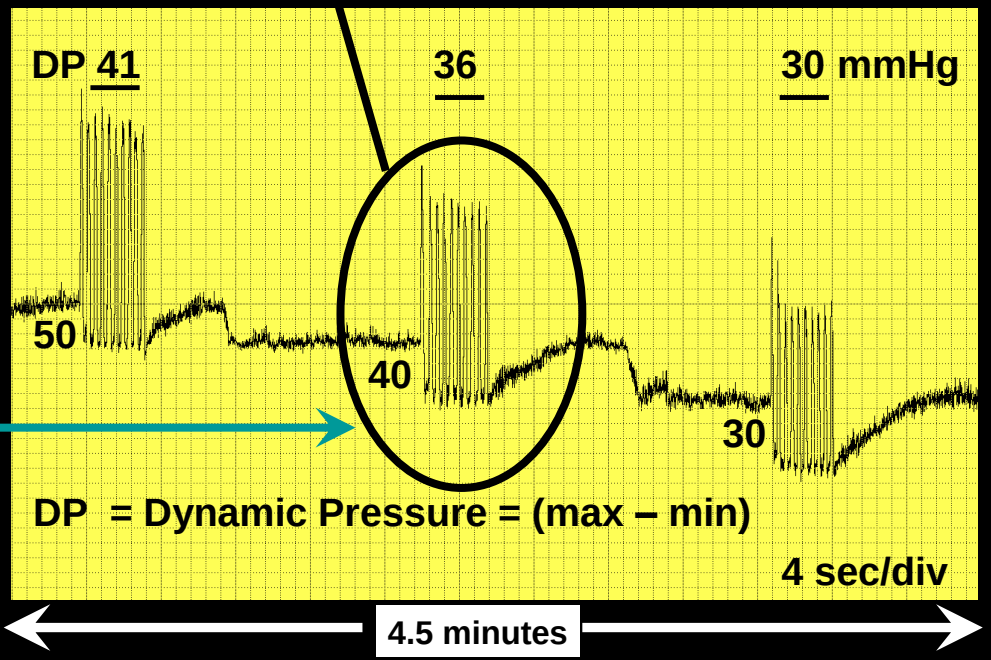
Major treatment component for venous ulcers and limb lymphedema

Medical Compression Pressures

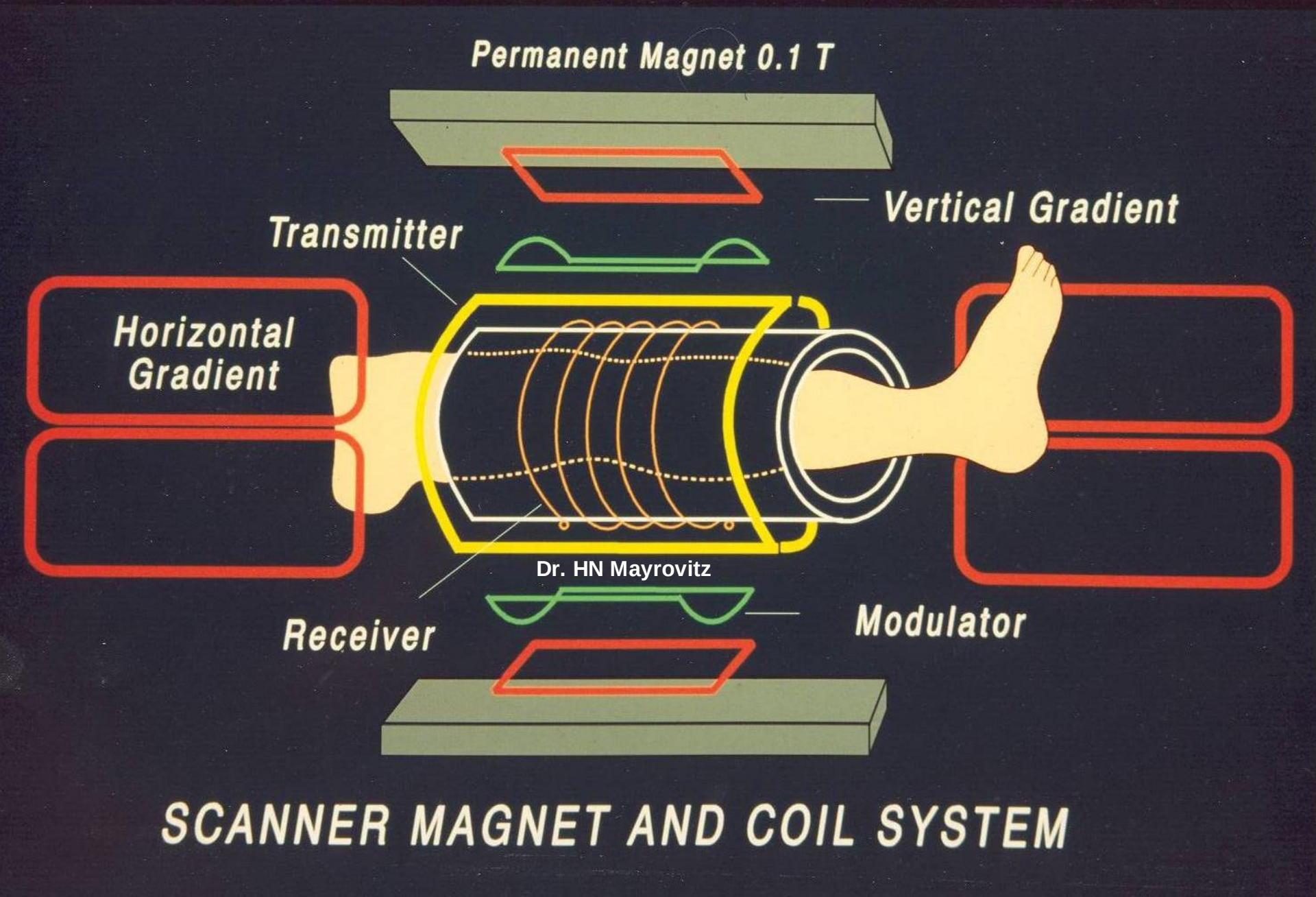
Pressures need to be adequate but not so high as to negatively impact blood flow.

A special concern is use in patients with co-present diabetes and/or lower extremity arterial disease.

Standard is about 40 mmHg at ankle

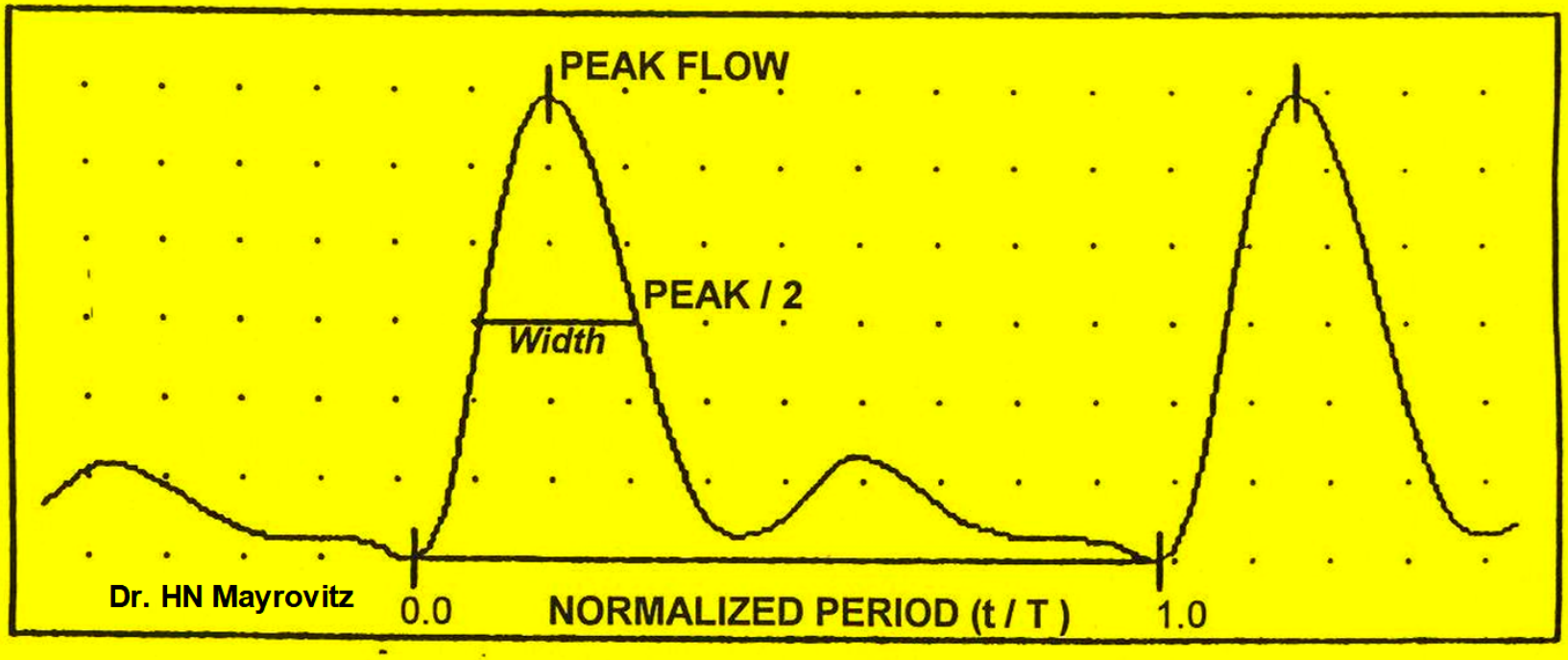


MRF Principle



System Setup

Flow Recording Parameters

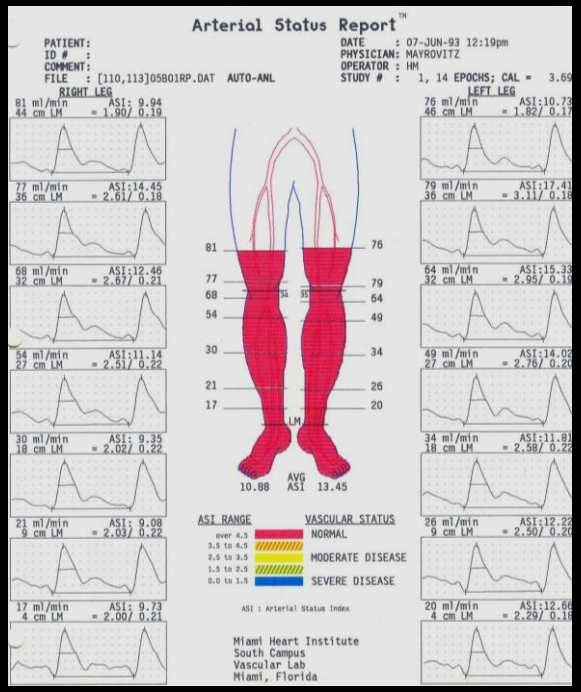


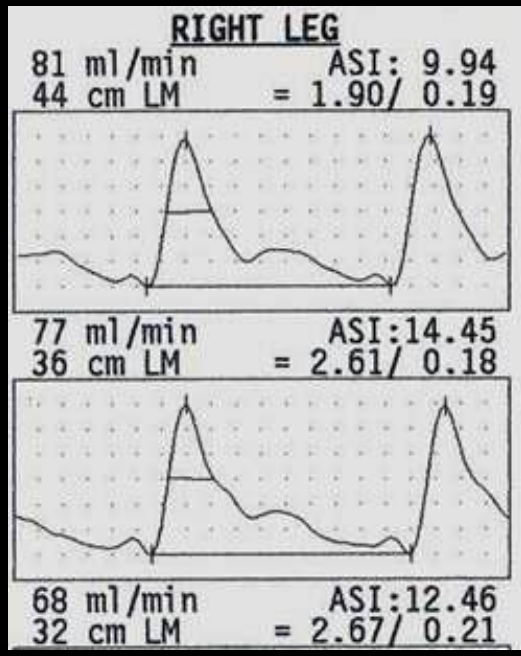
FLOW = (Area under flow-time curve) x Heart Rate

PERFUSION = FLOW / (Limb volume distal to measured site)

ASI = PERFUSION / ***Width***

Flow Signals at multiple limb sites with paired limbs simultaneously determined





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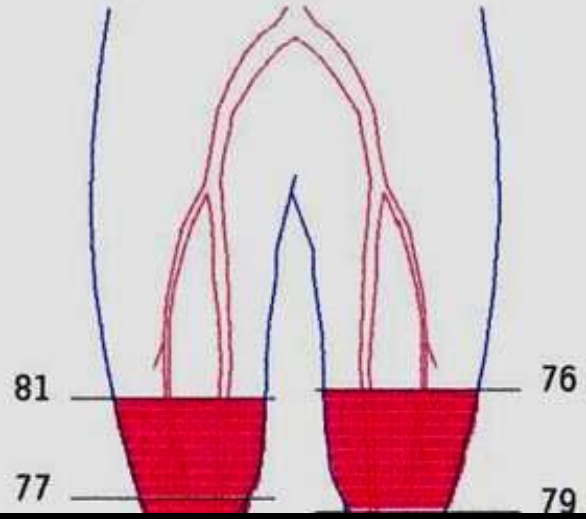
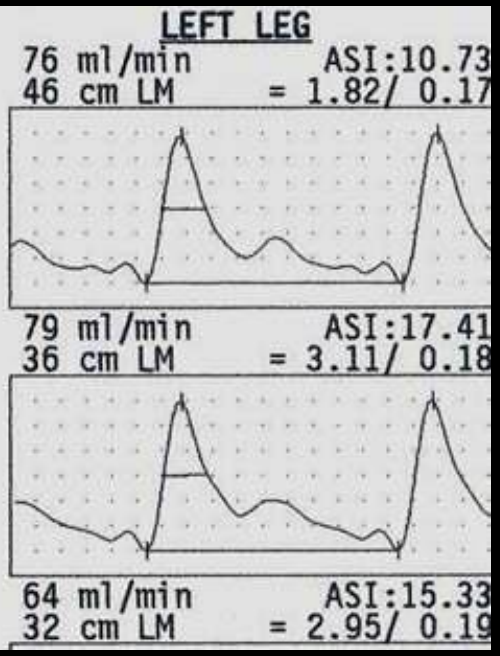
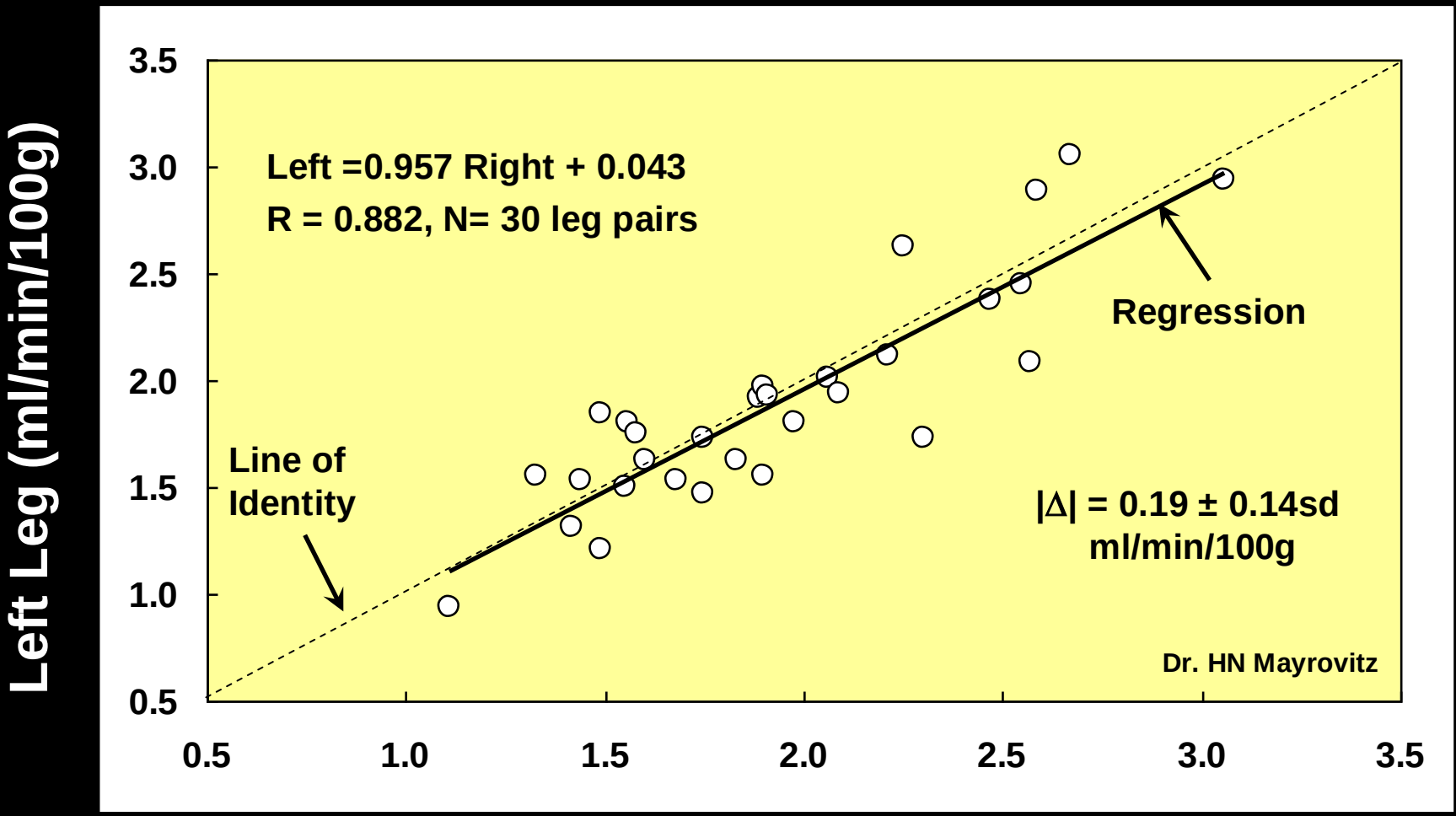
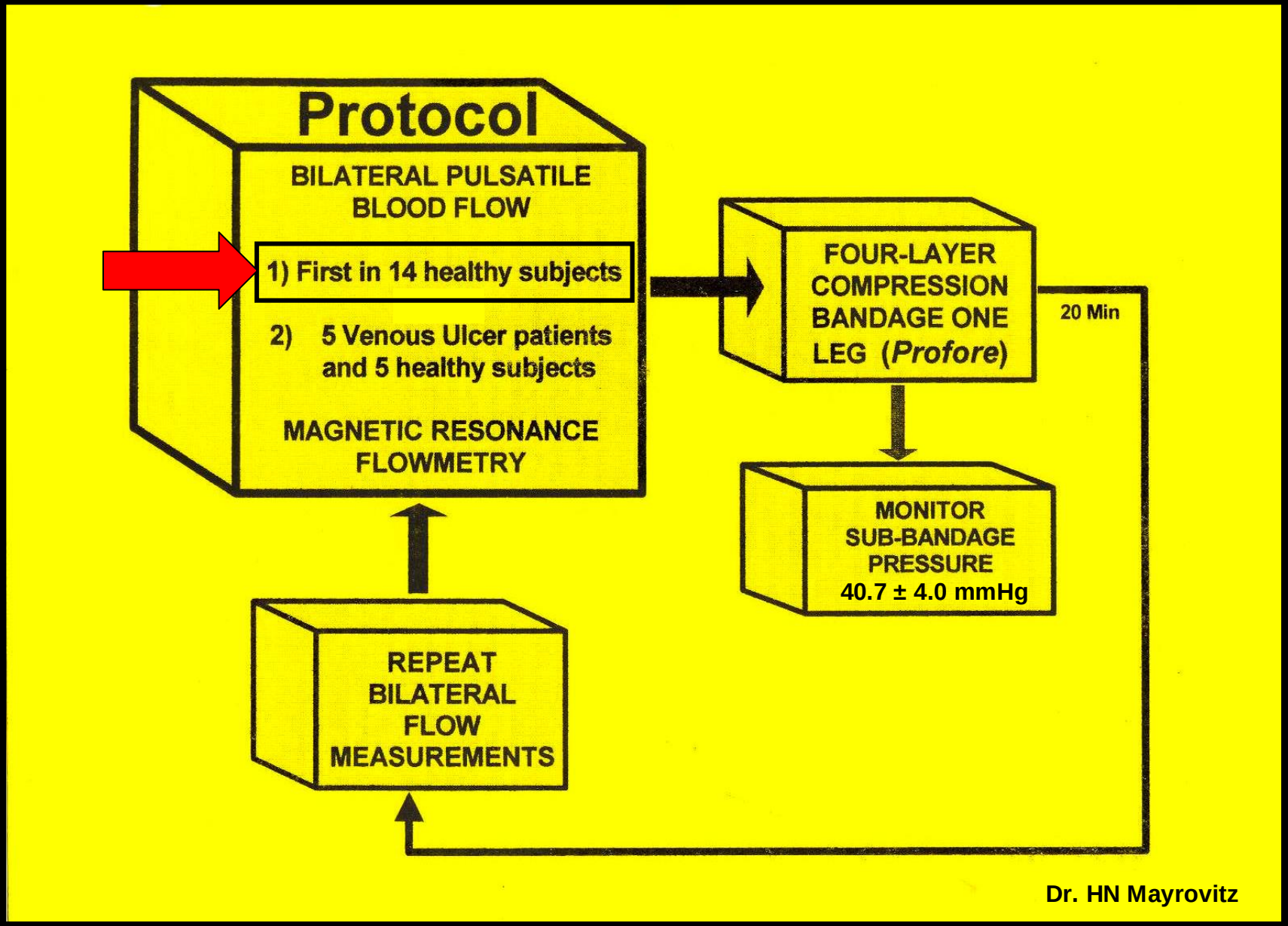




MRF Perfusion





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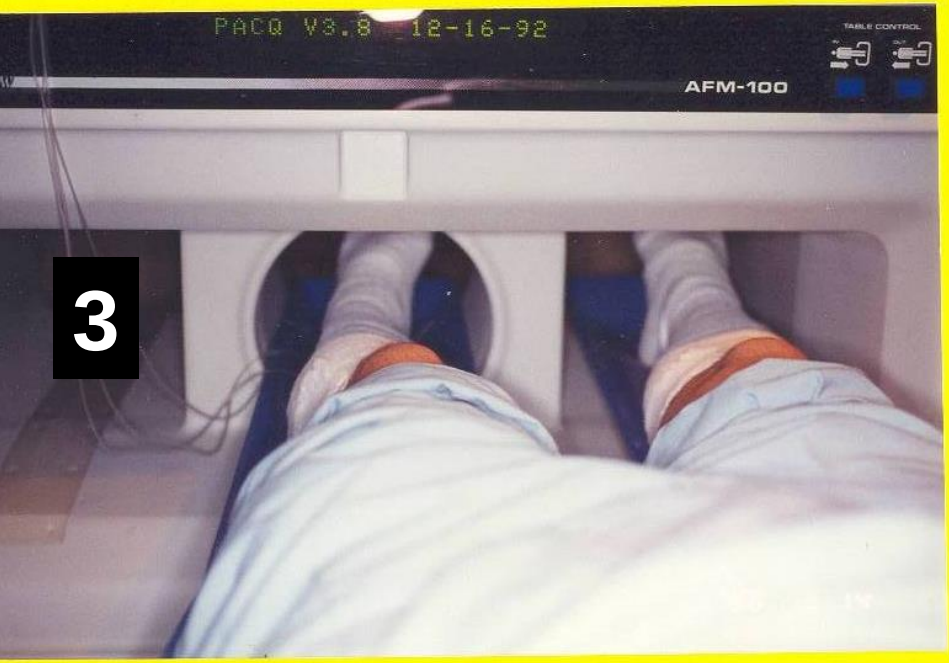
Pre-Compression Setup

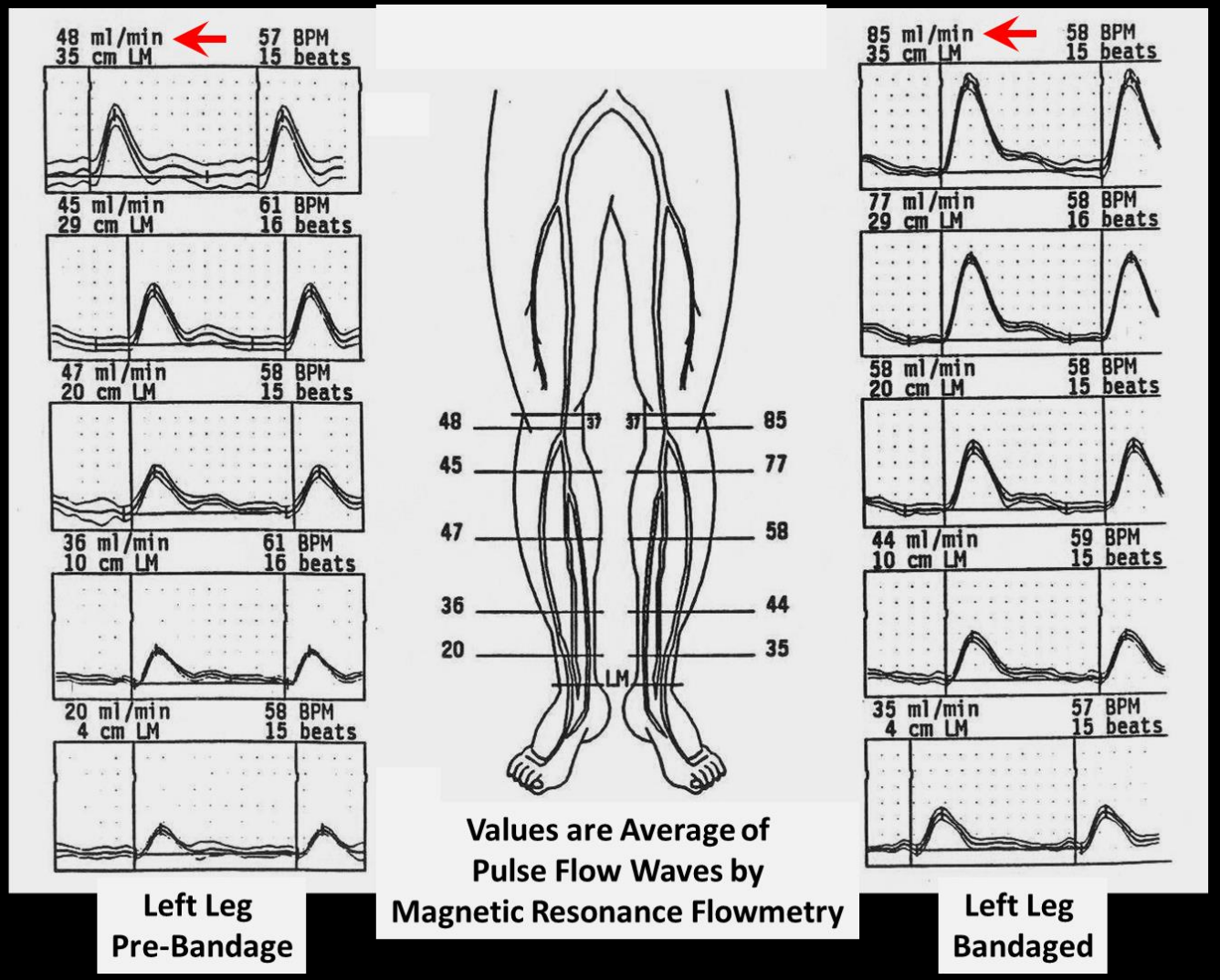
Profore layer 1 (no compression)



Baseline Flow with Layer 1

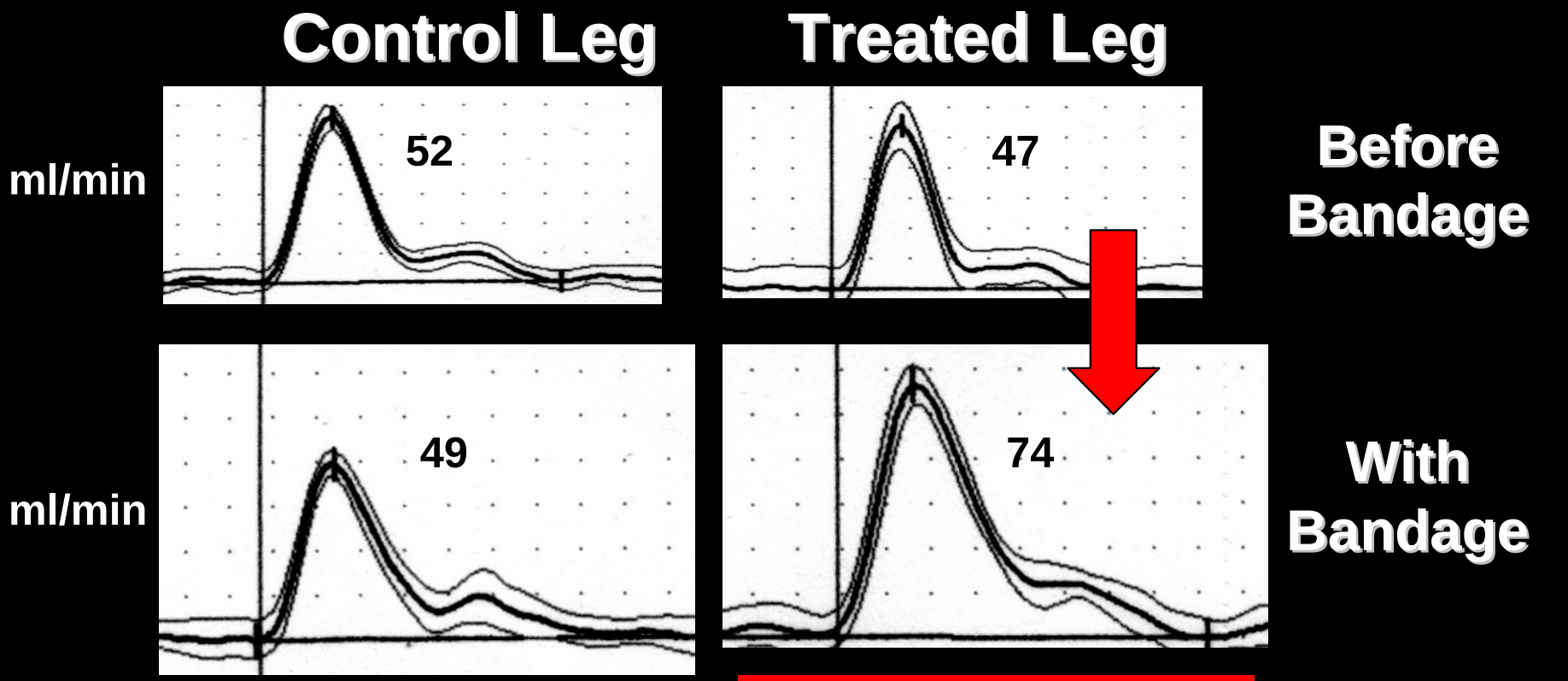
Unilateral Compression Flow

Blood Flow Response to Compression



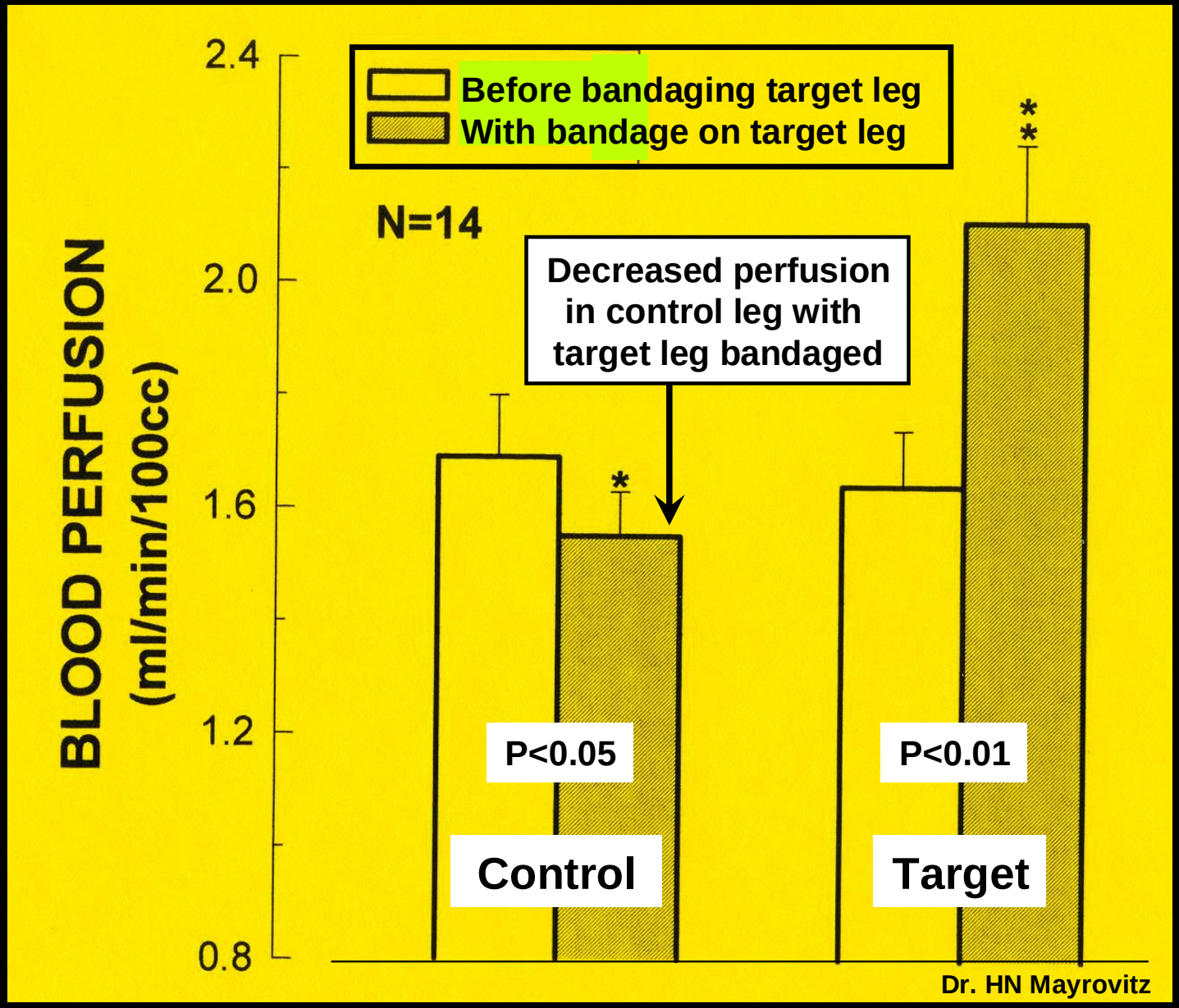
Arterial Flow Pulses

Below Knee Blood Flow via Nuclear Magnetic Resonance

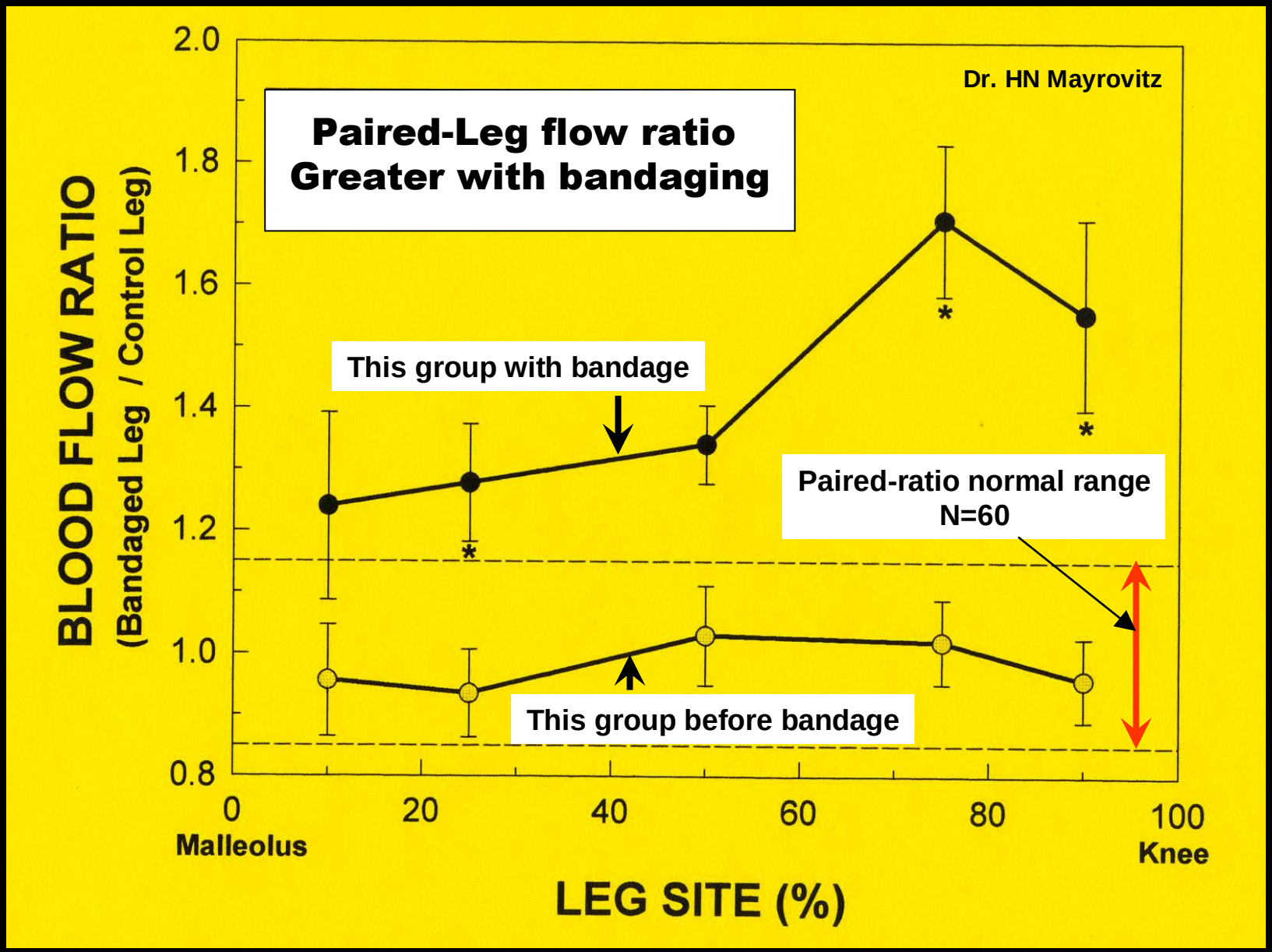


Increased pulses likely augment Lymph/venous transport

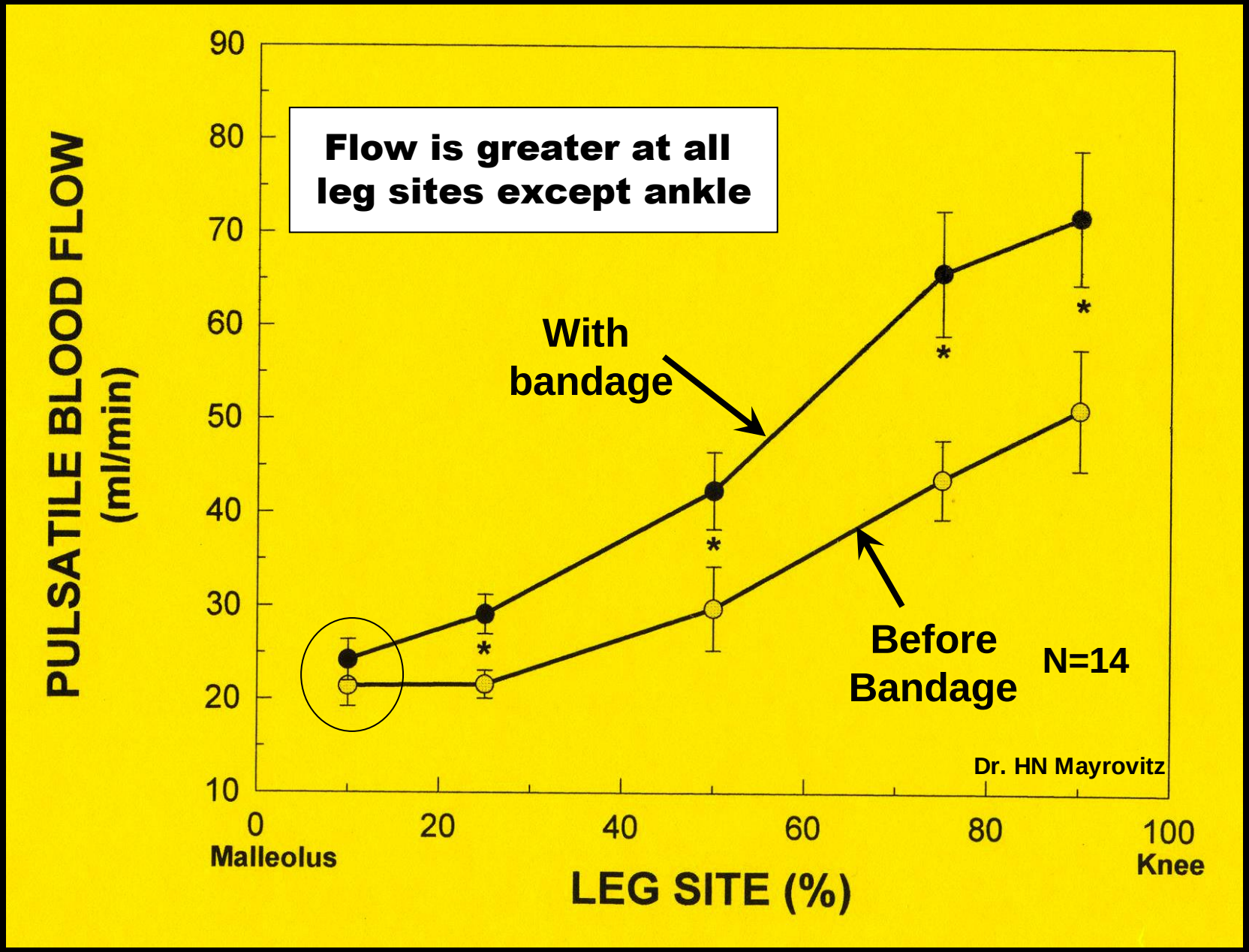
Perfusion Effects of Bandaging



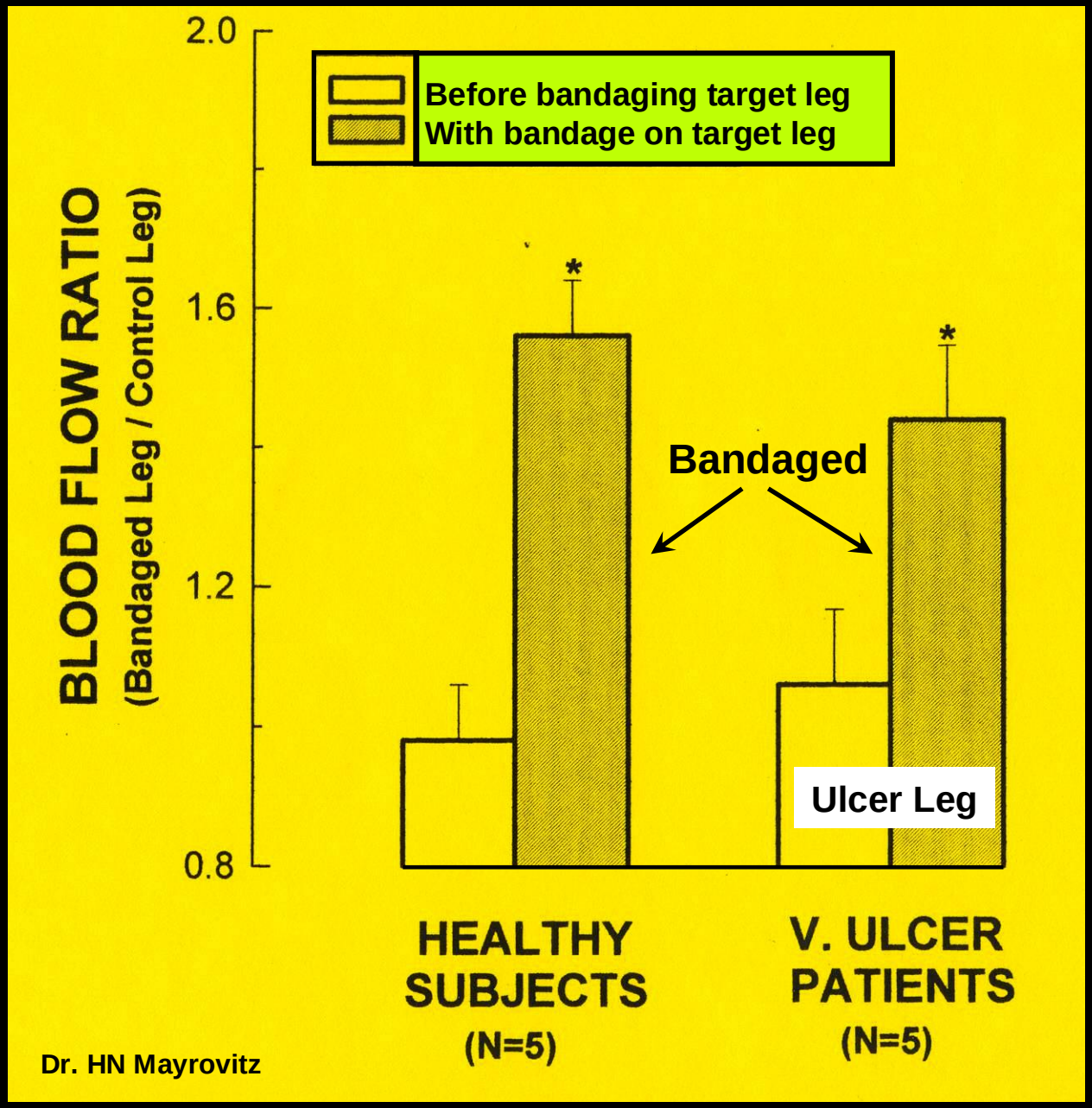
Paired Leg Flow Ratio Increases



Flow Increases with Compression

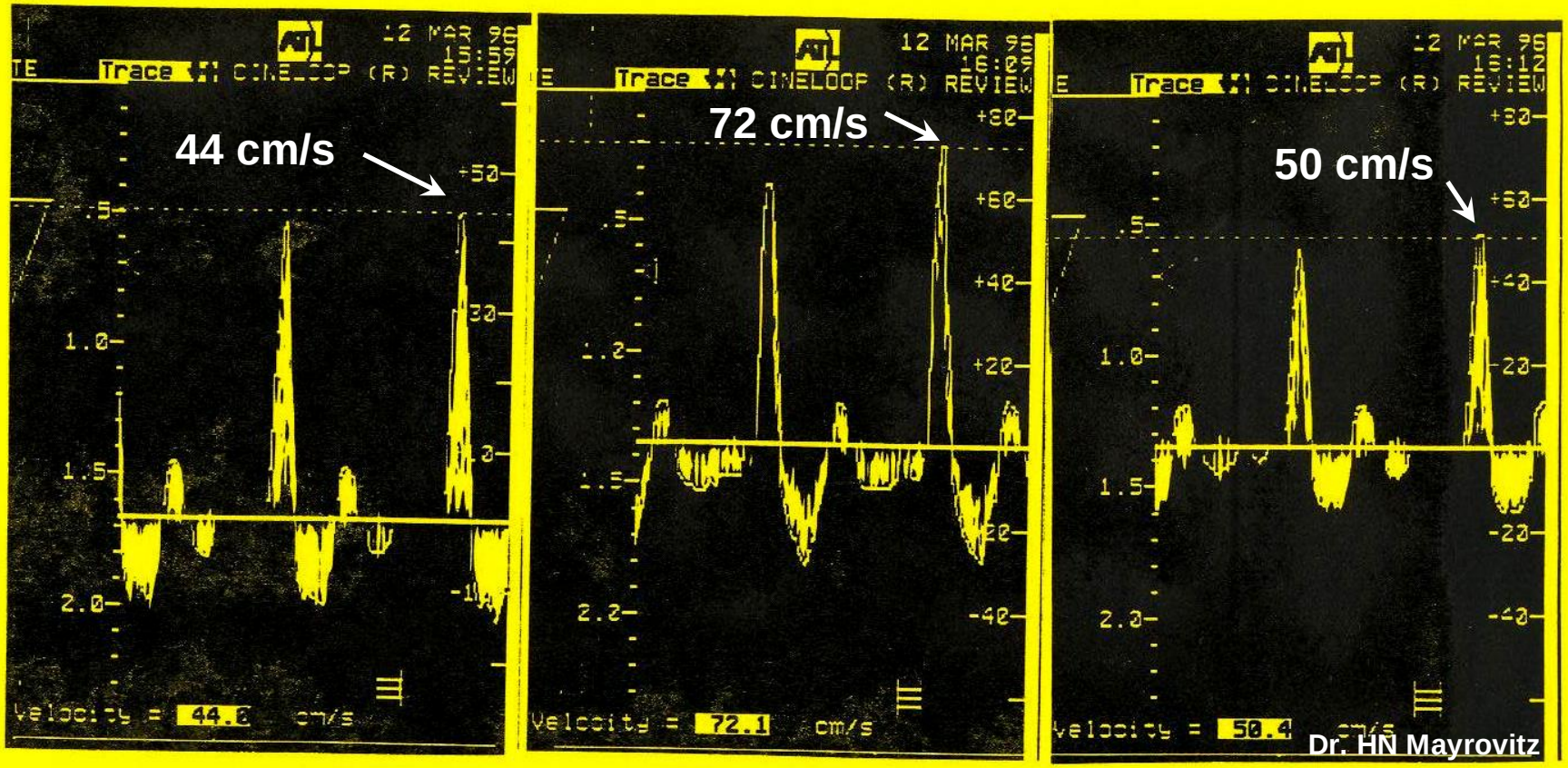


Similar Perfusion Increases



What are the Flow Augmenting Mechanisms of Compression?

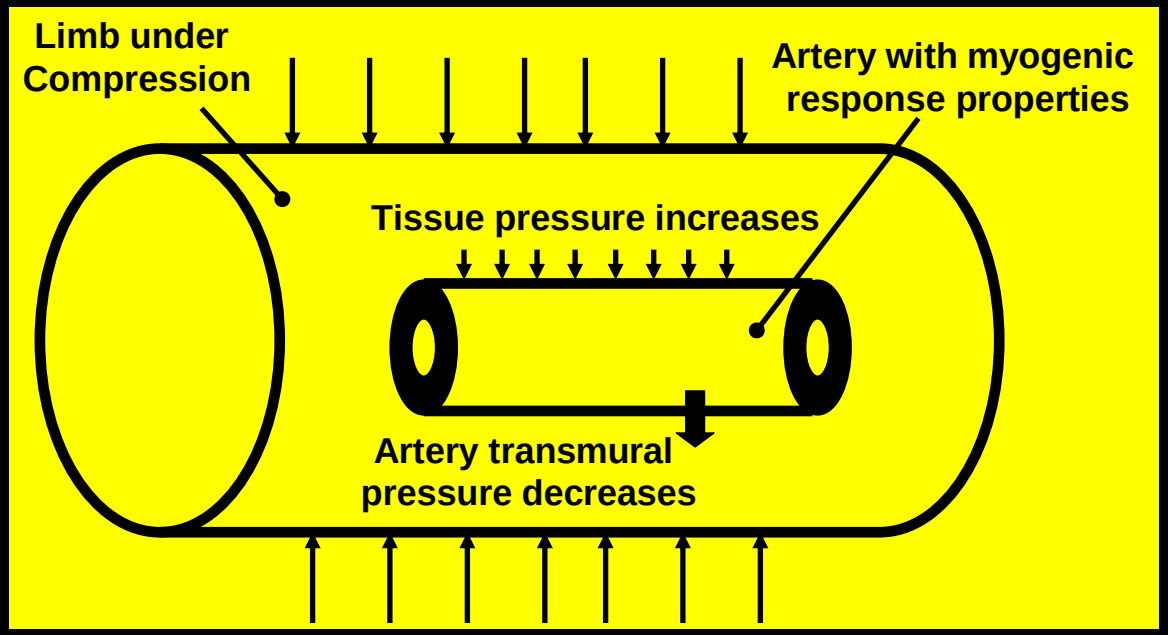
Doppler Ultrasound – Posterior Tibia



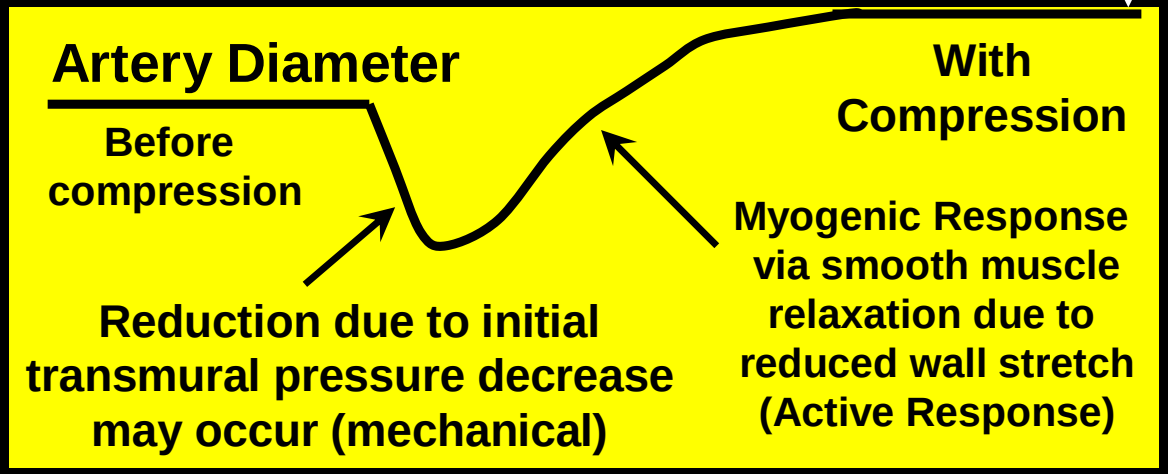
Before compression **With Compression** **Compression off**

DUS also demonstrates the compression effect

Myogenic Response



Reduced Arteriolar Resistance



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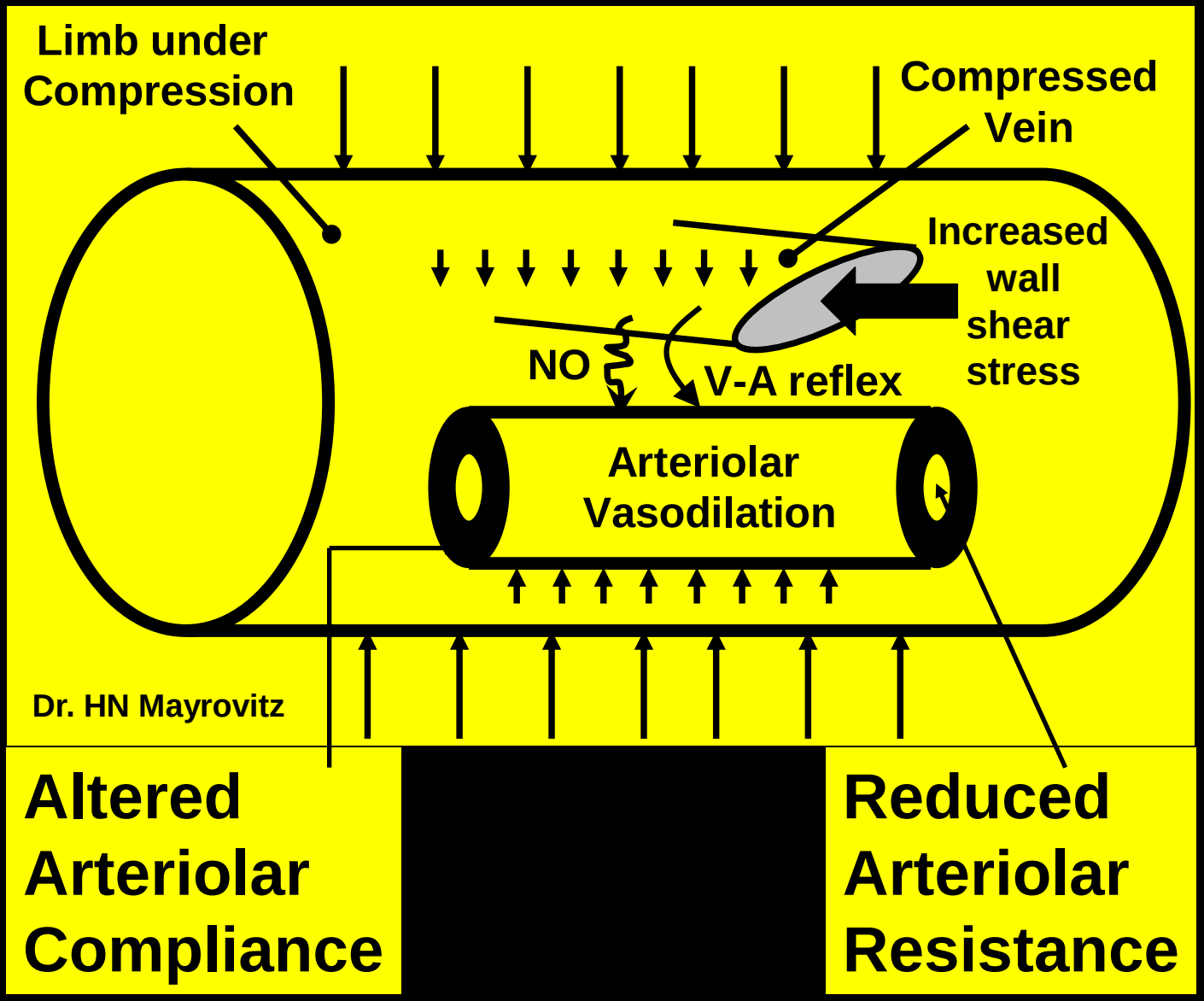
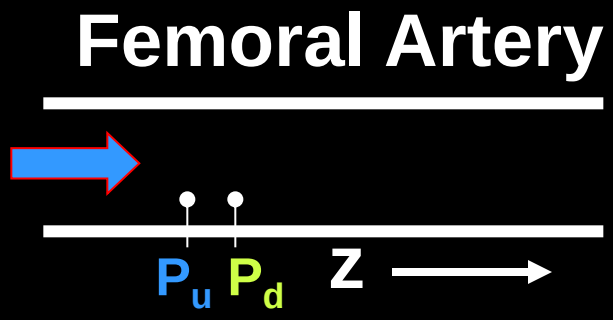
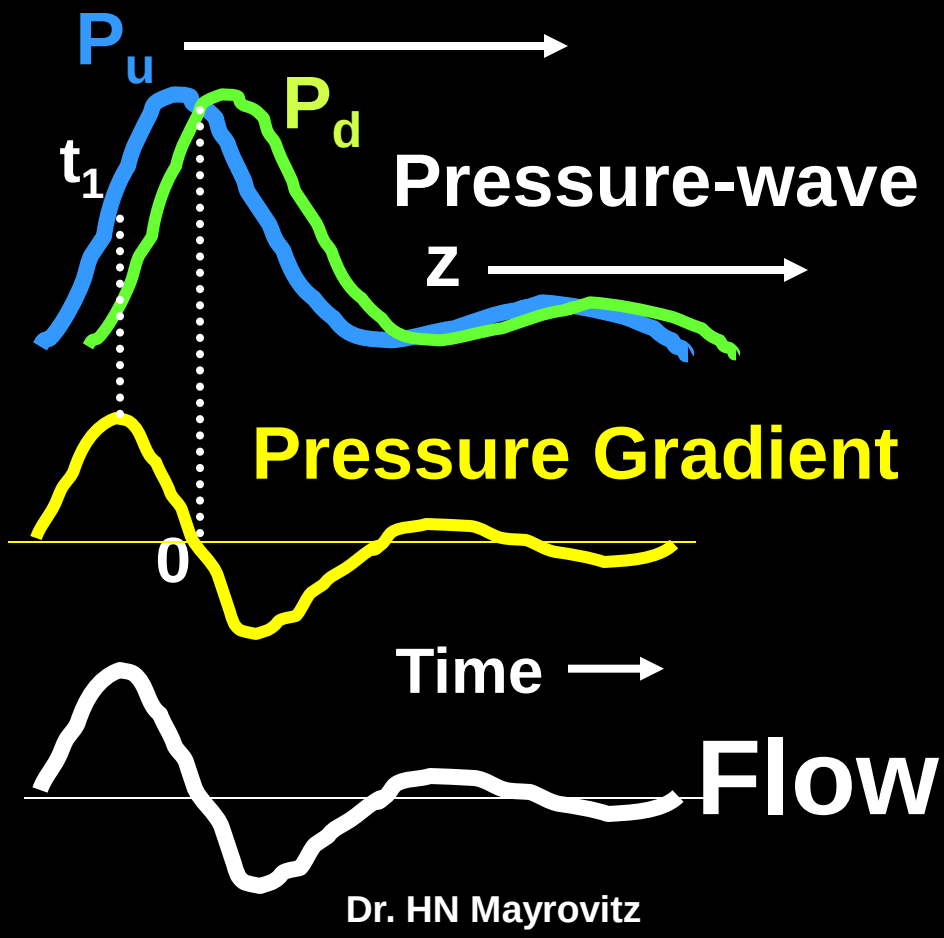
Veno-Arterial (V-A) Coupling



Compliance Related Affects



$$\frac{dp}{dz}$$ Pressure gradient (space derivative)



$$\text{Flow} \sim dp/dz \sim \frac{dp/dt}{c}$$

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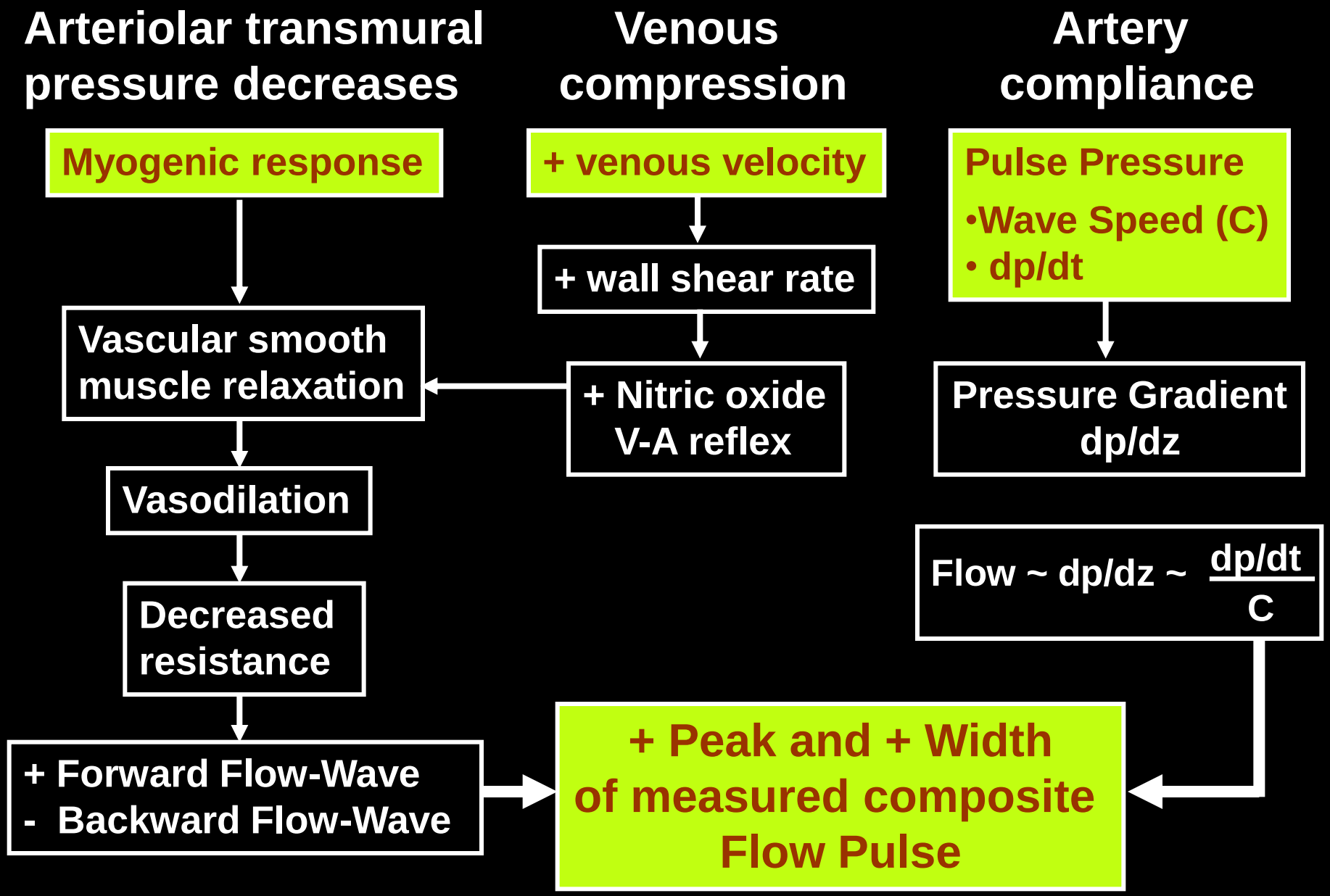
Flow pulse peak and pattern depend on pulse-wave speed and dp/dt both of which are affected by artery compliance

Flow Augmenting Mechanisms of Compression?



Summary

- Flow pulse peak and width are both increased
- Occurs in healthy legs and those with long-standing V. Ulcers
- Pulse flow increase may aid in reducing wbc-capillary effects postulated to be involved in V. ulcer etiology and maintenance
- Pulse flow increase may augment lymph/venous transport
- Mechanism of the flow increase being investigated include:
  - > Arteriolar vasodilation via
    - Transmural pressure affects
    - Veno-arterial coupling and NO
  - > Compression related increase in arterial compliance
  - > Altered arterial pulse-wave reflection features

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