Sub-bandage pressures: the Laplace law revisited.

Jan Schuren, RgN, BN, MSc.
Kay Mohr, BE.
3M Deutschland GmbH, Medical Markets Laboratory, Neuss, Germany.

Objective

To review the widespread belief that the Laplace law is a useful tool to predict and calculate sub-bandage pressures.

Recently, several studies were performed to compare the provided pressures of the new 3M™ Coban™ 2 Layer Compression System with established systems. Some of the results from these two different studies are presented below.

The Laplace law

The modified equation, known as the Laplace law, is frequently used to calculate sub-bandage pressures of compression systems and is summarized as:

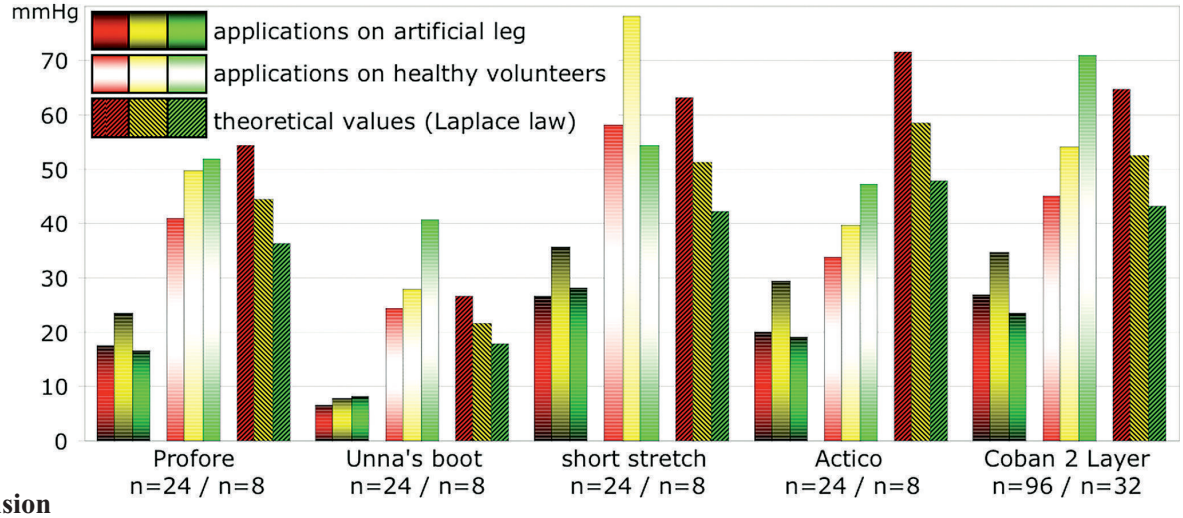
$$\text{pressure (mmHg)} = \frac{\text{tension (Kgf) x number of layers x 4620}}{\text{circumference (cm) x bandage width (cm)}}$$

Materials and methods

- 32 experts in the application of compression bandages were invited to apply a familiar compression system three times to a sensored artificial leg. Next they applied the new Coban 2 Layer System three times.
- In a second study, 4 invited experts in the application of compression bandages applied their most frequently used system eight times on healthy volunteers.
- In both studies, the following compression systems were compared to the Coban 2 Layer System:
  1. Profore™ Multi-Layer Compression Bandage System, (Smith & Nephew Medical Limited, Hull, England);
  2. Actico® Adhesive Short Stretch Bandage, (Activa Healthcare Limited, Staffordshire, United Kingdom);
  3. Unna's boot compression system, (Graham-Field Medicopaste®) covered with a 3M™ Coban™ Self-Adherent Wrap bandage roll (3M Health Care, St. Paul, USA);
  4. Rosidal® K Short Stretch Compression Bandage, (Lohmann & Rauscher International GmbH & Co. KG, Rengsdorf, Germany).
- For the applications on the artificial leg, theoretical pressure values on the three pressure sensors (positioned at 22, 27 and 33 cm leg circumference) were calculated with the Laplace equation and presented in the figure below as patterned columns. The force needed for the individual bandages (Kgf), was calculated from measurements on a tensile tester per manufacturers' recommendation.

Results

- Although all bandages in the two studies were applied by experts in the use of the systems under investigation, none of them could achieve the expected graduated compression on an artificial leg or on the legs of healthy volunteers. None of the tested compression systems gave pressures that would be expected from the mathematical Laplace equation. All collected data are presented in the graph below.



Conclusion

- The widespread belief that correctly applied compression systems give pressure values from 40 mmHg at the ankle joint, graduating to 17 mmHg below the knee, is based on mathematical equations and not supported by the results of the two presented studies.

3M Health Care
3M Center, Building 275-4W-02
St. Paul, MN 55144-1000
USA
1-800-228-3957
www.3M.com/healthcare

3M Canada
Post Office Box 5757
London, Ontario N6A 4T1
Canada
1-800-563-2921

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