

Wide vs. Narrow

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Disclosures:

Gavriely is the Chief Medical Officer and Shareholder of OHK Medical Devices Ltd, Karmel Medical Ltd and KarmelSonix Ltd.

History

- Bloodless surgical field is a common practice in the majority of limb orthopedic surgical procedures. More than **16,000 bloodless** limb operations are performed each day around the globe.
- The method was first described by Friedrich von Esmarch in 1873 by using an elastic strap, now called the Esmarch Bandage. It was improved by Dr. Harvey Cushing in 1908 who introduced the pneumatic tourniquet.



Harvey Cushing invented the pneumatic Tourniquet in 1908 to reduce scalp blood loss during craniotomies

Petit's Tourniquet from 1798.

From Savigny, JH *"The Most Modern and Approved Instruments Used in the Practice of Surgery"* The Letter Press by T. Bensley, London.



**Von Esmarch,
Friederich
August**

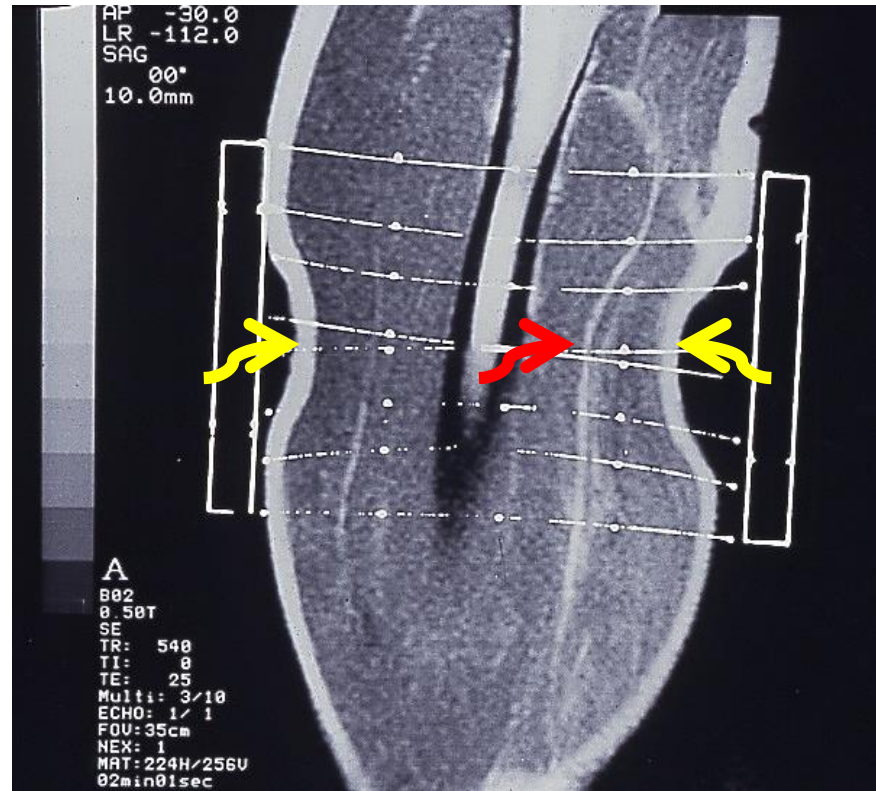
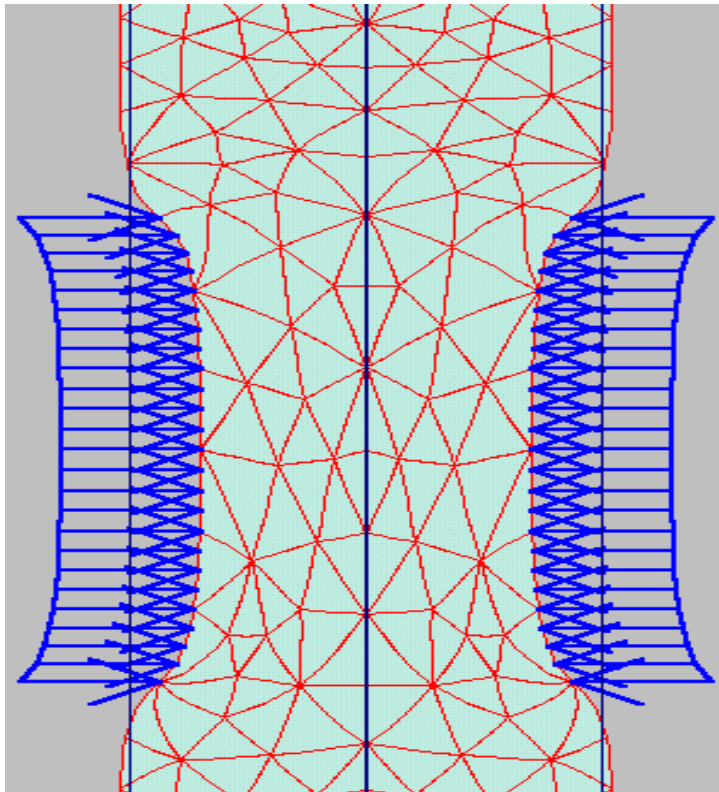


**Early Esmarch
Bandage and
(non-
pneumatic)
Tourniquet**



**Application of
the Esmarch
Bandage and
Tourniquet**





Right: MRI of the thigh under a pressurized pneumatic tourniquet (Estebe, personal communication, Rennes, France).

Left: Computational finite elements analysis (red strings) showing the deformation (strain) of a limb under circumferential pressure by a pneumatic cuff. From Levenberg E. OHK Archives 2002.

Note the similarities between the model results and the MR image of the limb above.

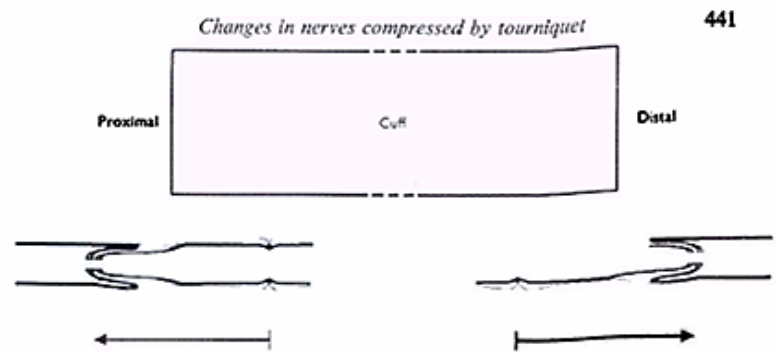
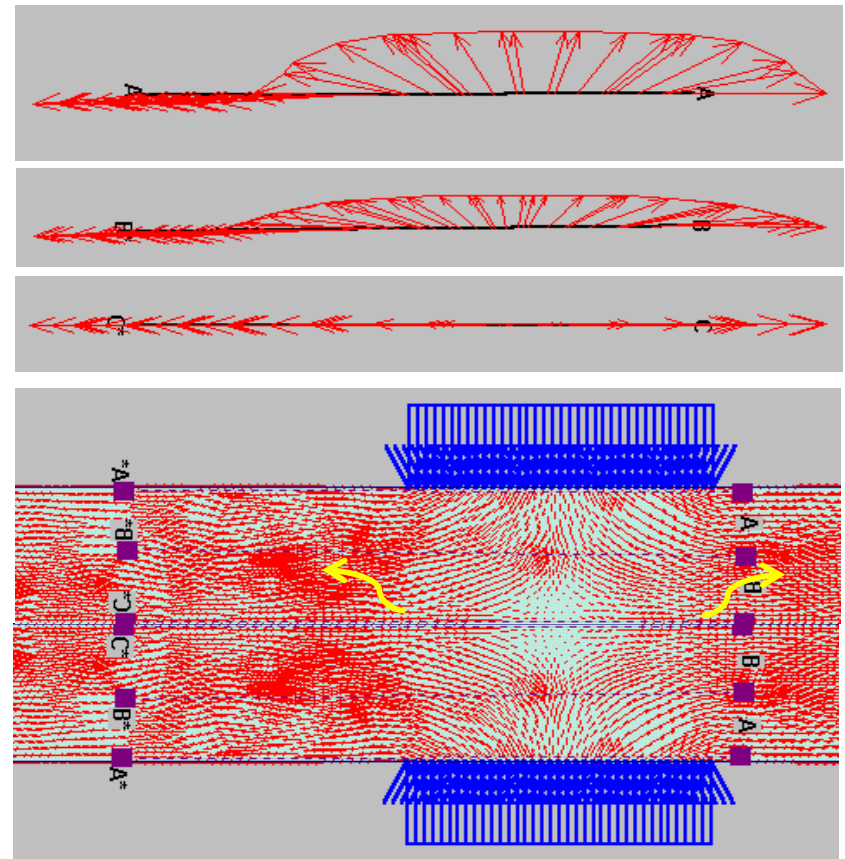
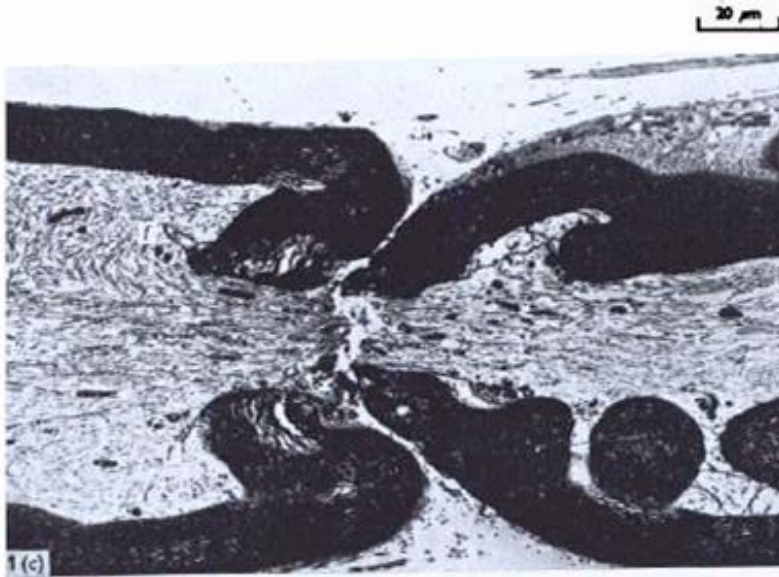
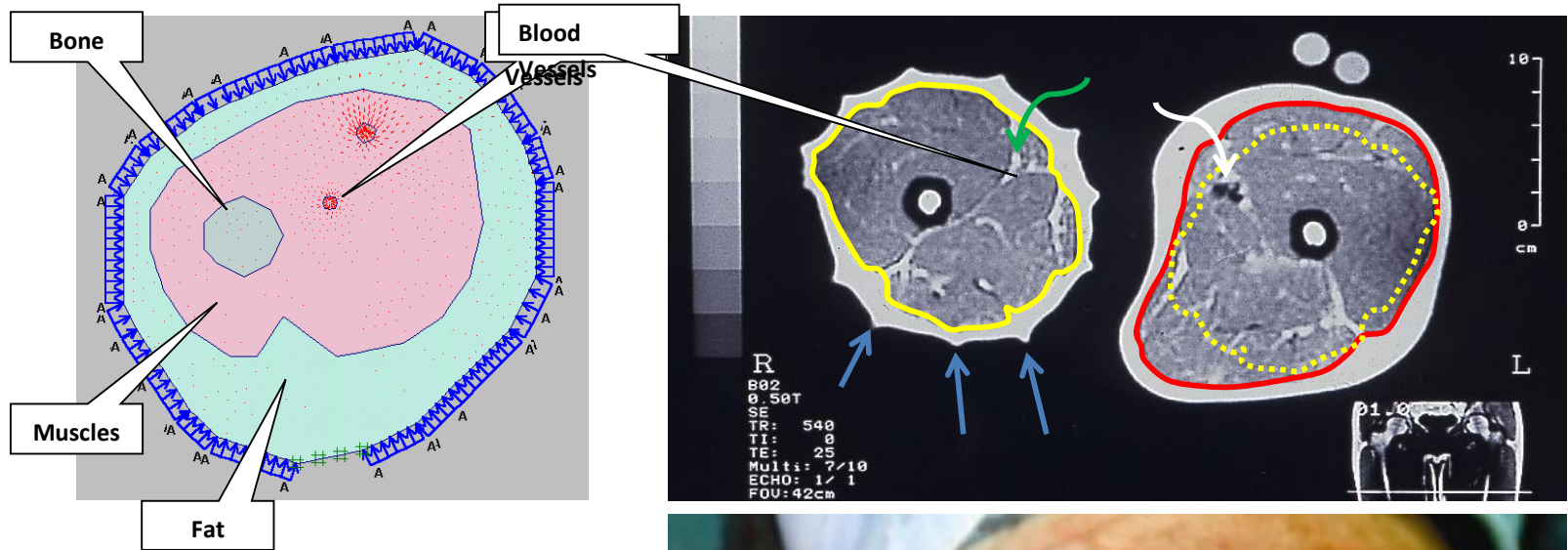


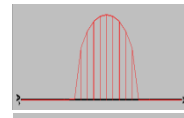
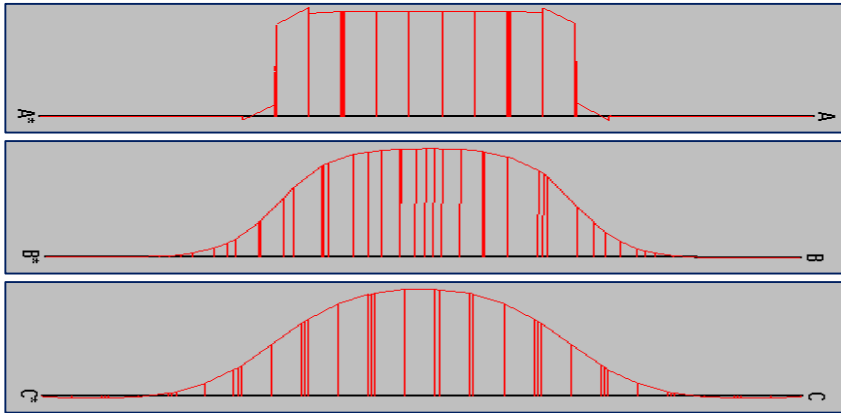
Fig. 6. Diagram to show the direction of displacement of the nodes of Ranvier in relation to the cuff.



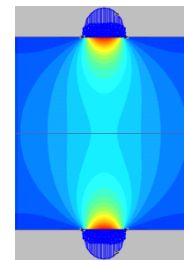
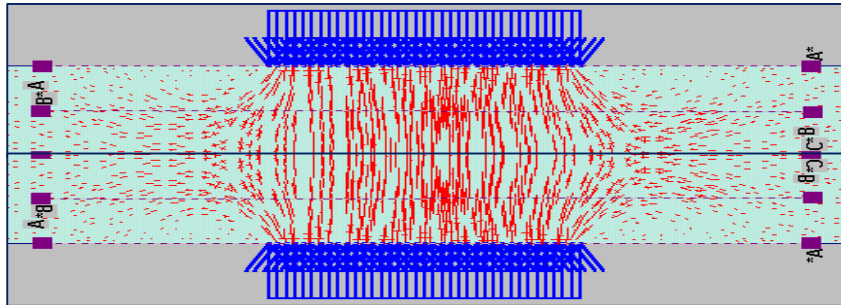
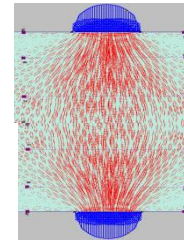
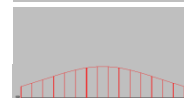
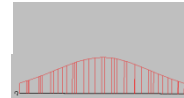
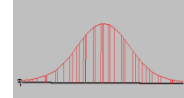
- **Clockwise from top:**
- Computational model of a limb under circumferential pressure. Note the tissue motion around the blood vessels leading to their closure
- MRI of the thighs. The left leg (L) is unpressurized, the right leg (R) is under pneumatic tourniquet pressure. The femoral artery is open and clearly seen in the left thigh (white curved arrow) and is closed in the right thigh (green arrow). The extent of deformation can be appreciated from the difference between the red and the dotted yellow perimeters. Note the creases of the skin where the inflated tourniquet pinched the excess skin (blue arrows).
- These creases correspond to the longitudinal elevations and linear blisters seen in the photo of the post tourniquet skin damage (white arrows). These so called “tourniquet burn” have been attributed to chemicals used in disinfecting the skin. Obviously the main cause is mechanical and associated with the pinching of the skin by the inner surface of the pneumatic tourniquet.



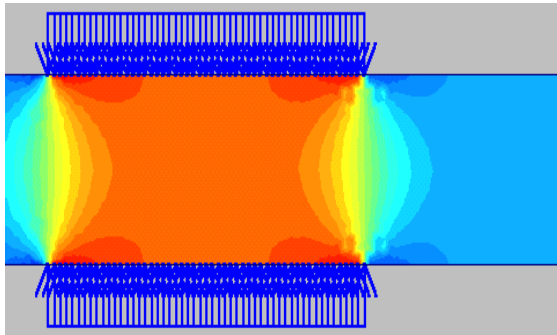
Pressure Distribution: Wide vs. Narrow



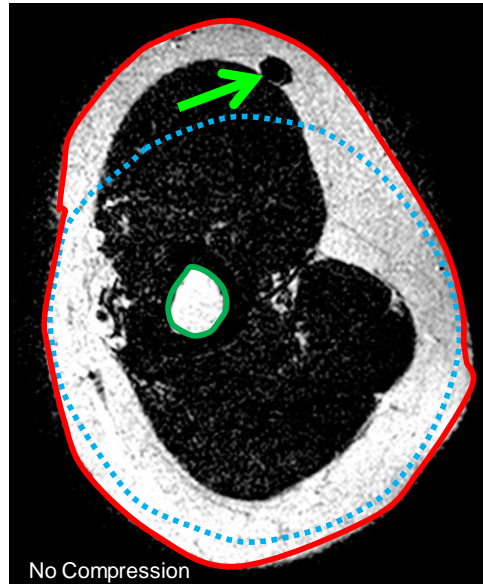
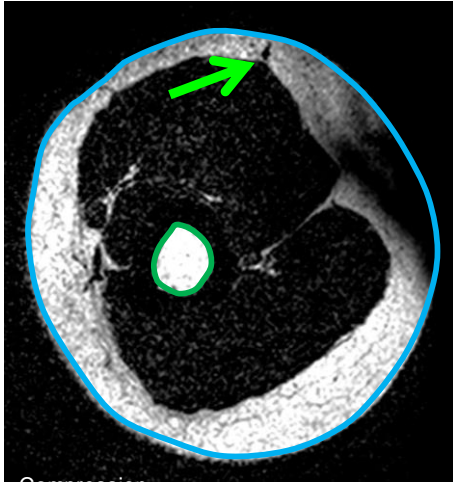
Wide Pneumatic
Tourniquet (Left)



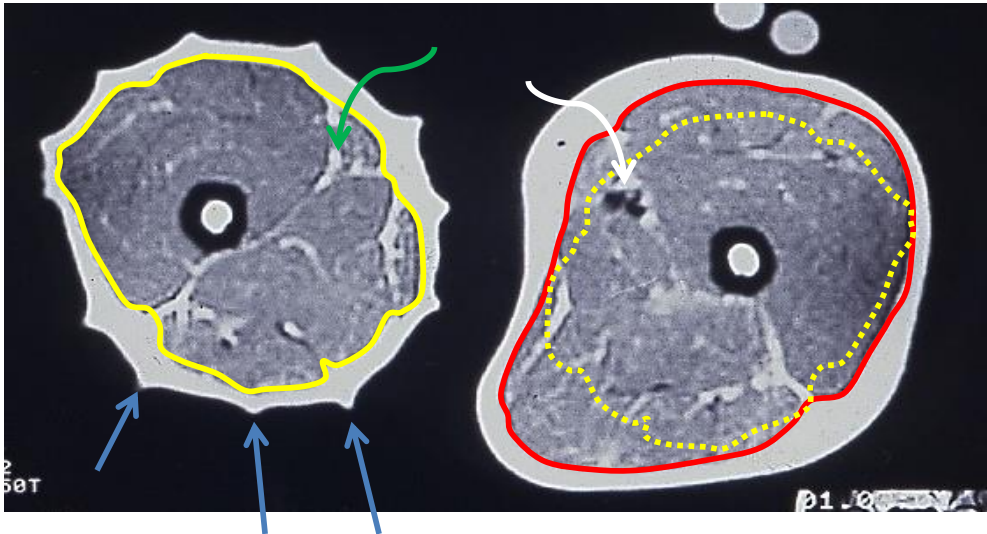
Narrow Tourniquet
(HemaClear®) (Right)



Tissue Deformation: Wide vs. Narrow



Narrow Tourniquet
(HemaClear®)



Wide Pneumatic
Tourniquet