



The swimming pool paradox, and what we can learn from it

Torbjörn Lundh^{1,2,3}, Marcus Baaz³ and Andreas Nilsson¹, ¹PressCise, ² **CHALMERS** UNIVERSITY OF TECHNOLOGY ³ UNIVERSITY OF GOTHENBURG

Question:

Why is 90 mmHg water pressure in a pool comfortable, but the same pressure under a bandage painful?

Answer:

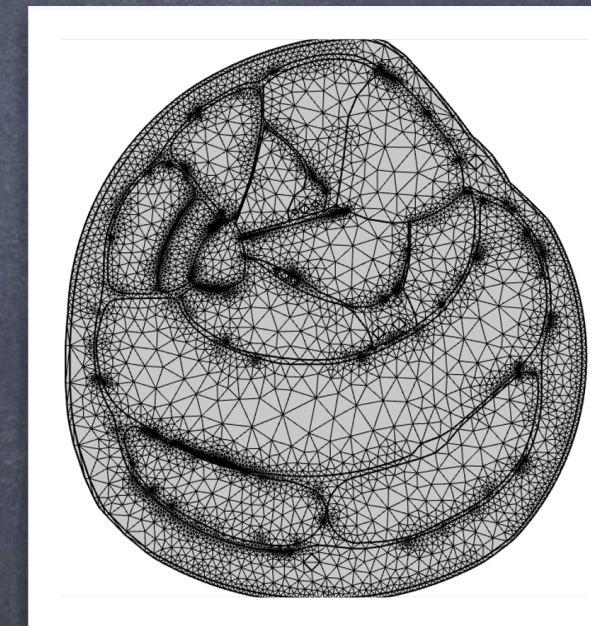
The pressure of a fluid is uniform in all directions, independent of local curvature of the leg. It provides a smooth, and hence, comfortable compression.

Method:

Possible physical and physiological mechanisms were investigated, a mathematical model was created. Simulations were performed using an MRI-scan of a leg and a numerical finite element method.

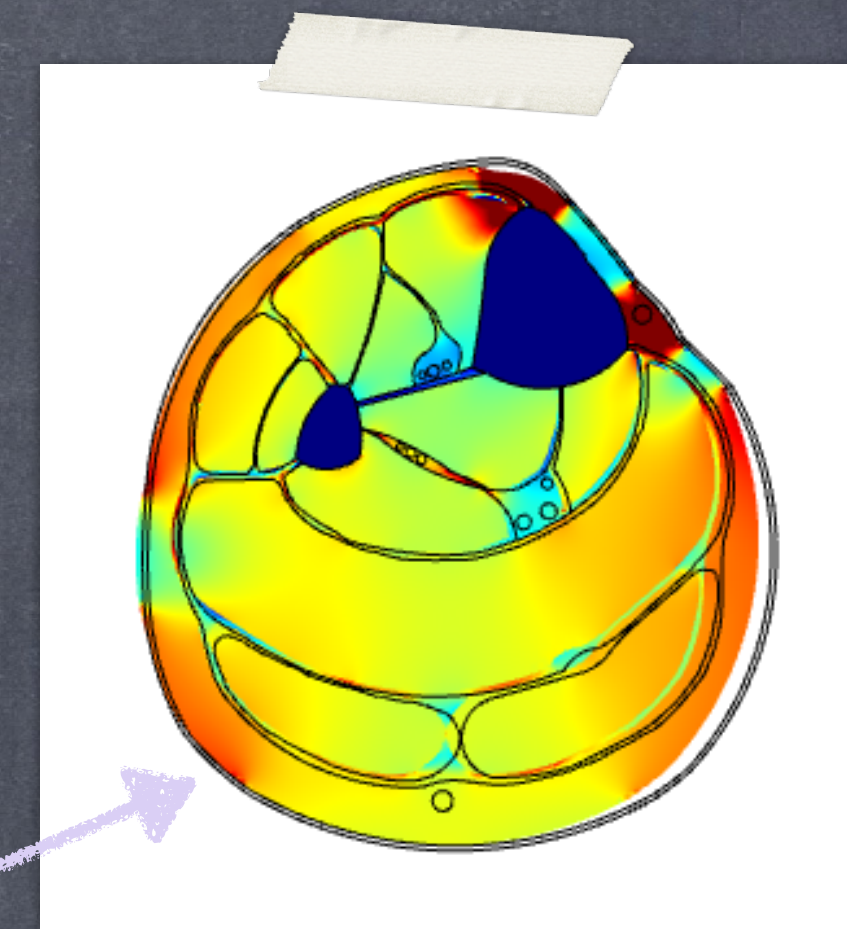
$$\begin{cases} \nabla(\mathbf{I} + \frac{\partial \mathbf{u}}{\partial \mathbf{X}})\mathbf{S} = 0, \\ \mathbf{S} = \frac{\partial \mathbf{W}}{\partial \mathbf{E}}, \\ W = C_1(\bar{I}_1 - 3) + \frac{1}{D_1}(J_{el} - 1)^2, \\ \mathbf{E} = \frac{1}{2}(\mathbf{F}\mathbf{F}^t - \mathbf{I}), \\ \mathbf{u}(B_1) = 0, \\ \mathbf{S}(B_2) = \mathbf{A}. \end{cases}$$

Visco elastic model

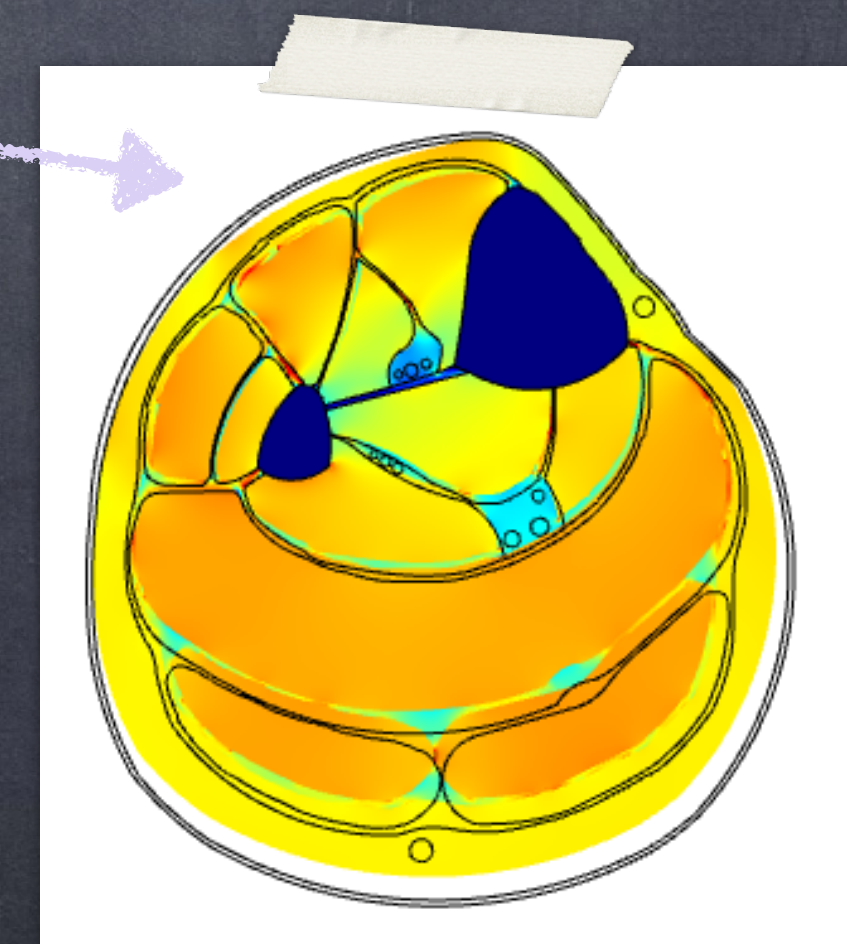


Finite Element Method

Results:



Numerical simulation of bandage



Numerical simulation of water

Take home message:

To improve patient comfort and compliance in compression treatment, compression garments should be designed to apply pressure evenly, mimicking the uniform pressure distribution of water.