The role of mechanical environment in regulating vascular network formation

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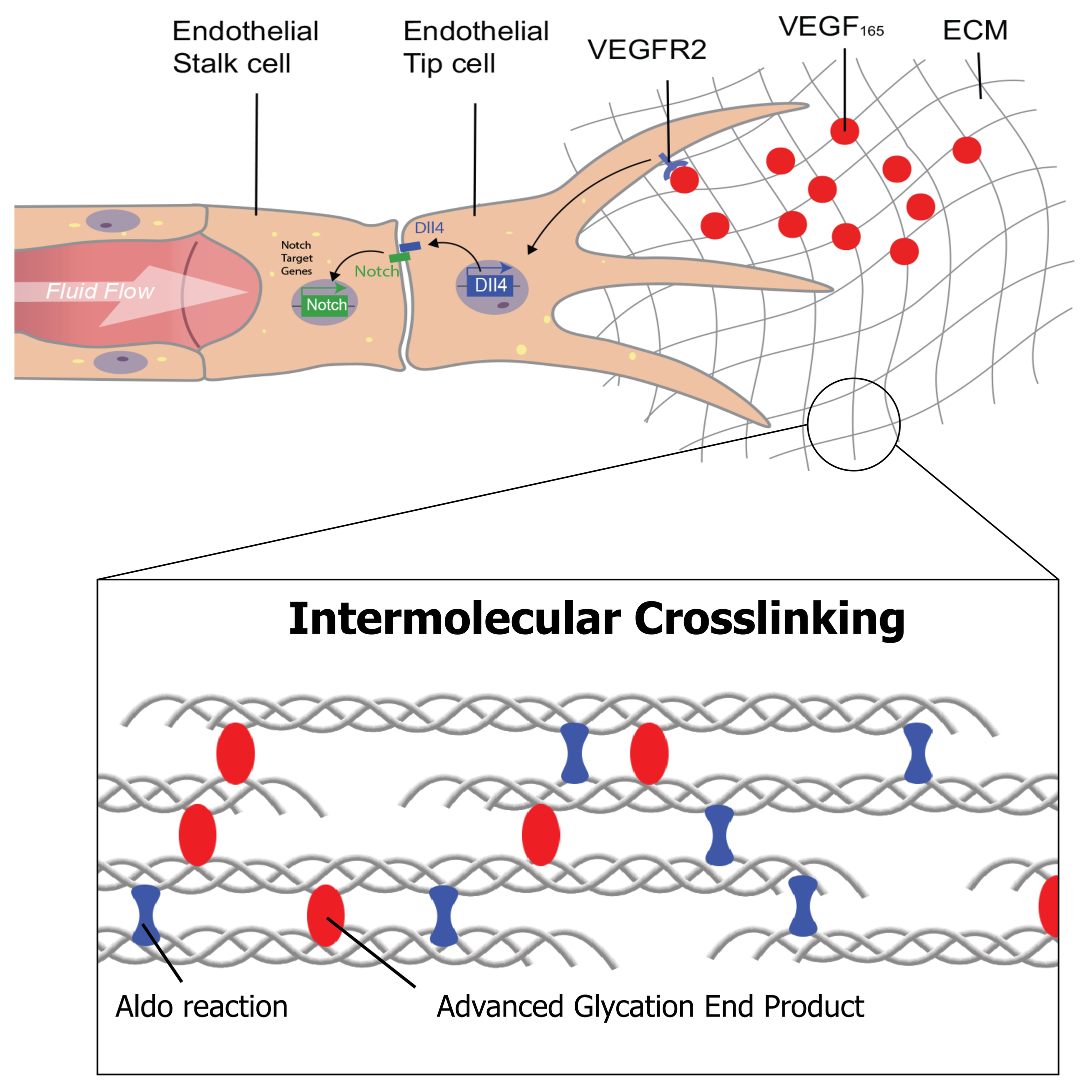
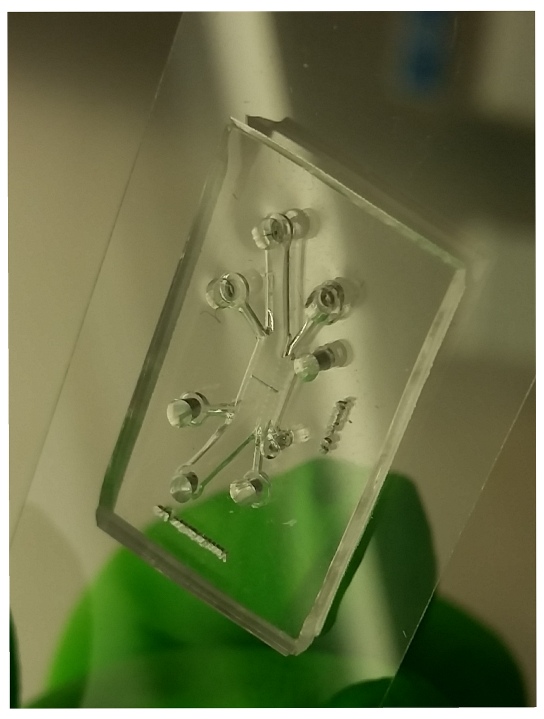
Introduction & Objectives

- Extracellular matrix (ECM) scaffold provides micro-enviromental information to cells, biophysically through structural and mechanical properties and biochemically through soluble and insoluble molecules
- we used collagen-based micro-chips in which the mechanical properties of collagen were tuned using non-enzymatic glycation of the collagen in solution
- By non-enzymatic glycation, reducing sugars interact with amino groups on proteins which form subsequently advanced glycation endproducts (AGE) that accumulate on proteins and cause cross-link formation causing increase of Young's modulus
- The effect of porosity changes with respect to changes in the D-(-)-Ribose concentration on interstitial flow and VEGF165 diffusion in a designed microfluidic system was simulated using COMSOL Multiphysics



Stiffness mediated interstitial flow and VEGF165 Diffusion

Microfluidic system



Assumptions

Porosity

$H_3 < H_2 < H_1$

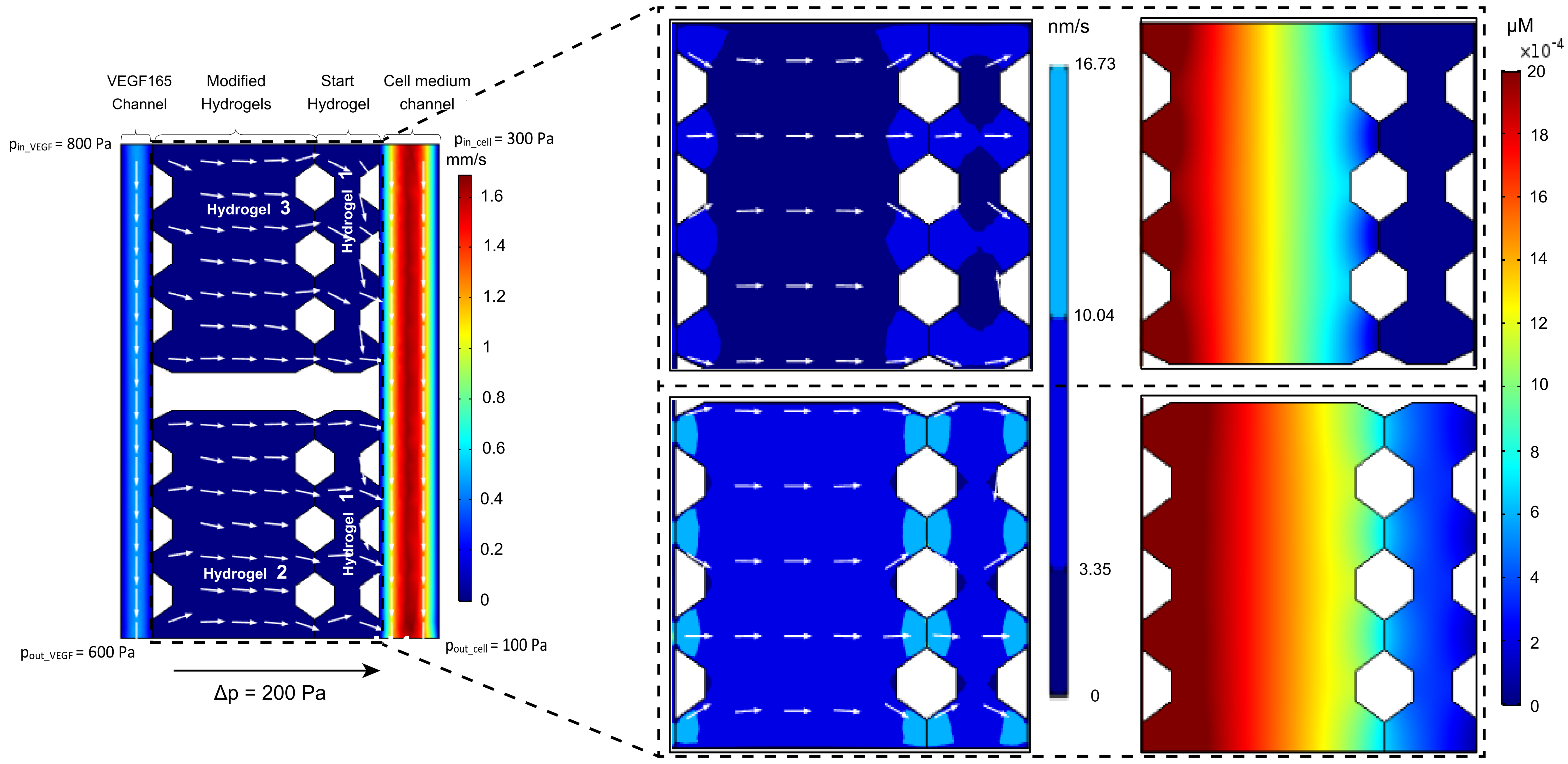
Young's Modulus

$E_3 > E_2 > E_1$

Ribose concentration

$C_{H3} > C_{H2} > C_{H1}$

Computational studies



Results

- computational studies show that by varying the porosity of hydrogel 2 and hydrogel 3, a difference in interstitial flow velocity between the upper and bottom part of the microfluidic system is optained
- furthermore this results in a difference int the VEGF165 gradients over these hydrogels

Outlook

- studying the effect of growth factor binding in mechanical manipulated hydrogels
- studying the effect on vascular sprouting in different manipulated hydrogels
- experimental confirmation of changes of diffusion coeffient of VEGF165 in manipulated hydrogels

Acknowlodgement

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