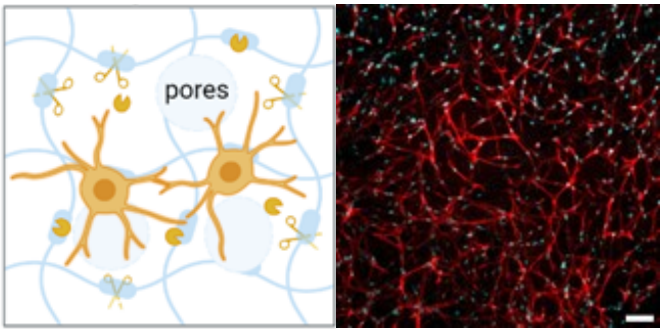
ETH zürich

Licensing Opportunity

Synthetic hydrogel matrix for collagen imaging on chip

Synthetic void-forming hydrogels



Collagen hydrogel

Fig. 1 (left) A synthetic void-forming matrix supports 3D networking of bone cells. (right) A collagen matrix impedes cell spreading and the formation of a 3D cell network.

Application

This microfluidic culture mimics early bone development in vitro. The on-chip assembly is accessible to various imaging techniques, which facilitate the monitoring of cell-secreted collagen fibres and diagnosing tissue disorders such as brittle bone disease, cancer and fibrosis. Also, in vitro screening of drug candidates is possible reducing the necessity of animal testing.

Features & Benefits

- structural and functional analysis of collagen fibres
- simulation of a wide range of tissue types
- cultivation of patient-derived cells

Publications

- "Synthetic biodegradable microporous hydrogels for in vitro 3D culture of functional human bone cell networks", Nat Commun 15, 5027 (2024), https://doi.org/10.1038/s41467-024-49280-3
- Patent pending

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Technology Readiness Level

1 2 3 4 5 **6** 7 8 9

Background

Human model systems such as organoids are sought after because they provide the physiologically relevant 3D environment for patient specific disease modelling and in vitro screening of drug candidates. Current model systems for the early stages of bone development lack a proper simulation of the interstitial flow within bone cavities. The fluid shear stress affects mineralization and in consequence the physiological cell network growth.

Invention

An osteoid-like matrix with adjustable porosity and stiffness is synthesized within the constraints of a microfluidic chip. The fluid flow through this microporous matrix supports natural mineralization. Osteoblasts embed themselves in mineral rich environments and differentiate into mature osteocytes forming a 3D cell network. The matrix is biodegradable, which is an important aspect for the pericellular remodelling of the growing bone.

The matrix is composed of transparent PEG hydrogels. Time-lapse imaging of fluid flow and perfusion culture is possible. Furthermore, cell-secreted collagen fibres are quantitatively assessable.

The synthetic matrix does not exhibit batch-to-batch variations like animal-derived Matrigel. Moreover, this microfluidic culture may reduce animal testing in the future.

The technology has been demonstrated in clinically relevant settings, growing a 3D bone cell network from patient-derived primary cells within 48 h and functional maturation towards an in vitro organoid model.