Abstract Submitted
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Fibre-reinforced hydrogels for tissue engineering[1] SARAH WATERS, HELEN BYRNE, MIKE CHEN, University of Oxford, MIGUEL DIAS CASTILHO, University Medical Centre Utrecht, LAURA KIMPTON, COLIN PLEASE, JONATHAN WHITELEY, University of Oxford — Tissue engineers aim to grow replacement tissues in vitro to replace those in the body that have been damaged through age, trauma or disease. One approach is to seed cells within a scaffold consisting of an interconnected 3D-printed lattice of polymer fibres, cast in a hydrogel, and subject the construct (cell-seeded scaffold) to an applied load in a bioreactor. A key question is to understand how this applied load is distributed throughout the construct to the mechanosensitive cells. To address this, we exploit the disparate length scales (small inter-fibre spacing compared with construct dimensions). The fibres are treated as a linear elastic material and the hydrogel as a poroelastic material. We employ homogenisation theory to derive equations governing the material properties of a periodic, elastic-poroelastic composite. To validate the mobel, model solutions are compared to experimental data describing the unconfined compression of the fibre-reinforced hydrogels. The model is used to derive the bulk mechanical properties of a cylindrical construct of the composite material for a range of fibre spacings, and the local mechanical environment experienced by cells embedded within the construct is determined.

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