A new bio-ink for 3-D printing with stem cells

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An artist's impression of bioprinting in action. It's a rapidly emerging technique for the building of living 3D tissue constructs.

Scientists at the University of Bristol have developed a new kind of bio-ink, which could eventually allow the production of complex tissues for surgical implants.

The new stem cell-containing bio ink allows 3D printing of living tissue, known as bio-printing.

The new bio-ink contains two different polymer components: a natural polymer extracted from seaweed, and a sacrificial synthetic polymer used in the medical industry, and both had a role to play.

The synthetic polymer causes the bio-ink to change from liquid to solid when the temperature is raised, and the seaweed polymer provides structural support when the cell nutrients are introduced.

Lead researcher Dr Adam Perriman, from the School of Cellular and Molecular Medicine, said: "Designing the new bio-ink was extremely challenging. You need a material that is printable, strong enough to maintain its shape when immersed in nutrients, and that is not harmful to the cells. We managed to do this, but there was a lot of trial and error before we cracked the final formulation.

"The special bio-ink formulation was extruded from a retrofitted benchtop 3D printer, as a liquid that transformed to a gel at 37°C, which allowed construction of complex living 3D architectures."

The team were able to differentiate the stem cells into osteoblasts – a cell that secretes the substance of bone (and chondrocytes) cells that

have secreted the matrix of cartilage and become embedded in it – to engineer 3D printed tissue structures over five weeks, including a full-size tracheal cartilage ring.

Dr Perriman said: "What was really astonishing for us was when the cell nutrients were introduced, the synthetic polymer was completely expelled from the 3D structure, leaving only the stem cells and the natural seaweed polymer. This, in turn, created microscopic pores in the structure, which provided more effective nutrient access for the stem cells.

The team's findings, featured on the cover of *Advanced Healthcare Materials*, could eventually lead to the ability to print complex tissues using the patient's own stem cells for surgical bone or cartilage implants, which in turn could used in knee and hip surgeries.

More information: James P. K. Armstrong et al. 3D Bioprinting Using a Templated Porous Bioink, *Advanced Healthcare Materials* (2016). DOI: 10.1002/adhm.201600022

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