3D-printed organs to solve donor shortages

Tom Whipple Science Editor

3D printers could one day be used to construct living bone, tissue and even organs to be implanted into patients after scientists showed that it was possible to manufacture complex biological structures and keep them alive.

Using a printing device in which ink was replaced by a gel containing cells, researchers were able to engineer living structures which kept functioning when implanted into animals. The advance opens up the possibility of creating bespoke replacement tissues and organs from patients' own cells, and eventually helping to alleviate global donor shortages.

For a paper, published in the journal *Nature*, the scientists made a human ear and part of a jaw bone and implanted them into a mouse and rat, where they matured into working tissue.

Several research groups have been working on developing 3D "bioprinters". The key advantage of such a technology is it would enable tissue parts to be designed digitally, made from the patient's own cells and then produced precisely and cheaply.

This would mean that a patient with a missing ear could have one made to the size and shape of their other ear, or people with a part of an organ in need of repair could have it built to precisely fit the required dimensions.

There have been big obstacles to success. One significant problem has been making sure the cells receive enough oxygen and nutrients. Without the ability to build a blood supply, the maximum thickness of printed tissues has been limited to around a fifth of a millimetre.

Scientists have made a human ear, which was then implanted into a mouse

"We can create small structures in the lab really easily," said Professor Anthony Atala from the Wake Forest Institute for Regenerative Medicine in North Carolina. "Up to 200 microns there is no problem — the cells you print can get nutrition from their surroundings. Any time you create a structure that is larger, the central portion doesn't survive. Nutrition can't get to that point."

By including a lattice of "microchannels", the researchers said they were able to solve this difficulty. These tiny channels, produced as the structure was printed, allowed nutrients to penetrate deep into the tissue.

This meant they could make living structures approaching the size needed in humans, that also stayed alive long enough after implantation that the animals' own blood vessels had time to extend into them.

He and his colleagues are already looking to try the system in humans. He said that perfecting it could revolutionise medicine. "We can already make tissues by hand and put them in patients," he said. "But this is about scale. Imagine you have a patient with a tissue defect. What you do is do some imaging of that area, and then based on that imaging we can download that into software program, and print a construction to fit the defect precisely." The technology could help hundreds of thousands of patients, he said.

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