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Thumbs up for 3D bone printer

07 March 2009 by [Andy Coghlan](#)
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EXACT replicas of a man's thumb bones have been made for the first time using a 3D printer. The breakthrough paves the way for surgeons to replace damaged or diseased bones with identical copies built from the patients' own cells.

"In theory, you could do any bone," says Christian Weinand of the Insel Hospital in Berne, Switzerland, head of the team that copied his thumb bones. "Now I can put spares in my pocket if I want," he says.

Weinand "grew" his replacement bones on the backs of laboratory mice, in the same way that Jay Vacanti of Massachusetts General Hospital famously [grew a human ear](#) from human cartilage cells back in 1997.



Exact replicas of a man's thumb bones have been made for the first time using a printer that uses natural materials for ink (Image: Gustoimages / SPL)

However, a surrogate mouse would normally be unnecessary, says Weinand. For example, if someone had lost a thumb, the replacement bones could be grown in situ. For now, the only options are to replace the thumb with the patient's own toe, or with bone fragments from elsewhere.

There are several steps in the new process. Firstly, you need a 3D image of the bone you want to copy. If the bone has been lost or destroyed, you can make a mirror image of its surviving twin.

This image is then fed into a [3D inkjet printer](#), which deposits thin layers of a pre-selected material on top of one another until a 3D object materialises.

Weinand loaded the printer with tricalcium phosphate and a type of polylactic acid - natural structural materials found in the human body. The resulting bone "scaffolds" contained thousands of tiny pores into which bone cells could settle, grow and eventually displace the biodegradable scaffold altogether.

A 3D printer deposits thin layers of a natural material that builds into a scaffold for bone cells

The team extracted CD117 cells from bone marrow left over after hip-replacement operations. CD117 cells grow into primordial bone cells called osteoblasts, which the team syringed onto the bone scaffolds in a gel designed to support and nourish them. Finally, the scaffolds were sewn under the skin on the backs of mice where they grew for up to 15 weeks, until the scaffold had changed into human bone (*Tissue Engineering Part A*, DOI: [10.1089/ten.tea.2008.0467](#)).

Anthony Hollander, a stem cell researcher at the University of Bristol in the UK, says that the work capitalises on a breakthrough a year ago, in which a Finnish team headed by Riitta Suuronen at the University of Tampere [reconstructed a man's jawbone](#) on a "scaffold" left for nine months in his abdomen. In that case, the stem cells came from the patient's own fat cells.

"The nice aspect of this new work is that a method was used to make sure the bones grew to the exact dimensions of a particular thumb," Hollander says. "The next stage will be to demonstrate that such implants are functional and that they acquire blood vessels when implanted."

Weinand says there were "hints" that blood vessels were nourishing the implants in the mice, so he is

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hopeful the same thing will happen in people. He hopes to apply to try out the procedure in the clinic in the near future.

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