TISSUE ENGINEERING

Technique Uses Body as 'Bioreactor' to Grow New Bone

Tissue engineers have long dreamed of starting with a small clutch of cells in a petri dish and growing new organs that can then be transplanted into patients. The strategy has worked for relatively simple, thin tissues such as skin and cartilage that don't depend on a well-formed network of blood vessels to deliver food and oxygen. But it hasn't panned out for more complex tissues shot through with vessels, such as bone and liver. Now a novel approach to tissue engineering that grows bone inside a patient's own body could change all that.

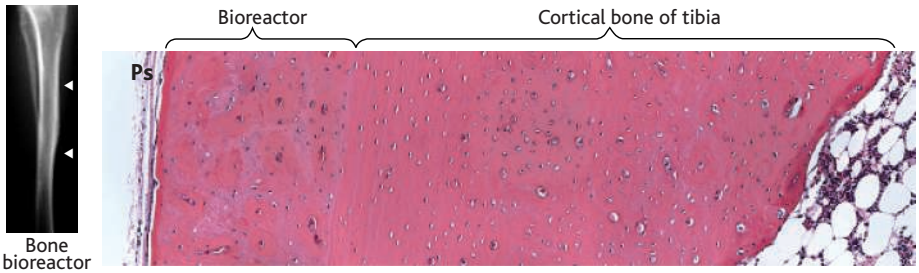
In a paper published online this week by the *Proceedings of the National Academy of Sciences*, researchers from the United States, the United Kingdom, and Switzerland report that they grew large amounts of new bone alongside the long leg bones of rabbits. When they harvested and transplanted the new bone into bone defects in the same animal, the defects healed and were indistinguishable from the original.

"This is a fresh, new strategy for tissue engineering that relies on the body's own capacity to regenerate itself," says Antonios Mikos, a tissue engineering specialist at Rice University in Houston, Texas. "I think it will have an enormous impact on the field."

The field of tissue engineering could use some help. Attempts to grow complex tissues outside the body have progressed in fits and starts. Italian researchers, for example, have coaxed bone marrow cells injected into a ceramic matrix to create new bone. But organisms have been unable to resorb and remodel the tissue, as occurs with normal bone. To avoid such problems, researchers led by tissue engineers Prasad Shastri at Vanderbilt University in Nashville, Tennessee, and Molly Stevens and Robert Langer at the Massachusetts Institute of Technology in Cambridge decided to see if they could let the body handle it itself.

Bones are sheathed in a thin membrane of cells called the periosteum. If a small wound or fracture occurs, cells in the periosteum can divide and differentiate into replacement tissue, including new bone, cartilage, and ligaments. Shastri wanted to see if he and his colleagues could use this same wound-healing response to generate new tissue.

The researchers injected a surgical saline solution between the tibia—the long, lower leg bone—and the periosteum of white rabbits, a standard small animal model for studying bone. This created a small, fluid-filled cavity into which they hoped new bone would grow. To prevent the cavity from collapsing as the saline is absorbed by the body, the researchers injected a gel containing a calcium-rich compound called alginate. Previous studies have suggested that calcium helps trigger cells in the periosteum to differentiate into new bone, and that is exactly what happened, the researchers report. Within a few weeks, the alginate cavities were filled with new bone. And when that bone was removed and transplanted to damaged bone sites within the same animals, the new bone integrated seamlessly.



Good as new. A surgically formed cavity acts as a "bioreactor" to grow new bone between the periosteum (Ps) and mature bone in the tibia of a rabbit (*above*), producing a slight bulge of new bone (*left*).

"I think the strength of this approach is its simplicity," Mikos says. "It doesn't rely on the delivery of exogenous growth factors or cells." That could make it a boon to orthopedic surgeons, who often need to harvest large amounts of bone from patients to fuse vertebrae in spinal fusions. That harvested bone usually comes from a patient's hip, a procedure that often produces pain for years. But if this approach works in people, it could enable physicians to generate new bone alongside a patient's shin, for example, which could then be transplanted to other sites.

The technique could also prove useful for other tissues. With a few tweaks, says Shastri, it works to generate healthy new cartilage. Now the team is looking to see if it can be used to generate liver tissue as well. If so, it may turn tissue engineers' dreams into reality.

–ROBERT F. SERVICE

CREDITS (LEFT TO RIGHT): M. M. STEVENS *ET AL.*, *PNAS* (2005); NPO LAVOCHKIN/THE PLANETARY SOCIETY

ScienceScope

Deadly Bacteria in China

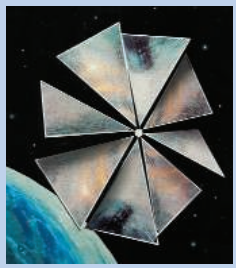
A mysterious disease that has caused at least 19 deaths in China's Sichuan Province is being blamed on *Streptococcus suis* type 2, a bacteria common in pigs throughout the world. Robert Dietz, a spokesperson for the World Health Organization in Manila, says laboratory confirmation is still pending but that the reported symptoms seem to be consistent with human *S. suis* infection. Human cases are rare, Dietz says, making it surprising that China has so suddenly recorded 67 to date. Although a more virulent strain of the bacterium could be the culprit, Dietz thinks that China's "enhanced surveillance capabilities" are a more likely explanation. But Marcelo Gottschalk, a *S. suis* expert at the University of Montreal in Canada, doubts the diagnosis. "It's just very strange for so many people to be infected in such a short time," says Gottschalk, who notes that hearing loss—a common human *S. suis* symptom—has not been reported in Sichuan.

–DENNIS NORMILE AND MARTIN ENSERINK

Updates

■ An epidemiologist who was subpoenaed for 25 years' worth of his data on lead exposure and health effects in children has won a compromise with paint companies (*Science*, 15 July, p. 362). Attorneys for the University of Cincinnati have agreed that Kim Dietrich will release a small subset of his data on children's IQs and lead levels that was recently published as part of a pooled analysis. The companies say they need the data to defend themselves against a lawsuit filed by the state of Rhode Island.

■ White House Office of Science and Technology Policy officials Kathie Olsen and William Alan Jeffrey were confirmed by the Senate last week for new positions as deputy National Science Foundation director and head of the National Institute of Standards and Technology, respectively. Olsen is a 52-year-old neuroscientist with experience at NASA; Jeffrey, 45, served previously at the Defense Advanced Research Projects Agency.



■ The Russian review board investigating the failed June launch of Cosmos 1, a privately funded solar sail spacecraft, has concluded that it never reached orbit due to a pump failure.

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