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## A material to close deep wounds and promote skin regrowth

Researchers are developing a collagen-based tissue template to aid in skin repair.

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This man had skin from his leg grafted to his hands, but that creates a second wound. Implants could change that. (Don Bartletti, Los Angeles Times / June 20, 2011)

By Amber Dance, Special to the Los Angeles Times  
June 20, 2011

A biological Jell-O with a structure as precise as a microchip's could someday be the surgeon's patch to seal large, deep wounds and help them regrow skin.

Using techniques borrowed from silicon chip design, researchers at Cornell University in Ithaca, N.Y., created a network of channels in soft sheets of collagen, a main component of skin. Body cells fill those channels with blood vessels — and that crucial blood supply, in turn, coaxes skin to regrow.

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This tissue template, described online May 6 in the journal *Biomaterials*, works well in mice. The researchers plan next to test it in pigs, which have more humanlike skin.

It's an exciting initial step, says Dr. David Kulber, a plastic surgeon at Cedars-Sinai Medical Center in Los Angeles, who was not involved in the research.

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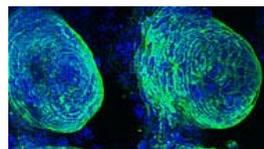
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Skin consists of two main layers: the thin, outer epidermis and a thicker under-layer called the dermis. (The dermis is the smooth, pink skin that appears under a blister.)

Surgeons can easily transfer epidermis from one part of the body to another to cover a shallow wound. But with deeper wounds, such as severe burns or injuries down to the bone, the dermis is gone. Similarly, when surgeons remove a tumor, they may have to take out a lot of tissue, leaving a deep, skinless area.

Wounds can't heal if they don't have a blood supply, so surgeons are always looking for ways to "jump-start" the growth of new blood vessels, Kulber says.

One traditional wound treatment is to graft in sections of dermis and muscle from elsewhere in the body, but that creates a second wound. Alternatively, surgeons already have artificial materials (called dermal templates) they can sew in to promote regrowth. In either case, the new material requires contact with healthy soft tissue and a blood supply — which isn't possible if the wound is bone-deep or if the surrounding tissue has been irradiated to shrink a tumor.

These dermal templates have pores for the blood supply to grow into, but it can take weeks for that to happen. In the meantime, the injured person is in pain and at risk of infection in the open wound.

Abraham Stroock, a Cornell chemical engineer, teamed with Dr. Jason Spector, a plastic surgeon at the Weill Cornell Medical College in New York, to come up with something better. They took a minimalist approach: "the simplest material possible," Stroock says. But though the material — collagen extracted from rats — is simple, the channels inside, carefully designed for optimum blood vessel growth, make the material work.

"We're trying to make a very precise microstructure, on the scale of a human hair, in a material that has properties like Jell-O," Stroock says.

The delicate material is 1 millimeter thick and feels like soft skin or silken tofu, he says.

The researchers tested their template in mice. Spector made a small slit in their skin and inserted a dime-sized piece of the template into the dermis. The researchers looked for blood vessels to form in the implant.

They found that cells penetrated all the way into the collagen structure within three days. Within two weeks, blood vessels crisscrossed the structure, and red blood cells cruised through them. Spector estimates that the new templates achieve a blood vessel network 30% to 40% faster than the current commercial templates.

Stroock isn't sure how the structure invites blood vessels, but he suspects that immune cells patrolling the channels secrete growth factors that call the rest of the body's repair team to the scene.

Dr. Malcolm Z. Roth, president-elect of the American Society of Plastic Surgeons, says that the work, while preliminary, probably would apply to people as well as the mice tested in the study. However, he notes that sometimes just a new skin is not enough. For wounds that reach to the bone, a person needs a fix that is durable and won't easily tear open again. Often surgeons have to graft muscle as well as dermis.

Any clinical use is still far off. But should future experiments be successful, the researchers envision a sheet-like material that surgeons could cut to fit and sew in place over a wound, protecting it from infection. A dermis would then form around and within the collagen template. Surgeons could graft epidermis on top.

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