**Lasers Demonstrate the Power to Heal Without Scarring**<http://www.scientificamerican.com/article.cfm?id=photochemical-tissue-bond>

**Green laser light can trigger collagen fibers to link up in nerves and other
damaged tissue**

By Larry Greenemeier  | May 5, 2010 | 19

The Laser at 50: Advancing Science through Beams of Coherent Light May 16 marks
the 50th anniversary of the first working laser, invented at Hughes Research
Laboratories in 1960. We take a look at the past, present and potential future
of this groundbreaking technology » May 14, 2010

PHOTOCHEMICAL TISSUE BONDING: A skin excision two weeks after surgery. Deep
sutures were used to bring the sides of the five-centimeter wound together. Then
the upper layer of closure was done with sutures on the right side and with
light activated technology on the left side. The redness on the right side is
caused by the sutures and leads to scarring. Image: IMAGE COURTESY OF WELLMAN
CENTER FOR PHOTOMEDICINE

When accidents happen, doctors typically rely on sutures, staples or adhesives
to fix the damage. These approaches work, of course, but they tend to cause
inflammation in the surrounding tissue and leave scars long after a wound has
healed. Researchers at Harvard Medical School and the Massachusetts General
Hospital Wellman Center for Photomedicine have recently completed a study they
hope will shine some light on this problem—laser light, that is.

Through a process called photochemical tissue bonding, a green laser interacts
with pink dye placed on a wound to stimulate healing. The researchers are
studying the use of this technique to reconnect severed peripheral nerves, blood
vessels, tendons and incisions in the cornea. "We set out to develop a
technology for tissue repair that would lead to much less scarring and could be
done on small structures such as a nerve or blood vessel," says Irene Kochevar,
a Harvard Medical School dermatology professor and Wellman Center researcher.
"If you don't have to use sutures, you don't stimulate inflammation, which leads
to fibrosis and collagen deposits [that create scar tissue]."

Kochevar and Robert Redmond, an associate professor of dermatology and associate
chemist at the Wellman Center, began a U.S. Defense Department–sponsored study
in early 2008 with Massachusetts General Hospital dermatologist Sandy Tsao, who
was removing skin lesions from patients. After an elliptical incision was made
to remove the lesion, part of the wound was repaired using sutures, while the
rest was treated with photochemical tissue bonding. Months after the incision
was made, the researchers found no scarring on the portion of the cut treated by
the dye and laser, she says.

The key lies in stimulating the body's own repair mechanisms. When a pink dye
known as "rose bengal" is placed on tissue and struck with a green laser beam
for three minutes, the dye absorbs the light, causing collagen molecules in the
tissue to cross-link and close a wound in a way that more resembles the coming
together of Velcro than the zipper-like markings left by sutures.

More recently, Kochevar and Redmond have been applying the technique to repair
damaged nerves in animals. "We take a piece of amniotic membrane, which is from
the innermost part of the placenta, put the pink dye on that membrane, wrap it
around the pieces of the severed nerve and irradiate the membrane," Kochevar
explains. "It's like putting a shrink wrap on the pieces that holds them
together." In some ways this is a better way to repair nerves than using sutures
because nerve material can sometimes sneak out into the surrounding muscle when
stitched together. Also, without sutures there's a lower chance of creating
inflammation that could retard nerve growth.

Looking forward, Kochevar says she would like to be able to reduce the amount of
time the laser needs to be trained on the dye in order for the bonding process
to begin—from a few minutes required today to only a few seconds in the future.
Kochevar also wants to develop a way increase the number of nano-sized bonds
created in the treated area of tissue, strengthening the cross-linking process
so that photochemical tissue bonding can be used on parts of the body—such as
elbows and knees—that require a lot of flexibility.