A doctor at the Institute for Regenerative Medicine in Winston-Salem, North Carolina, dips a specially constructed biodegradable mold—shaped like a bladder and seeded with human bladder cells—into a growth solution on March 30, 2006. In a medical first, working lab-grown transplant organs have been made from a patient's own cells.

The human body is remarkably adept at healing itself. Even when significant injuries cause people to lose chunks of their major organs, the tissues can fully regenerate.

Now doctors have harnessed the body's healing process to produce the first lab-grown organs for use in human patients.

The work, announced in today's online edition of the British medical journal The Lancet, involved implanting laboratory-grown bladders into children and teens with spina bifida.

Spina bifida is a birth defect that causes a host of medical problems, including kidney damage and incontinence due to poorly functioning bladders.

When surgery is needed, the traditional solution is to graft tissue from the patient's stomach or intestine onto the bladder. The same process can be used to "build" bladders for patients who have lost them due to bladder cancer.
"[Pieces of] intestines have been used for more than a hundred years," said Anthony Atala, director of the Institute for Regenerative Medicine at Wake Forest University School of Medicine in Winston-Salem, North Carolina.

But the intestine is designed to absorb nutrients, whereas the bladder is meant to prevent the reabsorption of waste products from urine.

"You can imagine the problems that ensue if you put in a tissue that is absorbing things it should be excreting," Atala said. "You wind up with chemical imbalances, increased infections, and increased cancer."

**Organ "Cake"**

The laboratory-grown organs resolve this by using bladder tissue grown from healthy parts of the patients' own malfunctioning organs.

The procedure begins with a biopsy. "We took a small piece of the bladder, less than half the size of a postage stamp," Atala said.

His team separated the cells into two types: muscle cells, which form a layer on the outside of the bladder, and urothelial cells, which line its interior. These cell types were grown separately in a process called tissue culturing.

Once the researchers had grown enough cells, which takes about a month, the scientists distributed them in layers over an artificial framework—a process that Atala compares to making a layer cake.

The organ "cake" was then "baked"—or more precisely, incubated—in an oven designed to mimic normal body conditions.

When the tissues had matured, the organ was implanted into the patient. The framework was gradually absorbed by the body, which replaced it with a layer of collagen.

Nerves and blood vessels also grew into place, allowing the new bladder to function normally.

**No More Waiting?**

Lab-grown bladders have been successfully used in seven young patients, some of whom have been followed now for more than seven years.

Atala refers to this process as regenerative medicine and hopes it may someday be an alternative to long waits for organ donations. One major advantage is that the organ's cells are the body's own.

"[With cells] coming from the same patient, you have no rejection issues," he said.

Rejection is a process in which the body's immune system attacks transplanted tissue as though it were an invading germ. In severe cases, this can cause transplants to fail.

The new procedure also has advantages over techniques using stem cells—unspecialized cells that can grow into any type of cell in the body—because the cells being used already "know" they are bladder cells.

"You don't have to coax these cells to become something else," Atala said.

Atala's team is currently working on growing about 20 other types of tissues and organs, ranging from blood vessels to the kidney, liver, pancreas, and heart.