# Medicine's Cutting Edge: Re-Growing Organs

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**(CBS)** *Imagine re-growing a severed fingertip, or creating an organ in the lab that can be transplanted into a patient without risk of rejection. It sounds like science fiction, but it's not. It's the burgeoning field of regenerative medicine, in which scientists are learning to harness the body's own power to regenerate itself, with astonishing results.* ***Correspondent Wyatt Andrews*** *brings you to the scientific frontier.*

Three years ago, Lee Spievack sliced off the tip of his finger in the propeller of a hobby shop airplane.

What happened next, **Andrews** reports, propelled him into the future of medicine. Spievack's brother, Alan, a medical research scientist, sent him a special powder and told him to sprinkle it on the wound.

"I powdered it on until it was covered," Spievack recalled.

To his astonishment, every bit of his fingertip grew back.

"Your finger grew back," **Andrews** asked Spievack, "flesh, blood, vessels and nail?"

"Four weeks," he answered.

**Andrews** spoke to Dr. Steven Badylak of the **University of Pittsburgh's McGowan Institute of Regenerative Medicine** and asked if that powder was the reason behind Spievack's new finger tip.

"Yes, it is," Badylak explained. "We took this and turned it into a powdered form."

That powder is a substance made from pig bladders called extracellular matrix. It is a mix of protein and connective tissue surgeons often use to repair tendons and it holds some of the secrets behind the emerging new science of regenerative medicine.

"It tells the body, start that process of tissue regrowth," said Badylak.

Badlayk is one of the many scientists who now believe every tissue in the body has cells which are capable of regeneration. All scientists have to do is find enough of those cells and "direct" them to grow.

"Somehow the matrix summons the cells and tell them what to do," Badylak explained. "It helps instruct them in terms of where they need to go, how they need to differentiate - should I become a blood vessel, a nerve, a muscle cell or whatever."

If this helped Spievack's finger regrow, Badylak says, at least in theory, you should be able to grow a whole limb.

**Advances That Go Beyond Theory**

In his lab at Wake Forest University, a lab he calls a medical factory, Dr. Anthony Atala is growing body parts.

Atala and his team have built, from the cell level up, 18 different types of tissue so far, including muscle tissue, whole organs and the pulsing heart valve of a sheep.

"And is it growing?" **Andrews** asked.

"Absolutely," Atala said, showing him, "All this white material is new tissue."

"When people ask me 'what do you do,' we grow tissues and organs," he said. "We are making body parts that we can implant right back into patients."

Dr. Atala, one of the pioneers of regeneration, believes every type of tissue already has cells ready to regenerate if only researchers can prod them into action. Sometimes that prodding can look like science fiction.

Emerging from an everyday ink jet printer is the heart of a mouse. Mouse heart cells go into the ink cartridge and are then sprayed down in a heart shaped pattern layer by layer.

Dr. Atala believes it's a matter of time before someone grows a human heart.

"The cells have all the genetic information necessary to make new tissue," Atala explained. "That's what they are programmed to do. So your heart cells are programmed to make more heart tissue, your bladder cells are programmed to make more bladder cells."

Atala's work with human bladder cells has pushed regenerative medicine to a transformational breakthrough.

In this clinical trial at Thomas Jefferson Hospital in Philadelphia, Dr. Patrick Shenot is performing a bladder transplant with an organ built with this patient's own cells. In a process developed by Dr. Atala, the patient's cells were grown in a lab, and then seeded on a biodegradable bladder-shaped scaffold.

Eight weeks later, with the scaffold now infused with millions of regrown cells, it is transplanted into the patient. When the scaffold dissolves, Dr. Shenot says what's left will be a new, functioning organ.

"The cells will differentiate into the two major cells in the bladder wall, the muscle cells and the lining cells," he explained. "It's very much the future, but it's today. We are doing this today."

**Repairing The Wounded**

Today, one of the biggest believers in regeneration is the United States military, which is especially interested in the matrix that regrew Lee Spievack's finger.

The Army, working in conjunction with the University of Pittsburgh, is about to use that matrix on the amputated fingers of soldiers home from the war.

Dr. Steven Wolf, at the **Army Institute of Surgical Research**, says the military has invested millions of dollars in regenerative research, hoping to re-grow limbs, lost muscle, even burned skin.

"And it's hard to ignore this guys missing half his skin, this guy's missing his leg," Wolf said. "You start asking the question, is there somebody out there with the technology that can do this for us?"

"You mean regrow the tissue?" **Andrews** asked.

"The answer," Wolf said, "is maybe."

At the burn unit at the Brooke Army Medical center, the very idea of regeneration brings a glimmer of hope.

Army Staff Sgt. Robert Henline was the only survivor of an IED attack on his Humvee north of Baghdad.

"It's a great idea," Henline said, talking with **Andrews** about the military's investment into the new technology. "If they can come up with something that's less painful and can heal it with natural growth, without all this scarring, it's definitely something to check into."

**Regeneration Race Goes Global**

Several different technologies for harnessing regeneration are now in clinical trials around the world. One machine, being tested in Germany, sprays a burn patient's own cells onto a burn, signaling the skin to re-grow.

Badylak is about to implant matrix material - shaped like an esophagus - into patients with throat cancer.

"We fully expect that this material will cause the body to re-form normal esophageal tissue," Badylak said.

And in a clinical trial at the University of Pittsburgh Medical Center, patient Mary Beth Babo is getting her own adult stem cells injected into her heart, in hopes of growing new arteries. Her surgeon is Dr. Joon Lee.

"It's what we consider the Holy Grail of our field for coronary heart disease," Lee said.

The Holy Grail, because if stem cells can re-grow arteries, there's less need for surgery.

"It's a big difference from open heart surgery to this," said Babo. "If people don't have to go through that, this would be the way to go ... if it works."

**The Business Of Regeneration**

Corporate America, meanwhile, already believes regeneration will work. Investment capital has been pouring in to commercialize and mass produce custom-made body parts.

The **Tengion Company** has bought the license, built the factory, and is already making those bladders developed at Wake Forest that we told you about earlier.

"We're actually building a very real business around a very real and compelling patient need," said Dr. Steven Nichtberger, Tengion's CEO.

Tengion believes regeneration will soon revolutionize transplant medicine. Transplant patients, instead of waiting years for a donated organ, will ship cells off to a lab and wait a few weeks to have their own re-grown.

"I look at the patients who are on the waitlist for transplant," said Nichtberger. "I look at the opportunity we have to build bladders, to build vessels, to build kidneys. In regenerative medicine, I think it is similar to the semi-conductor industry of the 1980s, you don't know where it's going to go, but you know it's big."

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For more on regenerative medicine and organ transplants, check out:

- The **McGowan Institute for Regenerative Medicine**.
- The non-profit **United Network for Organ Sharing**.
- The non-profit **Organ Procurement and Transplantation Network**.
- The non-profit organ and tissue donation group, **Gift Of Life Organ Donation**.
- **Wake Forest University**.
- **Tengion Company**.