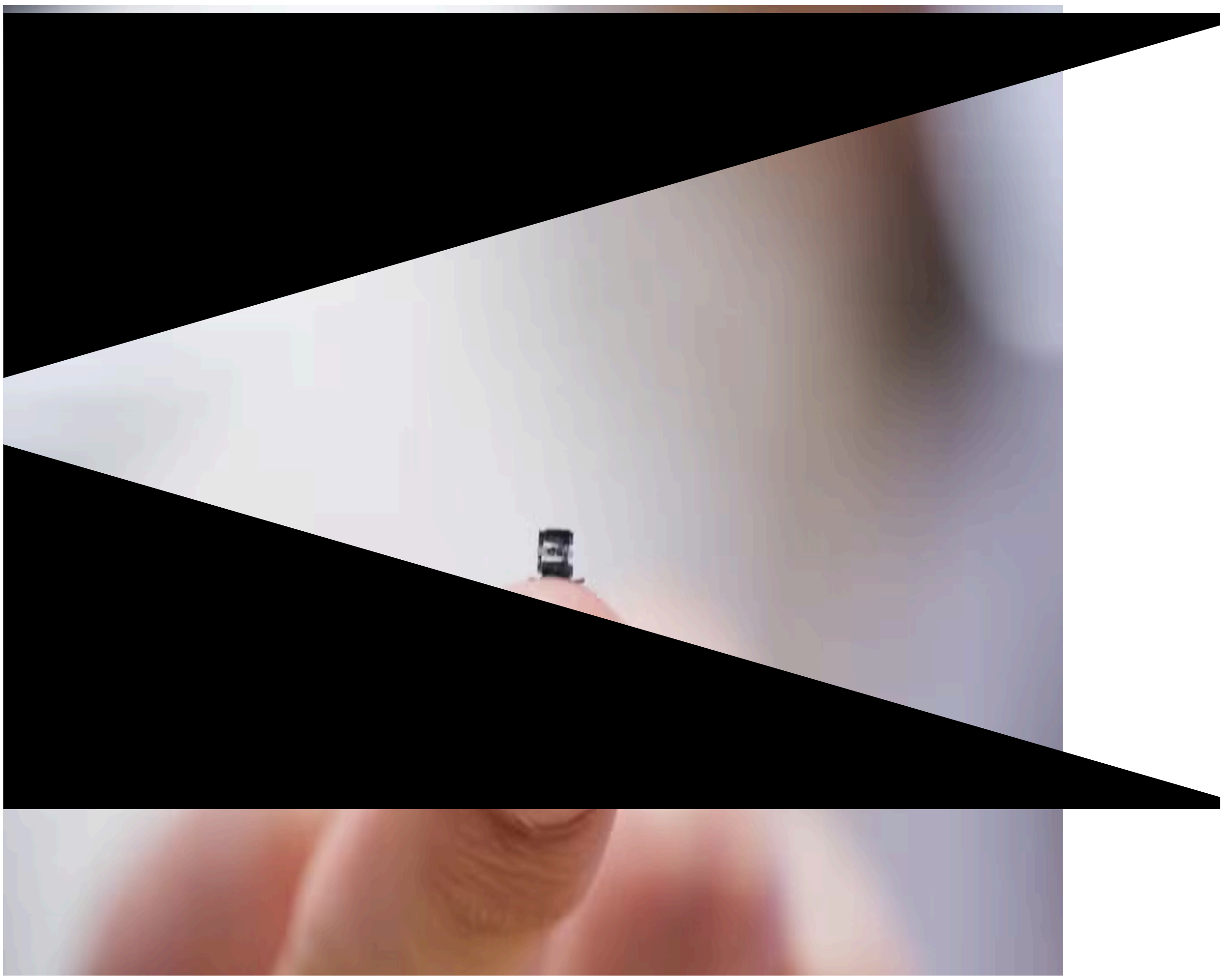
A surgical robot the size of a seed will operate on us from the inside

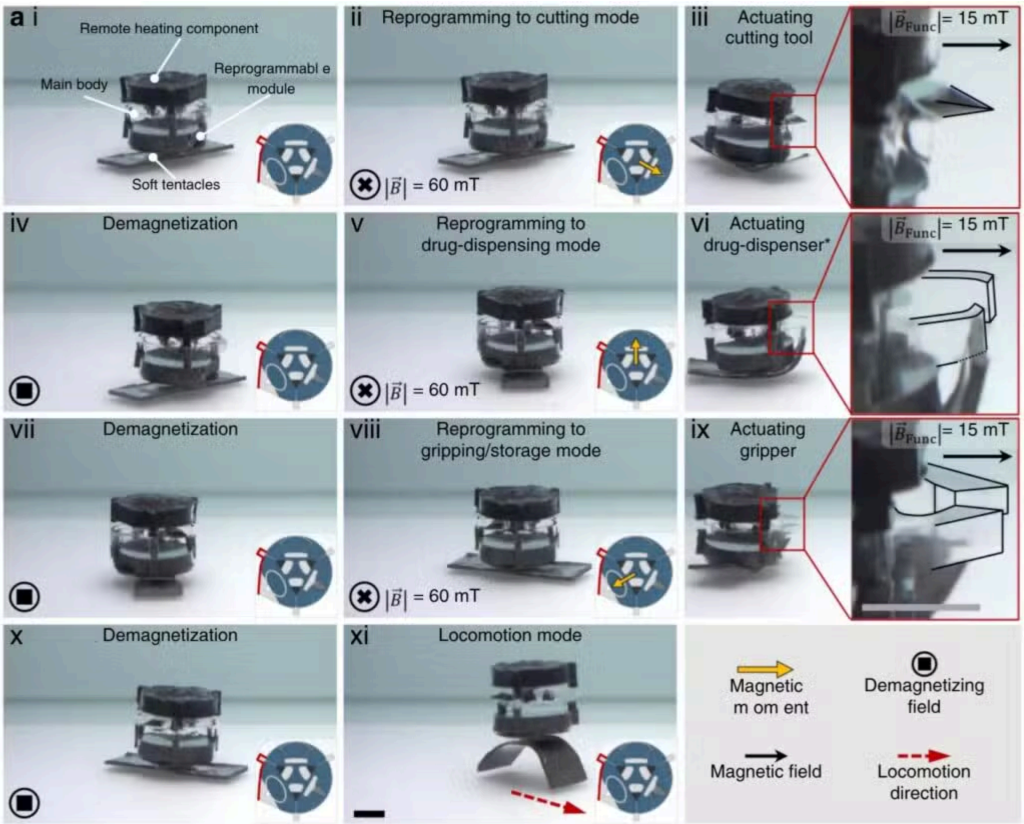
It moves across a chicken liver, cuts, grabs a sample, and is retrieved. The Singapore surgical robot measures 4,4 mm.

Gianluca Riccio 26 May 2026



On a piece of chicken liver in a Singapore lab, something tiny appears: it moves, slows down, activates a razor blade, and cuts into the tissue. Then it changes its mind: it grabs a sample, inserts it, and starts walking again. No wires, no motors on board: just magnetic fields, generated by coils around the scene. NTU's surgical robot does this, and more.

The number to keep in mind is 4,4 millimeters. Within this length, the team from Nanyang Technological University in Singapore **he inserted five operating functions:** Locomotion on soft and irregular surfaces, cutting biological tissue, drug delivery, sample collection and storage, and remote heat generation. *One at a time, of course.*But the surgical robot takes less than a second to switch from one to the other. The work, led by associate professor **Lum Guo Zhan**, came out on *Advanced materials*.



Architecture and functions of the tiny surgical robot developed in Singapore

How does such a small surgical robot change jobs?

The body is made of soft silicone materials (PDMS and Ecoflex, the same ones used in soft robotics) in which five-micrometer magnetic microparticles are literally embedded. At the center is a module that can be magnetized, demagnetized, and remagnetized in different directions: each orientation activates a different function. This is the trick that allows the same object to perform different functions without changing hardware.

There is a classic problem that miniaturization brings with it, and here it is worth dwelling on. When a magnetic robot becomes very small, the magnetic field tends to move it all at once, as if it were a single magnet: it's difficult to get just one part to react while keeping the others still. The Singapore team engineered different regions of the body so that only one responds to a given field, while the rest remains immobile. Translation: the robot can activate the razor blade without its entire body bending.

Plus, there's a sixth degree of freedom. Most magnetic microrobots move on three axes and rotate in two directions: five movements. This adds rolling around its long axis, useful for navigating narrow, irregular spaces, such as those inside a human body. And unlike "slime" robots, the gelatinous ones, it has a solid (though flexible) body: easier to remove when the job is done. A significant detail, if the idea is to let it roam around the body. *Because that's the idea, right?*

What they tested in the lab

The tests included chicken liver and gelatin-based materials that mimic soft tissue. The robot cut, dispersed particles that simulated a drug, grasped and retained a sample, and produced localized heat under a high-frequency alternating magnetic field: the same principle as magnetic hyperthermia, which is being studied for the treatment of certain tumors. The grasp also serves to enclose the removed piece of tissue inside the robot's body and remove it, a movement the authors simulated with the liver.

On biocompatibility: They exposed the materials to human skin cells, and over 99 percent remained viable. Under the experimental conditions, they say, the materials are essentially non-toxic. The logic of "bringing the cure where it's needed, without having it travel throughout the body" is the same as that which drives precision nanomedicine, from nanosystems that track the tuberculosis bacterium up to DNA origami that grab viruses.

Study Card

Publication: CSX Ng, YX Yeoh, NYW Foo, K. Radhakrishnan, GZ Lum, *"Miniature Soft Robot With Magnetically Reprogrammable Surgical Functions"*, Published on *Advanced materials* (2026). DOI: 10.1002/adma.202523056.

Promising, but still far away

Lum puts it bluntly: the long-term goal is for doctors to use these robots inside the body, guide them to the right spot, and operate on them. *Long term, indeed.* For now, we're at the chicken liver and gelatin stage, and the group is working with surgeons to understand how these systems might one day fit into real-world clinical workflows: how to guide them, monitor them, and control them outside the lab.

It's worth remembering that the same laboratory presented, at the end of 2024, a magnetic robot for drug delivery. The trajectory is clear, as is the pace. Another surgical robot from Singapore exists, more advanced, and sew a kernel of corn: except that's an operating room machine, not a walking seed.

When will we really see it?

Estimated horizon: **10-15 years,** and with an honest question mark above it.

Between a robot operating on a chicken liver and one operating inside a person, there's imaging to see it at work, animal models, clinical trials, and regulations that are far from light for semi-implantable devices. The mechanical part is the most advanced; the challenge is guiding it safely into a moving, breathing, and bleeding body.

If anything, the first to benefit will be those cases that currently have no alternatives: organs that are difficult to reach, where a large incision poses the real risk. The rest will come later, as always.

The image remains: a silicone seed on a piece of liver, which cuts, takes, preserves and leaves. A movie He had imagined it in 1966 with a submarine and a skeleton crew. Sixty years later, the crew is no longer needed.

But someone is still needed, outside the room, to decide where to send him.