

The Future of Surgery? Meet the Seed-Sized “5-in-1” Robot Changing the Medical Game



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When we think of surgery, we often picture large incisions, bulky instruments, and lengthy recovery times. But what if the future of medical treatment could fit on the tip of your finger?

Scientists at [Nanyang Technological University, Singapore \(NTU Singapore\)](#) have just unveiled a groundbreaking medical innovation: a **“5-in-1” surgical robot the size of a tiny seed**. Measuring just 4.4 millimetres long, this remarkable micro-device can navigate across soft, uneven surfaces inside the body to perform five distinct surgical tasks wirelessly.

Published recently in the academic journal [Advanced Materials](#), this innovation represents a massive leap forward in making minimally invasive surgeries safer, less painful, and incredibly precise.

One Tiny Robot, Five Incredible Superpowers

Typically, miniature medical robots can only perform one or two basic functions. The NTU Singapore team, led by Associate Professor Lum Guo Zhan from the [School of Mechanical and Aerospace Engineering](#), cracked the code to fit five vital surgical capabilities into a single, highly agile device.

Controlled remotely by weak magnetic fields, the robot can switch between these functions in under a second:

- **Navigate with Precision:** Unlike older models limited to basic movements, this robot has six degrees of freedom. It can literally “roll” along its axis, allowing it to navigate narrow, complicated, and irregular spaces deep inside the human body.
- **Cut Biological Tissue:** It can activate a tiny, specialised blade to perform precise cuts without the need for large external incisions.
- **Deliver Targeted Drugs:** The robot can carry and dispense medication exactly where it’s needed, reducing systemic side effects.
- **Grip and Store Samples:** Need a biopsy? The robot can grab a tissue sample and safely store it for retrieval.
- **Generate Heat:** By responding to high-frequency magnetic fields, the robot can emit localized heat. This is a massive breakthrough for potential cancer treatments, where targeted heat is used to destroy cancerous cells.

How Does It Work?

Building a multitasking robot the size of a sesame seed requires a lot of ingenuity. The NTU team built the robot using soft, flexible silicone-based materials commonly found in soft robotics (like PDMS and Ecoflex).

These soft materials are embedded with microscopic magnetic particles. The true genius lies in the robot’s reprogrammable magnetic module. By tweaking the external magnetic fields, researchers can make *only specific parts* of the robot react. This means it can change shape to deploy a cutting tool while the rest of its body stays perfectly still—a major hurdle that previous mini-robots couldn’t overcome.

And unlike “slime-like” soft robots, this device has a sturdy, solid-yet-flexible body, making it incredibly easy and safe to retrieve once the job is done.

Is It Safe?

When dealing with new medical tech, safety is paramount. The NTU team has already put the seed-sized surgeon to the test.

In laboratory trials, the robot successfully navigated and operated on biological tissue models, including simulated soft tissue and chicken liver. More importantly, they tested the robot’s materials against human skin cells. The results? **More than 99% of the cells remained completely healthy and viable**, proving the device is non-toxic and highly biocompatible.

What This Means for Our Wellness

For anyone who has ever felt anxious about going under the knife, this technology offers a glimpse into a much brighter, less intimidating future.

Dr. Yeong Leong Litt, a Senior Consultant from the [National University Hospital](#) who reviewed the innovation, noted that these robots have the potential to completely replace many aspects of traditional interventional surgery, ushering in a “new mode of therapy in medicine.”

While the technology is currently in the lab phase with the team now exploring ways to integrate imaging systems and test it in realistic artificial organs, the ultimate goal is clear. Soon, doctors may be able to guide these mini robots deep inside the body to heal us from the inside out, leaving the days of bulky surgical tools firmly in the past.

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Robyn Foyster is a multi-award-winning journalist, tech entrepreneur, and founder of Foyster Media, the company behind The Carousel, Women Love Tech, and Game Changers. With over 30 years’ experience across print, digital, television, and immersive media, Robyn has been a leading voice in shaping Australia’s female narrative. Robyn Foyster is a multi-award-winning journalist, tech entrepreneur, founder and owner of The Carousel, Women Love Tech, and Game Changers. With over 40 years’ experience across print, digital, television, and immersive media, Robyn has been a leading voice in shaping Australia’s female narrative. As editor and founder of Women Love Health, Robyn is passionate about empowering women through evidence-based, impact-driven storytelling. From wellness and personal growth to career development and sustainable

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