ROBOTS IN THE SURGICAL SUITE

Surgical robots have been used in operating rooms for 20 years, since Intuitive Surgical introduced its Da Vinci robotic system. The first move to surgical robots predates that by about 30 years, when NASA proposed remote-controlled robots to provide medical response to astronauts. Scientists could not overcome the long distances, however, and the first robot-assisted orthopedic surgery waited until 1984.

Now, operating room robots are poised for growth. The global market is expected to grow 22 percent between 2018 and 2025, according to some estimates. It could reach $9.7 billion by 2023. By 2017, some 877,000 surgeries worldwide used a robotic system.

But new systems are being developed and coming to market that will expand the use of surgical robots. Here are a few developments.

22% growth

877,000 surgeries

$9.7 billion

LARGE SYSTEMS

Credit: www.intuitive.com

5,500 robots

8-mm camera

2020 Ottava system

The market leader with some 5,500 robots operating in hospitals around the world, Da Vinci remains the gold standard for many hospitals and procedures. It is used for a diverse number of surgeries, including thoracic, colorectal, urologic, head and neck, gynecologic, and general. It is the standard of comparison with other units.

The Da Vinci Xi uses an operational cart with four arms, a mobile platform and master consol. Surgical instruments can be manipulated with cable-driven joints. The arms are boom-mounted with a capacity of three degrees of freedom, and an additional seven degrees can be achieved with its EndoWrist system that mimics movement of the human wrist. An 8-mm camera can be used in all ports, and provides high-resolution 3D visualization and motion scaling. It does lack haptic feedback.

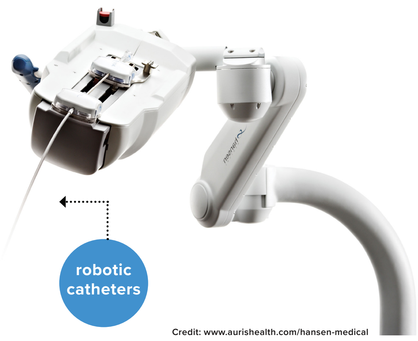
Johnson & Johnson is just one competitor for large robotic systems, and unveiled its Ottava system in 2020. It has six arms integrated into the operating table. It expects to begin clinical trials in 2022. The frim already has its Velys system for orthopedics and knee replacement on the market.

The MicroSurge system is smaller and still in development in Germany. It has three to five robotic arms, and two visualization modes with haptic interface.

MINIATURE TOOLS

Less involved surgical procedures use smaller robotic systems. Catheter ablation, for instance, uses a wire that is manually pushed through blood vessels and the heart. But it exposes surgeons to radiation from X-rays. Robots eliminate that exposure. They are much cheaper than many surgical robots and lighten the workload of clinical staff. Working remotely, physicians control robotic catheters and guide wires away from the radiation field. Many systems have been approved by the Food and Drug Administration and have been used since the mid-teens.

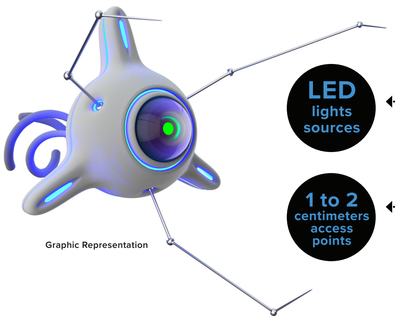
The development of miniature motors driving robotic arms has been a key technical advancement for smaller systems. They eliminate the need for large pulleys and motors, and open up use for small systems in laparoscopic surgery.



robotic catheters

Credit: www.aurishealth.com/hansen-medical

MICROROBOTS



Graphic Representation

LED lights sources

1 to 2 centimeters access points

The next step in robotic surgery promises to use microrobots. They are fundamentally different from existing systems that have physical connections to an operating console. Microrobots will be untethered, and would enter the system through even smaller access points than used now, which are often one to two centimeters. They could be directed through the body by LED lights sources or magnetically, using existing magnetic resonance imaging technology. To be successful, microbots must have a contained system of propulsion, accurate telemanipulation, consistent visualization, and miniaturized functionality. They are in the very early stages of development.

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