Will the future be out of our hands?

The development of robot-assisted surgery is proving to be as revolutionary to the 21st century as anesthesia and sterile technique was to the last one. Simon Henning takes a look at some of the technology that is shaping the future.

A surgeon attending a conference in Dubai answers an emergency call on her cell phone. She is needed immediately to perform coronary artery surgery on a patient in Los Angeles. Soon afterwards, still in Dubai, she logs on to her laptop computer and begins the operation.

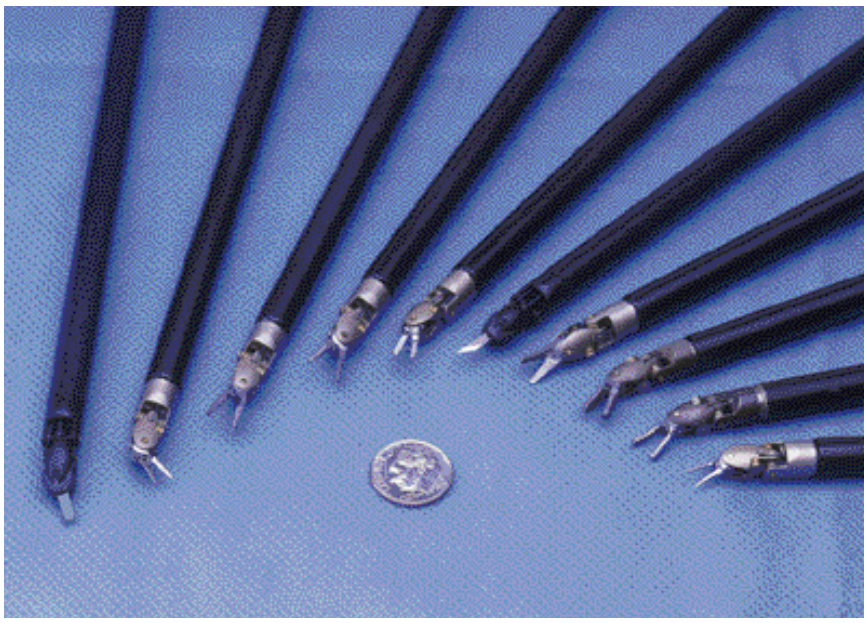
Sounds like science fiction? This scenario may not actually be too far in the future: the first generation of surgical robots is already being unveiled in operating rooms across the world and is lending a mechanical helping hand to surgeons.

Operated by remote control and voice activation, robotic assistants are being introduced to medicine because they allow for unprecedented control and precision of surgical instruments in minimally invasive procedures.

The potential is immense. Surgeons say that in the future such systems may be used to perform operations where the surgeon is located hundreds or thousands of miles away from the patient.

According to experts, the machines could make possible surgeries that no one has yet imagined, and that ultimately the technology could lead to more involved telesurgery.

Other possibilities include surgery in space, enabling experts to provide care in remote areas, and allowing doctors in developed countries to train colleagues in less-developed nations.



Researchers have developed several devices which mimic the hands of the surgeon during an operation.

One such example, the da Vinci Surgical System, uses a camera providing multiple images to give a surgeon a three-dimensional view inside the body. In addition, the system has specially designed ëwristsí at the end of the arms that mimic the actions of the surgeon, giving the robot more flexibility.

Although not the first surgical robot to perform minimally invasive surgery, the da Vinci system was employed to achieve a landmark in American surgical history.

On 15 January 2002, a 71-year-old retired businessman became the first patient in the USA to receive robotically-assisted coronary artery bypass surgery without a chest incision of any kind.

The operation was performed, using the da Vinci system, by Dr Michael Argenziano, director of robotic cardiac surgery, and Dr Craig Smith, chief of cardiothoracic surgery, as part of a clinical trial sanctioned by the USAís Food and Drug Administration (FDA), at NewYork-Presbyterian's Columbia Presbyterian Medical Center.

Traditional coronary artery bypass surgery requires open-chest surgery, which involves an eight to ten-inch incision made in the chest. Robotically-assisted surgery requires only three pencil-sized holes made between the ribs.

Through these holes, two robotic-arms and an endoscope gain access to the heart, making surgery possible without opening the chest. Multiple bypass operations using the da Vinci have already been performed in Europe.

According to Cornell University in the USA, studies show that patients who have minimally invasive operations get out of the hospital one to two days earlier than patients recovering from conventional cardiac surgery.

Dr Argenziano added: ìOther advantages of mini-

mally invasive surgery can include quicker patient recovery times, less pain, and dramatically less scarring than traditional open-heart operations.î

The da Vinci Surgical System, manufactured by Intuitive Surgical Inc, Mountain View, California, is designed to support the entire surgical team. The system consists of a surgeon console, patient-side cart, instruments and image processing equipment.

Features of the da Vinci system

- Tool control: The surgeon's arm rests on a cushioned pad in a console while his/her fingers use several rings to control the tools.
- Surgical tools: Three arms attached to a free-standing unit. One arm controls the camera; the other two have human wrist-like flexibility at the ends.
- Endoscopic camera control: Foot pedals.

To use the da Vinci system, a surgeon sits at a console, a few feet from the operating table, and looks into a viewfinder to examine the 3-D images being sent by the camera inside the patient.

The images show the surgical site and the two surgical instruments mounted on the tips of two of the rods. Joystick-like controls, located just underneath the screen, are used by the surgeon to manipulate the surgical instruments.

Each time one of the joysticks is moved, a computer sends an electronic signal to one of the instruments, which moves in sync with the movements of the surgeon's hands.

During the operation, a second surgeon stands at the side of the patient. If the patient experiences an emergency or the robot malfunctions, the device is immediately removed and the doctors perform conventional surgery.

The Zeus system, manufactured by Computer Motion Inc, has a similar setup to that of the da Vinci. It has a computer workstation, a video display and hand controls that are used to move the table-mounted surgical instruments.

Zeus employs the assistance of the Automated Endoscopic System for Optimal Positioning (AESOP) Robotic System. Released by Computer Motion in 1994, AESOP was the first robot to be cleared by the FDA for assisting surgery in the operating room.

It comprises just one mechanical arm, used by the physician to position the endoscope. Foot pedals or voice-activated software allow the physician to position the camera, leaving his or her hands free to continue operating on the patient.

The da Vinci and Zeus systems are part of a growing trend that has adapted industrial robotic technology for medical use. Neurosurgeons are using robots for more precisely targeted brain surgery and orthopedic surgeons are using navigation systems that make smaller incisions when replacing knees or hips.

But da Vinci and Zeus are the first to practice surgery. When the American Department of Defense began to fund research in the field back in the 1980s and 1990s, part of the intention had been to ìget a doctor in every foxhole.î

A robot working in a war zone but controlled from a safer location meant that urgent care could be delivered to where it was needed most without risking the lives of highly trained medical personnel.

And now, as technology continues to advance, it would appear that the future is in robotic hands. When one doctor joked that his ultimate goal was to ìoperate from the beachî, he may not have been too far from the truth.