

A Third Arm for the Surgeon

Among spinoffs in the field of health and medicine is a robotic aid to safer surgical procedures

In 1993, laparoscopic surgeons at the University of California San Diego (UCSD) Medical Center conducted trials on human patients of a new medical robot called AESOP, developed by Computer Motion, Inc., Goleta, California with the help of funding and technological assistance from Jet Propulsion Laboratory (JPL). It marked the first time a "robotic assistant" had been used in laparoscopic (minimally invasive) surgery.

AESOP stands for Automated Endoscopic System for Optimal Positioning, which means that AESOP's robotic arm holds, moves and positions a key instrument — the endoscope or laparoscope — for the surgeon in minimally invasive procedures.

Laparoscopy is a surgical method employed in roughly a million operations a year for such procedures as gallbladder removal, hernia repair, gynecological surgery, orthopedic surgery and neurosurgery; its goal is to reduce risk, cost and length of surgery/healing time by reducing the patient's trauma. In such procedures, the surgeon makes only tiny incisions in the patient's body and in one of them inserts the laparoscope, an optical tube with a camera at its end. The camera's image is projected onto two video screens, whose views guide the surgeon through the surgery.

With AESOP, the robotic arm that moves the tube and its camera is controlled by the operating surgeon rather than an assistant. The surgeon uses a foot pedal control to move the device for different views, from an overview of the operating site to a closeup for cutting or suturing. Foot control allows the surgeon use of both hands for the procedure. More importantly, the absence of a separate camera operator eliminates the possibility of miscommunication when the surgeon wants the camera repositioned.

In addition to reduced risk, AESOP offers other advantages, according to Dr. Jonathan Sackier, associate professor of surgery at UCSD and director of clinical studies for AESOP, who says that AESOP "improves the quality of the procedure; it allows the surgeon to directly control the field of vision, its movement is smooth and steady, and the memory vision is invaluable." He estimates that the three operations he personally performed with robot assistance were completed at least 20 percent faster — and at \$1,500 an hour for the operating room, that's significant. He points out, too, that less time under anesthesia is better for the patient.

AESOP is the result of Robotic Enhancement Technology (RET), an approach to robotic systems pioneered by Computer Motion, Inc. RET combines the intelligence of the operator and the dexterity of the robot to perform manipulations that neither could manage alone.

Founded in 1989, primarily as a research and development company, Computer Motion has performed contract work for such government agencies as NASA, the National Science Foundation, the National Institutes of Health and the



U.S. Navy, and for such private sector clients as GM Hughes, Allison Gas Turbine and Toyota. In 1991, the company began to apply its research efforts to the commercial marketplace, focusing on development of robotic systems for medical applications.

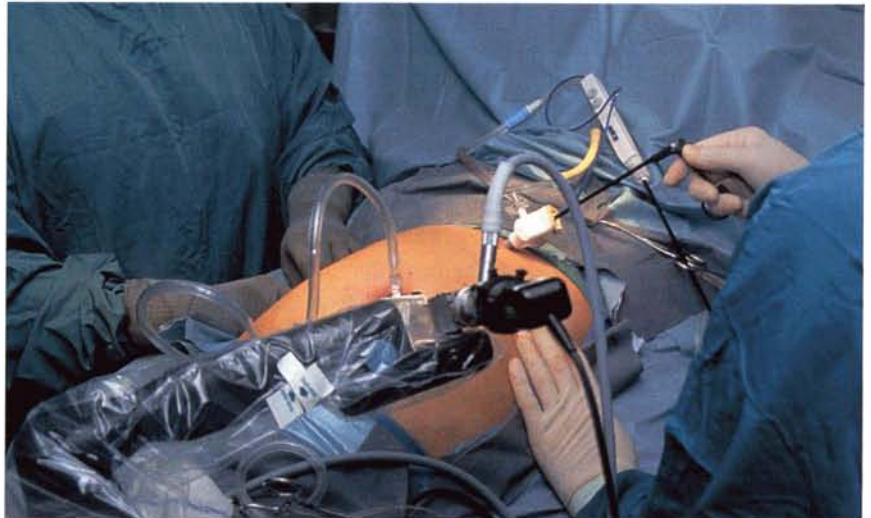
Computer Motion was helped by technology guidance and funding from JPL, a world leader in robotics. Under the direction of Dr. Neville I. Marzwell, technical manager for robotic systems and advanced computer technology, JPL is engaged in developing a number of semiautonomous systems for assembling space structures and servicing spacecraft. Marzwell's group is increasingly active in promoting the transfer of space technology to industry and JPL works closely with industry firms to adapt NASA technology to industrial applications.

In some instances, such as Computer Motion, JPL is able to award Small Business Innovation Research (SBIR) contracts to help a company commercialize a product.

"Through these relationships," says Marzwell, "we can offer technology and hands-on experience in exchange for a commitment from industry to bring a technology to market."

Dr. Yulun Wang, founder and president of Computer Motion, confirmed that "the NASA funding which we have received through the SBIR program has been highly beneficial to our rapid progress in the development of unique robotic systems."

At midyear 1994, nine other hospitals — in addition to the UCSD Medical Center — had initiated surgical procedures with AESOP and Computer Motion had received Food and Drug Administration approval to begin marketing the system to hospitals nationwide.



This photo illustrates the operation of the AESOP robot (foreground) as a surgeon's "third arm" in minimally-invasive surgery. AESOP is holding a tube with a tiny camera at its end in an incision; using a foot controller, surgeon Dr. Jonathan Sackler, director of clinical studies for AESOP, moves the tube and camera for changing views of the operating site. Below is a closeup of the AESOP system, including the robotic arm, a foot controller (left), a hand controller and the control computer.

