ABSTRACT

Robotic surgery make use of Robots to perform surgery. Major potential advantages of robotic surgery are precision and miniaturization. With our skilled surgeons and the robotic system, we can now use minimally invasive techniques in even the most complicated procedures like Cardiac surgery, Gastrointestinal surgery, Gynecology, Neurosurgery, Orthopedics, Pediatrics, Urology etc.

The software is "command central" for the device's operation, da Vinci, Aesop, Hermes etc. are different kinds of the Robotic systems. The combination of increased view and tireless dexterity is helping us to overcome some of the limitations of other types of less invasive surgery.

1. INTRODUCTION

Robotic surgery is the use of robots in performing surgery. Major potential advantages of robotic surgery are precision and miniaturization. Further advantages are articulation beyond normal manipulation and three-dimensional magnification. At present, surgical robots are not autonomous, but are always under the control of a surgeon. They are used as tools to extend the surgical skills of a trained surgeon.

Robotic surgery is different from minimally invasive surgery. Minimally invasive surgery (sometimes called laparoscopic surgery) is a general term for procedures that reduce trauma by performing operations through small ports rather than large incisions. Minimally invasive surgery is now commonplace for certain procedures. But until now, we haven't been able to use minimally invasive techniques for more complex operations. With our skilled surgeons and the robotic system, we can now use minimally invasive techniques in even the most complicated procedures like Cardiac surgery, Gastrointestinal surgery, Gynecology, Neurosurgery, Orthopedics, Pediatrics, Urology etc.

2. HISTORY

In 1985 a robot, the PUMA 560, was used to place a needle for a hip replacement. Intuitive Surgical System introduce the da Vinci Robot in 1995 and Computer Motion, AESOP and the ZEUS robotic surgical system. In 1988, the PROBOT was used to perform prostatic surgery in England. The ROBODOC from Integrated Surgical Systems was introduced in 1992, and is a robot to mill out precise fittings in the surgery. In 2001, Marescaux used the Zeus robot to perform a surgery.

3. DIFFERENT TYPES OF ROBOTIC SYSTEMS

Computer Motion of Santa Barbara California has become the leading producer of medical robotics. Different types of robots are da Vinci, Aesop, Hermes, and Zeus.

The da Vinci Surgical System was the first operative surgical robot. Products like Aesop, Hermes, and Zeus are the next generation of surgical equipment and are used together to create a highly networked and efficient operating room.

3.1. da Vinci Surgical System

Incorporating the latest advancements in robotics and computer technology, the da Vinci Surgical System was the first operative surgical robot deemed safe and effective by the United States Food and Drug Administration for actually performing surgery.

The da Vinci system was developed by Intuitive Surgical system, which was established in 1995. Its founders used robotic surgery technology that had been developed at SRI International, previously known as Stanford Research Institute. The FDA approved da Vinci in May 2001.

The da Vinci is a surgical robot enabling surgeons to perform complex surgeries in a minimally invasive way, in a manner never before experienced to enhance healing and promote well-being. It is used in over 300 hospitals in the America and Europe. The da Vinci was used in at least 16,000 procedures in 2004 and sells for about 1.2 million dollars. Until very recently surgeons options included traditional surgery with a large open incision or laparoscopy, which uses small incisions but is typically limited to very simple procedures. The da Vinci Surgical System provides surgeons with an alternative to both traditional open surgery and conventional laparoscopy, putting a
surgeon's hands at the controls of a state-of-the-art robotic platform. The da Vinci System enables surgeons to perform even the most complex and delicate procedures through very small incisions with unmatched precision. It is important to know that surgery with da Vinci does not place a robot at the controls; surgeons control every aspect of the surgery with the assistance of the da Vinci robotic platform. Thus da Vinci is changing the experience of surgery for the surgeon, the hospital and most importantly for the patient.

3.2. Aesop

Aesop's function is quite simple merely to maneuver a tiny video camera inside the patient according to voice controls provided by the surgeon. By doing so, Aesop has eliminated the need for a member of the surgical team to hold the endoscope in order for a surgeon to view his operative field in a closed chest procedure. This advance marked a major development in closed chest or port-access bypass techniques, as surgeons could now directly and precisely control their operative field of view. Today about 1/3 of all minimally invasive procedures use Aesop to control an endoscope. Considering each Aesop machine can handle 240 cases a year, only 17,000 machines are needed to handle all minimally invasive procedures, a relatively small number considering the benefits of this technology.

3.3. Zeus

Zeus is the youngest and most technically advanced robotic aid. Zeus contains robotic arms that mimic conventional surgical equipment and a viewing monitor that gives the surgeon a view of his operative field. More importantly, Zeus enables a surgeon to operate on a patient using joystick-like handles which translate the surgeon's hand movements into precise micro-movements inside the patient. For example a 1-cm movement by a surgeon's hand is translated into a .1 cm movement of the surgical tip held by a robotic arm. Zeus also has the unique capability of reducing human hand tremor and greatly increasing the dexterity of the surgeon. Zeus allows surgeons to go beyond the limits of MIS enabling a new class of delicate procedures currently impossible to perform. The main disadvantage is high machine cost. It is around 1 million dollars. Its FDA approval is pending.

3.4. Hermes

Unlike Aesop and Zeus, Hermes does not use robot arms to make the Operating Room more efficient. Rather Hermes is platform designed to network the OR, integrating surgical devices, which can be controlled by simple voice commands. Many pieces of surgical equipment are outside the range of sterility for the surgeon and must be manipulated by a surgical staff while Hermes enables all needed equipment to be directly under the surgeon's control. Hermes can integrate tables, lights, video cameras and surgical equipment decreasing the time and cost of surgery. Ultimately Hermes decreases the need for a large surgical staff and facilitates the establishment of a networked, highly organized OR. Ultimately Computer Motion is working to bring Hermes into 84,000 operating rooms worldwide.

4. WORKING OF ROBOTIC SYSTEM

Today's robotics devices typically have a computer software component that controls the movement of mechanical parts of the device as it acts on something in its environment. The software is "command central" for the device's operation. Surgeon sits in the console of the surgical system several feet from the patient. He looks through the vision system - like a pair of binoculars - and gets a huge, 3-D view of inside the patient's body and area of the operation. The surgeon, while watching through the vision system, moves the handles on the console in the directions he wants to move the surgical instruments. The handles make it easier for the surgeon to make precise movements and operate for long periods of time without getting tired. The robotic system translates and transmits these precise hand and wrist movements to tiny instruments that have been inserted into the patient through small access incisions. This combination of increased view and tireless dexterity is helping us overcome some of the limitations of other types of less invasive surgery. It's also allowing us to finally use minimally invasive surgery for more complex operations.
The working of da Vinci is explained as follows. There are four main components to da Vinci: the surgeon console, patient-side cart, Endo Wrist Instruments, and Insite Vision System with high resolution 3D Endoscope and Image Processing Equipment.

### 4.1. Surgeon Console
The surgeon is situated at this console several feet away from the patient operating table. The surgeon has his head tilted forward and his hands inside the system's master interface. The surgeon sits viewing a magnified three-dimensional image of the surgical field with a real-time progression of the instruments as he operates. The instrument controls enable the surgeon to move within a one cubic foot area of workspace.

### 4.2. Patient-side Cart
This component of the system contains the robotic arms that directly contact the patient. It consists of two or three instrument arms and one endoscope arm. As of 2003, Intuitive launched a fourth arm, costing $175,000, as a part of a new system installation or as an upgrade to an existing unit. It provides the advantages of being able to manipulate another instrument for complex procedures and removes the need for one operating room nurse.

### 4.3. Detachable Instruments
The Endowrist detachable instruments allow the robotic arms to maneuver in ways that simulate fine human movements. Each instrument has its own function from suturing to clamping, and is switched from one to the other using quick-release levers on each robotic arm. The device memorizes the position of the robotic arm before the instrument is replaced so that the second one can be reset to the exact same position as the first. The instruments' abilities to rotate in full circles provide an advantage over non-robotic arms. The seven degrees of freedom (meaning the number of independent movements the robot can perform) offers considerable choice in rotation and pivoting. Moreover, the surgeon is also able to control the amount of force applied, which varies from a fraction of an ounce to several pounds. The Intuitive Masters technology also has the ability to filter out hand tremors and scale movements. As a result, the surgeon's large hand movements can be translated into smaller ones by the robotic device. Carbon dioxide is usually pumped into the body cavity to make more room for the robotic arms to maneuver.

### 4.4. 3-D Vision System
The camera unit or endoscope arm provides enhanced three-dimensional images. This high-resolution real-time magnification showing the inside of the patient allows the surgeon to have a considerable advantage over regular surgery. The system provides over a thousand frames of the instrument position per second and filters each image through a video processor that eliminates background noise. The endoscope is programmed to regulate the temperature of the endoscope tip automatically to prevent fogging during the operation. Unlike The Navigator Control, it also enables the surgeon to quickly switch views through the use of a simple foot pedal.

### 5. ADVANTAGES
Robotic surgery offers many benefits over traditional surgery. The Robotic Surgical System is great for patients and for surgeons. Robotic surgery gives us even greater vision, dexterity and precision than possible with standard minimally invasive surgery, so we can now use minimally invasive techniques for a wider range.
The patient side benefits include,

- Reduced pain and trauma
- Fewer complications
- Less blood loss and need for transfusions
- Less post-operative pain and discomfort
- Less risk of infection
- Shorter hospital stay
- Faster recovery and return to work
- Less scarring and improved appearance

6. LIMITATIONS

- Current equipment is expensive to obtain, maintain, and operate.
- Surgeons and staff need special training.
- Data collection of procedures and their outcomes remains limited.

7. CONCLUSION

Robotic surgery is an emerging technology in the medical field. It gives us even greater vision, dexterity and precision than possible with standard minimally invasive surgery, so we can now use minimally invasive techniques for a wider range of procedures. But it's main drawback is high cost. Besides the cost, Robotic System still has many obstacles that it must overcome before it can be fully integrated into the existing healthcare system. More improvements in size, tactile sensation, cost, and are expected for the future.

8. REFERENCE

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