

# Da Vinci Surgical System

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In the past several years the use of robotics in surgery has changed many traditional surgical procedures. Using robotics to perform surgery, surgeons are able to minimize complications of traditional surgery. With the introduction of robotics, surgery can be performed through the smallest of incisions. This can reduce the time needed for recovery and also reduce the pain of recovery. One of the first surgical robots approved by the FDA for digital surgery is the da Vinci surgical system, with already over 210 devices in use throughout the United States, Europe, and Japan. The FDA approved Da Vinci surgical system in July of 2000 to perform surgical techniques such as cutting and suturing and this was the first surgical robot system to be cleared by the FDA.



Digital surgery had to overcome many obstacles in order to be approved by the FDA. The da Vinci surgical system reduced the average 2-3% infection to nearly zero. There are four main components to the da Vinci surgical system, the surgeon console, patient-side cart, endo wrist instruments, and insite vision system with high resolution 3D endoscope and image processing equipment. The da Vinci surgical system costs one million dollars. 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. 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. The feedback as of today is limited to sensing tool-on-tool collision, so the surgeon needs to rely almost solely on the visual field when suturing or contacting soft tissue. 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.

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.

The da Vinci Surgical System reduces hospital stays by about half, reducing hospital cost by about 33%. These fewer days in the intensive care unit are a result of less pain and quicker recovery. Though the size of the device is still not small enough for heart procedures in children, the minimally invasive nature of da Vinci does not leave a large surgical scar and still has some limited applications in children for the time being. Moreover, according to Intuitive Surgical, only 80,000 out of 230,000 new cases of prostate cancer undergo surgery because of the high risk invasive surgery carries, implying that more people may undergo surgery with this evolving technology. The main drawbacks to this technology are the steep learning curve and high cost of the device. Though Intuitive Surgical does provide a training program, it took surgeons about 12-18 patients before they felt comfortable performing the procedure.

### References:

- [http://biomed.brown.edu/Courses/BI108/BI108\\_2005\\_Groups/04/davinci.html](http://biomed.brown.edu/Courses/BI108/BI108_2005_Groups/04/davinci.html)
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