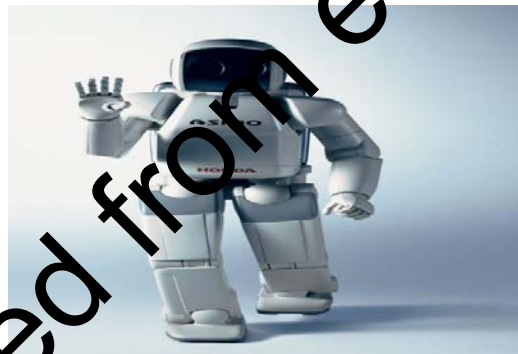


HEART SURGERY BY ROBOT “A NEW KID ON THE BLOCK”

Dr. A. Sumithra M.Tech., Ph.D.
Ms.M.Salome Helen Dharini, Ms.S.Gayathri
B.Tech.Information Technology (Final Year)
Department of Information Technology
Velammal College of Engineering and Technology
Madurai, India

ABSTRACT: Nobody can deny the fact that Robots play a vital role in the life of human beings. Robots play many roles in the medical field also. Robotics is nothing but the brain on a chip. Robots can be defined as follows: "An automatic device that performs functions normally ascribed to humans or a machine in the form of a human." Robots can do surgery in the absence of surgeons through voice activation and remote control. It performs surgery through very small incisions, greatly reducing the risk to patients. It also reduces complexity while handling the patients. This paper analyses the part of Robots in the area of heart surgery and brings the “NEW KID ON THE BLOCK TO LIGHT”.

I. INTRODUCTION



"An automatic device that performs functions normally ascribed to humans or a machine in the form of a human."

A robot is a virtual or mechanical artificial agent. In practice, it is usually an electro-mechanical system which, by its appearance or movements, conveys a sense that it has intent or agency of its own. The word robot can refer to both physical robots and virtual software agents, but the latter are usually referred to as bots. There is no consensus on which machines qualify as robots, but there is general agreement among experts and the public that robots tend to do some or all of the following: move around, operate a mechanical limb, sense and manipulate their environment, and exhibit intelligent behavior especially behavior which mimics humans or other animals

The first digitally operated and programmable robot, the Unimate, was installed in 1961 to lift hot pieces of metal from a die casting machine and stack them. Today, commercial and industrial robots are in widespread use performing jobs more cheaply or with greater accuracy and reliability than humans. They are also employed for jobs which are too dirty, dangerous or dull to be suitable for humans. Robots are widely used in manufacturing, assembly and packing, transport, earth and space exploration, surgery, weaponry, laboratory research, and mass production of consumer and industrial goods.

CHARACTERISTICS OF ROBOT:

1. It is artificially created.
2. It can sense its environment, and manipulate or interact with things in it.
3. It has some ability to make choices based on the environment, often using automatic control or a preprogrammed sequence.
4. It is programmable.
5. It moves with one or more axes of rotation or translation.
6. It makes dexterous coordinated movements.
7. It moves without direct human intervention.
8. It appears to have intent or agency

BENEFITS OF ROBOTS:

Robots offer specific benefits to workers, industries and countries. If introduced correctly, industrial robots can improve the quality of life by freeing workers from dirty, boring, dangerous and heavy labor. It is true that robots can cause unemployment by replacing human workers but robots also create jobs: robot technicians, salesmen, engineers, programmers and supervisors. The benefits of robots to industry include improved management control and productivity and consistently high quality products. Industrial robots can work tirelessly night and day on an assembly line without an loss in performance.

Consequently, they can greatly reduce the costs of manufactured goods. As a result of these industrial benefits, countries that effectively use robots in their industries will have an economic advantage on world market.

SURGERY:

This paper deals with only about Heart Surgery.

ROBOT-ASSISTED HEART SURGERY – AN INTRODUCTION:

Minimally invasive robot-assisted heart surgery (cardiac surgery) is a procedure that allows heart surgery to be performed through tiny incisions in the patients chest. Traditional open surgery requires that surgeons make incisions large enough to expose and provide access to the area that is being operated on. In minimally invasive surgery, in contrast, the instruments used for the surgery are inserted through incisions no larger than a dime (18mm or .7 inch), reducing the opportunity for bacterial infection, decreasing post-operative pain, and allowing for faster recovery.



LIMITATIONS OF ORDINARY SURGERY:

Invasive surgery is performed with the surgeon directly manipulating the surgical instruments. Range of motion at the operation site is limited. At the same time, the endoscope, a small flexible tube with a lighted optical system that is inserted through the tiny incision to view the surgery site, provides only a 2-dimensional image, and surgeons must learn to visualize the procedure by looking at a screen. All of the surgeon movements are counterintuitive as though he or she were operating while looking in a mirror. This way of operating is fine for procedures such as knee repair or gallbladder removal that do not call for the complex microsurgical movements needed for heart surgery. The instruments that are used for minimally invasive heart surgery are also longer than

instruments used for other types of surgery; therefore, the effect of hand tremors is magnified, making delicate manipulations difficult.

ADVANTAGES OF ROBOTS IN SURGERY:

To overcome these limitations with minimally invasive surgery, medical robots were developed.

1. In robot-assisted surgery, instead of directly moving the instruments the surgeon uses a computer console to manipulate the instruments attached to multiple robot arms.
2. The computer translates the surgeon movements, which are then carried out on the patient by the robot.
3. The console is located in the same operating room as the patient, but is physically separated from the operative workspace.
4. The surgeon does not need to be in the immediate location of the patient while the operation is being performed, it can be possible for specialists to perform remote surgery on patients from many miles away.
5. Robots can perform heart surgery without a human surgeon
6. In robot-assisted surgery, robots do not actually replace the surgeon, but rather enhance their ability to perform delicate, precise microsurgical movements.
7. The controls to operate the robots are provided by a human through voice activation and remote control;
8. In the United States, each robotic surgical system must receive approval from the FDA (Food and Drug Administration) for each surgical procedure during which a surgeon plans to use it.
9. For example, clearance for use in gallbladder surgery does not allow a surgeon to use the same robotic system to, say, remove a tumor.

Commercially available robotic surgical systems have similar setups which include a control console with joystick-like hand controls and a 3-D viewer, at which the surgeon sits, and table-mounted robotic arms. One of the robotic arms holds the endoscope and the other two or three arms carry the surgical instruments. Heart Surgery Types Performed with robotic surgical systems.

It is estimated that 70 to 90 hospitals in the United States now use minimally invasive surgical robots for heart surgery, and this number is expected to double by mid-2006.

THREE SURGERY TYPES

1. Atrial septal defect repair the repair of a hole between the two upper chambers of the heart,
2. Mitral valve repair the repair of the valve that prevents blood from regurgitating back into the upper heart chambers during contractions of the heart,
3. Coronary artery bypass re-routing of blood supply by bypassing blocked arteries that provide blood to the heart.
4. As surgeons experience and robotic technology develop, it is expected that robot-assisted procedures will be applied to additional types of heart surgery.

DA VINCI SURGICAL SYSTEM



During robotic heart surgery, surgeons use a computer-enhanced tool called the da Vinci Surgical System to perform complicated procedures through small incisions.

FEATURES:

Prostatectomies, cardiac valve repair and gynecologic surgical procedures

1.It has four robotic arms, three of them are for tools that hold objects, act as a scalpel, scissors, bovie, or unipolar or dipolar electrocautery instruments.

2.The fourth arm is for a camera with two lenses that gives the surgeon full stereoscopic vision from the console.

3.The surgeon sits comfortably and looks through two eye holes at a 3-D image of the procedure, meanwhile maneuvering the arms with two foot pedals and two hand controllers.



The "Da Vinci surgical system" is minimally invasive, meaning the incisions used for surgery are very small. The arms also take away the tension and stress inflicted upon the incisions in laparoscopic surgery. The patient is therefore more apt to recover quickly and leave the hospital, reducing the average cost of keeping a patient in the hospital (after having surgery with the Da Vinci) by 33%. The Da Vinci allows the surgeon to be more precise in his surgery, and operate with significantly less shake than in a normal unassisted procedure. The surgeon can operate around delicate blood vessels and operate on some of the surgically difficult tumors that could not be removed before. The visualization of the Da Vinci has many advantages, giving the surgeon control of the camera and giving the surgeon a 3-D image upon which to operate on. The Da Vinci even stimulates pressure to the surgeon's controllers when he presses against something with one of his instruments. The Da Vinci elicits positive publicity towards the hospital where it's stationed; oftentimes effecting a patient's decision over the hospital they go to for medical care in general.



ADVANTAGES:

1. The incisions are very small and, consequently, patient recovery is quick
2. Reduces the number of staff needed during surgery, nursing care required after surgery, and, therefore, the overall cost of hospital stays.
3. Compared with other minimally invasive surgery approaches, robot-assisted surgery gives the surgeon better control over the surgical instruments and a better view of the surgical site.
4. The surgical robot can continuously be used by rotating surgery teams

THE POTENTIAL BENEFITS OF THE DA VINCI PROSTATECTOMY ARE:

Effective Cancer Control

Improved and Early Return of Sexual Function

Improved and Early Return of Continence

Improved Results Over Traditional Treatments

Minimally Invasive Surgery:

Outcome	da Vinci [®]	Open	Lap
Cancer control			
T2 margin status	2.5 ¹	5.9 ²	7.7 ³
Complications			
Estimated blood loss (EBL)	109 ml ⁴	1355 ml ⁵	380 ml ⁶
Length of stay (LOS)	1.2 days ⁴	3 days ⁵	2.5 days ¹³
Major	1.7% ⁴	6.7% ⁵	3.7% ⁶
Minor	3.7% ⁴	12.6% ⁵	11.6% ⁶
Urinary function			
3 month	92.9% ⁷	57% ⁸	62% ⁹
6 month	94.9% ⁷	69% ⁸	77% ⁹
12 month	97.1% ⁷	73% ⁸	83% ⁹
Sexual function			
12 month	86% ¹⁰	71% ¹¹	76% ¹²

DA VINCI VS. OPEN SURGERY & LAPAROSCOPY

The following table looks at patient outcomes following surgery for prostate cancer (radical prostatectomy), and compares "best in class" data from three types of surgery. As you can see, da Vinci Prostatectomy (dVP) shows measurable advantages as compared to both conventional open surgery (open), performed through large incisions, as well as conventional minimally invasive laparoscopic (lap) surgery.

IMPLEMENTATION:

The Da Vinci system is implemented in foreign countries. In India it is implemented in only few places due to the cost effect. Future implementation is done to make this system more effective and research is still carried on to make this system implemented in all the countries.

CONCLUSION

Robotics is an absolutely fascinating field that interests most people. A robot can go where humans cannot. In fact, robots were created to help humans, especially in high risk or dangerous situations. Robots are filling an increasingly important role of enhancing patient safety in the hurried pace of clinics and hospitals where attention to details and where reliability are essential. In recent years, robots are moving closer to patient care, compared with their previous role as providing services in the infrastructure of medicine. The most surprising use of robots, perhaps, is their application in the actual performance of laparoscopic surgical procedures. the physical stress to perform surgical operations is reduced, so surgical robots are appreciated by surgeons who work more safely and proficiently!

In future ordinary surgery will be replaced by Robotic surgery which enhances the effectiveness of the SURGERY

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