



ROBOTIC SURGERY: A NEW HOPE IN MEDICAL SCIENCE

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ABSTRACT

Robots in the field of surgery have dramatically changed the procedures for the better. The most significant advantage to Robotic Surgery to the patient is the decrease in pain and scaring. By using cameras and enhanced visual effects, doctors can make the tiniest of incisions. In order for these arms to get inside the body and operate, they only need a few centimetres for an incision robotic technology is set to revolutionize surgery by improving and expanding laparoscopic procedures, advancing surgical technology, and bringing surgery into the digital age. Furthermore, it has the potential to expand surgical treatment modalities beyond the limits of human ability. Robots are amazing; they function like no human with only electricity and software. However, robots in surgery operate on a whole other level. These machines can run non-stop for however long it takes to complete the surgery whether it is succeeds or fails.

KEY WORDS: Dexterity, Geometry, MIS

INTRODUCTION

Robots are amazing; they function like no human with only electricity and software. However, robots in surgery operate on a whole other level. These machines can run non-stop for however long it takes to complete the surgery whether it is succeeds or fails. Robotic surgeons will perform heart surgery in 50 Minutes with the help of robotic machine. These robots are not “squeamish”. They cannot be infected with AIDS or other diseases and are resistant to radiation. In addition, these robots have great geometric accuracy and can use diverse sensors (chemical, force, acoustic, etc.) in surgery. These “surgeons” can also be designed for a large range of scales and are sterilized rather easily. Alongside their strengths are their weaknesses, both internal and external their shortcomings consist mostly in areas of simple human characteristics. While amazing surgeons, robots would go now here if they had to think and analyze for themselves, at least not with current technology. The robotic surgeons have terrible judgment, limited dexterity and hand-eye coordination. Robots are not people though, so they are weak in these areas and humans must improve them in the future for the sake of robotic surgery and saving people’s lives. In addition to these limitations, their technology, if very sophisticated, is limited to only one type of surgery for a given robotic surgeon. This means that a hospital would have to invest in many robots to cover all their surgery. Also, technology is in a state of flux. In other words, it is evolving and can be unstable at times. These robots can perform heart surgery, but cannot complete relatively simple procedures like mending bones. Robotic surgeons are amazing advantages to have in the medical field. However, they are still in their infancy and are far from ready to replace humans. Human strengths and limitations. Finally, human surgeons are easy to instruct and debrief, that is, if they are patient. As for the weaknesses of human surgeons, they are such as to make a grave difference. For example, humans are prone to fatigue and tremor, which can cause major problems if a surgeon’s hand jerks suddenly. As well, our hands are not developed enough to make such fine and subtle movements

inside a patient’s body and they have limited dexterity outside of the natural scale. Humans do not have the fine geometric systems internally that robots do. Consequently, they have limited geometric accuracy. Finally, human surgeons are extremely susceptible to infection and radiation.¹⁻⁴

Benefits to the patient: The revolution of robotic surgery has brought many benefits to patients undergoing surgery. These are classified into two main areas, namely “minimally invasive” and “Health”⁵⁻⁷

In the area of “Minimally invasive”:

- 1) Improved cosmetic outcome (reduced intervention areas, less scaring, etc)
- 2) Fewer complications such as less blood loss, less pain, etc.

In the area of “Health”:

- 1) Shorter hospital stays
- 2) Less patient morbidity
- 3) Shorter convalescence for patients (after the hospital)

Strengths And Limitation Of Human And Robot

Human Strengths:

- Strong hand-eye coordination.
- Dexterous.
- Flexible and adaptable.
- Can integrate extensive and diverse information.
- Able to use qualitative information
- Good judgement.
- Easy to instruct and debrief

Human limitation:

- Limited dexterity outside natural scale.
- Prone to tremor and fatigue.
- Limited geometric accuracy.
- Limited ability to use quantitative information.
- Large operating room space requirement.
- Limited sterility.
- Susceptible to radiation and infection.

Robot Strength:

- Good geometric accuracy.
- Stable and untiring.
- Can be designed for a wide range of scales.

- May be sterilised.
- Resistance to radiation and infection.
- Can use diverse sensors (Chemical Force) in control.

Robot Limitation:

- Poor judgement.
- Limited dexterity and hand-eye co-ordination.
- Limited to relatively simple procedures.⁸⁻¹⁰

Categories Of Robotic Surgery: Robotic surgery can be further divided into three subcategories depending on the degree of surgeon interaction during the procedure:

Supervisory-Controlled: Supervisory-controlled: The procedure is executed solely by the robot, which will act according to the computer program that the surgeon inputs into it prior to the procedure. The surgeon is still indispensable in planning the procedure and overseeing the operation, but does not partake directly. Because the robot performs the entire procedure, it must be individually programmed for the surgery, making it extremely expensive to gather several images and data for one patient.

Telesurgical: A telesurgical system, also known as remote surgery, requires the surgeon to manipulate the robotic arms during the procedure rather than allowing the robotic arms to work from a predetermined program. Using real-time image feedback, the surgeon is able to operate from a remote location using sensor data from the robot. Because the robot is still technically performing the procedure, it is considered a subgroup of robotic surgery.

Shared-Control System: Shared-control system: This system has the most surgeon involvement. The surgeon carries out the procedure with the use of a robot that offers steady-hand manipulations of the instrument. This enables both entities to jointly perform the tasks.¹¹⁻¹²

Computer-Assisted Surgery & Robotics: Through computer-assisted surgery, surgeon obtains 3-D visualization allowing greater visibility, corrective alignment and balance of the implant joint. Joint replacement surgery with the aid of a Navigation System helps improve the results of your procedure. The System empowers surgeons to accurately fit new implant components specifically to the anatomy of the body, potentially giving you:

- More exact implant placement
- Extended life of the implant
- Optimal joint positioning which restores mobility
- Decreased possibility of a revision surgery
- Faster recovery
- Improvement in your quality of life

Advanced computer-assisted surgical solutions that greatly enhance the precision and accuracy of hip and knee replacement surgeries. Think of a Navigational System as an assistant to surgery, providing surgeon extra support and guidance. The System helps surgeon more precisely align knee implant with computer imaging. Most importantly, with a navigational system your surgeon is able to better optimize the implant's alignment according to the structure of body. Computer-Assisted Surgery also facilitates Minimally Invasive Surgery (MIS) because it acts as an extension of the surgeon's eyes and hands. It helps surgeons operate more effectively through a smaller incision.

Advantages

- A significant decrease in the blood loss & other potential complications which is usually encountered in surgery.

- Reducing the operative time which relieved the patient of all the risks accompanying prolonged stay under anaesthesia.
- A relatively reduced post-operative hospitalization stay.
- Ability of the patient to resume his normal life in a period of only 24 to 48 hours after undergoing Robotic Surgery.
- Much better surgical efficacy which decreased the probability of surgical complications.
- Much lower risks of infection and healthier surgical outcomes.
- Ability to perform complicated surgeries with ease and with better results.
- More confidence & comfort to the surgeon in his surgical practice.
- Addition of more surgical operations that were not considered doable with older surgical techniques.

DISADVANTAGES

- Robotic surgery is a new technology and its uses and efficacy have not yet been well established.
- It is costly and affordability would be limited.
- The size of the systems has relatively large footprints and relatively cumbersome robotic arms. Use in smaller patients will be difficult.
- The size could also alter the direct access to the patient during surgery¹³

Medical Application: Robotic surgery can accomplish what doctors cannot because of precision and repeatability of robotic systems. Besides, robots are able to operate in a contained space inside.

- Robots especially suitable for non-invasive or minimally invasive surgery.
- Robots have been demonstrated or routinely used for heart, brain, spinal cord, throat, and knee surgeries
- Robotic surgery improves consistency and quality; it is becoming more and more popular.
- Robotic diagnosis reduces invasiveness to the human body and improves the accuracy and scope of the diagnosis. One example is the robotic capsular endoscope that has been developed for non-invasive diagnosis of gastrointestinal tract.
- Robotics is for providing artificial components to recover physical functions of human beings such as robotic prosthetic legs, arms and hands.
- Robotic devices and systems can also help elderly people move around; this includes intelligent wheeled chairs, walking-assistance machines, and limb-empowering robotic devices. For example, a new type of powered walker. It is capable of sensing pressure from both the left and right arms.
- Robotic capsular endoscope for examination of gastrointestinal tract.¹⁴

CONCLUSION

Robotic systems will replace conventional laparoscopic instruments in less technically demanding procedures. In any case, robotic technology is set to revolutionize surgery by improving and expanding laparoscopic procedures, advancing surgical technology, and bringing surgery into the digital age. Furthermore, it has the potential to expand surgical treatment modalities beyond the limits of human ability. Whether or not the benefit of its usage overcomes the cost to implement it remains to be seen and much remains to

be worked out. New technologies, such as virtual reality, haptics, and telementoring, can powerfully ally with surgical robots to create a new medium for acquisition and assessment of surgical skills through simulation of all operations that can be done via the robot.

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