Robotic Surgery

Phong Thanh Nguyen, M. Lorate Shiny, K. Shankar, Wahidah Hashim, Andino Maseleno

Abstract*: There has been exponential development in procedures and publications based on robot-assisted concerning automated helped laparoscopic medical procedure in last decade. From many available reviews it has been seen that in many fields of surgery this technology allow to produce a safe and efficient method. This is a costly process. In gynecology the randomized controlled trials are missing, but the accessible proof proposes that in the field of gynecology the robotic surgery can decrease dismalness as it performs in high-volume centers it can be cost effective. It is necessary to provide training for safe and effective evolution in robotic surgery programs.

***Keywords* : Gynaecology, laparoscopy, robotics, robotic surgery,training.**

I. INTRODUCTION

It can see that over the last few years the robots can appear in operation room [1]. There any many fields in which the robotic technology is used regularly like in brain surgery guide instruments about tumors and it endoscopes in minimally invasive surgery. In robotic surgery initially the hip replacement surgery to shape the bone is the base of this technology [2, 3, 4]. Within the femur the surgeon plans the prosthetic replacement joint location that is based on three-dimensional (3-D) computed tomography images. In the pre surgical plan to form the precise shape in surgery robot moves a high-speed cutting tool. The resulting outcome is far batter that it will get from conventional hand-held cutting tools [5].

In the hospital, the appearance of robotic tools has been seen 20 years before [6]. In 1985 initially the a robot assisted surgical procedure is occurred, in a delicate neurosurgical biopsy that was non-laparoscopic surgery it used PUMA 560 robotic surgical arm [7].

As see the growth in robotic surgery it can see that now robots have artificial intelligence. Some robots like Honda's ASIMO will look like human. It is seen in figure 1. This type of robot can do the work that a human can do and they are self conscious and self aware. When it is consider about the human work doing by the robot then often it denote about future, but the robotic surgery is already is the part [8].

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It has been nearly 20 years since the first appearance of robotic instruments in the operating room of the hospital [6]. The first documented use of a robot assisted surgical procedure occurred in 1985 when the PUMA 560 robotic surgical arm was used in a delicate neurosurgical biopsy, a non-laparoscopic surgery [7].

Figure 1: Honda's ASIMO

To define the benefits of a robotic surgery it is necessary to first take a look about characteristics of machine and human. Based on distinct capabilities of robot there developed many application in recent years. The main difference between human and machine is accuracy and precision, and the ability to take the copious, quantitative, detailed information. By using computer, intrasurgical sensors and 3-D imaging data the robots can guide the instruments about the pathological structures inner side of the body.

Human can sense the touch, they have hand-eye coordination and unexcelled dexterity in this manner they can be superior [5].

Some strength of humans and robots are as follows:

Table 1: strength of humans and robots

Humans	Robots
Strong hand-eye coordination	Good geometric accuracy
Dexterous (at human scale)	Stable and untiring
Flexible and adaptable	Can be designed for a wide range of scales
Can integrate extensive and diverse information	Can be designed for a wide range of scales
Able to use qualitative information	May be sterilized
Good judgment	Resistant to radiation and infection
Easy to instruct and debrief	Can use diverse sensors chemical, force, acoustic, etc. in control

Limitations of humans and robots are shown in table given below:

Table 2: Limitations of humans and robots

Humans	Robots
Limited dexterity outside natural scale	Poor judgment
Prone to tremor and fatigue	Limited dexterity and hand-eye coordination
Limited geometric accuracy	Limited to relatively simple procedures
Limited ability to use quantitative information	Expensive
Large operating room space requirement	Technology in flux
Limited sterility	Difficult to construct and debug
Susceptible to radiation and infection	

II. HISTORY

At National Aeronautics and Space Centre (NASA) in early 1980's the concept of robotic surgery was first introduced. The surgical and virtual reality robots were developed with Stanford Research Institute. The concept of telepresence surgery was proposed. In 1990's robotic surgery was commercialized. Complete development of robotic surgery was the next step. In late 1990's the da Vinci robotic system and Zeus robotic system were presented. In both robotic systems the surgical workstation controlled from remote manipulators. There has been a wide development in less than 20 years time. The Computer Motion was used for Intuitive Surgery in 2003. Currently the commercially available telerobotic system is the da Vinci system. In 2000 for general surgery the da Vinci system was approved [1].

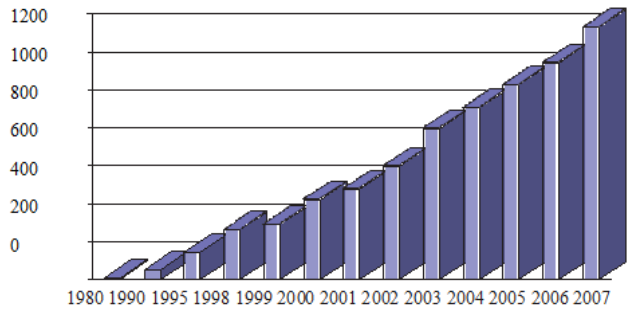

Figure 2: in www.embase.com. Publications graph about robotics

III. OVERVIEW OF ROBOTIC SURGERY

The surgery that can perform using instruments that are attached to arm of that robot is known as the robotic surgery. The robotic arm controlled with a computer by doctors who are using robots for surgery. The robots that are used in medical field have to concern about measurement of safety, software, hardware and kinematics because they have to complete the task in contact of the patients and they have to deal with medical staff. Some task like:

1. The functionalities uses should be application-specific
2. in unstructured environments accomplish non-repetitive work
3. they should be MRI-compatible and sterilizable [10]

IV. OPERATION MODES

Basically there are three operation modes of robots operations are:

1. Autonomous mode

In this mode on the basis of predefined instructions the robot automatically drives the tools. A complete autonomous robot can, get needed information, can move without manually control and can work without instructions of human.

2. Hands-on mode

In this type of mode the user drive the robot manually. This type of robot behave like the assistance tools which manage critical work when it is difficult to perform through human hand and also provide sensitive information.

3. Tele-operated mode

In this type of mode the robots are controlled with suitable mapping. The operation is performed using three components like Communication system, Master model and Slave model [10].

V. SURGICAL ROBOTS CLASSIFICATION

The system of robotic surgery can divided in three parts:

1. The system that controlled Supervisory
2. The Telesurgical systems
3. The system that Shared the control

1. The system that controlled Supervisory

When performing surgery the supervisory-controlled systems use specific set of instructions. In the first step the surgeon input the data into robots, this input data start the controlled motions and then perform the surgery. In this type of system error cannot occur. If something happen that is not previously defined then surgeon must watch and control the condition [11].

Figure 3: supervisory-controlled robotic system.

2. The Telesurgical systems

To assist a surgeon which is operate the a geographically-separated patient[[12] Telesurgery robotics systems are used. This type of system useful in dangerous or remote environments like space, underserved regions, underserved regions etc. the

place where the medically trained people are not available the automatic surgically related work is very crucial. With the help of the telesurgical systems the remote surgery can possible.

Figure 4: Telesurgical system demonstration

3. The Shared-control systems:

In Shared-control robotic systems most of the work is done by human although this type of system aid surgeons during surgery. In Shared-control robotic systems the instruments are operate by surgeons itself. The robotic system monitor the performance of surgeon and through active constraints it provide support and stability [14].

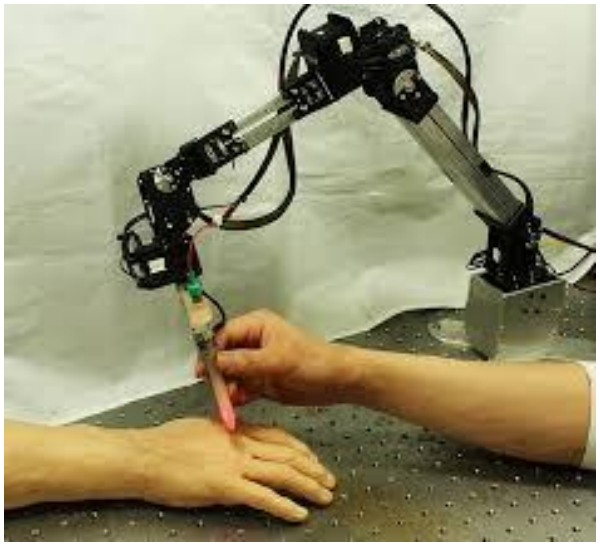

Figure 5: Shared control robotic surgery system demonstration

VI. ROBOTIC SYSTEM

1.AESOP

In 1994 for laparoscopic or endoscopic camera (AESOP 3000) Automatic camera support system was developed and it set a milestone in the area of robotic surgery. On the operating table a mechanical arm mounted and it set the position of laparoscopic camera in AESOP. By hand, voice control or foot pedals the camera can set on particular position [16].

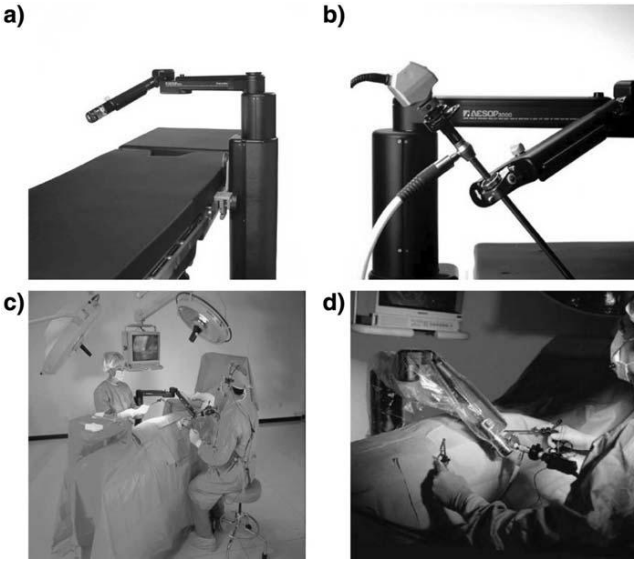

Figure 6: The Automated endoscope system for optimal positioning (AESOP).

2. ZEUS Robotic Surgical System

In 2001 FDA approved the Zeus robotic surgical system. The American Company Computer Motion manufactured this. On the operating table there mounted three robotic arms. To hold the laparoscopic camera (AESOP 3000) one robotic arm is used and it is voice activated robot. Other two robotics system are behaved as the extension of surgeons' arm. At the console the surgeon sits and wears the glasses to create a 3D image [17].

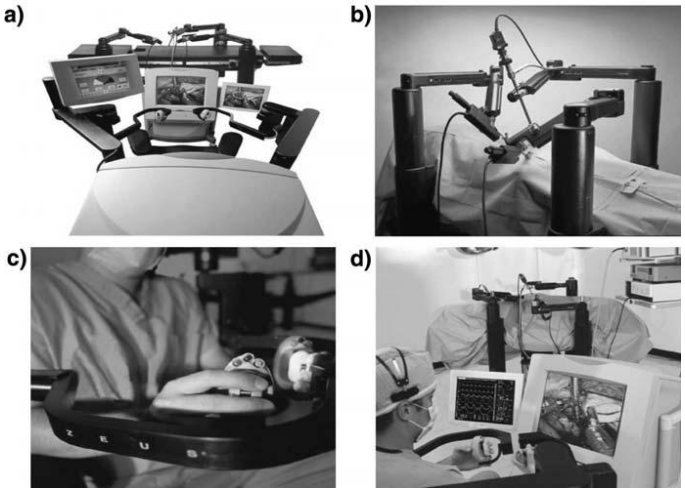

Figure 7: ZEUS robotic systems.

3. DA VINCI robotic system

This type of robotic system is based on the concept of master and slave. The da Vinci Surgical system has three parts:

1. the console of surgeon where by using tele-manipulators the surgeon can sit, view and operate
2. The second component is robotic cart. This cart has 4 arms that mount on wheels that can be moved
3. The third component is named vision cart. It provides binocular vision and 3D image [18].

Figure 8: DA VINCI robotic system demonstration

VII. BENEFITS OF ROBOTIC SURGERY

As compared with open surgery the robotic surgery has many benefits like:

1. Infection risk will reduce
2. Decrease the problem of discomfort and pain
3. Decrease the possibilities of transfusions and blood loss
4. It provide fast recovery
5. Hospitalization period can be short
6. It provide minimal scarring

Advantages

For a surgeon the robotic surgery provide many advantages like:

1. Greater precision
2. Enhanced dexterity
3. Increase visualization [19].

By using robotic surgery a surgeon can perform the crucial surgical operations. The surgical robots are a computer controlled device that is self powered use to manipulation of surgical instruments and programmed to aid in the positioning. In this way the robotic surgery system provide accuracy, better control and flexibility to surgeon [20].

VIII. CONCLUSION

It can see that in the course of the most recent couple of years the robots can show up in operation room. There any numerous fields where the robotic technology is utilized routinely like in cerebrum medical procedure guide instruments about tumors and it endoscopes in negligibly obtrusive medical procedure. In robotic surgery at first the hip substitution medical procedure to shape the bone is the base of this innovation. The subsequent result is far btter that it will get from regular hand-held cutting tools. There has been exponential improvement in techniques and productions dependent on robot-helped concerning computerized helped laparoscopic restorative methodology in a decade ago. From numerous accessible surveys it has been seen that in numerous fields of medical procedure this innovation permit to deliver a protected and proficient strategy. This is an expensive procedure.

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