

Robots in the Medical field

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Introduction

What is a robot? According to the World English Dictionary, a robot is “a mechanical device that can be programmed to carry out instructions and perform complicated tasks usually done by people.”(World English Dictionary).In recent years, there has been a shift from traditional methods in surgery to new methods, the use of robots. Surgical robotics is a new technology that is one of the most talked about subjects in surgery today. It is considered as a new revolution in medicine where there is no doubt that it is slowly becoming a very important surgical tool for all doctors all over the developed and developing world. Still evolving, robots in the medical field are increasing the desire of both patients and doctors to search for the most advanced and effective treatment options for hospitals across the world. This research paper will start by discussing the background of surgical robotics and how it came to be. Then the potential benefits this new technology offers. We will also discuss the legal and ethical issues as well as security concerns and social problems. Finally, we will look into further required research and end with a conclusion.

Background and History

Ever since Czech playwright Caryl Chesson introduced *robota*, meaning forced labor, in his play *Rossum's Universal Robots*, robots have become a more important subject in reality rather than just an idea in a play. The first robot successfully designed for commercial use called “Unimate” was built in 1958 for General Motor’s use in heated machines and welding. Since then the cross over from industrial robots to surgical robots has been a slow process but from the beginning was envisioned to extend the capabilities of human surgeons. The history of robotics began with “Puma 560”. In 1985, this robot was used by Kwok et al to perform neurosurgical biopsies with better precision. In 1988, “Puma 560” was the used to perform a transurethral resection of the

prostate. Eventually, this system led to the development of “PROBOT”. “PROBOT” was a robot designed with a job that specifically performs a transurethral resection of the prostate.

While the “PROBOT” was being designed, another robotic system for hip replacement surgery called the “ROBODOC” was being designed too in Sacramento, CA.

In addition, in the early 90s some scientists of the NASA joined the Stanford Research Institute (SRI) that worked from virtual reality to telemanipulator for hand surgery. As these robots developed, many surgeons joined the team to work on the potential as well as the limitation of these systems. The SRI got noticed by the US Army which then became interested in decreasing wartime deaths as much as possible. With the help of US Army funding, they were able to create the system, and since then it has been tested on animal models but never implemented for actual battlefields purposes. Eventually, the work of several surgeons and engineers on surgical robotics systems for the Army led to the introduction of robotics to the civilian surgical community.

Da Vinci System

The Da Vinci system is a master-slave surgical robot that was the first “intuitive” robot to be approved by the FDA. It has a multiple of arms that are operated from a console with video assisted visualization and computer enhancement (Christian Torres,2011). At first, this system was used for prostate removal, but with more research it evolved into being used for heart valve repairs, hysterectomies, and throat cancer surgeries. A great benefit from the Da Vinci robotic surgery system is it is able to provide superior clinical results when compared to non-robotic surgeries. This system has been successful due to the following reasons: computer 3-D visualization, precise robotic-assisted prostate surgery, comfortable console for the surgeon that reduces fatigue, shorter hospitalization, less blood loss, minimized scarring and reduced pain for patients (Christian Torres,2011).

Potential Benefits

Robotics is revolutionizing the health care industry especially as new innovations are being introduced and are currently being used and benefitting the following areas.

Surgery

Robots are used to help surgeons control movement and to make more targeted incisions — especially useful when working on delicate procedures such as cardiac or neurosurgery. In addition to precision, it helps surgeons with having less invasive surgeries. The 3D visual display and fully articulating instruments are other things that benefit surgeons during surgeries. Robotic surgery has really made the patients' lives much better by making recovery much easier. The advantages from this technology for the patients are: Less pain after surgery, smaller and fewer scars, shortened recovery period and fewer complications.

Education and Administration

From the education perspective, robots are especially useful when training new doctors and teaching surgical methodologies. The Pregnant Robot, for example, can simulate the birth of a child. From an administrative perspective, robots are also affecting the way hospitals are run and the way medications are distributed. Robots benefit by making sure hospital visits are shorter, and the risk of infection minimized.

Diagnosis

Robots can help improved diagnostic capabilities by offering more sophisticated methods of detection with less invasive procedures. For example, the Breast Biopsy Robot can provide 3D diagnostic information via ultrasound and perform an optional biopsy.

Rehabilitation

Robots are often used to help treat patients undergoing physical therapy, including use in prosthetics. Some examples include the Exoskeleton, which can help patients with muscular dystrophy or other neuromuscular diseases to regain some strength; or the DEKA Arm, a prosthetic arm that can be controlled by a patient's thoughts.

Legal and Ethical Issues

It is no secret that robotic surgery has opened many doors for surgical practice, but with new technology comes new training and experience. The conflict of laws explains what happens to the practitioner in case undesirable mishaps happen and how it can legally be followed up in Judicial Courts. It is important to remember that in case of any complications, in addition to physician and hospital, the manufacturer of the robotic system may be sued. This is why in respect to ethical issues equipment safety and reliability, providing correct information, and maintaining confidentiality is very important. In addition to the respect for ethical issues, the high cost of robotic surgery will lead to the lack of such systems in most of the public hospitals. The lacks of systems translate into the restriction of most people from the benefits offered by the new technology. Another worrying subject for some people is the question whether or not robots will completely replace surgeons. Many believe it is a threat to the traditional doctor-patient relationship and an unsafe way to practice medicine.

Security Concerns

Like all new technologies there are security concerns. Usually, all hospitals try the best they can to respect those concerns and take the proper action for all of their patients (Ann Surg, 2004). Some patients worry about whether or not the surgeon are experienced enough to use this new technology. The worry about whether or not they should trust the surgery will be a success in the

hands of a surgeon and a robot in between. Another concern for some people is that all patient personal information is electronically transferred and controlled by a computer, so there is a great concern with “electronic eavesdropping.” The patient’s personal information should be kept confidential (Stanberry B., 2000). This means that a lot of effort is required to keep the personal patient information confidential.

Social Problems

As previously mentioned, safety is a huge concern for both patients and doctors. There is always a possibility for errors to happen especially when robots are programmed by human beings when who in turn are only human and can make mistakes. This makes people not trust robots easily making them believe that they will be harmed instead of getting better. Most of these people are whom who have not heard of robotic surgery before. Since surgical robotics is a new technology, it needs time for people to become more aware and acquainted with it to begin to trust in it and make use of the various benefits it offers.

Further Required Research

Since the first surgical robots in 1985, surgical robotics has been constantly evolving. According to Jian S Dai, the chair of Mechanisms and Robotics in King’s College London, about \$5.7 billion value was recently spent on this new innovative technology. Any new innovation needs further required research. A way engineers and doctors are improving this new technology is by working on getting an even more precise position of surgical robotic instruments (Russel A. Faust, 2007). In this way surgeons will have more accurate control as well as reducing the percentage of making a mistake. Although very expensive and a dropped idea in the past, there has been a renewal interest by the military for using robotic surgery in battlefields in the year 2005. This allowed surgeons and engineers to conduct further and deeper research since then.

Conclusion

To conclude, robots have come a long way from the industrial world to entering the medical world. And the truth of the matter is that they will keep on improving as long as surgeons and hospitals thrive for the best results in advanced medicine. With further research, robotic surgery will keep on advancing in the medical world and slowly become more accepted by people. Like any other new innovation, there will be ethical and legal concerns as well as social problems, but nothing is impossible, and everything can certainly be worked on (Michael D., 2012). Although many people have some worries about where this technology might be going, there is no doubt that the benefits outshine the concerns and disadvantages some might worry about.

Reference Page

Ann Surg (January 2004). Robotic Surgery(A Current Perspective). Retrieved from

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1356187/>

In this article that is retrieved from the PMC (US National Library of Medicine National Institutes of Health), the author discusses a general overview of the history of robotic surgery. The author also discusses current robotic surgical systems, advantages and disadvantages of robot-assisted surgery, practical uses of surgical robots today and the future of robotic surgery.

Ferdinando Rodriguez, y. B., & Davies, B. (2010). Robotic surgery: From autonomous systems to intelligent tools. *Robotica*, 28(2), 163-170. doi:

<http://dx.doi.org/10.1017/S0263574709990427>

In this article, the author gives a brief history of robotic surgery. The author then talks about methods to improve accuracy in this new technology.

Michael, D. O., Kaddour Bouazza-Marouf, Kerr, D., Gooroochurn, M., & Vloeberghs, M.

(2010). A methodology for design and appraisal of surgical robotic systems. *Robotica*, 28(2), 297-310. doi: <http://dx.doi.org/10.1017/S0263574709990658>

In this article, the author talks about how surgical robots are constantly expanding with new ideas and research. New opportunities come with mistakes and different risks. The article discusses specifically the “applied research” in surgical robotics.

Russel A. Faust (2007). *Robotics in Surgery: History, Current and Future Applications*. New York, NY: Nova Science Publishers.

In this book, the author discusses the history of robotics in surgery and how this new technology is being applied now and how new research and development will lead to its future applications.

Stanberry B. (June 2000). *Telemedicine: barriers and opportunities in the 21st century*.

Internal Medicine, 247 (615-628). Retrieved from:

<http://onlinelibrary.wiley.com/doi/10.1046/j.1365-2796.2000.00699.x/full>

In this article that is retrieved from the online Wiley Library, the author mostly focuses on the security concerns as well as social problem of robotics in surgery.

Christian Torres, (July 18,2011). *Robotic surgery extends its reach in health care, hospital*

marketing. *Washington Hospital Care*. Retrieved from:

http://articles.washingtonpost.com/2011-07-18/national/35237750_1_robotic-surgery-da-vinci-robotic-technology

This article in the Washington Post talks about how robotic surgery is the future of medicine. The author also mentions a brief summary of the Da Vinci. The author then discusses costs and competition as well as complications.