

A STUDY ON SURGICAL ROBOTS AND THEIR RECENT DEVELOPMENTS

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Abstract – In recent years, Robotics has been rapidly developing with outstanding growth and innovation. This paper aims to analyze the key developments in the sub-domain of robotics such as medical robots, especially surgical robots. Surgical robots have evolved as a transformed force in the medical field in the way of performing complex surgical procedures. In this paper a comprehensive review of the latest trends, developments, and the challenges faced by the surgical robots and their instruments have been provided, including minimally invasive robotic surgery, telemedicine, remote surgery and robot-assisted surgery across various specialties in the medical field. This paper also provides the developments in surgical robots and their instruments in surgical precision, AI-driven decision support, and remote surgery capabilities, also provides the ability of surgical robots in the field of healthcare to address the challenges and enhance the specialized healthcare systems. This review offers a valuable resource for healthcare specialists, and researchers for gaining a better understanding of the evolution and the recent state of surgical robots and its impact on healthcare practices.

Keywords – Robotic surgery, Healthcare, Medical, Surgical Robots, Telemedicine.

1. INTRODUCTION

Robotics is concerned with the design and development of robotic systems. A robotic system has the capability of doing functions and activities for people to make their lives easier and to manage the typical work process. Robotics is a multidisciplinary engineering field that covers electrical, mechanical, computer science, bioengineering, and other fields. These technologies are being utilized to create a machine that can take the place of people and do human-like activities. Later, robotics technology allowed for the development of personal and service robots to aid people in a variety of industries. Medical robots and surgical systems are a fast-expanding sector within service robotics.

Evolution in Medicine and Computer Technology has opened massive steps in the field of surgery. Implementation of Robotic Surgery (RS) in the operating theatre improved the quality and risk of several surgical procedures. Particularly, robotic surgery is a minimally invasive method that reduces post-surgery recovery time. In this case, the surgeon follows certain steps to administer the instrument. The steps involve direct manipulation or control of access

through computers. Robotic surgery can be performed without the presence of a surgeon leading to the advantage of remote surgery. The surgical robot arms carry tools like light, cutting tools, and a camera [1].



Figure 1. Surgical Robot and Surgery Process.

2. EVOLUTION OF ROBOTIC SURGERY

The concept of robotic surgery evolved about 25 years ago to assist orthopedic surgery. Arthrobot was the earliest surgical robot invented in Vancouver in 1983 to place the patient's leg over the vocal remark of the surgeon. The robot performed almost 60 arthroscopic surgeries within the first 12 months [2]. In 1985, the PUMA 200 robot was used to orient the cannula during brain biopsy under CT guidance. In the later 1980s, Brian Davies et al., at Imperial College in London developed a PROBOT to assist the prostate surgery. The advantage of PROBOT was its size and accuracy. In 1991 Alberto and his team developed a robot for the resection of the prostate (TRUP) which was used in clinical trials [3].

In 1992, ROBODOC was developed for an orthopedic operation on the femur for the replacement of the hip [4]. Similarly, CRIGOS [5] and Maquet CASPAR [6] were also developed for orthopedic surgery. The surgical robot developed by Yulan Wang in 1989 was able to move an endoscope during the surgical Laparoscope operation [7]. This system was commercialized as AESOP (An automated endoscopic system for optimal positioning) and used in the operation room. Later the AESOP system is remodeled into Zeus Robotic surgical system with additional arms and different surgical tools [8]. In 1994, Steve Charles and the

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