

Research article

Evaluation of the use of robotic surgery with remote simulation for use in the field of Medical Tourism and Pro-Tourism development

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Abstract

Today, using modern technology and software simulation, it is possible to help the medical tourism industry with the support of treating patients all over the world in order to treat diseases for those who are not able to migrate. Therefore, in this study we consider all the essential parameter to reach to the best condition for medical tourism using robotic and artificial intelligence (AI) system. Recently, information technology has penetrated in all fields and changed the face of many phenomena. In the field of medicine, engineering and tourism, the use of this technology is becoming a necessity by using advance robots. Telemedicine is a general concept used to describe various aspects of telemedicine care. The main idea of telemedicine is to transmit information via electrical signals and to automate clinical services and counseling all around the world by advance and smart system. Use of robots, AI and the creation of medical robots as assistants to physicians. The success of medical robot's design and construction means that the realization of such ideas cannot be unexpected. Today, the use of robots in various fields of medicine, from the creation of small cavities without the need for deep incisions to complex surgeries has become possible. One of the goals of telemedicine is to improve patient care, improve access and medical care for rural areas and deprive better access to physicians for counseling. Telemedicine includes distance counseling E-learning, remote monitoring, remote surgery treatment of skin diseases telemedicine ultrasound imaging, pathology, and remote cognitive disorders treatment. The observation indicated that using progressed telemedicine and remote surgery has become possible in which skilled surgeon in one country with strong internet connections and precise technical infrastructure can perform the surgery quickly.

Keywords: Medical Technology, Robot, Remote surgery, Tourism industries Telemedicine

1- Introduction

The Internet and its expansion have made a great difference in science, industry, medical

science, and medical tourism industries. The advent of the computer and its development, and then advanced information systems such as

computer networks and the globalization of the Internet leads better medical and dental treatment. Among this advance technique, the medical sector providing better services to all people by Internet [1-3]. Telemedicine is a bridge between medical and dental science and engineering, in which the medical community has engineering facilities to improve the health of the community. Smart surgery event is a type of surgery performed by a surgeon who is away from the patient [4-8]. The surgeon is not physically present with the patient and is able to control a remote operation through communication tools, which shows the interesting aspect of the applications of this method. Patients can be described using video conferencing and until the initial screening of candidates for surgery. During surgery, telemedicine can be used to communicate with another professor that the operation can be used. Televisions can also be used for postoperative follow-up and robotic-based surgeons allow highly trained medical personnel to perform Minimally Invasive Surgery (MIS remotely) by surgical robots, providing skilled care from remote locations [9-14]. This feature may be used in military locations and allows surgeons to perform surgery for patients in deprived areas or in A New York-based physician monitored surgical instruments inserted into the operating room by a robot. In this operation, the patient resumed normal activities after a week [14-22]. Robotic surgeons are able to use very delicate tools on their fingers that increase surgical accuracy, reduce a significant percentage of human error, and make the 21st century level of health care safer and more efficient. Robotic surgery technology was first used in 2000 and is increasingly used in complex surgeries such as hysterectomy (removal of the uterus), gallbladder resection, and heart valve reconstruction [23-34]. Unlike potential medical errors made by the surgeon during surgery, robotic surgeons are equipped with advanced mechanical arms that allow ultra-precise operations on deep tissues within the body [31-36]. In robotic surgery, the surgeon

remote war zones. Eventually robots can be brought to the battlefield for immediate service. The robot is essential for precise operations such as brain surgery and can compensate for the limitations of a surgeon's hand. The surgeon's hands have many limitations and surgeon get tired during the operation. There are many places in the brain that the surgeon can normally reach and controls a group of robots. The main robot has three arms under the surgeon's control, one arm to hold the endoscope and two arms to work with other surgical instruments [9-14]. In addition to being controlled by a surgeon, this robot performs some simple operations automatically and autonomously [14-18]. Remote surgery is based on the presence of distant and haptic (tactile) feedback. Advance's telecommunication combined with robotic technology which can be considered as telemedicine. Using this idea to perform a specific surgery, a team of leading surgeons can be brought together from all over the world without having to leave their place of residence [19-24]. Train or use the remote surgery system to perform specialized surgeries in remote areas or on the battlefield. A more advanced version of this robot is now in use in the operating rooms of world-famous hospitals. monitors the surgical process near the operating room through a three-dimensional (3D) screen. Computer technology translates the surgeon's hand movements into the precise use of the robot's tool. The surgeon's hand vibrates during the operation, the computer system is able to detect the surgeon's error and does not transmit it to the robot [37-42]. This technology also makes it possible for the surgeon to use very delicate tools that cause less damage to the patient's body by reducing the amount of bleeding and the need for blood transfusion during surgery [36-48]. The robot surgery consists of three main parts such as the main robot that stands next to the patient and has four endoscope camera arms with high magnification power that is in the service of hands, eyes and surgeons. There is a place for the robot to sit and control the robot using

computer that converts what the camera sees into 3D images as shown in Fig. 1.

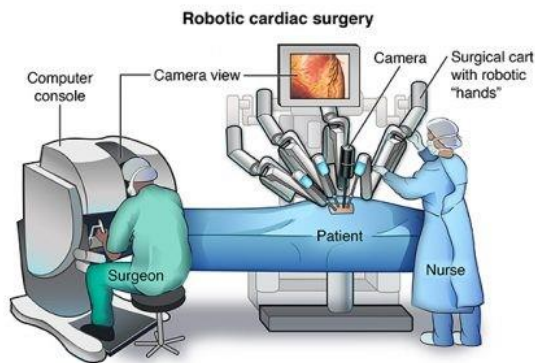


Fig. 1 Image of using a robotic system in the operating room for intelligent surgery



Fig. 2 Image of a multi-nozzle intelligent robot for surgery with multifunctional artificial hand

Fig. 1 shows the mechanism of intelligent robotic surgery, which used as artificial intelligence and biomechanics to easily perform remote surgery for patients in weak countries or patients with mobility problems. In this method, which is given special attention in the health and medical tourism industry, different types of robots with different degrees of freedom (DOF) can be used. In robotic surgeries, incisions may be made on the patient's body to perform the surgery more accurately. In other words, the robotic arms move in such a way that there is no vibration and therefore the incisions may be made in their exact place. However, when the surgery is performed by a physician, the surgeon's shaking hand when making an incision at the

surgical site will place limitations on the treating physician. In robotic surgery, incisions are made on the patient's body to perform the surgery more accurately [45-51].

2-Artificial Intelligence, IoT on Health Tourism

The impact of technology on health tourism has taken on new forms with the development of technology frontiers and the spread of new technologies. AI helps with the data that an outpatient gives to a software or application about his or her condition. Follow-up of health tourists using AI may become a more accurate and scientific process [36-44]. Patients can receive better and more accurate advice by entering their age, weight, and current conditions using artificial intelligence. On the other hand, small medical devices and gadgets that work with IoT technology give medical centers the opportunity to monitor the condition of their patients anywhere in the world [45-58]. Although robotic surgery is a new topic, it has made good progress over the years. Hence, much of the research in the medical engineering faculties of the world's leading universities has been devoted to medical robots and robotic surgery. The use of robots during surgery will increase the surgeon's accuracy during surgery. Surgeon robots can also play a very important role in saving time and reducing the time of complex surgeries [59-64]. A group of researchers have developed a prototype of a robotic capsule that attaches to the intestine without damaging tissue. The robotic capsule is so sticky that it fits snugly into the gut and is soft enough that it does not damage the gut tissue. This sticky robot, which can be swallowed like a regular pill, then moves through the body to reach the intestines. Such a robot can provide accurate, painless observation inside the body and revolutionize the performance of biopsies (tissue biopsies), drug delivery, heart treatment, and other medical applications [58-66]. In other words, the robotic arms move in such a way that there is no vibration and therefore the incisions may be made in their exact place. However, when the surgeon

performs the surgery, the surgeon shaking his hand while making the incision at the surgery site may have limitations for the treating physician. In addition, because the robotic surgeons can be able to penetrate deep into the human body. Therefore, only by making a small incision, the surgery can be performed accurately on the patient and there is no need to make large incisions. In such cases, the patient will recover faster after surgery. The console, which is intended to be the physician's location, allows the physician to be able to control the surgical procedure in this way [67-76]. The console provides a virtual world of surgery conditions for the physician so that the physician can monitor the patient undergoing surgery at 20x magnification. The surgeon's robot sends information such as flexibility, pressure, and tissue strength at the surgical site to the computer console, and the physician determines how the robotic arm moves based on this information [52-61]. Advantages of surgical robots as reduction of long recovery period after surgery Postoperative pain Time required for hospitalization and related costs. The use of robots during surgery increases the surgeon's accuracy during the operation. Robots are able to create incisions desired by the surgeon without vibration and with high accuracy, on the other hand, the use of these robots saves time. The benefits of this method for the patient can be reduced postoperative pain, less scarring, less bleeding and less risk of infection, as well as shorter hospital stay and accelerate the recovery period and faster return to daily activities. One of the advantages of this device is that the surgeon sits in a sitting position and follows the surgery more easily. These robots equipped with artificial intelligence can be used to treat astronauts. Doka Group experimental robot uses 3D ultrasound technology along with an artificial intelligence software. As an example, during prostate surgery, the computer uses the collected images to create three-dimensional images of the prostate. It then sends these images to the robot and the surgeon [65-68].

3-Disadvantages of remote surgery

One of the most important issues in the remote sensing system is that although the surgeon's robots increase the surgeon's agility, they are less valuable than the surgeon's natural hand and produce a better view of the operating field, but reduce the surgeons' ability to feel tissue properties [63-69]. In routine operations, they use their sense of touch to get feedback from the tissue being operated on during surgery to decide on the condition of the tissue being operated on [55-62]. Lack of sensory feedback, an expensive rite, lack of understanding of the patient's environment by the physician, control delays in power-feedback applications, along with operating field video display delays, affect performance on the road. Guide the use of tools such as robots to perform surgery with everyone. Patients' desire to undergo surgery due to the new technology. Create a 25-second delay on the monitors according to the conditions of the doctors. Delay time to less than one-fifth of a second when the surgeon sees the knife move until it actually makes the incision increases the chance of cutting the wrong spot. At present, the robot can operate at a maximum distance of about 300 km in connection with the wire and 35 km with wireless connection [58-64]. In coronary conditions, robots provide a lot of help to patients so that the patient does not need the help of a nurse directly and does not cause the spread of respiratory disease like COVID 19 [35, 37, 70]. For this reason, patients and even tourists were treated in very comfortable conditions as shown in Fig. 3.



Fig. 3 Robots used in COVID19 duration [35-37]

These days, when it comes to the impact of technology on health tourism, we must also pay attention to the technologies used in medical equipment, assistant robots, surgical robots and the role that these devices and facilities which can play an important rule for foreign patients. Many hospitals in India, Iran and Turkey have a medical tourism in their advertisements and marketing campaigns maneuver on technologies and technological equipment produced by world-renowned brands. Many believe that the future of treatment depends on these advanced devices, and that the greatest impact of technology on health tourism which come from the same region.

4-Type of telecommunications

The first and most difficult step for telemedicine programmers is to choose the type of telecommunications that includes different types in terms of bandwidth and various types in terms of telecommunication technology such as microwave satellite, wireless, cable, The Internet. The choice depends on the needs of the program, the availability of costs, and the approach to technology in the future [60-63]. Since, the function of telemedicine is based on two-way transmission of audio and video information, the development of this technology is the key to the successful clinical use of telemedicine.

5- Network and tourism industries

Rapid and stable communication between the distant and patient centers is critical for the clinical use of telemedicine, and therefore it is necessary to provide communication networks with appropriate technical considerations. The network must be able to track data transmission and be able to connect to other networks. Technical characteristics such as bandwidth, information processing, information security and information traffic are in this subset [62-66]. In recent years, the advancement of medical technology in Tourism industries is shown as an emergence of new technologies in many countries like

North Cyprus, India and Iran has led to the construction of surgical robots to the attention of knowledge-based companies and experts in this field, but it should be noted that this technology is a new phenomenon in Iran and although in more than a decade robots are used in the medical field, but often all the equipment used in this field has been imported and made in other countries [46-51].

The system consists of two main parts, the remote surgery console and the surgeon robots located on the patient's bed. The handles in the surgical console record the movements of the surgeon's hands and at the same time the surgeon's robots perform the same movements on the patient's bed's body. The connection between the guiding robots in the surgical console and the robots following the patient's bedside is provided through the Internet, so the surgery can be controlled and performed in the farthest parts of the country or even on a remote ocean-going ship. Also, this device has the ability to compare the movements of the surgeon's hands and as a result, increase the accuracy and finesse of the movement in performing very delicate movements. Also, 3D printing technology has gradually gained a foothold in medical education. To provide an alternative to a living human being for training surgeons and students physicians developed a method of using 3D printing to create artificial organs. They looked and felt like real organs and even bled like them. Since then, the use of 3D printing in educational institutions has expanded as it increases future physicians' understanding of anatomy and pathology, leads to a better understanding of processes, and improves the trainee's skill set and confidence [22-25]. Using simulation software for specific mechanical prediction can help and improve the efficiency of metallic devices and equipment made in the medical engineering and mechanical engineering industry. The use of materials with suitable mechanical properties and vibrations response can help a lot, which is possible by using finite element analysis (FEA) and molecular dynamics (MDs) simulation [77-78]. There is potential in the

field of tourism and especially medical tourism from a new economic perspective that countries can help their communities through tourism science. Through this pro-tourism, it is possible to encourage the natives and the society to prevent their migration by having technology. These communities can be happy with pro-tourism and have a good face and vision. Tourism can prevent the indigenous migration of natives to large cities, and these spaces can keep natives in rural areas due to the good weather. This type of ecotourism increases economic growth, especially the knowledge-based and traditional economies. [84-85].

6- Conclusion

Many researchers introduced the first narrow-gauge operator-follower-trap, in which guide and follower robots were separated by a head and an electrical mechanism. In general, in these generalized nonlinear controllers, the adaptive position control of the arm robots, which was provided to overcome the uncertainty of the parameter provided by the robot, is also bilateral. Simulation is one way to ensure the performance of surgeon robots. In fact, the simulation helps researchers assess the various possible scenarios that may occur during surgery, thus providing realistic data to the robots. In many European countries, this method is used to build surgical robots because the simulation allows the points needed for a surgery to be precisely defined. Attention should also be paid to the technologies used in medical equipment, assistant robots, surgical robots, and the role that these devices and facilities can play in attracting foreign patients. Many hospitals in India and Turkey that have a say in medical tourism in their advertisements and marketing campaigns maneuver on technologies and technological equipment produced by world-renowned brands. Many believe that the future of treatment depends on these advanced devices, and that the greatest impact of technology on health tourism will come from the same region; However, we have to be a little patient until that day arrives.

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