Reflection on the Application of VR Technology in the Teaching of Gynecological Surgery for Regular Trainees

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Abstract: Virtual reality technology, or VR technology, has been rapidly popularized and developed in various fields since 2016 due to its powerful immersion, interactivity, and conceptualization. Even modern medicine combined with VR for disease diagnosis and treatment is no longer a fantasy, and the launch of virtual classrooms has opened a new door for medical education. For the clinical surgery teaching of gynecology and obstetrics, the teaching expectation is very high. Clinical surgery teaching hopes to achieve the best teaching results in the shortest time, and rapid growth requires a lot of training and accumulation. In actual clinical teaching work, there is a gap between reality and ideals. Regular trainees do not have many practical opportunities. But VR technology is likely to solve this problem, and can even be extended to the surgical teaching for interns in obstetrics and gynecology rotation, general practitioners, etc. In addition, the application of robot-assisted surgery technology in obstetrical and gynecological surgeries is becoming more and more mature, which brings new possibilities for VR technology-assisted clinical surgery teaching.
***Keywords*:** virtual reality technology, teaching obstetrics and gynaecology surgery, robot assisted surgical technology

1. Introduction

In learning basic clinical surgical operations, obstetrical and gynaecological regular trainees are often met with several difficult problems. Firstly, the surgical site in obstetrics and gynaecology is special, resulting in a difficult operation — the pelvic space is small and contains many organs, such as intestine, uterus and bilateral adnexa, ureter and bladder, important vascular, nerves and so on. Because of the complexity of structure, if the anatomy is not clear, it is easy to hurt other organs in surgery. Secondly, obstetrics and gynaecology surgical object is special, leading to high surgical requirements. Obstetrics and gynaecology surgery often affects a woman's sexual and reproductive function. If the surgeon is not careful and sugical steps are not clear, it is easy to create medical disputes, which also invisibly gives a huge pressure to the operation staff. Thirdly, obstetrics and gynaecology surgical procedures are diverse, resulting in great surgical flexibility and numerous methods, such as hysterectomy, laparotomy hysterectomy, laparoscopic hysterectomy, vaginal hysterectomies and even AI-assisted laparoscopic hysterectomy. Proficiency in these skills and procedures requires considerable time and effort. And the burdensome of clinical work results in less time left to be self digested by practitioners which creates contradictions. Forth, special environment for teaching surgery in obstetrics and gynaecology leads to less pratical opportunity during the undergraduate period. Students learn local dissection when female corpse occupy a minority. Students usually learn by rote memorization. By the time they come to clinical practice, students are afraid to practice, in the meanwhile, teachers are afraid of student manipulation, which leads to alienation of knowledge of obstetric and gynecological surgery. Fifth, as the application of robot assisted surgery technology in the field of obstetrics and gynecology becomes increasingly widespread, participating in robotic surgery and mastering robot-assisted surgical technology has also become a higher pursuit among obstetricians and gynaecologists. In an abroad survey on the training and use of robotic surgical technology for residents in the general surgery field [1], it was found that more than 90% of robotic surgery had an involvement of residents, however less than 40% of the residents had relevant training or education before their first participation in robotic assisted surgery. This is not only because robotic assisted surgery belongs to the newer and more advanced surgical method, but also due to the scarcity of robotic teaching resources and the inequality between the large surgeon base. All the above, it has become several major stumbling blocks for teachers to teach and for students to learn well. Therefore, the authors proposed to introduce VR technology to assist teaching conventional surgery in obstetrics and gynaecology.

2. Applications of VR technology in medicine

VR (virtual reality) technology, which is virtual reality technology, is a digital human-computer interface technology that completes corresponding experiential operations such as vision, hearing, touch, and motion by first purposefully creating an

ideal environment through computer technology and then relying on visualization and sensing technology to immerse users into that environment [2]. Due to its strong interactivity, immersion, and internality, VR technology has been used in many fields, such as military simulation, medical treatment, indoor design, remote education, and daily entertainment. Previously, scholars have studied the role of VR technology in surgical education, noting that it is beneficial for medical students, residents, and practicing surgeons in improving technical skills, team training, and decision-making skills [3]. In medical technology, some scholars have already applied it in stereotactic surgery of brain surgery. Firstly, they use the patient's original CT or MRI scan data to build a three-dimensional model on a computer, and then they can complete the positioning in the patient's head by using the machine arm connected to the computer. Then the surgeon can rely on the virtual reality equipment to build a virtual surgical environment to complete the virtual surgical practice and deepen the understanding of stereotactic surgical procedures and path [4]. VR in combination with current medical technologies innovations can reduce patient trauma, with significance for patient recovery after surgery.

3. VR technology can bring about a change in the teaching way of basic surgery versus robot assisted surgery in obstetrics and gynaecology.

3.1 The basic surgery of obstetrics and gynecology is highly compatible with robot-assisted surgery teaching and VR technology

As mentioned earlier, obstetrics and gynaecology surgical objects are special. Students have few opportunities to practice which leads to unfamiliar to surgical steps and procedure. But for a woman and obstetricians, surgical skills are essential. The high and low level of operating skills of doctors directly affect patients' benefits. We can establish a virtual operating room environment and a " standard patient " by VR technology. students can see the surgical field through devices such as head-mounted augmented reality devices, data gloves, and three-dimensional trackers reaching for the surgical instruments, feeling the touch sensation of the tissues, and independently completinga virtual surgery. Previous major can start from setting the standard surgical steps, the approximate surgical flowand let students understand the whole surgical process better; going small, we can train from a single needle pass, one incision and suture, allowing students to practice basic work more realistically and repeatedly. VR surgical techniques can be applied even in the training of laparoscopic and robot assisted surgery, reducing the need for laboratory animals while increasing training opportunities andfrequency, improving proficiency and accumulating experience. VR technology can not only channel the enhance students' learning interest and concentration, but also bring a strong interest in participation, and in the practical progress of learning. And this tecnology meetsthe requirements of students' learning outside the workplace such as hospitals, they can use mobile ARdevices to complete situational, interactive learning. VR devices can also be worn for immersion experiential learning if conditions permitted, there are no restrictions on places and spaces.

3.2 VR technology has been gradually applied to the clinical treatment of obstetrics and gynecology

With the development of computer science, three dimensional reconstruction technology is no longer attainable, it can be applied in all aspects of our lives. Even some apps that can display coarser 3D human anatomy have been available for many years. Some scholars have done 3D reconstruction of female pelvic anatomy on the Dextroscope platform [5], and found a more ideal and easier way to 3D reconstruction and visualization operation of female pelvic structures. This has undoubtedly also made it more feasible to apply VR technology to the teaching of gynecologic surgery. While in obstetrics, the desktop virtual reality system based on C / S model has also been long held by scholars, some basic training systems for obstetric surgery have been fabricated by modeling, online simulation and interaction rendering using main computer and interaction equipment. Scholars have cleverly applied the system to two teaching instruments: 1. To give students a preliminary impression of obstetric surgery through simulation animation. 2. To increase knowledge understanding and stimulate learning interest through VR simulated surgical training [6].

3.3 Realizability of VR technology in robot-assisted surgery teaching and guiding significance of automated teaching framework for surgical training

Robot assisted surgery, a product of rapid development of modern medical technology, leads the new wave of more meticulous, precise and minimally invasive surgery, and more and more surgical fields are beginning to introduce and develop robot assisted surgery. And the current surgical robot itself comes with virtual reality simulators, and many scholars at home and abroad have focused on developing an automated teaching framework to compensate for the lack of expert teaching and guidance when training physicians in spontaneous simulation, not only providing physicians with the information "what should I do" but also adding the feedback of "how can I do it properly" and "what did I do wrong". As in an abroad

randomized trial of a training method for robot assisted needle penetration technology [7], scholars utilized an automated teaching framework to assist VR simulators to guide trainees in the practice of this skill of needle penetration. It was found that the Automated Instructional framework was able to deliver more targeted and individualized learning protocols and that this instructional framework was attainable on VR simulators for surgical robots. Just that this VR simulator is based on the surgical robots themselves means that each surgical robot can meet the training requirements of only one trained physician at a time. In the future, we envision that hardware can be enhanced at the current level of software technology to load VR simulation technologies, automated teaching frameworks, and head mounted or mobile VR devices with greater convenience and flexibility to meet the training requirements of more trainees.

3.4 Prospects for the development of VR technologies in the 5G era

Although VR technology has evolved rapidly, there are also many limitations facing the application of technology. Prominent aspect among these is that the VR immersive experience is very demanding on broadband, a long network delay will cause the field of vision to be out of sync with the machine This condition, when the device is worn for an extended period of time, can easily cause vertigo and discomfort to the experiencer. And the advent of 5G era brings faster network speed, larger capacity and lower time delay. This time delay is only within a few milliseconds. High definition, strong fluency and low time delay will make VR technique exert its abnormally strong immersion, and also effectively reduce vertigo probability. The arrival of the 5G era will certainly cause an explosive growth of the VR industry. The cloud VR platform, in turn, allows all VR applications to run on the cloud, uses the powerful computing power of the cloud and the rendering ability of the graphics card to realize the processing of VR application operation results, discards the past expensive " hosts ", direct wireless and VR helmets for data interaction, reduces VR development and application costs, and truly realizes the experience of VR technology at any time and by thousands of users. And this is also shining the light on medical education careers, resource sharing, telemedicine and remote education.

4. Conclusion

The use of VR technology in medicine has already begun, and there are also scholars who dexterously combine it with existing medical technologies to create new technology systems that benefit more patients. And a department with intense clinical work and extreme accountability such as obstetrics and gynaecology. Especially at the shock of the new wave of surgical robotics of Da Vinci, it will take a great deal of effort for practitioners to be skilled in mastering the surgical methods and steps that underlie obstetrics and gynaecology, adapt and master the new technology of robot assisted surgery. The introduction of VR technology assisted basic surgery in obstetrics and gynaecology, as well as robot assisted surgical teaching, can both improve students' learning enthusiasm, increase students' autonomous opportunity., let students experience the surgical process systematically and immersively, which promotes students' mastery of their knowledge of gynaecology and obstetric surgery, guide students to discover problems, solve problems proactively, and provide better environment for students who are in clinical learning at obstetrics and gynaecology department with innovativeness.. And with the promotion of 5G era, remote teaching can also be achieved. VR technology is also an emerging technology, and the difficulties faced by its wide application have been conquered one by one, Under the guidance of the fifth generation mobile communication technology, virtual reality will lead to a technological explosion. VR technology will also play an increasingly important role in medical education.

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