Plastic surgery in the metaverse: challenges and opportunities (1302 words)

Introduction

The 'metaverse' refers to an upgraded form of the internet where the users are immersed in a stable and standardised virtual environment that applies to various aspects of life, including surgery [1]. This concept poses opportunities and challenges to plastic and reconstructive surgery, specifically surgical training in this field. 'See one, Do one, Teach one' describes the established traditional surgical training model. It involves surgical trainees observing and performing a surgical procedure and imparting this skill to future trainees [2]. Nevertheless, technology advances constantly along with medical and surgical innovations. Surgical training should therefore align with their dynamic nature. Virtual reality (VR) is a type of immersive technology used in the metaverse [3, 4]. Figure one depicts some of the components that a surgeon can use to exploit the benefits of VR [5]. Plastic and reconstructive surgery trainees face numerous challenges regarding the duration and the curriculum of their training pathway and situations that require remote learning. This essay supports the increase in engagement with the metaverse during plastic and reconstructive surgery training to address these issues while balancing difficulties that can arise during the efforts of its establishment.

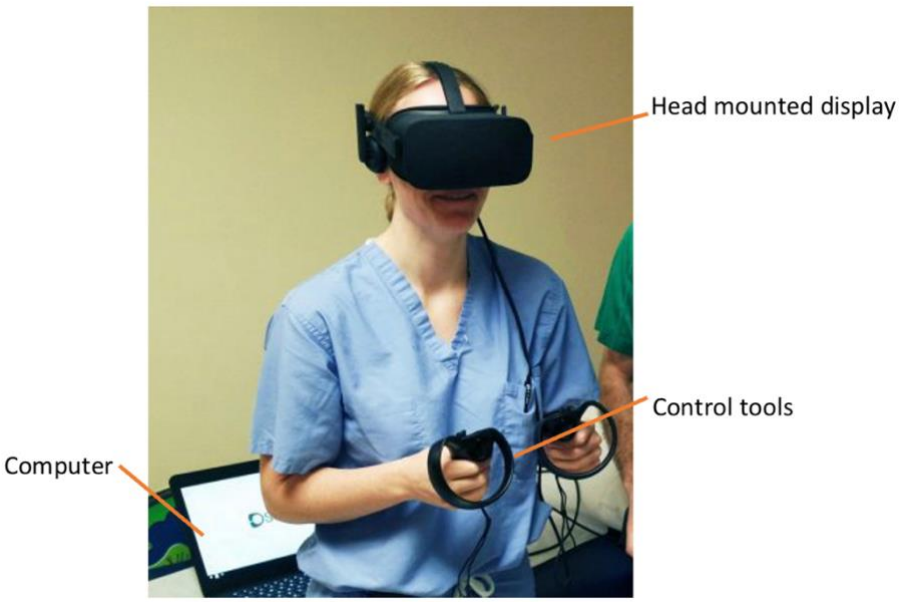

Figure 1: Virtual reality technology.

Immersive technologies such as a head mounted display, control tools with position trackers and a computer.

Adapted from [5].

Virtual reality and plastic and reconstructive surgery training pathway and curriculum

Firstly, VR can impact the duration of the training and the structure of the plastic and reconstructive surgery curriculum. This specialty requires up to eight years of training in the United Kingdom (UK) [6], where trainees need to achieve specified competencies [7]. This route can be lengthened for several reasons, like focusing on academia, undertaking fellowships, or personal commitments[8]. At the same time, completing specific procedures is a requisite of the curriculum. Trainees must perform some of these more often than others [7]. However, some hospitals may offer limited opportunities to practice some of these procedures due to limited resources and increased numbers of trainees [9].

Further considerations in the context of surgical training include the subjective judgment of the trainees' progression as they perform procedures and interact with patients by their supervisors [10]. Additionally, a UK study shows inaccuracy when completing surgical logbooks due to the pressure on trainees to reach specific targets for their training, delineating the immense number of procedures and the limited opportunities trainees have to complete them [11]. Finally, another study on general surgery that could apply to plastic and reconstructive surgery indicated that surgical trainees are only sometimes ready to perform procedures when completing their training independently. It is unknown whether the trainees' autonomy is sufficient for their future independent practice [12].

These challenges, the constantly evolving and advancing world of technology, and the complexity of novel surgical techniques justify the proposition of the 'future of surgery report' [13] for implementing metaverse technology in the changing surgical curriculum. Trainees will be able to practise more procedures, become more confident, and, therefore, more efficiently use their time to operate on an actual patient. Furthermore, VR offers a safe space where surgical errors will not have devastating effects, and thus, trainees can avoid them in real-world situations. Figure two highlights the results of a randomised controlled trial supporting this argument as the number of surgical errors of trainees that used virtual reality as part of their education was significantly lower ($p<0.06$) than of trainees who did not [14]. To add, VR can be an easy way for trainees who have taken time off to refresh their skills quickly when they return to practice. VR could also allow for the simulation of other aspects of the curriculum, such as decision-making and patient interaction.

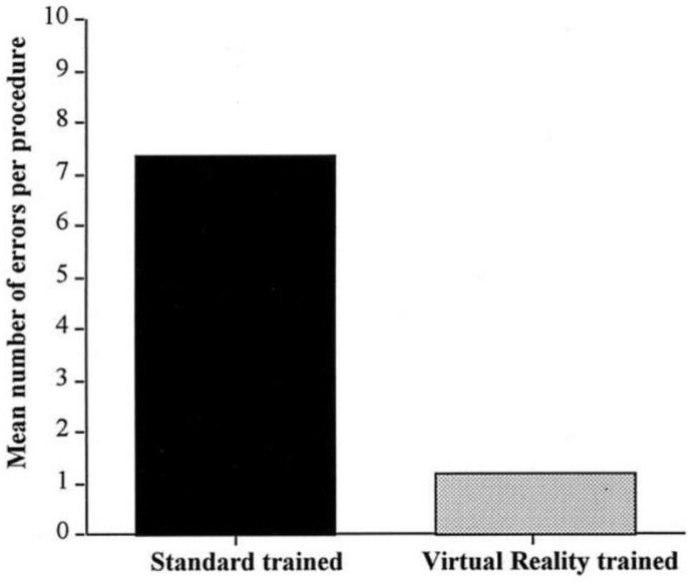

Figure 2: Virtual reality vs standard surgical training

The graph shows that trainees who only follow the standard training methods make on average more errors per procedure than those who use virtual reality in their training.

Adapted from[14].

Moreover, introducing a standardised VR programme in all aspects of plastic and reconstructive surgery can help trainees receive an objective judgment of their progress, minimising any subjectivity from their supervisors. Finally, the metaverse can significantly improve the confidence of surgical trainees in performing procedures independently and enhance their interaction with actual patients in many aspects of surgical practice.

Remote learning and virtual reality

VR can be helpful in cases where a pandemic or a war can prevent formal training. Specifically, the recent pandemic has significantly impacted plastic and reconstructive surgery. Surgeons were working in different departments to cope with the virus's demands or isolate due to the infection. Moreover, the pandemic led to a shift from aesthetic and elective operations to emergency procedures like trauma and burns[15]. Therefore the opportunities for teaching and learning in the context of the standardised plastic and reconstructive surgery curriculum were altered. Trainees have potentially missed crucial opportunities to develop vital skills. In particular, 53.3% of European plastic surgery trainees reported lower confidence in their skills and knowledge due to the pandemic [16].

Additionally, plastic and reconstructive surgery is essential in treating war wounds, thus requiring many surgeons to practise their skills [17]. However, the overall effects of war are devastating and surgical training is diverted from the traditional curriculum to emergencies or halted overall due to other severe consequences of war [18]. The metaverse can help both trainees and consultants in this case. Firstly, with the help of VR, trainees can practise procedures found in their curriculum when appropriate and thus gain adequate skills to perform them. Moreover, due to the complexity and variability in the different surgical presentations of war wounds, surgeons using VR can quickly assess certain anatomical variables before proceeding to an operation [19]. Finally, the current war in Ukraine has shown how telemedicine has helped surgeons save lives. Surgeons located at a safe environment were guiding their colleagues working in war-zones on approaching certain injuries that required a higher level of expertise or a different technique due to the limited resources [20]. VR can further enhance this experience by providing three-dimensional graphics.

Challenges

Implementing the metaverse in plastic and reconstructive surgery can be challenging. The wide availability of immersive technologies and the employment of specialised technology professionals impose a new financial challenge to healthcare systems like the NHS [21,22]. Experienced surgeons must reach a consensus on creating standardised virtual resources. While this can be beneficial, the uniqueness of the various techniques taught at different institutions is not appreciated. The establishment of this technology will need a general change to the infrastructure of traditional training. It might also lead to training diverting from a more critical and authentic system to a homogenous and standardised approach. Immersive technology can only partially substitute the

real-world experience of patient interaction and the variation in the anatomy and physiology of different people [3].

To counteract these challenges, more research is required. For example, the creation of resources can be done after evaluating a high number of cases for each procedure and identifying the most typical presentation in terms of anatomy and physiology for patients of different demographics. To continue, the metaverse should be used to enhance the training experience and not replace it, as surgeons will feel more prepared and confident when performing surgery and still receive constructive criticism and advice from their supervisors. Similarly, while patient interaction is difficult to simulate, a general structure can be appreciated through VR, and therefore, trainees can be better prepared when facing difficult situations. Finally, the benefits of using the metaverse in the NHS counteracts its cost as it can increase the efficiency and confidence of its trainees[3, 14].

Conclusion

Having discussed the various considerations regarding the current plastic and reconstructive surgery training pathway and curriculum, the contribution of the metaverse can be of great value. This essay has discussed examples of the use of VR for training in different situations and the results of studies proving the significant effect on reducing surgical errors when training encompasses VR. While acknowledging certain challenges that can arise in establishing this technology, its overall benefits in surgical training and patient care are incomparable. Consequently, a judicious and stepwise process involving the metaverse in plastic and reconstructive surgery training can revolutionise the trainees' experiences in this field.

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