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VR, reconstructive urology and the future of surgery education

Mikołaj Frankiewicz, Malte W. Vetterlein, Marcin Matuszewski & Young Academic Urologists (YAU) Trauma and Reconstructive Urology Working Group

The COVID-19 pandemic has disrupted surgical training worldwide, and reconstructive urology training has been neglected at the expense of more urgent life-saving procedures. To help address this problem, virtual reality must become a fundamental training aid in modern reconstructive urology surgery education.

Worldwide, emphasis on educating urologists in the field of reconstructive urology is less than adequate. In 2011, the Reconstruction Steering Committee of the American Urological Association raised this issue in a white paper focusing on the challenges and the future of reconstructive urology[1]. The lack of reconstructive urology training was already of concern before the COVID-19 pandemic resulted in unprecedented demands on health-care systems, as well as global travel restrictions.

Over the past four decades, urethral reconstruction has progressed enormously, and a substantially increased range of treatments that focus on patients' quality of life is available. Moreover, the prevalence of urethral stricture disease is likely to rise considering the increasing number of iatrogenic urethral strictures, which in some populations account for half of urethral stricture disease cases treated with urethroplasty[2]. This trend could be further pronounced owing to the ageing population in nearly all regions of the world. Yet, reconstructive urology was almost entirely abandoned during the COVID-19 pandemic at the expense of more urgent life-saving procedures. In addition to delayed diagnosis, reduced access to consultations and postponing elective surgeries, the pandemic also directly affected surgical skills and training. Fellowships, formal exchange programmes and live surgery courses at noted centres of excellence such as those in London, Hamburg and Santiago have been cancelled or strictly limited. Notably, opportunities to gain surgical experience for trainees have decreased, while stress levels and associated negative mental health repercussions have risen[3].

On the other hand, substantial opportunities have been unexpectedly revealed during the pandemic. Increased educational activities via virtual platforms and the development and application of virtual reality (VR) training tools are noteworthy developments. In particular, VR – for many years the basis of education in industries such as aviation – must become one of the fundamentals of modern education in surgery. Today's technology finally allows the trainee to begin learning before entering the operating room. Hands-on practice and live courses carry unquestionable value in surgical training; however, considering their high cost and major organizational challenges during crises such as the COVID-19 pandemic, other solutions must be sought. Fundamental changes are necessary owing to not only pandemic-related restrictions, but also the possible upcoming economic crisis and the need to reduce expenses across all activities, including travel costs.

VR training models fill the gap left by in-person training and complement education in the form of lectures or online presentations. The pandemic has undoubtedly accelerated the implementation of VR technology, which has developed rapidly over the past 30 years[4]. The ongoing revolution in surgical education using virtual modelling and simulation incorporates not only technical skills training but most of all emphasizes the role of objective metrics and criterion-based tools in the assessment of trainee progress. Quantitative measures such as hand motion tracking patterns are becoming increasingly accurate by implementing machine learning improvements[5]. Highly advanced VR simulation platforms are already available and validated for various surgical approaches, including robotic (da Vinci Skills Simulator), laparoscopic (LAPMentor) and endoscopic (TURPsim) surgery. However, validated methodology for incorporating VR training is still lacking in reconstructive urology, which to date primarily uses non-VR, task-based simulation models. These models are not specific to single operations but are instead intended to develop basic skills.

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Meticulous evaluation of skill transfer from a VR simulation to the operating room is of utmost importance. In most available surgical simulators, progress is evaluated through execution times, precision of hand gestures and questionnaires. Applying VR training to reconstructive urology procedures might be particularly demanding as these measures provide little feedback regarding the quality of performance and functional outcomes. Moreover, the multitude of surgical techniques applicable for treatment of a single disease (for example, hypospadias) makes creating the VR software even more demanding.

As VR technology that enables personalized learning environments in reconstructive urology has not yet been developed, for the time being this field requires alternative approaches. Reconstructive urology curriculums can be improved by implementing explanatory and instructional sessions based on VR, enhanced with already known non-VR kits such as Adult Male Circumcision Trainer[6]. Training can also be enhanced using 3D printing technology, which enables the creation of low-cost models from any location without substantial investment of resources and time[7]. Additionally, 3D-printed penile models composed of a synthetic hydrogel

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tissue that can mimic the biomechanical properties of human tissue have been successfully created for training in penile prosthetic surgery[8].

Although these approaches are far from the sophisticated algorithms and technology contained in ready-to-use VR systems, combining tutorials based on VR with dedicated surgical kits might be an efficient step in the evolution of surgical education in reconstructive urology. This approach could be safe and practicable even during crises such as the COVID-19 pandemic, as shown by the University of Toronto lung transplantation team who created a training curriculum by augmenting independent practice with a bench model of vascular anastomoses using regular video conferences and individual feedback during the pandemic[9].

The face of surgical education has evolved rapidly in the past 30 years; however, despite ubiquitous technological advances, ultimately the evolution of education will depend as much on surgeons' creativity as the developments of medical engineers.

Mikołaj Frankiewicz[1] ✉, **Malte W. Vetterlein**[2], **Marcin Matuszewski**[1] **& Young Academic Urologists (YAU) Trauma and Reconstructive Urology Working Group***

[1]Department of Urology, Faculty of Medicine, Medical University of Gdańsk, Gdańsk, Poland. [2]Department of Urology, University Medical Center Hamburg-Eppendorf, Hamburg, Germany. *A list of authors and their affiliations appears at the end of the paper.

✉e-mail: mfrankiewicz@gumed.edu.pl

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Competing interests

The authors declare no competing interests.

Additional information

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Young Academic Urologists (YAU) Trauma and Reconstructive Urology Working Group

Mikołaj Frankiewicz[1] **& Malte W. Vetterlein**[2]

A full list of members and their affiliations appears in the Supplementary Information.