THE APPLICATION OF SIMULATORS IN DENTAL MEDICINE STUDENTS' TRAINING

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ABSTRACT

The simulation training of dental students has developed rapidly in recent years. The development of new technologies and virtual reality are an indispensable part of the education of dental students. The introduction of simulators in the education of dental students supports the harmonization and integration of knowledge from the pre-clinical and clinical education of the students. The opportunity to train on simulators in the field of dentistry helps future dentists to put their theoretical knowledge into practice and gain confidence to work with patients. Simulation operators are included in the students' pre-clinical exercises. In recent years, computer-based simulation and virtual reality-based simulation have become an indispensable part of the pre-clinical training of dental students. Nowadays, there is a wide range of dental simulator models with different features and functions. Some of them are: DentSim, Haptic Technology, Moog Simodont Dental Trainer, HapTEL, the Geneva System, Robotic Patients for Virtual Dental Patient Simulation, Virtual Reality Dental Training System, PerioSim, the VirDenT system, the Forsslund System, DSETM Expert Dental Simulation Units—KaVo Dental. In addition to student training, these simulators can also be used to assess learner performance or quality control various teaching methods. The development of new technologies marks successes in the development and improvement of the simulators applied in the training of dental medicine students. The virtual patient application provides many opportunities to recreate clinical situations in virtual reality and will make learning even more rewarding and interesting for dental students.

Keywords: dental simulators, virtual reality, digital technologies, virtual patient

INTRODUCTION

The simulation training of dental students has developed rapidly in recent years. The development of new technologies and virtual reality are an indispensable part of the education of dental students. The introduction of simulators in the education of dental students supports the harmonization and integration of knowledge from the pre-clinical and

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Received: 2022 Accepted: 2022 clinical education of the students. The opportunity to train on simulators in the field of dentistry helps future dentists to put their theoretical knowledge into practice and gain confidence to work with patients.

AIM

The aim of the present study is to investigate the application of simulators in the education of dental students and to clarify the process of creating and using a virtual simulation to support their education.

MATERIALS AND METHODS

For the period September 2018–October 2021, in the available database (PubMed, BioMed Central, ScienceDirect, Scopus, Web of Science, Embase), a systematic analysis of scientific publications investigating the application of simulators in the education of dental students was carried out.

RESULTS

Simulation operators are included in the students' preclinical exercises. In recent years, computer-based simulation and virtual reality-based simulation have become an indispensable part of the pre-clinical training of dental students. Nowadays, there is a wide range of dental simulator models with different features and functions. Some of them are: DentSim, Haptic Technology, Moog Simodont Dental Trainer, HapTEL, the Geneva System, Robotic Patients for Virtual Dental Patient Simulation, Virtual Reality Dental Training System, PerioSim, the VirDenT system, the Forsslund System, DSETM Expert Dental Simulation Units-KaVo Dental. In addition to student training, these simulators can also be used to assess learner performance or quality control various teaching methods.

DentSim

DentSim (1) is a virtual system for teaching students the subject of prosthetic dentistry. It enables students to use their practical knowledge with the possibility of visual tracking of the relevant procedure, real-time feedback, and evaluation of their performance (2,3,4,5). DentSim is an advanced training simulator for dental training. While working on a simulator, the movement of the student's handpiece and the tooth are optically tracked and analyzed in real time (6). The device evaluates the work process, not just the end result (7). It provides immediate visual and digital feedback regarding the fidelity of the preparation, its appearance according to the planned fixed construction, and its smoothness. The trainees can correct their mistakes and later check if they have achieved their goals (6).

Haptic Technology

Haptics offers dental training using virtual reality, a 3D environment (8). Combined with a visual display, sensor technology can be used to train students by improving their coordination and dexterity. It visualizes objects (teeth, alveolar bone, instruments, handpieces, burs, implants) within a simulated virtual image of the mouth (9).

Moog Simodont Dental Trainer

They offer sensor devices that provide a variety of dental procedures that can be practiced in a virtual environment, including diagnosis and treatment planning, cavity preparation, and preparation for crowns and bridges (10). This simulator allows dental students to be trained in operative dental procedures in virtual reality settings by receiving visual and audio sensory information. Instrumentation and teeth are simulated to train skills such as caries removal and tooth preparation for crowns. The students' work can be tracked and evaluated by the software and the teachers (11,12).

Robotic Patients for Simulation

Virtual Dental Patient—the virtual dental patient is designed to help students become familiar with dental anatomy, instrument handling, and procedural challenges (13). The simulator allows the user to: perform virtual preparation of teeth in the oral cavity using a phantom sensor device (SensAble Technologies Inc.) (14) to control the operating tool.

Virtual Reality Dental Training System

The virtual reality system is a dental simulator that uses virtual reality technology for cavity preparation (4). The software simulates a range of dental instruments and filling materials. The system allows virtual restoration of teeth.

The Forsslund System

The Forsslund system is designed to provide virtual reality training in molar extraction (15).

KAVO Dental Simulation Units

DSETM Expert Dental Simulation Units-KaVo Dental, are used for pre-clinical practical training of students of dental medicine, as well as for taking courses in implantology, endodontics, aesthetic restorations with the aim of increasing the qualifications of already graduated dental doctors. The dental simulator is a modular structure that can be used individually by each student (16). The workstation includes a patient simulator, electronically controlled patient positioning, aspiration, low-speed and high-speed handpieces, water/air handpiece, diamond bur stand, simulator control pedal, lighting system, ergonomic desk, phantom models with upper and lower jaw teeth, which are fixed with the help of a magnet in the oral cavity of the dental simulator, a chair for the correct ergonomic posture of students during work, camera, computer, and monitor. Different phantom models with teeth are applied in different disciplines: propaedeutics of prosthetic dentistry, propaedeutics of conservative dentistry, propaedeutics of pediatric dentistry, periodontology and implantology.

CONCLUSION

The development of new technologies marks a success in the development and improvement of simulators applied in the training of dental students. Dental simulators help provide an additional learning and teaching opportunity to acquire skills in various areas of dentistry where students can learn, develop, and improve their operative skills in a new and fun virtual simulation environment. The virtual patient application provides many opportunities to recreate clinical situations in virtual reality and will make learning even more rewarding and interesting for dental students.

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