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Letter to Editor

Simulation in Dentistry: An Evolving and Exciting Sphere

Dear Editor

Education has to evolve with continuous technological development. Due to students' global migration for higher education with transnational collaborations, there is an increased demand for educational standards by stakeholders, including parents. Relatively, the education sector acknowledges the importance of implementing a more efficient and evidence-based curriculum.

In dental education, the development of fine motor skills is very critical. It must be accomplished by progressive instruction in preclinical courses itself. Besides, numerous studies highlighted the stress experienced by dental students when they started performing dental clinical procedures after completing their preclinical training. The instructors are expected to address the students' stressful concerns.

Simulation has been used in pre-clinical dentistry education for many years. During the 18th century, restorative procedures were practiced on extracted teeth and bench-top models, as documented by the Baltimore College of Dental Surgery in Ohio.[1, 2] Since extracted teeth were in short supply, and the clinical setting was not as realistic, phantom head simulators were developed in the early 1900s. These were cast-bronze cases mounted on a metal pole, with upper and lower dental casts that resembled a human jaw with artificial or extracted teeth in occlusion. Mannequins with wooden heads and torsos, as well as masticatory equipment, were designed to improve the realism of pre-clinical simulation. These virtual patients, also known as mannequins, are currently used in pre-clinical training simulation labs at several dental educational institutions. Students are expected to replicate the operations on plastic or extracted teeth after studying instructional diagrams, photos, and models of the required techniques. An instructor then assesses the completed work and usually provides verbal feedback as well.

With the latest advancements in haptics, robotics, and virtual reality technologies, dental simulation provides more ideal practice settings, which will facilitate switching from the traditional model-based simulation laboratory to the clinic. Dental simulators may currently simulate clinical procedures such as restorative dentistry, endodontics, periodontal assessment, implant placement, and even dental extractions.[3]

An updated advanced curriculum must be revised to enhance students' skills, knowledge, and professional values. Thus, students can confidently enter into clinical contexts. To develop these skills, advanced simulation-based preclinical dental training is strongly recommended.

In the manual preclinical dental training, students are not trained on the commonly found clinical situations such as drifting, supra eruption, and tilting caused by arch integrity loss. Therefore, the students could be trained to address these expected clinical variations using simulation techniques. Researchers recommended problem-based learning, which might be beneficial for the students by enhancing their confidence level.

Simulation techniques emerged in the healthcare sector in the late 1960s. Mannequins were initially used to train in anesthesia delivery.[4] The latest advancement is a haptic virtual reality (VR) simulator that provides sensory feedback. By this technique, the actual clinic setup can be reconstructed. Thus, mannequins are positioned exactly the same as patients, with an average mouth opening and mandibular movements. It is also possible to simulate the pulp chamber, tongue, periodontium, and surrounding soft tissue structures found in the patient's mouth.

Haptics is the science of using touch (tactile) sensation and control to interact with computer applications. Haptics can be used to enhance a virtual reality or three-dimensional environment. Haptics technology can be used in conjunction with a visual display to train individuals for hand-eye coordination tasks, such as dental and medical procedures. Within a recreated virtual world of the mouth, it generates the illusion of material (teeth, alveolar bone, instruments, handpieces, burs, implants) and force. Using the senses of touch and proprioception, the haptic devices enable the operator to perceive

the manipulation of objects by providing force feedback of the virtual dental operating instruments as they come into contact with virtual teeth and alveolar bone.

The MOOG Simodont Dental Trainer was developed in collaboration with MOOG Nieuw-Vennep and the Academic Centre for Dentistry Amsterdam (ACTA), both in the Netherlands. Through the use of this Dental Trainer, dental students can receive tactile, visual, and audio-sensory information while being instructed in operative dental procedures in a dedicated immersive virtual reality environment. To develop hand skills, such as crown preparation and tooth decay treatment, dental burs and hand instruments are simulated. The system incorporates dental diseases to enable training from a problem-based approach. Teachers can modify and construct scenarios, while staff and software can monitor and evaluate students' work.[5]

The technology contributes to providing an additional learning and teaching opportunity for talents in several areas of dentistry by allowing students to study, grow, and enhance their operative skills in an engaging and cutting-edge virtual simulation environment. Thus, this article highlighted the necessity of integrating simulation into the preclinical dental education curriculum.

Authors' Contribution

Q A. A, PP.M, and D.D: Concept, writing, and reviewing the manuscript. All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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