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Local anesthesia training with mixed reality advanced dental simulators



KEYWORDS

Dental simulator;
Digital dentistry;
Local anesthesia;
Surgery;
Virtual reality

As dentistry continues to rapidly evolve, new technologies are arising within each specialty, making it essential for educational institutions to keep up with such advancements. One of the latest ways of educating future clinicians is the use of mixed reality advanced dental simulators (MRADSs).^{1–5} Such simulators allow for individuals to use a combination of virtual reality and tangible objects in order to mimic realistic patient experiences.

MRADSs have allowed students to practice different procedures such as prosthodontics and operative dentistry. Recently, new software application has been added to these simulators which offers the users the ability to exercise local anesthesia administration. Local anesthesia, especially the inferior alveolar nerve block (IANB), is a critical component of the surgical aspect of dentistry. The patient's opinion on dental procedures, such as extractions, osteotomies, and implant placements, is mostly based on the pain management. Achieving successful levels of analgesia increase patient comfort and make procedures more efficient for clinicians, resulting in an increase of patient satisfaction after complex procedures.

While the administration of anesthesia has a big effect on the patient's trust in their dentist, the IANB failure rates can be substantial and mostly due to the clinician's lack of technique rather than the anatomical variations seen in some patients. Operators, especially dental students and recent graduates, are likely to feel anxious and doubtful when injecting, resulting in failure to identify the

anatomical landmarks useful in applying the block and assumptions as to where to position the needle.

Institutions educate their students on anatomy, physiology, and pharmacology in order to better prepare them for administering local anesthesia. Following the curriculum, students practice administering the intraoral injections on manikins. While the texture of the manikin can resemble the penetration of soft tissue during anesthesia administration, the anatomy of the vasculature and nerves is absent. Although this training is an essential part of the dental school curriculum, an additional transition from classroom to patient is needed, such as these advanced simulators.

MRADSs allow clinicians to improve their manual dexterity by using a variety of components such as high resolution 3-dimensional display, instruments and handpieces, adjustable patient head with upper and lower jaw, and high-fidelity haptics with a large working range (Fig. 1). The screen displays both the realistic objects and the virtual world. In addition, the simulator integrates a haptic sensation of the virtual elements, resulting in the feeling of an authentic patient injection. A successful IANB is related to local anesthetic injection in close proximity to the nerve before it enters the mandibular foramen. The software provides the user with different settings that show various layers of the oral cavity such as the musculature, innervations, vasculature, and cranial and facial bones. As a result, the user has the option of visualizing all the vital

<https://doi.org/10.1016/j.jds.2023.03.008>

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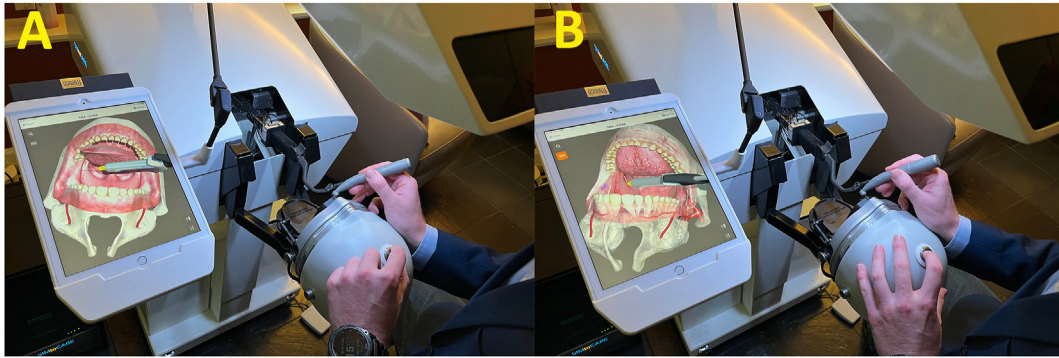


Figure 1 Mixed reality advanced dental simulator. (A) Integration of phantom head elements with haptic feel of virtual elements. (B) Various layers of the oral cavity during injection.

structures and where the anesthetic was displaced as well as any cross-section of the oral cavity. This allows for the student to receive instant and subjective feedback on the angulation and depth of the needle.

In conclusion, the mixed reality dental simulators can introduce dental students to realistic expectations of the clinic setting. The combination of preclinical course and simulators can better prepare students for intraoral injections and significantly increase the confidence of dental students as well as the success rate for IANB on patients undergoing complex and time-consuming procedures.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

Acknowledgments

This work was not supported by any organizations.

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Received 7 March 2023
Final revision received 8 March 2023
Available online 22 March 2023