International Journal of Advanced Research and Development
ISSN: 2455-4030
Impact Factor: RJIF 5.24
www.advancedjournal.com
Volume 3; Issue 4; July 2018; Page No. 40-42

Periosim: haptic-based 3d virtual reality teaching and training simulator in dentistry: A review

Niraj Chaudhari[1], Gaurav Thakare[2]
[1] Reader, CSMSS Dental College & Hospital, Aurangabad, Maharashtra, India
[2] PG Student, CSMSS Dental College & Hospital, Aurangabad, Maharashtra, India

Abstract
Haptic technology (sense of touch) along with 3D-virtual reality (VR) graphics, creating lifelike training simulations, was used to develop a dental training simulator system (PerioSim©). This preliminary study was designed to evaluate whether faculty considered PerioSim realistic and useful for training and evaluating basic procedural skills of students. The haptic device employed was a PHANToM™ and the simulator a Dell Xeon 530 workstation with 3D, VR oral models and instruments viewed on a stereoscopic monitor. An onscreen VR periodontal probe or explorer was manipulated by operating the PHANToM for sensing lifelike contact and interactions with the teeth and gingiva. Thirty experienced clinical dental and dental hygiene faculty judged the realism of the system. A PowerPoint presentation on one screen provided instructions for the simulator use with the 3D, VR simulator on a second stereoscopic monitor viewed with 3D goggles. Faculty/practitioners found the images very realistic for teeth and instruments, but less so for gingiva. Tactile sensation was realistic for teeth but not so for gingiva. The onscreen instructions were very useful with high potential for teaching. Faculty members anticipated incorporating this device into teaching and were enthusiastic about its potential for evaluating students' basic procedural skills. This study suggests that the preliminary "evidence-of-concept" was successful and PerioSim may aid students in developing necessary dental tactile skills.

Keywords: educational research, preclinical dental training, 3D virtual reality, haptics-based dental simulator, faculty content validity study

Introduction
Visual acuity and sensory motor skills are critical requirements for success in dentistry. Dentists and dental hygienists initially acquire these skills by practicing on replicas of human teeth and subsequently during supervised training on patients. Instructors find visual skills are easily described and explained, but verbal descriptions of tactile sensations are limited and difficult to describe. Current teaching technology does not allow a student to experience exactly how something should feel. With a haptic device (sense of touch), it is possible to capture tactile sensations, allowing users to feel what instructors have programmed them to feel. Such a prototype virtual reality (VR), dental training simulator (PerioSim©) has been developed at the University of Illinois at Chicago (UIC) College of Dentistry (COD).
Although the conventional techniques have their own importance in training but to practice on live patients, students/clinicians must know how to use the tools and the material properties of the organs (e.g. before taking up surgeries on real patients, we need to have a feel of soft tissues and bone texture, which is not possible in a conventional setup). Hence, a system, which simulates real dental procedures graphically and haptic ally, will be a better option to increase students' knowledge/experience level and to perform mock surgeries before they actually practice them on Live patients. Hence, introduction of haptic technology can bring about better outcomes with less error. It is a technology of tactile feedback that makes use of a user's sense of touch by applying vibrations, forces or motions to the user [1].

Background and Principal
Haptics-based simulators employ a haptic device and a platform to facilitate dental practicing (virtual models of a human tooth or mouth). The trainee holds the stylus of haptic device instead of real dental instruments and can manipulate the instruments, shown on the screen, which in turn reproduces clinical sensations in the hand of the operator through tactile feedback.
It works on the principles of creating virtual environment, which replaces the reality, and user can interact to perform various motor and perceptual tasks. It can help one to be mentally transported and immersed in virtual worlds through various computer software's.

Hardware includes
- Monitor and speakers
- Haptic interface device (stylus)
- Glasses and helmets for visualizing 2D video display as 3D
- Gloves to feel the sensations.

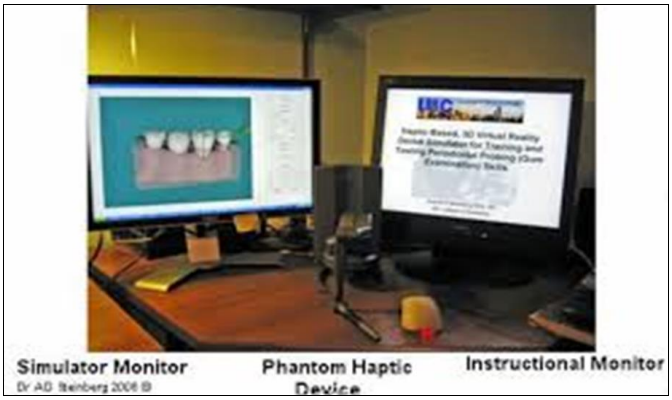

Fig 1

Application

PerioSim, a computerized virtual reality (VR) system that shows a 3-dimensional model of a quadrant of a lower arch, along with the controls to create a transparent version in which teeth, gingiva, bone and all underlying supportive structure are visible, is valuable in dental training. The system offers 3D, VR graphics and tactile sensation (haptics) allowing the user to feel a variety of dental instruments, such as a Shepherd's hook explorer for training in visualizing and detecting the feel of an caries active white spot lesion or use a VR periodontal probe to probe and evaluate the disease status of a periodontal pocket. The instrument pressure (in grams of force being applied to the gingival area) can also be viewed on a gauge and recorded. A control panel is available for fine control of a variety of parameters such as instrument and model selection, degree of model transparency, navigation, haptic fidelity of tissues and tremor modulation. Furthermore, the system allows instructors to create short scenarios of periodontal procedures, such as periodontal probing, which can be stored and played back by the student at any future time. During playback the trainee can cradle the stylus, observe a "ghost" of the original instrument and view the on-screen instrument movement. A recorded procedure can be paused and the 3D component of the program permits playback from any angle, so that the user can observe various views of an instrument as well as the tooth and gingival relationships during a procedure. The recorded procedure file can be transferred to any computer and, by using our proprietary viewer, the procedure can be observed as recorded in the simulator. This offers great training and testing potential for a variety of procedures.

In a second (playback) mode, the trainee holds the haptic stylus and actually physically feels it guiding his/her hands through exactly the same movements, and encountering the same tactile feedback, felt by the instructor who recorded the procedure. A testing component is available to both test and evaluate the student's ability to emulate the instructor's periodontal procedures scenario. Upon initiating the testing mode, the trainee can perform the same procedure recorded by the instructor and receive instant grading of how well he/she performed the procedure in all aspects of the procedure.

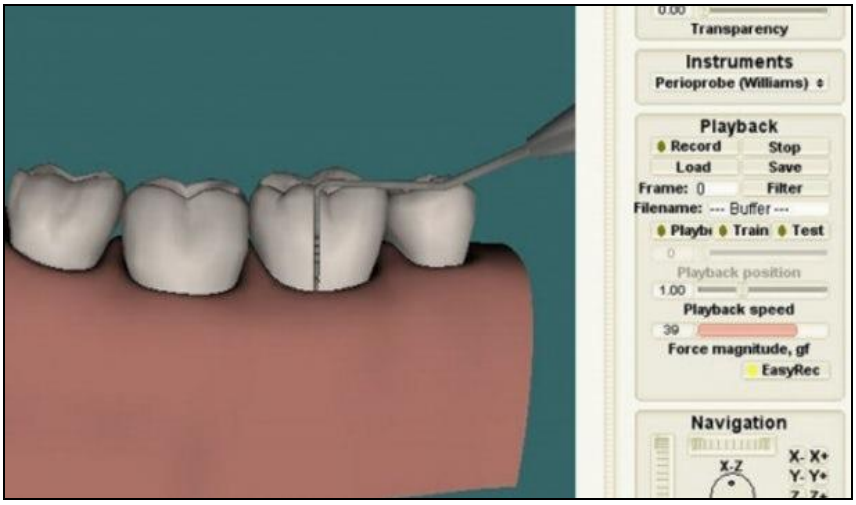

Fig 2

Advantages

- Reinforcement of learned dental concepts
- Correct use of dental instruments
- Correct ergonomic positioning: Incorrect operator or patient positioning can result in blocking the camera from reading the LED sensors and prevents the user from continuing by warning signals. This encourages the students to practice good ergonomic habits
- Good psychomotor skills [4].
- Faster acquisition of skills: Students attain a competency-based skill level at a faster rate than with traditional simulator units (phantom heads). This can result in changes in dental curriculum and earlier entrance into the pre-doctoral clinic.
- Self-evaluation: Students have immediate, unlimited, and objective access to detailed feedback of their work
- Standardized evaluation
- Positive student perception [5].

Disadvantages

- Virtual of augmented reality dental simulators are at an early or experimental stage
- A system limitation with the current design: The tactile perception for gingiva is not very real

- The initial cost of this advanced technology simulation can be substantial. Difficult equipment to maintain and repair: Technology-based systems require faculty/ engineering staff to be available for training and supervision of the laboratory

Conclusion

Virtual reality is the next step in dental education. The technologies of virtual reality innovate how clinical training takes place. Unlike existing systems for clinical courses, virtual reality systems overcome the limitations of phantom head systems and provide standardized case, objective assessment, and interactivity. They encourage a self-assessment process to identify self-directed learning and should become an integral part of any student training program.

References

1. Buchanan JA. Use of simulation technology in dental education. J Dent Educ. 2001; 65:1225-31. [PubMed]
2. Steinberg AD, Banerjee P, Drummond J, Zefran M. Progress in the development of a haptic/virtual reality simulation program for scaling and root planning. J Dent Educ. 2003; 67:161-5.
3. Luciano C, Banerjee P, DeFanti T. Haptics-based virtual reality periodontal training simulator. Virtual Real. 2009; 2:69-85.
4. Lefroy J, Brosnan C, Creavin S. Some like it hot: Medical student views on choosing the emotional level of a simulation. Med Educ. 2011; 45:354-61. [PubMed]
5. Bal GB, Weiss EL, Gafne N, Ziv A. Preliminary assessment of faculty and student perception of a haptic virtual reality simulator for training dental manual dexterity. J Dent Educ. 2011; 75:496-504. [PubMed]