Frameless

Volume 4 | Issue 1 Article 28

October 2021

# Simulating Implant Procedures in Dentistry

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The School of Dentistry in partnership with the health sciences library at the University of Utah developed VR simulations for dental implants. The benefits of using the technology included providing endless scenarios, evaluation measures, and experiential learning experiences for students [1]. The school administration found that the simulations kept pace with the requirements of regulatory authorities, helped reduce costs in dental education, and found that students who trained in VR scored significantly better than traditional methods largely due to their ability to repeat tasks and receive instant feedback [2, 3].

The classroom has a Vive professional tracking system integrated into the room. Students are in groups of 5 around a headset system. Students practice surgically implanting dental implants in VR. The peers and a licensed dentist grade the students' performance, and the computer tracks their work.

This research demonstration recreates an entire practicing dentist experience and includes understanding the anatomy, radiology, cutting filings and crown preparations, and restoring implants and prosthetics. Four digital modules were created to simulate implant procedures in Dentistry, and include:

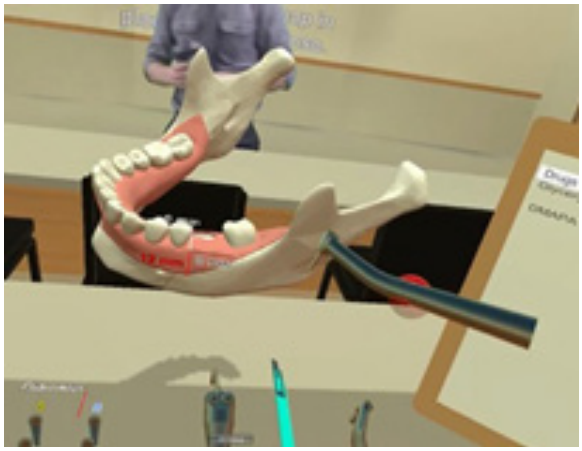

*Fig. 1. Dental module introducing students to the VR dental experience*

- **Direct and indirect dentistry module** simulates tooth cutting and allows students to practice cutting teach from a digitally designed tooth library.

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*Submitted April 15th, 2022*
*Accepted April 15th, 2022*
*Published online April 18th, 2022*

- **Restorative implant module** simulates the placement and restoration of dental implants. With the click of a button, the software can generate a limitless number and variety of patient scenarios.
- **Dental anatomy module** allows students to familiarize themselves with basic dental structures. Using CT scans, this module allows students to go spelunking through the tortuous caverns within an oversized molar root canal and incisors that are 25 times their usual sizes.
- **Dental radiology module** allows students to familiarize themselves with 3D dental scans through use of photogrammetry so scans become lifelike.

## APPLICATIONS

In classroom environments, haptics devices and Vive Pro headsets are calibrated alongside Oculus Quests. Students put on a Head-Mounted Display (HMD) and interact with the virtual world using hand tracking or controllers. Students are in a stationary location and require very little movement. Each demonstration has a level of data collection that gets posted to a database. The database maps onto an e-mentoring application that can link into university-level learning management systems or exported to a simple accounting spreadsheet, for easy grading and review for students.

## CONCLUSION

VR allows a dentistry school to create virtual scenarios that lecture, simulation clinic, and patient clinic cannot provide by offering endless dental scenarios in a virtual world.

**Keywords**– *virtual reality, dental, teeth*

*Table 1.*

| Timestamp | UID | Object | Grabs | Longest hold | Total hold | Correct |
|---|---|---|---|---|---|---|
| 4/25/2019 17:48:28 | 101 | maxillary First Pre-molar | 14 | 7.575652 | 23.09065 | |
| 4/25/2019 17:48:28 | 101 | Mandibular Central Incisor | 8 | 6.930193 | 17.12599 | |
| 4/25/2019 17:48:28 | 101 | maxillary Second Pre-molar | 12 | 7.563078 | 14.07186 | |
| 4/25/2019 17:48:28 | 101 | Mandibular First Molar | 8 | 2.976717 | 7.419136 | |
| 4/25/2019 17:48:28 | 101 | maxillary canine | 6 | 4.80895 | 7.907371 | |
| 4/25/2019 17:48:28 | 101 | Maxillary Molar | 10 | 3.45337 | 8.239147 | |
| 4/25/2019 17:48:28 | 101 | Mandibular First Pre-molar | 8 | 6.229895 | 17.51081 | |
| 4/25/2019 17:48:28 | 101 | Mandibular Canine | 6 | 6.529516 | 8.772834 | |
| 4/25/2019 17:48:28 | 101 | maxillary Lateral incisor | 2 | 3.465774 | 3.465774 | |
| 4/25/2019 17:48:29 | 101 | maxillary central incisor | 2 | 3.56538 | 3.56538 | |
| 4/25/2019 17:58:21 | 102 | maxillary Second Pre-molar | 4 | 5.664036 | 9.050459 | |
| 4/25/2019 17:58:21 | 102 | Maxillary Molar | 14 | 9.03046 | 21.35734 | |
| 4/25/2019 17:58:21 | 102 | Mandibular Second Pre-molar | 8 | 5.61922 | 9.307329 | |
| 4/25/2019 17:58:21 | 102 | maxillary Lateral incisor | 0 | 0 | 0 | |
| 4/25/2019 17:58:21 | 102 | maxillary First Pre-molar | 0 | 0 | 0 | |
| 4/25/2019 17:58:21 | 102 | maxillary canine | 0 | 0 | 0 | |

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