A Novel Approach to Clinical Simulation in Removable Partial Denture Treatment

Sabrina S. Garcia-Hammaker, DDS, MS[a]; Mark D. Snyder, DDS[b]; Gustavo Mendonça, DDS, MSc, PhD[c]; Berna Saglik, DDS, MS[d]

[a]Clinical Assistant Professor, Biologic and Materials Sciences & Prosthodontics, University of Michigan School of Dentistry, Ann Arbor, MI

[b]Clinical Assistant Professor, Biologic and Materials Sciences & Prosthodontics, University of Michigan School of Dentistry, Ann Arbor, MI [3] Clinical Associate Professor of Dentistry

[c]Clinical Associate Professor, Biologic and Materials Sciences & Prosthodontics, University of Michigan School of Dentistry, Ann Arbor, MI

[d]Clinical Associate Professor, Biologic and Materials Sciences & Prosthodontics, University of Michigan School of Dentistry, Ann Arbor, MI

Conflict of interest: None

Corresponding author:

Sabrina Garcia Hammaker, DDS, MS

University of Michigan School of Dentistry

1011 N. University Ave., #1020

Ann Arbor, MI 48109

samireth@umich.edu

734-9365032

Sabrina S. Garcia-Hammaker, DDS, MS; Mark D. Snyder, DDS;

Gustavo Mendonça, DDS, MSc, PhD; Berna Saglik, DDS, MS

Dr. Garcia-Hammaker is Clinical Assistant Professor, Biologic and Materials Sciences & Prosthodontics; Dr. Snyder is Clinical Assistant Professor, Biologic and Materials Sciences & Prosthodontics, Clinical Associate Professor of Dentistry; Dr. Mendonça is Clinical Associate Professor, Biologic and Materials Sciences & Prosthodontics; Dr. Saglik is Clinical Associate Professor, Biologic and Materials Sciences & Prosthodontics. All authors are in the University of Michigan School of Dentistry. Direct correspondence to Dr. Sabrina Garcia Hammaker, 734-936-5032, samireth@umich.edu.

PROBLEM

Dental students are required to complete at least one removable partial denture (RPD) prosthesis prior to graduation. The interruption of clinical activities due to the COVID-19 pandemic impaired some students from completing certain clinical requirements. Although temporary modifications were made following CODA recommendations, three students still required clearance to return to school to complete the patient-based RPD requirement.

SOLUTION

Since elective patient care was not an option, a non-aerosol producing simulation clinic alternate activity was designed and implemented in two stages:

1. Online Exercise: Students were required to complete pre-assigned online modules. Each module was carefully designed to consist of pertinent scientific articles, instructional videos, and PowerPoint presentations related to the delivery and maintenance of an RPD. Student formative assessment was done at the completion of each module with a short questionnaire, which was a combination of multiple choice and essay questions. Completion of the entire exercise was a prerequisite to proceed to stage two.

2. Simulated Removable Prosthodontics Clinic Case: Pre-prepared partially edentulous (Kennedy Class II, modification 1) maxillary and mandibular Frasaco® AN-4 typodonts (Greenville, NC, USA) were scanned using an intraoral scanner (Trios 3; 3Shape, Copenhagen, Denmark). For each arch, a one-piece RPD (framework, denture base, denture teeth) was designed (3Shape Dental Systems RPD module; 3Shape, Copenhagen, Denmark) and 3D-printed (Form2; FormLabs Inc., Boston, MA) in grey resin (FormLabs Inc., Boston, MA) to simulate a laboratory processed RPD (Figures 1-4). The one-piece

RPD included the following features: overextended flanges, hyperocclusion, and pressure areas in the intaglio surface of the denture base. Each student set up a simulated clinical environment in the assigned clinic, following standard infection control guidelines and PPE use. The typodont was mounted to a manikin head and shroud. Students were required to successfully deliver the 3D-printed maxillary and mandibular RPDs. Students were assessed on their ability to recognize and perform necessary adjustments to ensure successful delivery of an RPD. Infection control and patient management competencies were tailored accordingly to the simulation, but no other changes were made to the grading rubrics associated with the RPD competency exercise.

Examination integrity was ensured with an honor code statement, browser lockdown, and faculty supervision throughout the entire simulation exercise.

RESULTS

The RPD requirement was presented and evaluated through an alternative education activity to the students who were unable to complete the delivery of the prosthesis on a patient. In an attempt to provide the affected students with a meaningful learning experience, maxillary and mandibular 3D-printed models were used to simulate the delivery of an RPD.[1] Students' feedback was overwhelmingly positive. The exercise allowed them to improve and reinforce their critical thinking and hands-on skills.[2] Although the clinical exercise was meant to emulate the delivery of a laboratory processed RPD, the brittleness of the material used to print the 3D model did not allow the students to perform other clinical procedures, such as clasp adjustment. Differences in materials' properties (framework alloy vs. 3D printing resin) and clasp adjustment techniques were briefly discussed prior starting the activity. Also, the students missed the patient interaction that occurs during delivery since the procedure was done on a manikin. Overall, the exercise outcome was satisfactory and with some improvements could be considered in the future as a novel method to assess preclinical learning.

References

1. Mahrous A, Schneider G. Enhacing student learning of Removable Prosthodontics using the latest advancements in virtual 3D modeling. J Prosthodont 2019:28:471-472

2. Goodacre CJ: Digital learning resoruces for prosthodontic education: the perspectives of a long-term dental educator regarding 4 key factors. J Prosthodont 2018;27:791-797

Figures

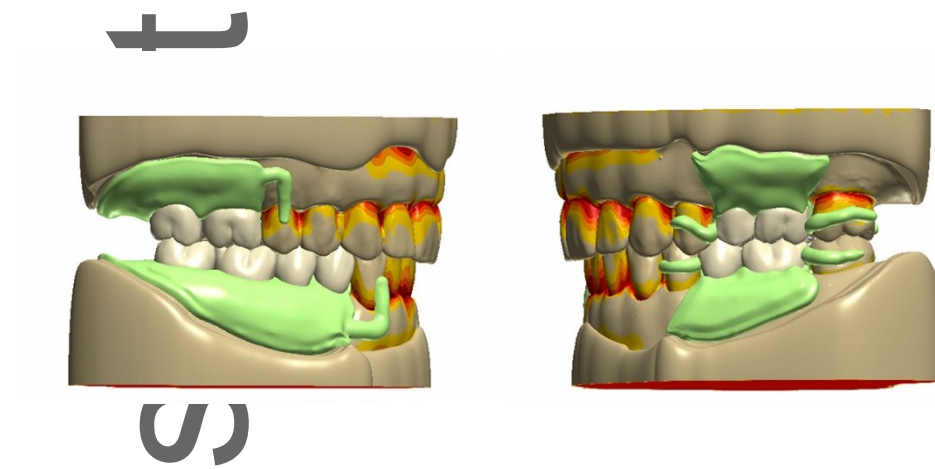Figure 1.
Screenshots
during one-
piece RPD
digital design.

Figure 2. 3D printed models, lateral view.
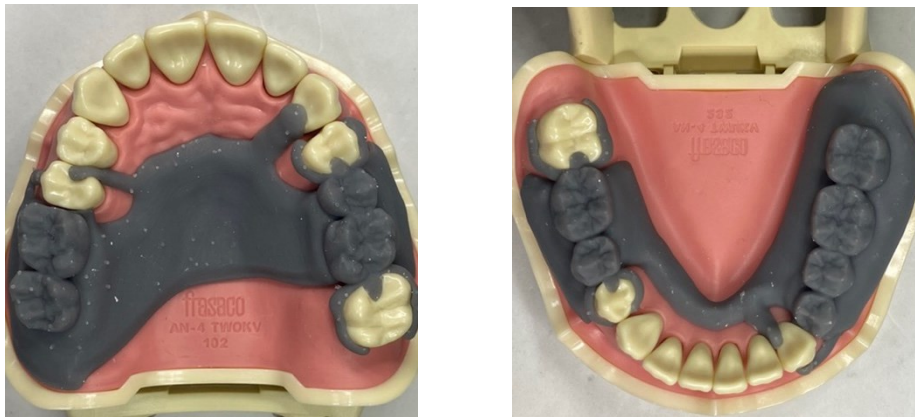
Figure 3. 3D printed models, occlusal view.

Figure 4. Close up of occlusal rest fully seated in rest seat preparation.

Three-dimensional models have been used in dental education[1] and have demonstrated increased spatial visualization by students.[2-6]

Three-dimensional models have been used in dental education[1] and have demonstrated increased spatial visualization by students.[2-]

Enhancing Student Learning of Removable Prosthodontics Using the Latest Advancements in Virtual 3D Modeling
Ahmed Mahrous, DDS, MS & Galen B. Schneider, DDS, PhD, FACP

Correspondence
Ahmed Mahrous, Clinical Assistant Professor,
Department of Prosthodontics, University of
Iowa, College of Dentistry, 801 Newton Rd.
DSB, Iowa City, IA 52242. E-mail:
ahmedmohamed-mahrous@uiowa.edu

Abstract
When educating dental students or prosthodontic residents, a picture can be worth a
thousand words. If that is so, then what could enhanced 3D modeling be worth relative
to enhancing student learning? The answer is undoubtedly more than what a picture
can provide. That is why the use of 3D models has become increasingly common with
respect to patient care. The 3D modeling allows the patient to visualize more clearly
the proposed treatments and outcomes; however, while 3D modeling has started to
make an appearance in dental education, many of the current 3D modeling techniques
do not offer the flexibility needed for dental education and enhanced student learning.
At the University of Iowa, the use of 3D modeling software has enabled the creation of
3D models that can be altered or customized to be used in a more flexible way to teach
students in the arts and complexities of removable partial denture (RPD) design and
associated components. This educational technique article will: (1) demonstrate how
these 3D models can be used to enhance student perception and learning regarding
RPDs; and (2) will demonstrate using videos and web-based portals to show how the
3D RPD models were created and then used for educational purposes.

Removable prosthodontics education can be challenging for
dental students. This is particularly true relative to technologi-
cal advancements that have evolved rapidly over the past several
years; however, 3D models and computer-generated imagery
have become commonplace in the entertainment industry and
media. In recent years, consumer-grade computers have be-
come powerful enough to harness this power and deliver it to
consumers. Many free software packages give consumers the
ability to generate and design a 3D model of anything they
would like to create. At first, using 3D modeling software can
be challenging for a novice; however, the advantages of in-
troducing 3D modeling in dental education and using such an
educational platform for educating dental students and residents
in the art of removable prosthodontics are hard to ignore.
Three-dimensional models have been used in dental
education[1]
and have demonstrated increased spatial visualiza-
tion by students.[2-]

Enhancing Student Learning of Removable Prosthodontics
Using the Latest Advancements in Virtual 3D Modeling
Ahmed Mahrous, DDS, MS & Galen B. Schneider, DDS, PhD, FA