Simulation Training in Implant Restorative Care for Single-Tooth Sites and Implant Overdenture Prosthetic Rehabilitation

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Abstract

Introduction: Current preclinical implant rehabilitation training may lack fidelity to clinical experiences, leaving students less prepared for patient care. A pilot course was created to enhance this fidelity in training.

Methods: In a lecture format, learners are introduced to treatment planning for single-tooth sites. During hands-on exercises using typodonts within a simulation mannequin head, learners fabricate provisional implant crowns, make open and closed tray impressions, and pour impressions for single-tooth implant crown fabrication. In a benchtop exercise, learners place attachments into complete denture prostheses to attach to implant abutments on a mandibular model. Student performance was evaluated using preestablished assessment rubrics, with students self-assessing their performance using the same rubric parameters.

Results: Two independent clinical performance assessments and a written multiple-choice assessment were conducted, with all students passing these assessments. After graduation, participants were surveyed as to how well the course prepared them to provide implant restorative care. Over half of the course participants rated the course as valuable to very valuable in preparing them to provide implant rehabilitation to future patients. Nearly all respondents agreed that the course should be offered to current dental students.

Discussion: Since simulated procedures performed in a mannequin head more closely approximate patient care, this methodology may more effectively advance students to the level of competency in implant rehabilitation. Future course expansion may include treatment of multiple tooth sites, incorporating the mannequin head into the overdenture prosthetics module, and surgical training.

Keywords
Dental Implants, Implant-Supported Dental Prostheses, Preclinical Simulation Training

Educational Objectives

After completing this course, learners will be able to:

1. Demonstrate the parameters for consideration during treatment planning for single-tooth implant rehabilitation.
2. Demonstrate competency in providing the following single-tooth implant restorative procedures: making open and closed tray impressions, generating working casts for fabrication of single-tooth implant crowns, and fabricating immediate provisional single-tooth implant restorations.
3. Demonstrate competency in providing the following implant overdenture prosthetic procedure: insertion of two attachments into a previously fabricated implant overdenture prosthesis.

Introduction

Current preclinical dental education curricula in implant rehabilitation for predoctoral students make use of simulation typodont models containing implant analogs. Students commonly hold these typodont models in their hands as they perform specified simulated implant treatment procedures. Such training methodologies lack fidelity to true clinical experiences and fail to provide preclinical students with an accurate perspective to conceptualize how the simulated procedures they perform translate to clinical practice. This may result in students being less prepared than is desired to provide patient care in implant rehabilitation.
Few reports exist in the current literature describing alternative methods to more accurately simulate implant rehabilitation patient care in preclinical training. This is in spite of recent reviews of the current state of dental curricula in which the need to advance training in implant rehabilitation for predoctoral students was identified.

This pilot course was created to meet the perceived need to enhance simulation training for preclinical dental students in the field of implant rehabilitation. By making use of models designed to function within a simulation mannequin head for most of the session procedures, this course creates a more realistic training experience for students consistent with other simulated training in restorative and prosthetic dentistry. The knowledge-based lecture material presented includes detailed treatment-planning considerations as an accompaniment to this high-fidelity hands-on experience.

Methods
A multimedia presentation/hands-on course was designed at the Midwestern University College of Dental Medicine-Illinois (CDMI) to instruct preclinical dental students in providing implant restorative care for both single-tooth edentulous segments and complete edentulism in a simulated patient care environment. In a lecture format, learners are introduced to parameters for assessment of a single-tooth edentulous site as part of the process of treatment planning for implant rehabilitation. In a series of hands-on exercises that includes use of typodont models placed into simulation unit mannequin heads, learners are guided through the step-by-step processes for fabrication and delivery of a cement-retained single-tooth provisional implant crown for site #8, including the preparation of a temporary implant abutment. Learners then perform impression-making procedures using both open and closed tray techniques, followed by pouring an impression to generate a master cast for implant abutment/definitive single-tooth crown fabrication. With the use of typodonts within the mannequin heads, this training segment more closely simulates the actual patient care experience. In a benchtop exercise, learners are guided through the step-by-step process of placing two attachments into a prefabricated complete denture prosthesis designed to attach the prosthesis onto two implant overdenture abutments contained within a model of an edentulous mandibular arch.

Resources required for participation in this course include access to view PowerPoint presentations and original videos (provided by us) demonstrating preparation of a provisional implant abutment. Two additional videos demonstrating placement of implant attachments into mandibular overdenture prosthesis are also included (videos provided courtesy of Dr. Michael Scherer and Dr. Scott Maclean, respectively). Learners require access to simulation facilities as appropriate to conduct the exercises. Detailed course requirements are listed below.

Material Needs
- Typodont models that permit removal of a selected tooth followed by modification using an implant analog luted in place using autopolymerizing acrylic resin (e.g., ModuPRO Pros typodont).
- Implant components and instrumentation including impression copings, implant analogs, temporary abutments, implant overdenture attachment kits, and appropriate hand drivers (e.g., ASTRA TECH OsseoSpeed).
- Materials commonly used for impression making, pouring impressions, and in the fabrication of provisional restorations in implant restorative dentistry.
- Typodont models containing two mandibular implant overdenture attachments and a corresponding mandibular implant overdenture prosthesis (e.g., Paradigm Dental Models, ZEST Anchor).
- Materials commonly used for pickup/retention of implant overdenture attachments within a denture prosthesis (e.g., Chairside Attachment Processing Material).

Course Files Provided
Session one comprises two modules: Module 1 - Treatment Planning for Single-Tooth Implant Rehabilitation (Appendix A) and Module 2 - Fabrication of an Immediate Single-Tooth Provisional Implant Restoration (Appendix B). Additionally, there are seven training videos demonstrating temporary abutment preparation (Appendices C-I).

Session two comprises Module 3 - Impression Making and Master Cast Fabrication for Single-Tooth Implant Restoration (Appendix J.) Session three comprises Module 4 - Placing Attachments Into Complete Implant
Overdenture Prostheses (Append K), as well as training videos on placement of implant attachments into a mandibular overdenture prosthesis (Appendices L-M).

Facility Needs
The course requires preclinical dental simulation facilities containing mannequin heads and dental instrumentation as commonly used in dental education for simulated patient care training.

Length of Session
Faculty should allot one 3½-hour session each for (a) presentation and training in single-tooth implant provisionalization, (b) impression making and pouring/trimming of final casts, and (c) implant overdenture attachment placement into a prefabricated mandibular overdenture prosthesis. Additionally, 3½-hour sessions should be allotted for both independent student practice in preparation for independent clinical performance assessments (ICPAs) and the ICPAs and written assessment.

Faculty preparation needs to include access to all presentations and videos by both faculty and students, faculty calibration in advance of the course, and an adequate faculty-to-student ratio for effective simulation training (we recommend a 1:10 to 1:12 ratio).

The course was introduced to the fourth-year (DMD-4) dental students at Midwestern University CDMI. Student performance during each training session was assessed by calibrated course faculty using preestablished assessment rubrics. Students self-assessed their performance using the same rubric parameters. Upon course completion, two ICPAs were conducted. During the first ICPA, independent student performance in preparing a temporary implant abutment and fabricating a cement-retained provisional implant crown was assessed. In the second ICPA, student independent performance in placing two implant attachments into a complete mandibular overdenture prosthesis to attach to the two abutments contained in the edentulous mandibular model was assessed. A final written multiple-choice assessment was conducted to test cumulative knowledge acquired on a variety of topics presented during the quarter, including this course on implant rehabilitation.

After graduation, course participants were contacted with a request to complete an anonymous online survey in an attempt to determine course effectiveness as judged by the participants. Instructions included responding to the following questions: “Rate the value of your experience in the simulated implant rehabilitation training session provided during DENT 1851 in preparing you to provide single-tooth implant restorative treatment to your future patients” and “Rate the value of your experience in the simulated implant rehabilitation training session provided during DENT 1851 in preparing you to provide implant overdenture prosthetic treatment to your future patients.” Participants were asked to rate their responses to each question using a scale of 1 to 5 (of no value to very valuable). Participants were also asked, “Would you recommend that the DMD-3 students at CDMI (Midwestern University Class of 2016) take this course?” This required a yes or no response. All responses were qualitatively assessed as proportional values.

Results
One hundred twenty-nine DMD-4 students participated in this pilot course inaugurated during the fall academic quarter of 2014. Using the assessment rubrics, course faculty judged the students to have satisfactorily completed all assignments for each training session. All students then satisfactorily completed both ICPAs and the final multiple-choice assessment. Outcomes for this written assessment were not examined to determine the level of student performance specifically in the area of implant rehabilitation.

Seventy-one participants (55%) responded to the postgraduation online survey, with 62 respondents (88.7%) rating the course as valuable to very valuable in terms of preparing them to provide single-tooth and implant overdenture prosthetic implant rehabilitation treatment to future patients. Seventy of the respondents (98.6%) agreed that the course should be offered to current dental students.

Discussion
Providing students with meaningful preclinical exercises in implant rehabilitation presents challenges in dental education. High-fidelity simulation training is critical for preparing students to perform safe and effective implant rehabilitative patient care within a dental school clinic and ultimately in clinical practice. This course
uniquely contributes to implant rehabilitation education through the heavy emphasis on sessions that make use of a simulated mannequin head. Procedures are then performed in a manner that most closely approximates patient care. It is anticipated that this enriched preclinical implant training will more effectively aid dental students to advance to the level of competency in implant rehabilitation. The course offers further potential for incorporation into continuing education courses designed to augment training for new dental school graduates and other dental health professionals who might wish to advance their training through this simulated experience. We are unaware of other courses in implant rehabilitation commonly used in dental school education today that offer a level of high-fidelity preclinical training experiences in implant rehabilitation similar to that provided by this course.

Successful postcourse ICPA outcomes demonstrated that participants had acquired the necessary skill sets to perform each exercise at a satisfactory level. The results of the postgraduation survey suggest that participants identified value in this simulated training in preparing them to provide these specific areas of implant restorative care. These results also suggest that the course content is sufficient to prepare learners in provisionalization and impression making for single-tooth sites as well as for placing attachments into implant overdenture prostheses.

In order to successfully deploy this educational resource, make sure all PowerPoint modules and videos are available for independent learner review prior to the course to enhance learner understanding of course content and session performance. Acquire in advance all materials and implant parts required to conduct the course. Discuss with administrators ways to plan the course within confines of curricular schedules and institutional budgets. Detailed calibration of faculty participants is also helpful in effective use of this module.

The course offers significant opportunities for future expansion to improve the training experiences. Near-term steps planned at Midwestern University CDMI to be taken to improve this educational resource include the following:

1. Use of an edentulous mandibular typodont model designed to function within the simulation mannequin head to improve training fidelity in implant overdenture prosthetic treatment.
2. Training in fabrication of both cement-retained and screw-retained provisional implant crowns.
3. Expansion of posttraining surveys to be conducted with both future graduates and students currently practicing in the university clinic to more closely assess the impact of training on clinical performance in implant rehabilitation and identify further avenues for course improvement.

We have additional recommendations for future changes to improve this educational resource. One is treatment of multiple continuous sites to simulate fixed partial denture prosthetic treatment in implant rehabilitation within the simulation mannequin head. Another is the creation of an edentulous segment to permit surgical implant placement training within the simulation mannequin head.

Challenges for implantation of this educational resource include financial resource commitment required by a sponsoring institution. Costs incurred include onetime purchases of models, implant parts, and instruments as well as recurrent costs for consumable materials and implant parts. In order to approach costs in a fiscally responsible manner, it is possible to implement the course in a stepwise approach. This may include conducting the individual modules at different times throughout the 4-year curriculum. In the future, this preclinical training in implant rehabilitation at Midwestern University CDMI will be conducted over the course of 2 years for the DMD-2 and DMD-3 students. Based on the favorable student responses, this course has become a routine part of the curriculum at Midwestern University CDMI.
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Ethical Approval
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References

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