Removable Partial Denture Education in U.S. Dental Schools

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Purpose: A survey of U.S. dental schools was conducted in 2001 to determine the curricular structure, techniques, and materials used in predoctoral clinical removable partial denture (RPD) programs.

<u>Materials and Methods</u>: The questionnaire was mailed to the chairperson of the prosthodontic/restorative departments of 54 U.S. dental schools. Of these, 44 schools returned the completed survey, resulting in a response rate of 82%.

<u>Results</u>: Results from this survey show that a large majority of schools are using similar materials in clinical RPDs; for instance, using modeling compound for border molding final impression trays (61%) and using a semi-adjustable articulator for mounting preliminary casts (90%) and final casts (98%). In addition, a large majority of schools are using similar techniques in clinical RPDs, such as border molding the edentulous areas of the final impression tray (80%) and using the altered cast impression technique (59%). A set post-insertion protocol is present for patients who receive partial dentures in the majority of the schools (93%). Only 25% of schools reported incorporating new educational materials such as the use of Portrait artificial teeth at the predoctoral level. Eighteen percent of schools are allowing students to graduate without a set number of RPD clinical requirements as has been traditionally the case.

<u>Conclusions</u>: Predoctoral clinical RPD programs vary from school to school, yet a large percentage of schools agree on many topics.

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INDEX WORDS: dental education, removable prosthodontic education, survey, removable partial denture materials, techniques, clinical curriculum

I N 1995, the Institute of Medicine published a report emphasizing the need for dental educators to reassess the predoctoral prosthodontic curriculum to make it more relevant to clinical practice for the general practitioner.¹ Such a curriculum will be important, considering that millions of individuals without complete dentitions will require prosthodontic treatment well into the 21st century.²

With the introduction of preventive dentistry in the middle of the 20th century, most people

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now realize that natural teeth can be retained for life. In the past two decades, there has been a steady decline in the prevalence of tooth loss and edentulism in the United States,³ and the number of people who are retaining their natural teeth is growing rapidly.^{4,5}

There have been recent speculations among prosthodontists and dental educators that if edentulism and tooth loss continue to decline in the coming decades, the need for prosthodontic services will also decline; however, a recent report showed a large and growing need for prosthodontic treatment that will exceed the supply available in the years 2005, 2010, and 2020.³ This report estimated that the need for fixed and removable partial dentures (RPDs) would actually increase due to the substantial growth of the U.S. population and the extended life expectancy of the population.

Therefore, dental education programs must continually evaluate their portion of the removable prosthodontic curriculum to ensure that the dental health needs of society and the goals and objectives of the commission on Dental

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Accreditation of the ADA are being met.⁶ Prosthodontic curriculum and laboratory delegation surveys are useful tools in assessing prosthodontic education.⁶

In the partially dentate patient, dental implants are a possible treatment option; however, due to increased cost of treatment and lack of insurance coverage of dental implants, RPDs still need to be taught in dental schools as a mode of treatment.

The aim of this survey was to determine the current trends in predoctoral RPD clinical programs and to determine what newer educational techniques and materials are being used by U.S. dental schools.

Materials and Methods

In November 2001, a questionnaire (see Appendix) was mailed to the chairperson of the prosthodontic/restorative departments of 54 U.S. dental schools, requesting information on their predoctoral clinical RPD curricular content. Following a second mailing to schools that had not returned the questionnaire within a 3-month period, 44 of the 54 schools responded, yielding a response rate of 82%.

The survey contained 16 multiple-choice questions and asked the respondents to circle all responses that applied to their programs. The option of providing a specific answer other than the listed choices was available for each question. The questions were pilottested on-site by faculty members who approved of the questionnaire before it was mailed to other schools.

Results

Artificial Teeth Available in Clinics for Students to Use (Question 1)

The type of artificial teeth available for RPD cases are summarized in Table 1.

Materials Used in Border Molding the Final Impression Trays for the Partially Dentate Patient (Question 2)

The materials available for border molding RPD impression trays are summarized in Table 2.

 Table 1. Type of Artificial Teeth Used for Clinical RPDs

Answer	Number of Schools Responding (%)
Bioblend only	3 (7)
Biotorm only	0(0)
Portrait only	11 (25)
Ivoclar only	0(0)
Myerson only	1 (2)
Other* only	0(0)
Bioblend, Bioform, and Portrait	9 (20)
Bioblend and Portrait	2(5)
Bioblend, Bioform, Portrait, and	1 (2)
Ivoclar	
Other [*] and Portrait	4 (9)
Bioblend and Bioform	3 (7)
Bioform and Portrait	3 (7)
Bioblend, Bioform, Portrait, and	2 (5)
Myerson	
Bioform and other*	1 (2)
Portrait and Ivoclar	2(5)
Bioblend, Bioform, Portrait,	1(2)
Ivoclar, and other*	- (-)
Bioform, Portrait, and Ivoclar	1 (2)

*Other included Vitapan, Justi, Verident, and Classic.

Use of a Custom Tray for Making Final Impressions of Partially Dentate Arches (Question 3)

Twenty-one schools (48%) reported that they teach their students to use a custom tray for making final impressions of partially dentate arches; 4 schools (9%) reported that they did not teach this; 18 schools (41%) indicated that they "sometimes" use a custom tray for the final impression. Some of the comments of the schools that responded "sometimes" were: "maxillary always, mandibular rarely," "for mandibular distal extension situations." One school (2%) did not respond.

Border Molding the Edentulous Areas of the RPD Final Impression Tray (Question 4)

Thirty-five schools (80%) indicated that they teach border molding of the custom tray for the edentulous areas of the final impressions; seven schools (16%) indicated that they do not teach this. Of the seven who replied that they do not teach border molding, two schools indicated that they border mold "only for altered cast procedures." Two schools (4%) indicated "other" as their response. This included "sometimes" and "when appropriate, not routine."

Answer	Number of Schools Responding (%)*
Modeling impression compound only	27 (61)
Polyvinylsiloxane only	1(2)
Polyether only	0 (0)
Polysulfide only	0(0)
Wax materials only	0 (0)
Other** only	5 (11)
Modeling impression compound and polyvinylsiloxane	2 (5)
Modeling impression compound, polyvinylsiloxane,	1 (2)
Modeling impression compound, polyvinylsiloxane, and other**	1 (2)
Modeling impression compound and other**	1 (2)
Modeling impression compound and polysulfide	2 (5)
Modeling impression compound and wax materials	2 (5)
Modeling impression compound and polyether	1 (2)
No response	1 (2)

 Table 2. Material Used for Border Molding Final Impression Tray in Clinical RPDs

*Rounding error, does not equal 100%.

**Other included no border molding, light-cured composite resin (Triad, Denstply, York, PA), Coe-Comfort (GC America Inc., Alsip, IL), irreversible hydrocolloid, and utility wax.

Amount of Wax Relief for Custom Tray for a RPD (Question 5)

Twenty-nine schools (66%) indicated that they teach placement of relief wax on the teeth and the edentulous areas; six schools (14%) indicated they place relief on the teeth areas only; three schools (7%) indicated they do not use relief; one school (2%) indicated they place relief on edentulous areas only; three schools (7%) indicated "other." "Other" included: "no custom trays used," "edentulous areas for altered cast procedures only," and "case-based." Two schools (4%) did not respond.

Articulator Used to Mount Final Casts (Question 6)

Forty-three schools (98%) indicated that they use a semi-adjustable articulator to mount final RPD casts; one school (2%) indicated that it uses a combination of the following: "simple hinge type articulator with lateral movement capacity, semi-

Number of Schools Answer Responding (%) Polysulfide only 7(16) Polyether only 1(2)3 (7) Polyvinylsiloxane only Irreversible hydrocolloid only 11(25)Other only (Coe-Comfort) 1(2)Polysulfide and polyvinylsiloxane 4 (9) 1(2)Polysulfide, polyether, and polyvinylsiloxane Polyvinylsiloxane and 6(14) irreversible hydrocolloid Polysulfide, polyvinylsiloxane, 4(9)and irreversible hydrocolloid 6(14)Polysulfide and irreversible hydrocolloid

adjustable articulator and it depends on the occlusal scheme."

Articulator Used to Mount Preliminary Casts (Question 7)

Forty schools (90%) indicated that they use a semiadjustable articulator; two schools (5%) indicated that they use a simple hinge type articulator with lateral movement capacity. Two schools (5%) did not respond.

Materials Used for Final Impressions of Partially Dentate Arches (Question 8)

The materials used for RPD final impressions are summarized in Table 3.

Flasking of RPDs by the Students (Question 9)

Forty-one schools (93%) indicated that their students do not flask their clinical RPD cases; one school (2%) indicated that its students flask their RPDs. Two schools (5%) indicated "sometimes" and responded "only if the students choose to do so because of time constraints."

Material Used for RPD Frameworks (Question 10)

The materials for RPD frameworks are summarized in Table 4.

Table 3. Materials Used for Final Impressions of RPDs

Table 4. Materials Used for RPD Frameworks

Answer	Number of Schools Responding (%)*
Chrome-cobalt only Ticonium only Vitalium only Other only Chrome-cobalt and ticonium Chrome-cobalt, ticonium, and	18 (41)6 (14)9 (20)0 (0)2 (5)2 (5)
Chrome-cobalt and vitalium Ticonium and vitalium Vitalium and other (chrome-cobalt without nickel) No response	3 (7) 1 (2) 1 (2) 2 (5)

*Rounding error, does not equal 100%.

Use of Attachments (Question 11)

Twenty-seven schools (61%) indicated that they did not incorporate attachments with RPDs; 17 schools (39%) indicated that they use attachments. The schools that reported they were using attachments indicated they were using the following attachments: ERAs (Sterngold, Attleboro, MA), Zest Anchors (Zest Anchors Inc., Escondido, CA), Rothermann (Sterngold), O-rings, and intracoronal attachments.

Availability of an In-House Laboratory Responsible for Fabricating RPD Frameworks (Question 12)

Twenty-nine schools (66%) indicated that there is no in-house laboratory for the fabrication of RPD frameworks; 15 schools (34%) indicated that they have an in-house laboratory. An additional question pertaining to the schools with an in-house laboratory asked whether the students are given an opportunity to cast a RPD framework. Of the 15 schools that had the in-house laboratory, 3 schools (20%), responded that they give the students the opportunity to cast a RPD framework; 12 schools (80%) responded that they do not give the students this opportunity.

Use of the Altered Cast Technique for Bilateral and Unilateral Distal Extension Situations (Question 13)

Twenty-six schools (59%) indicated that the students are required to perform the altered cast technique for both bilateral and unilateral mandibular situations; eight schools (18%) indicated that the students are not required to perform this technique. Ten schools (23%) indicated "other." "Other" included: "not a requirement but is done in over 50% of cases," "only if necessary," "optional in the maxilla," "students are encouraged to evaluate support achieved with record base and pressure indicating paste to determine if an altered cast is required," and "in some situations."

A Set Post-Insertion Protocol for RPD Patients (Question 14)

Forty-one schools (93%) indicated that there is a set protocol for post-insertion adjustment visits of RPD patients in the clinics; two schools (5%) indicated that there is no set protocol. One school (2%) did not respond.

Minimum Number of RPD Units (1 arch = 1 unit) That a Student Must Complete to Graduate (Question 15)

Thirty-four schools (82%) indicated that there is a minimum number of units a student must complete toward graduation; ten schools (18%) indicated that there is no minimum number. For the schools that replied that there were minimum requirements, the mean number of units was 3, the median was 3, and the range was 1 to 6 units.

Transitional RPD Arches (units) or Partial Arches Required Toward Graduation (Question 16)

Twenty-three schools (52%) indicated that transitional/interim RPDs do not count toward graduation requirements; 20 schools (45%) indicated that they do count toward graduation requirements. Of the 20 schools that indicated that these prostheses count toward graduation, some of their write-in responses included: "worth 1/2 of a unit," "worth 1 unit," "depends on the complexity of the cases," "we do not count units." One school (2%) did not respond to this question.

Discussion

The results of this clinical RPD curriculum survey of U.S. dental schools show that prosthodontic education is strikingly similar in some aspects and diverse in others.

A large majority of schools are using similar materials and techniques in clinical RPD. Slightly less than half the respondents (48%) are teaching the use of a custom tray for making final impressions; however, border molding remains a commonly performed procedure for final impressions (80%). Modeling impression compound for border molding final impression travs appears to be the material of choice for many programs (61%); however, there is a wide variability in the type of final impression material used among schools. Irreversible hydrocolloid seems to be used most widely (25%), followed by polysulfide (16%) and polyvinylsiloxane (7%). Similarly, the materials used for the fabrication of RPD frameworks vary among schools. Chrome-cobalt (41%), vitalium (20%), and ticonium (14%) are the most widely used materials. The type of artificial teeth used among schools also varied. Portrait teeth seem to be the most widely used teeth exclusively (25%).

The semi-adjustable articulator is the type of articulator most widely used for mounting final casts (98%) and preliminary casts (90%). This is consistent with results from previous studies, which showed that 86% of dental schools were using a semi-adjustable articulator in the preclinical RPD curriculum.⁷ Similarly, 98% of schools were using this type of articulator in the clinical complete denture program.⁸

In this survey, the trend appears to be that the majority of schools (93%) are not requiring students to flask their RPD cases. This is consistent with a previous survey⁷ of preclinical RPD curricula of U.S. dental schools that found a majority of schools (91%) were not requiring processing of RPDs by students in the laboratory. Similarly, a study of clinical complete denture programs revealed that 80% of dental schools were not requiring students to flask their complete denture cases.⁸ Therefore, these results indicate a trend toward the increased use of technicians for the completion of laboratory-related tasks.

Fifty-nine percent of schools are requiring students to complete the altered cast impression technique for their clinical cases. This is consistent with a 1984 survey⁹ that looked at removable prosthodontic curricula in U.S. dental schools and found that only 48% of schools were teaching the altered cast impression technique for mandibular distal extension partial dentures at the predoctoral level. Also this study found that only 12 schools (24%) required that students flask partial dentures. This is a higher percentage compared with the current study, which found that only one school (2%) required students to flask RPDs. In addition, in the current study, 66% of schools indicated that there is no in-house laboratory support for RPD cases. This is in sharp contrast to the 1984 survey⁹ of schools which showed that 96% of schools were providing the services of certified dental technicians at their institutions.

These results indicate an apparent trend that fewer schools are now delegating work to inhouse laboratories; rather, these schools are sending work to commercial laboratories. This finding is consistent with previous studies,^{10,11} which looked at the amount of clinical laboratory work delegated by dental students to the laboratory technicians. These studies showed that there is a trend toward decreased use of in-house laboratory technicians for flasking RPDs, 68% in 1977 versus 57% in 1995. One reason delegation of laboratory work to commercial laboratories has increased is because of the gradual decrease of in-house laboratory support in the past couple of decades.¹⁰ Another reason for this increase could be that schools are now focusing more on teaching their students to become competent in clinically relevant skills rather than laboratory-related skills that can be delegated.¹²

Most schools (93%) agree on the necessity of having a set post-insertion protocol for RPD patients. Similarly, most schools (82%) are requiring a minimum number of RPD requirements for graduation. This is consistent with a previous survey of clinical complete denture programs, which showed that 84% of dental schools have a minimum number of complete denture requirements for graduation.⁸ One reason some schools are not requiring RPDs for graduation could be the increased use of dental implants and implantsupported fixed restorations as an alternative treatment modality to the removable prosthesis for the partially dentate arch.

Conclusions

A survey was conducted for clinical RPD curriculum in all predoctoral American dental schools. Eighty-two percent responded. Information obtained from the responding schools included materials and educational techniques used and requirements toward graduation. The responses were tabulated. There is some variability from school to school on certain aspects of the techniques and materials used and graduation requirements. However, there were some similar trends indicated by the large percentage of schools agreeing on:

- *1.* Teaching of border molding for edentulous areas of RPD final impressions,
- 2. Type of material used for border molding,
- 3. Use of wax relief on teeth and edentulous areas,
- 4. Articulator used for mounting both preliminary and master casts,
- 5. Delegation of flasking the RPDs to the laboratory technician,
- 6. A set post-insertion protocol for adjustments,
- 7. Lack of use of attachments with RPDs,
- 8. Sending cases to commercial laboratories for framework fabrication,
- 9. Use of the altered cast technique for bilateral and unilateral distal extension situations,
- *10.* Requiring a minimum number of RPD units for graduation, and
- 11. Not counting transitional/interim RPDs toward graduation.

The questions with the most variable responses were:

- 1. Use of a custom tray for final impressions,
- 2. Type of artificial teeth used,
- 3. Type of material used for final impressions, and
- 4. Type of material used for RPD frameworks.

Appendix: Questionnaire sent to U.S. Dental Schools

Name of Dental School	
Date of Survey Completion	

Instructions: Please circle all responses that apply to your school's removable prosthodontic clinical curriculum. More than one answer may be selected. All data collected will be kept strictly confidential and will not be identified by individual schools in any future publications or presentations. Thank you for your cooperation.

The following questions relate to the clinical curriculum in REMOVABLE PARTIAL DEN-TURES:

- What kind of artificial teeth do you currently have available in your clinics for your students? a Bioblend
 - b Bioform
 - c Portrait
 - c Portrai
 - d Ivoclar
 - e Myerson
 - f other (please specify)____
- 2. What material(s) do you currently teach for use in border molding the final impression trays for the partially dentate patient?
 - a modeling plastic impression compound
 - b polyvinylsiloxane
 - c polyether
 - d polysulfide
 - e wax materials
 - f other (please specify name of product and company)_____
- 3. Are you currently teaching your students to use a custom tray for making final impressions of partially dentate arches?
 - a yes
 - b no
 - c sometimes
- 4. Do you teach border molding of the custom tray for the edentulous areas of the removable partial denture final impressions?
 - a yes b no
 - no
 - c other (please specify)_____
- 5. How much relief (area of relief) is used to relieve a custom tray for a removable partial denture?
 - a relief on teeth areas only
 - b relief on edentulous area only
 - c relief on teeth and edentulous areas
 - d no relief

e other (please explain)_____

6. In the fabrication of removable partial dentures, what type of articulator are students being taught to mount final casts on?

- a simple hinge type articulator with lateral movement capacity
- b simple hinge type articulator without lateral movement capacity
- c a semi-adjustable articulator
- d other (please explain)_____
- 7. In the fabrication of removable partial dentures, what type of articulator are students being taught to mount preliminary casts on?

- a simple hinge type articulator with lateral movement capacity
- b simple hinge type articulator without lateral movement capacity
- c a semi-adjustable articulator
- d other (please explain)_
- 8. What materials are currently being used for use as a final impression material for partially dentate arches?
 - a polysulfide rubber base
 - b polyether
 - c polyvinylsiloxane
 - d irreversible hydrocolloid
 - e other (please specify)_
- 9. Do students flask their own removable partial dentures for their clinical cases?
 - a yes
 - b no
 - c sometimes (please specify)
- 10. What material is being used for removable partial denture frameworks?
 - a Chrome-cobalt
 - b ticonium
 - c vitalium
 - d other (please specify)_
- 11. Are students treating patients using removable partial dentures with attachments?a yes (please specify)______

b no

- *12.* Is there an in-house laboratory that fabricates removable partial denture frameworks?
 - a yes b no

If yes, are students given the opportunity to cast a removable partial denture frame-work?

- a yes
- b no
- *13.* Are students required to perform the altered cast technique in bilateral and unilateral distal extension removable partial denture cases?
 - a yes
 - b no
 - c other (please specify)
- 14. Is there a set protocol for post-insertion adjustment visits of removable partial denture patients in the clinics?
 - a yes
 - b no

- 15. Is there a minimum number of removable partial denture arches (1 unit = 1 arch) that a student must complete in order to graduate?
 - a yes
 - b no
 - If yes, what is the number?____
- *16.* Do transitional/interim removable partial dentures count as arches or partial arches toward graduation requirements?
 - a yes
 - b no
 - c If yes, how many units?_____

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