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# Laboratory Quality Assurance in the Department of Restorative Dentistry at the University of Illinois at Chicago, College of Dentistry

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## Abstract

**Purpose:** The purpose of this study was to evaluate data collected in University of Illinois at Chicago College of Dentistry (UIC COD) laboratory quality assurance (QA) forms, analyze the collected data, and create a report of the findings. The goals of the study were to (1) identify the most common mistakes occurring during laboratory and clinical procedures when performing prosthodontic treatment, (2) note the incidence and trends of mistakes made by D3, D4, and IDDP2 students, and (3) observe any differences in the types of mistakes made by D3, D4, and IDDP2.
**Materials and Methods:** QA data from June 1, 2007 to May 31, 2009 were evaluated based on forms gathered from the QA dental laboratory from all D3, D4, and IDDP2 students' submissions. All students had graduated from the UIC COD at the time of collection. Data were recorded for type of errors made in submission of laboratory work (Indirect Restorations [IR], Removable Partial Dentures [RPD], Complete Dentures [CD]), year of student in dental school (D3, D4, IDDP2), and frequency of rejection for each respective student. The frequency of common mistakes were pooled, evaluated, and reported by respective class year.
**Results:** The five most common laboratory submission errors for D3, D4, and IDDP2 students were nearly the same among student years for IR, RPD, and CD. D4 students had disproportionately higher numbers of work rejections compared to D3 and IDDP2 students.
**Conclusions:** D4 students had a higher percentage of laboratory submission errors compared to D3 students for all laboratory procedures. There were similar types of errors noted between foreign-trained students (IDDP2) and domestically trained students (D3, D4).

Quality assurance (QA) of predoctoral dental student laboratory work is an integral part of dental school operations. According to the American Dental Association's (ADA) Commission on Dental Accreditation (CODA), QA is defined as a cycle of PLAN, DO, CHECK, ACT that involves setting goals, determining outcomes, and collecting data in an ongoing and systematic manner to measure attainment of goals and outcomes.[1] The final step in QA involves identification and implementation of corrective measures designed to strengthen the program. CODA standard 5-1 requires that each "dental school conducts a formal system of QA for the patient care program that demonstrates evidence of: standards of care, an ongoing review of a representative sample of patients, mechanisms to determine the causes of treatment deficiencies, and patient review policies, procedures, outcomes, and corrective measures."[1] Recently approved accreditation standards to be implemented by July 1, 2013 also include provisions for students to routinely assess their own progress toward overall competency and individual

competencies as they progress through the curriculum. Students may also use these provisions to identify learning needs and create personal learning plans. Effective QA programs use targeted interventions inserted into measured work processes to produce these improvements.[2] The programs are typically managed by an education committee that works with individuals in the institution to take periodic process measurements, plan and implement interventions, and inform constituencies of the results.[2]

It is important to note that QA is a combination of efforts between dental educators, staff, and dental students. Benchmarks must be in place for a variety of purposes including design and validation of programs, examination, and review of students.[3] They can also strengthen the accreditation process undertaken by professional and statutory bodies. Furthermore, benchmark information can be used by institutions as part of their program approval process and to set degree standards. Standards should also be developed by formal groups of experts within the dental academic community. Therefore, the goal of an effective assessment strategy should provide the starting point for students to adopt a positive approach to effective and competent practice and reflective and lifelong learning.[3]

There has also been discussion in the dental community about a lack of programs in dental education addressing the need for dentists to be technically knowledgeable in performing and discussing laboratory procedures.[4] Despite this, within dental education, curriculum reform proposals have recently recommended even further reductions in laboratory exposure for dental students. McGarry and Jacobson advocate that "dentistry must not abdicate its responsibilities in dental technology as it pursues a path away from rehabilitation services toward a projected future of prevention services. With decreasing educational exposure and training in dental laboratory procedures, dentists will have difficulty participating with dental laboratory technologists to fabricate laboratory-based rehabilitative and elective therapies."[4] They further concluded that without significant guidance from dental professionals in establishing laboratory standards in education and practice, proprietary interests and commercial biases could set the laboratory and clinical standards of the future. According to a 2006/2007 American Dental Association (ADA) survey on dental education, there has also been a reduction of 181 clock hours in prosthodontics since the 1990s.[5] New CODA standard 2-23g to be implemented by July 1, 2013, calls for "communicating and managing dental laboratory procedures in support of patient care."[1] Therefore, dental education institutions must create standards for dental students to better recognize errors and articulate with the laboratory what is technically possible.

At the University of Illinois at Chicago College of Dentistry (UIC COD), QA measures have been in place since the 1990s, and current standards of Clinical QA (CQA) procedures were last modified in 2006. The goal of this procedure was to enhance the student's ability to evaluate his or her own work, to expedite the turnaround time from the commercial laboratory to the clinic, enhance the student's ability to write a laboratory prescription, and, finally, to form effective communication with the commercial dental laboratory to reduce the remake or repair rate. After finishing clinical procedures in restorative treatment, third year (D3), fourth year (D4), and second year international dental degree program students (IDDP2) typically send laboratory work (indirect restorations [IR], removable partial dentures [RPD], complete dentures [CD]) at various procedure stages to commercial dental laboratories for fabricating prostheses. Before submitting, students are required to present their work for QA evaluation by a clinical faculty member. This detailed evaluation is completed by two full-time prosthodontists within the Department of Restorative Dentistry at UIC.

The purposes of this study were to evaluate data collected in UIC laboratory QA forms, analyze the collected data retrospectively, and create a report of the findings. The goals of the study were to (1) identify the most common mistakes occurring during laboratory and clinical procedures when performing prosthodontic treatment, (2) note the incidence of mistakes made among D3, D4, IDDP2 students, and (3) observe any differences in the types of mistakes made by D3, D4, and IDDP2 students.

## Materials and methods

QA data from June 1, 2007 to May 31, 2009 were evaluated based on forms gathered from the QA dental laboratory from all D3, D4, and IDDP2 students' submissions. All included students had graduated from the UIC COD at the time of collection. Data were recorded for type of errors made in the submission of laboratory work for IR, RPD, CD (Appendices 1 to 3). Among data recorded were type of errors made in submission of laboratory cases, year of the student in dental school (D3, D4, IDDP2), and frequency of rejection for each respective student. The former student names were numerically coded to preserve anonymity. A total of 5925 laboratory evaluations were analyzed during this study period, comprised of 3860 IR, 925 RPD, 1140 CD evaluations. The experimental protocol was approved by the UIC Institutional Review Board office (IRB #2009–0540).

The nature of student errors were coded based on standardized forms used by QA examiners when reviewing laboratory submissions of predoctoral clinicians. While similar in format, evaluation criteria varied between IR, RPD, and CD submissions. Dental school year was noted for submissions made from June 2007 to May 2009 with a change in student year in May 2008. Dental student names were recorded as numeric codes for the purpose of determining the number of times in a given year a unique student received a rejection for a particular submission. Due to a shift in class year during the evaluation period, some dental students were evaluated twice—once during their junior year and again during their senior year. This shift offered a direct comparison of whether the same students made the same frequency of errors during different phases of their dental education.

All student data were entered into a spreadsheet (Microsoft Excel 2007, Seattle, WA). Following compilation of data, the frequency of common mistakes were pooled, evaluated, and reported. Descriptive statistical analysis was performed to examine the results using statistical software (Statistical Package for the Social Sciences, Version 17.0; SPSS Inc, Chicago, IL). A chi-square test for independence was performed to determine whether an association exists between the expected frequencies of error for dental student class year and the observed

**Table 1** Combined total IR, RPD, CD% rejections

| Class | Total IR evaluations | Number of IR evaluations rejected | % rejection IR evaluations | Total RPD evaluations | Number of RPD evaluations rejected | % rejection of RPD evaluations | Total CD evaluations | Number of CD evaluations rejected | % rejection of CD evaluations |
|---|---|---|---|---|---|---|---|---|---|
| D3 | 876 | 109 | 12.4 | 268 | 37 | 13.8 | 469 | 43 | 9.2 |
| D4 | 2299 | 370 | 16.1 | 486 | 153 | 31.5 | 461 | 124 | 26.9 |
| IDDP2 | 685 | 131 | 19.1 | 171 | 43 | 25.1 | 210 | 21 | 10.0 |
| Total | 3860 | 610 | 15.8 | 925 | 233 | 25.2 | 1140 | 188 | 16.5 |

**Table 2** Indirect restorations—most common errors by year

| IR | D3 | D4 | IDDP2 | Overall (610 total) |
|---|---|---|---|---|
| Rank 1 | Need cast of provisional or diagnostic cast (16) 14.7% | Improper articulation (58) 15.7% | Improper articulation (21) 16.0% | Improper articulation (90) 14.7% |
| Rank 2 | Cast not surveyed or tripoded (12) 11.0% | Margins unclear on impression (37) 10.0% | Need cast of provisional or diagnostic cast (15) 11.4% | Need cast of provisional or diagnostic cast (56) 9.2% |
| Rank 3 | Improper articulation (11) 10.1% | Inadequate occlusal reduction (34) 9.2% | Cast not surveyed or tripoded (11) 8.4% | Margins unclear on impression (56) 9.2% |
| Rank 4 | Margins unclear on impression (10) 9.2% | Cast not surveyed or tripoded (33) 8.9% | Inadequate occlusal reduction (10) 7.6% | Cast not surveyed or tripoded (56) 9.2% |
| Rank 5 | Other (10) 9.2% | Other (26) 7.0% | Custom incisal guide table needed (10) 7.6% | Inadequate occlusal reduction (52) 8.5% |

frequencies of the most commonly encountered causes of QA rejection. Depending on the hypothesis of interest, one of three chi-square tests were performed to evaluate correlation between class year to each of the most common errors made during each of the three respective dental work disciplines submitted for QA evaluation—IR, RPD, CD. The five most common laboratory submission mistakes made overall by all three class years were evaluated. Likewise, the five most common laboratory submission errors were noted according to respective dental student year after data were compiled, pooled, and evaluated. The total number of laboratory submissions by dental students was tabulated with an electronic record keeping system (Axium, ExanAcademic, Las Vegas, NV) at the UIC COD.

The top five errors were compiled for respective class year for IR (ADA Codes D2752, D2750, D2740, D2790, D6242, D6212, D2952, D2962, D6750, D6752), RPD (ADA Codes D5211, D5212, D5213, D5214), and CD (ADA Codes D5110, D5120, D5130, D5140). UIC COD protocol requires QA evaluation of mounted IR casts when sending for FPD fabrication. For RPD care submissions, UIC laboratory QA evaluations were completed when sending the mounted casts for cast framework fabrication and after the wax try-in prior to final processing. UIC protocol for CD care submissions required laboratory QA evaluations to be completed after mounting using wax rims, after the anterior try-in, and immediately prior to processing of the completed wax setup. In this study, as the common errors were compiled, the number rejected compared to the total number of work orders submitted were expressed as a percentage. All data regarding number of laboratory work sent, received, and rejected were compiled and recorded by ADA procedure code in the aforementioned electronic record keeping system. Trends among the various years were analyzed to determine whether there were similarities in errors between US trained dental students (D3, D4) and foreign-trained dental students (IDDP2), incidences of rejection among each respective year of dental student, and whether there was any differences in the types of mistakes made by D3, D4, and IDDP2 students.

## Results

Upon evaluation of QA forms based on dental student year, students reported very similar procedure errors for each respective discipline. In most cases, different student years tended to have made the same top five most common laboratory submission errors. When analyzing data from IR submissions (Table 1), an average of 16.8% of submitted dental student laboratory work was rejected overall. Among these, the top five errors were similar among D3, D4, and IDDP2 student years, although the order of rankings among the top five varied among class years (Table 2). Overall, the most common errors included improper articulation of casts, lack of inclusion of a diagnostic cast, unclear margins on the impression, lack of surveyed casts for crowns to be RPD abutments, and inadequate occlusal reduction of tooth preparations. IDDP2 students had a marginally higher incidence of work rejection at 19.1%, compared to 16.1% and 12.4% for D4 and D3, respectively.

For RPD submissions, it was noted that 25.2% (Table 1) of submitted laboratory work was rejected by QA faculty prior to fabrication. The top five most common submission errors were different among student years (Table 3). For example, undercuts in rest seats (B2) and lack of positivity of rest seats (B3) were the 4th and 5th most common errors for D3 students, comprising 10.8% and 8.1%, respectively, of RPD work rejection; however, these mistakes did not rank among the common top five errors for D4 and IDDP2 students. The most significant

**Table 3** Removable partial denture—most common errors by year

| RPD | D3 | D4 | IDDP2 | Overall (233 total) |
|---|---|---|---|---|
| Rank 1 | Improper contacts in maximum intercuspation (8) 21.6% | Improper articulation of diagnostic casts (41) 26.8% | Improper contacts in maximum intercuspation (10) 23.2% | Improper articulation of diagnostic. casts (56) 24.0% |
| Rank 2 | Other (8) 21.6% | Other (29) 19.0% | Other (10) 23.2% | Other (47) 20.2% |
| Rank 3 | Improper articulation of diagnostic casts (7) 18.9% | Improper contacts in maximum intercuspation (26) 17.0% | Improper articulation of diagnostic casts (8) 11.0% | Improper contacts in maximum intercuspation (44) 18.9% |
| Rank 4 | Undercut in rest seats (4) 10.8% | Not surveyed or tripoded (13) 8.5% | Not surveyed or tripoded (3) 7.0% | Not surveyed or tripoded (18) 7.7% |
| Rank 5 | Lack of definition of rest seats (3) 8.1% | Framework not seated (8) 5.2% | Framework not seated (3) 5.2% | Framework not seated (13) 5.6% |

**Table 4** Complete dentures—most common errors by year

| CD | D3 | D4 | IDDP2 | Overall (188 Total) |
|---|---|---|---|---|
| Rank 1 | Lack of posterior palatal seal in master cast (20) 46.5% | Lack of posterior palatal seal in master cast (44) 35.5% | Lack of posterior palatal seal in master cast (9) 42.9% | Lack of posterior palatal seal in master cast (73) 38.8% |
| Rank 2 | Unacceptable working contacts (8) 18.6% | Unacceptable working contacts (24) 19.4% | Unacceptable working contacts (4) 19.0% | Unacceptable working contacts (36) 19.9% |
| Rank 3 | Insufficient balance of tooth setup (4) 9.3% | Insufficient balance of tooth setup (13) 10.6% | Insufficient balance of tooth setup (1) 4.8% | Insufficient balance of tooth setup (18) 9.6% |
| Rank 4 | No/Light contacts in maximum intercuspation (4) 9.3% | No/Light contacts in maximum intercuspation (13) 10.6% | No/Light contacts in maximum intercuspation (1) 4.8% | No/Light contacts in maximum intercuspation (18) 9.6% |
| Rank 5 | Other (3) 7.0% | Other (11) 8.9% | Other (1) 4.8% | Other (15) 8.0% |

finding was that overall, students tended to have more problems with RPD work than CD and IR work. In this study, D4 students performed most poorly with 31.5% of submitted work rejected. The five most common errors noted for RPD submissions was improper articulation of diagnostic casts, other unspecified errors such as missing acrylic shade or missing denture identification labels, improper contacts in maximum intercuspation, lack of surveying or tripoding of master cast, and improper seating of RPD framework (Table 3).

Finally, CD submission (Table 4) showed notable similarities in student errors among dental student years. It was noted that overall, 16.5% of submitted CD work was rejected by QA faculty (Table 1). The top five submission errors were the same for all student years, and errors even fell in the same rank for all dental students. With respect to overall rankings of CD submission errors, over one third of all errors (38.8%) were due to lack of a posterior palatal seal carved into the master cast. Most common CD problems in order of rank were lack of a posterior palatal seal in the master cast, unacceptable working contacts of tooth setup, lack of sufficient balance in setup, lack of contact in maximum intercuspation, and other unspecified problems such as missing acrylic shades or missing denture identification labels (Table 4).

The chi-square test revealed that dental class year related to frequency of error was not statistically significant overall. Using a cutoff $p$ value $= 0.05$, comparisons of the mean values showed no statistically significant differences except in one isolated instance, which was not explainable. Overall, no association appeared to exist between class year designation and the number of students making one error over another even though the numerical quantity of errors was higher for D4 students.

## Discussion

There is a lack of literature exploring QA and common errors in prosthetic laboratory work performed by students in predoctoral dental programs. The results of this study should provide information useful in reducing the number of remade laboratory items and also ensuring that quality of dental prostheses are within clinically acceptable guidelines. This will enhance student learning, improve and expedite patient treatment experiences, and reduce the unnecessary financial expense of remaking laboratory items. The results will also allow UIC COD faculty to centrally monitor the care being provided in the clinics to ensure it is consistent with the formally adopted treatment guidelines of the Department of Restorative Dentistry.

Having noted the five most common errors for all years of dental students, it was evident that similar problems arose regardless of year of training, international or domestic training, and experience of the student. It is likely that students and clinicians alike are prone to certain problems over other types of issues. In the majority of QA criteria that faculty evaluated, no errors were noted; however, of the issues that arose, numerous errors were noted for those criteria. One of the most common errors for removable prostheses was lack of contact in maximum intercuspation (18.9%). With the exception of the lack of posterior palatal seal for CD submissions (38.8%), other similarly common issues for CD and RPD categories were high, light, or lack of contact in maximum intercuspation and lack of working contacts (9.6% and 18.9%, respectively).

While there was no formal calibration between the two faculty members who evaluated the cases, both examiners had similar training. Both examiners have been faculty members

at the UIC COD for over 10 years, and each have completed a postgraduate training in prosthodontics at an accredited US institution. Moreover, both faculty examiners were integral in creating the criteria for the standardized UIC QA forms used in this study. Due to the extensive discussion and planning that went into development of the current QA program, it is acceptable to conclude that while there may be interexaminer error, the results are valid because the faculty had been trained and calibrated to reduce measurement error. Furthermore, since there were only two examiners used, and both played a role in establishing the evaluation criteria, this further minimized the impact of any interexaminer error.

The findings in this study are significant, because dental education is similar in many institutions within the United States. A 2001 survey by Petropolous and Rashedi found that while clinical CD and RPD predoctoral programs vary from school to school, a large percentage of schools agree on many topics. Some common findings were that it appears that most schools (84%) have a minimum number of CD arches students must complete toward graduation.[6] However, 16% reported not having any minimum requirements for graduation.[6] For CD laboratory submissions in this study, there were startling similarities in common errors made between student years, with 38.8% of rejected work submissions being from lack of a posterior palatal seal carved into the master cast. This suggested a lack of understanding of denture processing procedures and the rationale for performing certain steps during CD fabrication.

In a similar study by Petropolous and Rashedi, it was found that predoctoral clinical RPD programs vary from school to school, yet a large percentage of schools agree on many topics.[7] The data from this UIC study revealed that, overall, dental students who submitted RPD work experience a QA rejection rate of over 25%. Therefore, it is likely that dental students from other schools have similar problems in the RPD fabrication process, since much of US dental school RPD education is similar. Most dental schools have incorporated a quality control (QC) program that evaluates work sent to (84%) and returned from (73%) the laboratory.[7] The significance of this clinical RPD curriculum survey of US dental schools shows that prosthodontic education still varies to a certain degree among schools, and that it is crucial that QC programs are in place at all institutions to improve student education and patient care.

This potential lack of understanding of laboratory procedures as students translates into poor communication with laboratory technicians in practice. It has been noted that dental laboratory technicians consider newly qualified dentists to have a poor understanding of dental technical procedures and techniques.[8] In a survey study by Juszcqyk et al, it was found that out of 803 dental laboratories, only 9% scored communication as very good, and only 26% considered that dental students were taught to communicate with dental laboratories effectively.[8] It was concluded in the study that most laboratory technicians identified three common themes: lack of recognition by the dental team, lack of effective communication in the laboratory script, and a lack of knowledge by the dentist of technical procedures.

The concept of reduced emphasis on the training of the dental student in technical aspects has been the trend of dental schools around the country. Similarly, national board examinations have mimicked the trend by eliminating laboratory procedures. For example, the Northeast Regional Board licensing examination eliminated all laboratory procedures in 1994. Instead, the examination focused entirely on patient care procedures. The consequence is that there is little accountability for the new dentist to know how to communicate effectively with the laboratory through clear laboratory prescriptions or with adequate materials submitted with cases. Furthermore, this view is supported by a 1998 survey of US dental schools that compared curricular structure, techniques, and materials used in predoctoral fixed prosthodontics courses to the delegation of laboratory procedures in preclinical and clinical fixed prosthodontic programs.[9] This study found that among the dental schools surveyed, there is more student laboratory involvement in preclinical programs of fixed prosthodontics than there is in clinical programs in the completion of laboratory procedures.[9] In clinical fixed prosthodontic programs, there was a high emphasis on patient care and less on laboratory techniques that can be delegated to laboratory technicians.[9] This could potentially make it difficult for students to adequately self evaluate and manage these types of procedures. It is safe to conclude, therefore, that laboratory technique by dental students cannot be perfected, or even practiced, if the majority of work is delegated to laboratory technicians.

One interesting finding was that even after factoring in a higher number of total laboratory submissions for D4 students compared to D3 students, D4 students had a higher percentage of rejected cases. For example, of the 876 D3 submissions for evaluation for IR, 109 cases (12.4%) were rejected. There were 2299 D4 IR submissions, with 370 (16.1%) rejected. The trends were similar for CD and RPD submissions as well. When comparing D3 versus D4 rejections rates for RPD, the disparity was quite staggering—D3 students submitted 268 work orders with 37 rejected (13.8%), while D4 students submitted 486 work orders with 153 rejected (31.5%). While one would expect that higher levels of experience would mean fewer errors in submitted laboratory cases, this clearly was not the case based on the findings of this study. Possible reasons for this include pressure for D4 students to get requirements completed before graduation, stress from National Board Examinations, and extended periods of time away from the school for extramural rotations. During the D4 year at UIC, students spend approximately 8 weeks at extramural rotation sites away from clinical faculty. At most of these extramural sites, no laboratory submissions are needed, so the students may not get practice in preparing and handling laboratory submissions during this formative period.

Based on these findings, one can try to determine what effective instructional techniques can be integrated into routine clinical education practice by dental educators in the future and what aspects of the clinical learning environment should be addressed to improve the overall quality of the laboratory submission. The quality of prosthodontic dental care delivered by predoctoral dental students is highly influenced by members of the dental support staff. Faculty members are a major part of QA and one of the primary influences on whether submission of lab work and approval by COD laboratory QA staff occurs. Faculty time spent with students in the clinic, dental experience of clinical instructors, and number of work orders submitted with students may also influence the outcomes. Measuring

faculty outcomes is another important role of an effective QA program. Therefore, it would be beneficial to institute formal in-service training for faculty to standardize techniques taught to students. The role of faculty will be analyzed and reported on in a separate publication.

## Conclusions

(1) Based on statistical analysis, it can be concluded that class year of dental students does not influence the distribution of errors made during laboratory submission.
(2) The five most common errors noted for IR submissions were improper articulation of casts, lack of inclusion of a diagnostic cast, unclear margins on the impression, lack of surveyed casts for crowns to be RPD abutments, and inadequate occlusal reduction of preparations.
(3) The five most common errors noted for RPD submissions were improper articulation of diagnostic casts, other unspecified errors, improper contacts in maximum intercuspation, lack of surveying or tripoding of master cast, and improper seating of RPD framework.
(4) The five most common errors noted for CD submissions were lack of a posterior palatal seal in the master cast, unacceptable working contacts of tooth setup, lack of sufficient balance in setup, lack of contact in maximum intercuspation, and other unspecified problems.
(5) International students did not make significantly different types of errors than US trained students.

Laboratory technique by dental students cannot be perfected, or even practiced, if the majority of work is delegated to laboratory technicians. Therefore, we believe more laboratory technique emphasis should be placed within the predoctoral dental curriculum to ensure that graduating dentists are adequately prepared and understand the patient care support procedures.

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**Appendix 1** Indirect restoration QA abbreviation key

A: Diagnostic casts
  1. Improperly articulated
  2. Need opposing cast
  3. Need cast of provisionals or Diagnostic cast
  4. Need opposing cast
  5. Need interocclusal record
B: Working casts
  1. Improperly articulated
  2. Needs to be articulated
  3. Poorly trimmed dies
  4. Dies not seating completely
  5. Margins unclear on cast
  6. Margins unclear on impression
C: Preparation design
  1. Preparation is undercut
  2. Margins incorrect for design
  3. Inadequate occlusal reduction
  4. Inadequate retention
  5. Inadequate axial reduction
D: Tooth as an RPD abutment
  1. Partial design not included
  2. Cast not surveyed or tripoded
  3. Need wax rim/teeth set
  4. Partial not included
E: Metal framework
  1. Inadequate room for porcelain
  2. Occlusion high
F: Custom incisal guide table
  1. Needed
  2. Incorrect
G: Other
  1. Need impression
  2. Other

**Appendix 2** Removable partial denture QA abbreviation key

A: Diagnostic casts
1. Improperly Articulated
2. Needs to be articulated
3. Not surveyed or tripoded
4. Needs opposing cast
5. Master cast too large
6. Design not drawn on Diagnostic cast

B: Rest seats
1. Too shallow
2. Undercut
3. Lack positivity or definition

C: Guide planes
1. Not parallel
2. Not defined
3.Too short

D: Abutment tooth undercut
1. Missing or insufficient
2. Improperly positioned
3. Needs to be marked

E: Tooth position/occlusion
1. Teeth not properly set
2. High, light, or no contacts in maximum intercuspation
3. Working contacts unacceptable
4. Balancing contacts unacceptable

F: Festooning
1. Wax on teeth or major connector
2. Case inadequately sealed
3. Framework not seated

G: Other
1. Need acrylic shade
2. Need denture identification labels
3. Other

**Appendix 3** Complete denture QA abbreviation key

A: Casts
1. Improperly articulated
2. Need opposing cast

B: Tooth position/occlusion
1. Teeth not properly set
2. High in maximum intercuspation
3. No/Light contacts in maximum intercuspation
4. Working contacts unacceptable
5. Not sufficiently balanced
6. Balancing interference

C: Festooning
1. Attached gingival contour
2. Papillae contour
3. Gingival crest contour
4. Lingual/Palatal contour
5. Wax too rough
6. Wax too thick
7. Wax too thin
8. Wax remaining on teeth
9. Base inadequately sealed

D: Other
1. Posterior palatal seal
2. Need acrylic shade
3. Need denture identification labels
4. Other