



VCU

Virginia Commonwealth University
VCU Scholars Compass

Theses and Dissertations

Graduate School

2010

Endodontic Education and Educators: Who is teaching our predoctoral students and what methods are being taught?

Ellison Turner
Virginia Commonwealth University

Follow this and additional works at: <https://scholarscompass.vcu.edu/etd>



Part of the [Endodontics and Endodontology Commons](#)

© The Author

Downloaded from

<https://scholarscompass.vcu.edu/etd/2141>

This Thesis is brought to you for free and open access by the Graduate School at VCU Scholars Compass. It has been accepted for inclusion in Theses and Dissertations by an authorized administrator of VCU Scholars Compass. For more information, please contact libcompass@vcu.edu.

School Of Dentistry
Virginia Commonwealth University

This is to certify that the thesis prepared by Ellison Paige Turner entitled “Endodontic Education and Educators: Who is teaching our predoctoral students and what methods are being taught?” has been approved by her committee as satisfactory completion of the thesis requirement for the degree of Master of Science in Dentistry

Karan J. Replogle, DDS, MS, Virginia Commonwealth University School of Dentistry

Al M. Best, PhD, Virginia Commonwealth University School of Medicine

Karan J. Replogle, DDS, MS, Endodontics Department Chair, Virginia Commonwealth University School of Dentistry

S. A. Black Jr., MS, DMD, PhD, CAGS, Assistant Professor, Virginia Commonwealth University School of Dentistry

Laurie Carter, DDS, PhD, Director of Advanced Dental Education School of Dentistry

Dr. F. Douglas Boudinot, Dean of the Graduate School, Virginia Commonwealth University School of Dentistry

Endodontic Education and Educators: Who Is Teaching Our Predoctoral Students and
What Methods Are Being Taught?

A thesis submitted in partial fulfillment of the requirements for the degree of Master of
Science in Dentistry at Virginia Commonwealth University.

by

Ellison Paige Turner
BS, Furman University 1997
DDS, University of North Carolina at Chapel Hill, 2003

Program Director: Karen J. Replogle, DDS, MS
Departmental Chair, Department of Endodontics,
Virginia Commonwealth University School of Dentistry

Virginia Commonwealth University
Richmond, Virginia
May 2010

Table of Contents

Pages

List of Tables	iii
List of Figures	iv
Abstract	v
Introduction	1
Material and Methods	4
Results	5
Discussion	20
References	25
Appendices	28
Vita	32

List of Tables

Tables	Pages
1: Type of Dental School	5
2: Region of Dental School.....	7
3: Graduate Programs	8
4: Start of Pre-Clinical and Clinical Instruction	9
5: Start of Patient Treatment	10
6: Clinical Instructors for Predoctoral Students.....	11
7: Microscope Availability	12
8: Microscope Frequency of Use	12
9: Rotary Instruments.....	13
10: Irrigation	15
11: Intracanal Medicament	16
12: Obturation Material.....	17
13: Obturation Method	18

List of Figures

Figures	Pages
1: Type of Dental School	6
2: Region of Dental School.....	7
3: Start of Pre-clinical and Clinical Instruction	9
4: Start of Patient Treatment.....	10
5: Clinical Instructors for Pre-Doctoral Students.....	11
6: Rotary Instruments.....	14
7: Irrigation Solution.....	15
8: Intracanal Medicament	16
9: Obturation Material.....	17
10: Obturation Method	19

Abstract

ENDODONTIC EDUCATION AND EDUCATORS: WHO IS TEACHING OUR PREDOCTORAL STUDENTS AND WHAT METHODS ARE BEING TAUGHT?

By Ellison Paige Turner, DDS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of
Science in Dentistry at Virginia Commonwealth University.

Virginia Commonwealth University, 2010

Program Director: Karan J. Replogle, DDS, MS
Departmental Chair, Department of Endodontics,
Virginia Commonwealth University School of Dentistry

A survey was conducted to assess the current state of predoctoral endodontic education in the United States. Fifty-one schools received surveys and 73% responded. Seventy-six percent were from public schools with most having a graduate endodontic program (84%). Preclinical training most often began in the spring of second year and clinical training started in the fall of third year (each 54%). All programs that responded stated that endodontists routinely instruct students in the clinic. Sodium hypochlorite 2.5% was the irrigation of choice. Calcium hydroxide was the most common intracanal medicament. Cold lateral condensation with gutta-percha was the most frequently indicated obturation technique. Sixty-two percent of programs had microscopes, with 1-2 cases treated with microscope per week. Findings suggest that endodontists are still an integral part of teaching predoctoral dental students in the United States.

Introduction

United States dental schools are charged with educating thousands of students each year with the most current and evidence-based clinical information in the field of dentistry (1). Currently, there are 58 accredited dental schools in the United States that will graduate 4,603 students in 2010 (2,3). After four years of education, these students will have gained a new vocabulary, significant dental background, and experience enabling them to become an integral part of the health care system. Over half of these students will continue to advanced dental education programs, while the remainder will enter a career in general practice (3,4).

Endodontics has been a clinical specialty in dentistry since 1964 and has remained a fundamental part of the treatment planning process in dental schools and dental practice. The goal of predoctoral endodontic education is for students to gain a working knowledge of endodontics that will enable them to treat patients ethically and skillfully, all the while, understanding their limitations. They can graduate from dental school understanding which cases to treat and when to refer to a specialist (5). Seventy-five percent of the root canal therapies in the United States are performed by general dentists. Endodontists perform 25%. This team approach to patient treatment presents an opportunity to maintain the highest standards of endodontic practice in patient care (6).

Endodontics is defined by the Commission on Dental Accreditation as “the branch of dentistry that is concerned with the morphology, physiology and pathology of the human dental pulp and periradicular tissues.” Endodontists today complete at least

a 2-year residency program after dental school to increase their knowledge, skill and proficiency in endodontic therapy and apical surgery. Their curriculum involves the basic clinical sciences including biology of the normal pulp, the etiology, diagnosis, prevention and treatment of diseases and injuries of the pulp, and associated periradicular conditions (6).

Dental schools have placed more emphasis on root canal therapy in predoctoral education, encouraging students to perform state-of-the-art endodontics and encouraging them to take this ability into private practice (1,7). The move toward incorporating rotary instrumentation into predoctoral programs has made “the road to successful clinical outcomes in endodontics easier to achieve” (8). Clinical progress in endodontics has shortened treatment time while improving efficacy and safety. However, the operator must be trained adequately to successfully of treatment, recognize limitations, and understand when to refer to a specialist.

Studies have shown that root canals done by endodontists have a significantly higher success rate than those completed by general dentists (9,10). Yet, referrals to specialists are perceived by endodontists to be at an all-time low; and cases being referred and treated are more complex (24). Have predoctoral programs produced a more highly trained and proficient general dentist?

In recent years, there has been growing concern relating to the difficulties in recruiting and retaining endodontic educators. Although the shortage of educators is found in all areas of dentistry, the clinical specialties are most affected (11). With faculty shortages, budget cuts and dental school restructuring, some schools have incorporated

their endodontic departments into larger “mega-departments”, where several clinical disciplines exist under one department chair (12). In this model, dental students are exposed to endodontics as a subspecialty of a larger entity. It has been purported that in this mega-department model, general dentists serve as the endodontic faculty for these predoctoral programs. Some schools continue to maintain specialty departments, with the department of endodontics designing, implementing, and teaching predoctoral students (13). For some educators, this presents an interesting philosophical dilemma. Should endodontic predoctoral education be the purvey of the specialty of endodontics and endodontists; should it be managed and taught by general dentists; or should it be some combination of endodontists and general dentists?

The objective of this questionnaire was to survey predoctoral program directors to determine who is teaching the predoctoral endodontics, when preclinical and clinical education begins, and what methods of root canal instrumentation, irrigation and obturation are being taught.

Methods and Materials

The research protocol for this study was reviewed and approved by the Institutional Review Board of Virginia Commonwealth University as exempted research (IRB#HM12595). Surveys were distributed via email to fifty-one current predoctoral endodontic program directors in the United States. The list of program directors was obtained directly from the American Association of Endodontics Educational Affairs Committee. Survey data was managed with online Inquisite Survey Software (Version 8.0, Inquisite, Inc.). (See Appendix A for complete online survey).

Each predoctoral program director was asked to respond to a series of twelve questions. (See Appendix B for letter to program directors). Information was gathered about region and type of dental school, faculty supervision both pre-clinically and clinically, microscope availability, and method of instrumentation, irrigation and obturation. Questions employed a forced choice menu format but included opportunities for write-in responses for specific questions. Descriptive statistics were employed and answers to multiple-choice questions were analyzed by determining the percentage of respondents who chose each option.

Results

Thirty-seven surveys were returned from the 51 pre-doctoral endodontic programs, representing a return rate of 73%. Fourteen were not returned or were returned incomplete and were, therefore, not included in the study results. Survey and descriptive statistics are presented in Tables 1-14. Survey questions are displayed in bold text and answers are presented in table format when appropriate. In some cases, percentages do not add up to 100% since the survey allowed for multiple answers within a question.

Question #1 solicited the type of dental school. Seventy-six percent of the respondents were from a state supported dental school and 24% were from a private school as shown in Table 1 and Figure 1.

TABLE 1. Type of Dental School

	N	%
Type of dental school		
Public (State supported)	28	76
Private	9	24

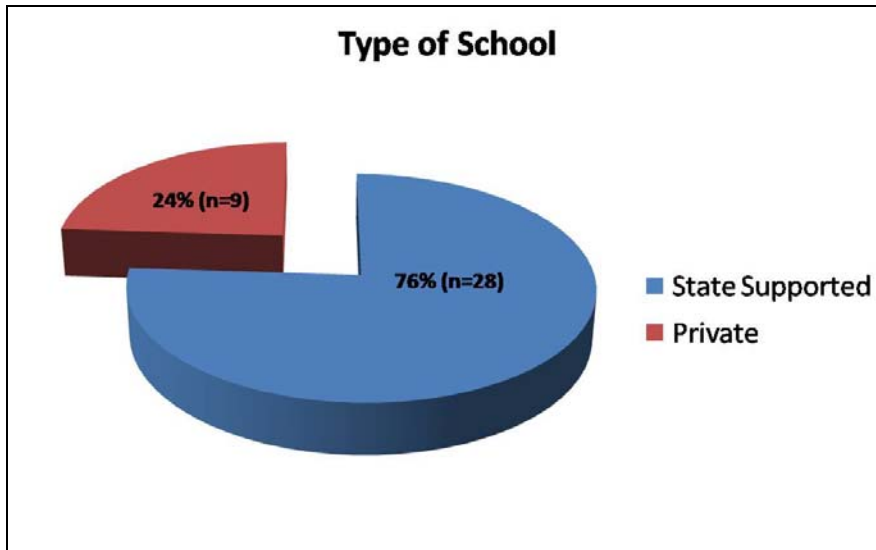


Figure 1. Type of Dental School

Predocloral program directors were asked in question #2 to specify the region of their dental school. Programs in the Middle Atlantic, East South Central, East North Central and West South Central were represented with the highest percentage of respondents at 14%, 17%, 11%, 22% and 14%, respectively. New England, West North Central, Mountain, and Pacific had below 10% representation at 8%, 3%, 6% and 8%. No significant correlation was found between region of dental school and any of the survey questions. These results are found in Table 2 and Figure 2.

TABLE 2. Region of Dental School

	N	%
Region of Dental School		
New England (ME, VT, NH, RI, MA, CT)	3	8
Middle Atlantic (NY, PA, NJ, DE, MD)	5	14
South Atlantic (WVA, VA, NC, SC, GA, FL)	6	17
East South Central (KY, TN, MO, KS, OK, AR)	4	11
East North Central (MI, OH, IN, IL, WI)	8	22
West North Central (MN, IA, NE, SD, ND)	2	6
West South Central (TX, LA, MS, AL)	5	14
Mountain (MT, ID, WY, UT, CO, AZ, NM)	1	3
Pacific (WA, OR, NV, CA, AK, HI)	3	8

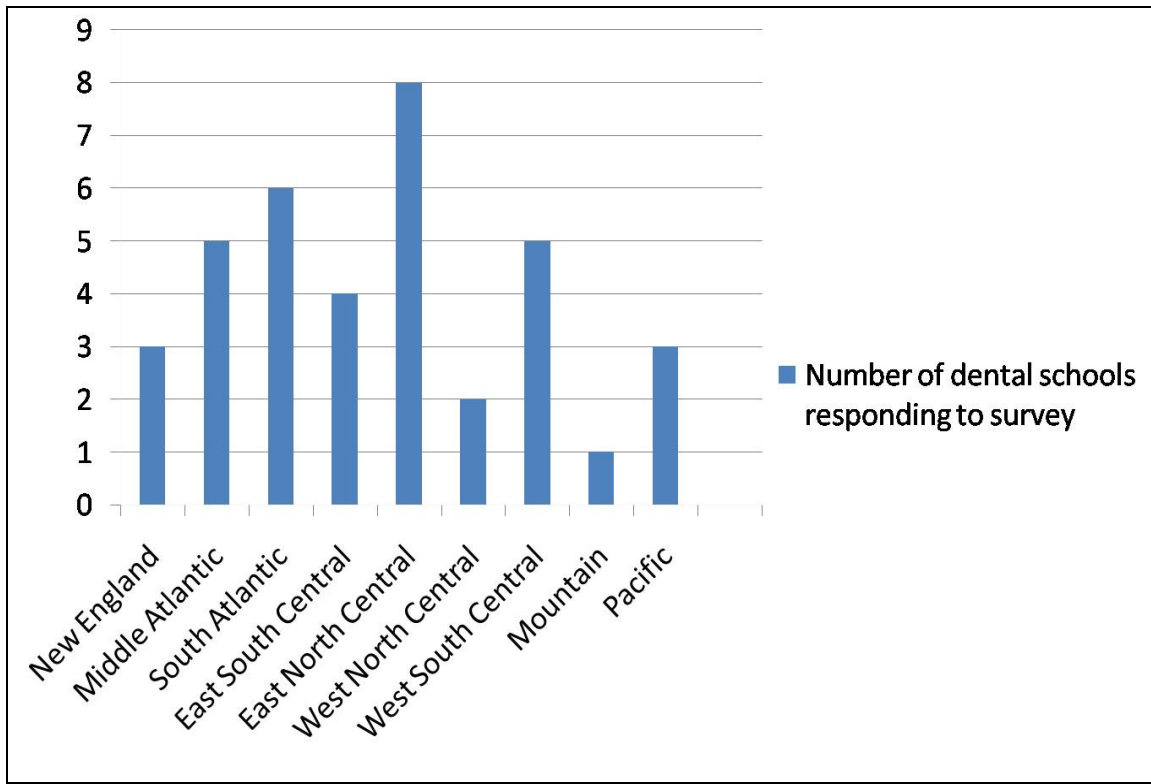


Figure 2. Region of Dental School

Question #3 was asked to determine what percentage of schools with predoctoral endodontic programs also had a Postgraduate Advanced Education Program in Endodontics. Eighty-four percent of respondents reported a graduate program while 16% had none. There were no significant relationships between other questions and the presence of a graduate program. See Table 1 for results.

TABLE 3. Graduate Programs

Question 3: Do you have a graduate program at your school?	N	%
Yes	31	84
No	6	16

Question #4 was asked to determine in which semester the preclinical curriculum for predoctoral dental students began. The majority of students begin their training in the spring of second year (54%). Almost all predoctoral programs have begun their preclinical training before the fall of 3rd year (see Table 4 and Figure 3). This question provided no opportunity for a write-in-response, so the “other” response (3%) had no clarification.

TABLE 4. Start of Pre-clinical and Clinical Instruction

Question 4: What semester do students begin their endodontic predoctoral curriculum in the classroom?

	N	%
Spring 1 st year	2	5
Summer 1 st year	0	0
Fall 2 nd year	9	24
Spring 2 nd year	20	54
Summer 2 nd year	5	14
Fall 3 rd year	0	0
Spring 3 rd year	0	0
Other	1	3

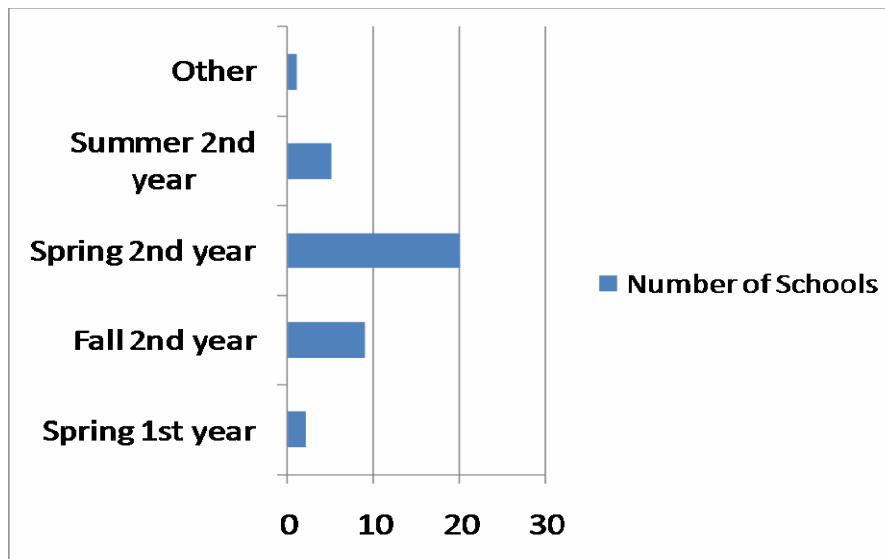


Figure 3. Start of Pre-clinical and Clinical Instruction

Question #5 also addressed the time for training of predoctoral dental students, and asked when students begin treating patients for endodontic therapy. In most programs this occurs in the fall of 3rd year (54%), and has begun in all programs by summer of 3rd year. One program allows predoctoral students to see patients in the fall of 2nd year when

the majority of other programs have not yet started preclinical (see Table 5 and Figure 4).

TABLE 5. Start of Patient Treatment

Question 5: What semester do students begin treating endodontic patients in the predoctoral clinics?	N	%
Summer 1 st year	0	0
Fall 2 nd year	1	3
Spring 2 nd year	2	5
Summer 2 nd year	7	19
Fall 3 rd year	20	54
Spring 3 rd year	4	11
Summer 3 rd year	3	8
Fall 4 th year	0	0
Spring 4 th year	0	0

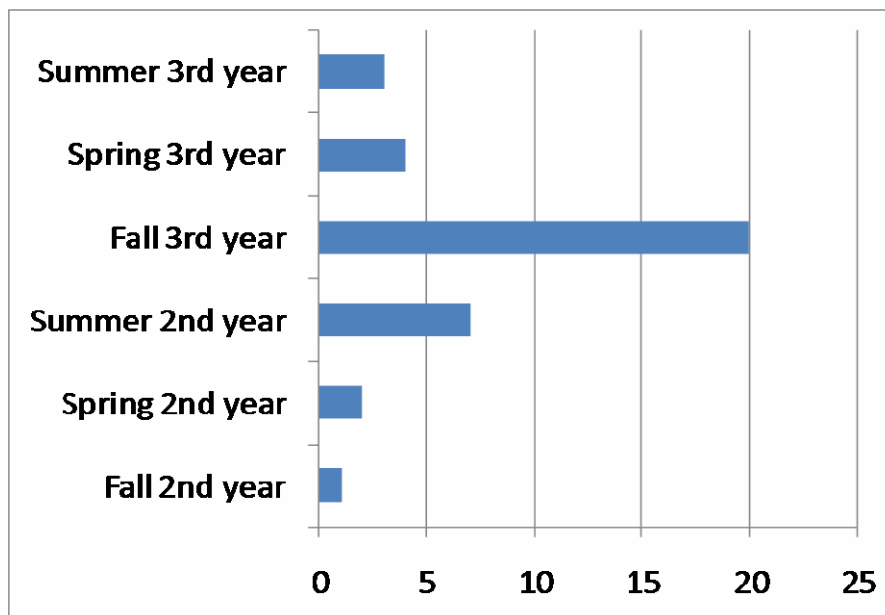


Figure 4. Start of Patient Treatment

Program directors were asked in question #6 to report who *routinely* instructed their predoctoral students in clinic. This question was a “check all that apply format,” therefore, the percentages do not add up to 100%. Endodontists routinely instruct predoctoral students in all the responding programs (100%). General dentists and post-graduate endodontic resident instruct in 19% and 54% of programs, respectively (see Table 6 and Figure 5).

TABLE 6. Clinical Instructors for Pre-doctoral Students

Question #6: Who routinely instructs the students in the predoctoral endodontic clinic (check all that apply)?

	N	%
Endodontists	37	100
General dentists	7	19
Post-graduate endodontic residents	20	54

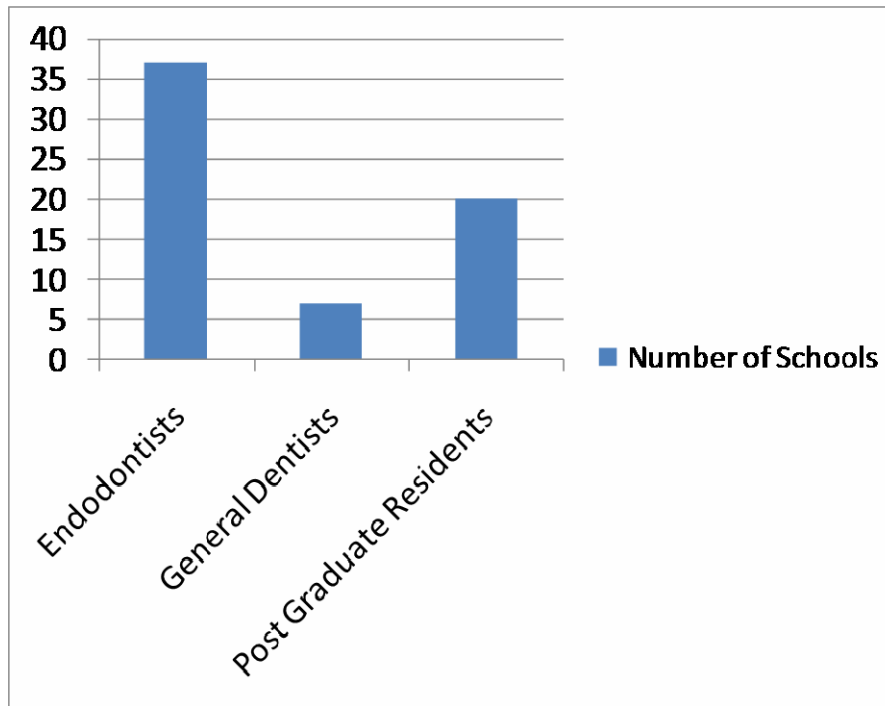


Figure 5. Clinical Instructors for Pre-doctoral Students

The program directors were asked in question #7 if they have a microscope available for endodontic cases completed in the predoctoral clinics. Sixty-two percent reported that they do and 38% reported that they do not (see Table 7). If the schools responded 'yes' to the question, they were asked to quantify how often the microscope is used. Fifty-two percent reported 1-2 cases per week, 35% reported 2-5 cases per week, and 13% reported 5-10 cases per week (see Table 8).

TABLE 7. Microscope Availability

Question #7: Do you have a microscope available for use in the predoctoral clinics?	N	%
Yes	23	62
No	14	38

TABLE 8. Microscope Frequency of Use

Continuation of Question #7	N	%
If yes, how often is it being used for cases in the predoctoral clinics?		
1-2 cases/week	12	52
2-5 cases/week	8	35
5-10 cases/week	3	13
>10 cases/week	0	0

Questions #8-12 solicited information regarding instrumentation, irrigation and obturation. In question #8, predoctoral directors were asked to answer which rotary instruments are used in the clinics. This question was in a “choose all that apply” format so percentages do not add up to 100%. The majority of programs are using Densply Profile™ (65%). Brasseler Sequence™ and Sybron K3™ have 35% of the market share, collectively. It was notable that 0% of schools reported using “none” of the rotary instruments in their clinical curriculum. See Table 9 and Figure 6 for results.

TABLE 9. Rotary Instruments

Question #8: What rotary instrumentation system is used routinely by the predoctoral students for root canal treatment (choose all that apply)?	N	%
Densply Profile™	24	65
Sybron K3™	6	16
Densply Protaper™	3	8
Brasseler Sequence™	7	19
Discus Light speed™	1	3
Prosystem GT™	4	11
Densply Vortex™	3	8
None	0	0
Sybron Twisted™files	0	0

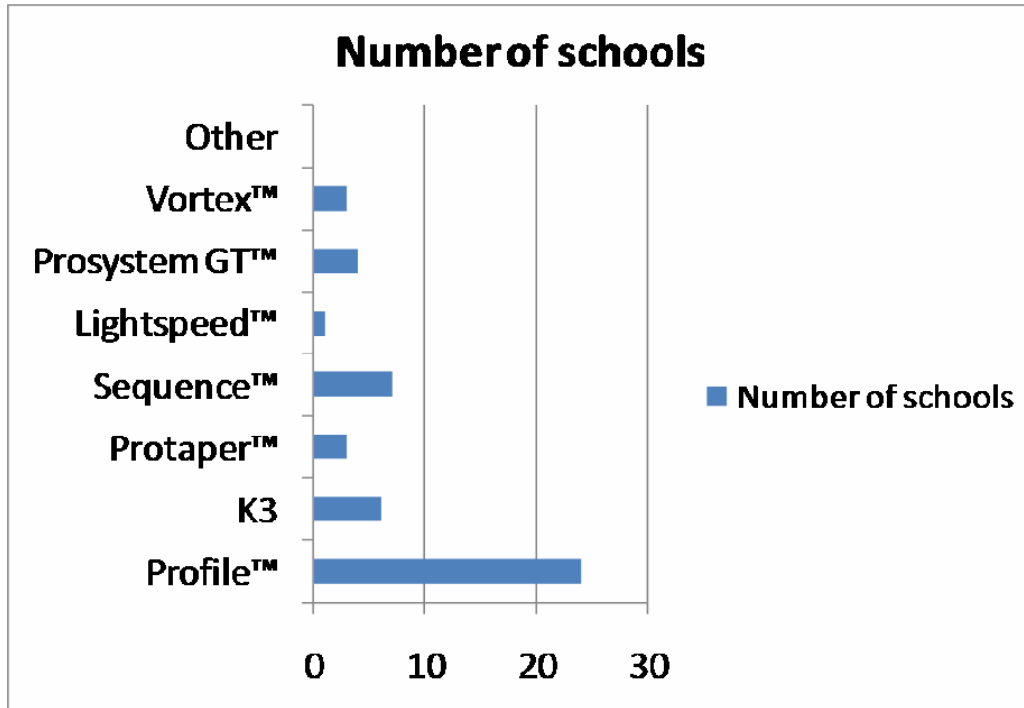


Figure 6. Rotary Instruments

Question #9 asked which irrigation solution is used in predoctoral endodontic treatment. Ninety-five percent of schools use sodium hypochlorite in some concentration, with 2.5% is used in 22 of the 37 schools (59%). One school reported using saline and one, water (see Table 10 and Figure 7). No schools reported using Chlorhexidine in any concentration or Biopure™MTAD by Densply for irrigation.

TABLE 10. Irrigation Solution

Question #9: Which irrigation solution is used routinely during root canals performed in the predoctoral clinics?

	N	%
Sodium Hypochlorite 5.25%	9	24
Sodium Hypochlorite 2.5%	22	59
Sodium Hypochlorite 1%	2	5
Sodium Hypochlorite 0.5%	2	5
Saline	1	3
Other (water)	1	3
Chlorhexidine 0.12%	0	0
Chlorhexidine 2%	0	0
Biopure™ MTAD	0	0

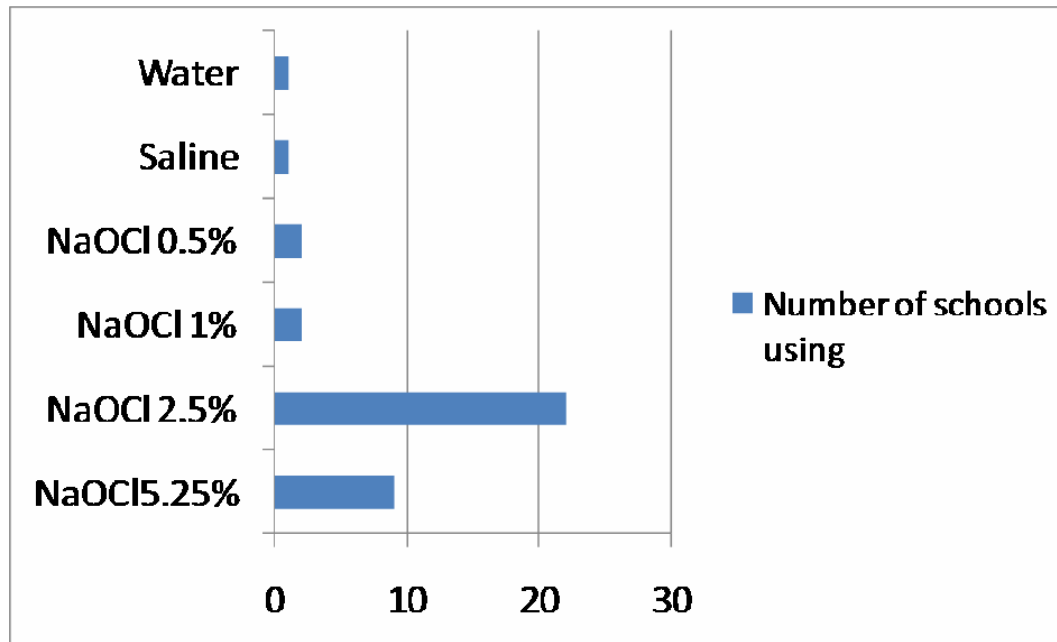


Figure 7. Irrigation Solution

Intracanal medicaments were addressed in question #10. Ninety-five percent of the respondents use calcium hydroxide between root canal visits. One school reported using nothing and one reported using chlorhexidine gel (see Table 11 and Figure 8).

TABLE 11. Intracanal Medicament

Question #10: In the predoctoral clinics, which intracanal medicament is used routinely between visits?	N	%
Calcium Hydroxide	35	95
Chlorhexidine Gel	1	3
Nothing	1	3
Dexamethasone	0	0
Formocresol	0	0

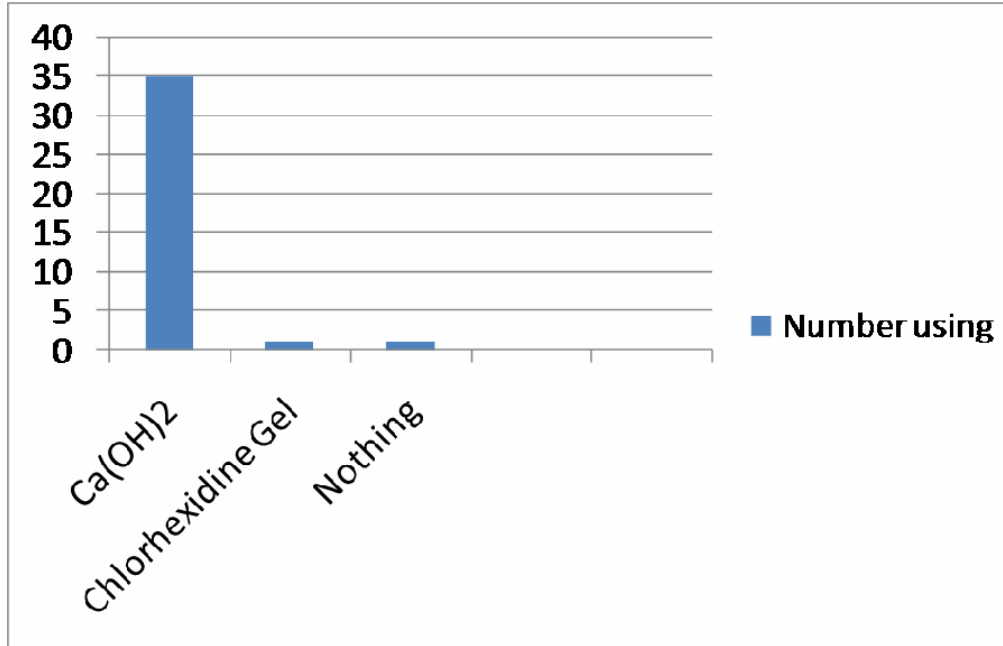


Figure 8. Intracanal Medicament

Respondents were asked about obturation material in question #11. Gutta-percha is used in 95% of programs responding. Synthetic polymer obturation is used in one program. There was the opportunity for a write-in response on this question and one program responded “carrier-based obturation.” Method of obturation was not addressed in this question, so this response was considered erroneous since the respondent did not clarify the material for carrier-based obturation (see Table 12 and Figure 9) .

TABLE 12. Obturation Material

Question #11: In the predoctoral clinics, which of the following materials is used routinely to obturate canals?

	N	%
Gutta-Percha	35	95
Synthetic polymer	1	3
Other (carrier based obturation)	1	3

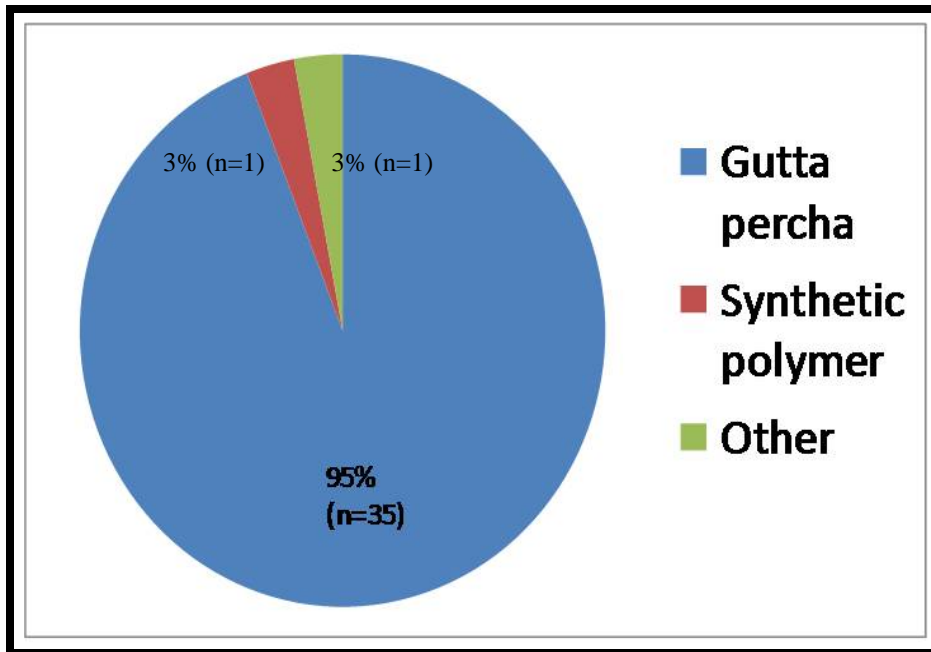


Figure 9. Obturation Material

Question #12 addressed obturation method. Seventy-six percent of respondents teach cold lateral obturation, 5% teach carrier-based and 8% teach warm vertical. This question also contained a response for “other” and presented an opportunity for a write-in response. Eleven percent of respondents (four program directors) answered “other” and wrote further explanation. Other techniques indicated were the use of warm vertical in combination with another technique (two programs), Simplifil™ (a carrier-based obturation in which the carrier is removed and the remainder of the canal is backfilled with warm vertical obturation) (one program), and continuous wave technique with Calamus unit for warm vertical backfill (one program) (see Table 13 and Figure 10).

TABLE 13. Obturation Method

Question #12: In the predoctoral clinics, which method is used routinely to obturate canals?

	N	%
Cold lateral	28	76
Carrier-based	2	5
Warm Vertical	3	8
Other	4	11
Single cone	0	0

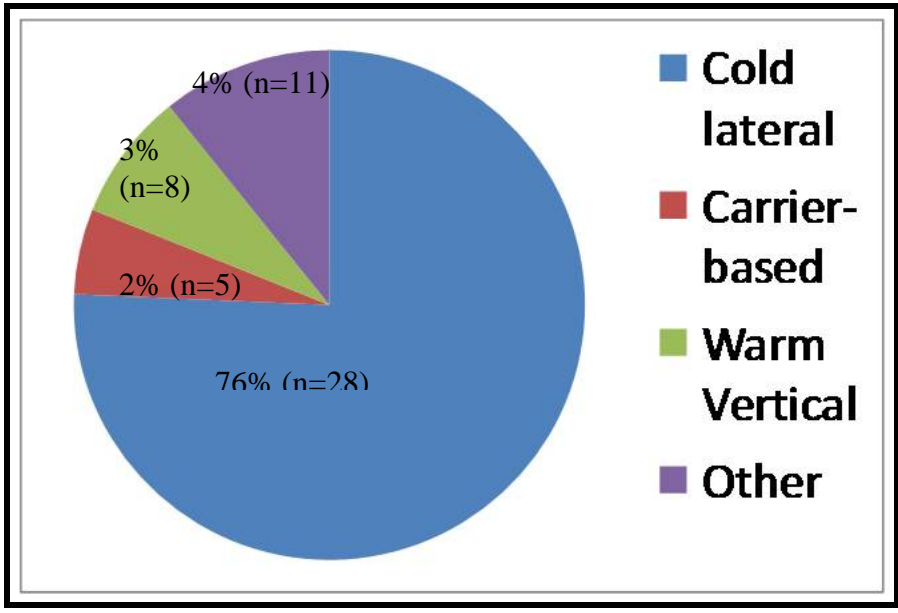


Figure 10. Obtureation Method

Discussion

In the United States (U.S), there are 58 accredited dental schools with more than 15,000 students enrolled in predoctoral education programs (2). For the purpose of this survey, the AAE's Educational Affairs Committee released 51 predoctoral endodontic program directors' email addresses for the existing accredited programs in the U.S. These programs operate under the existing Commission of Dental Education (CODA) Standards for U.S. Dental Schools (14). They are as follows:

“At a minimum graduates must be competent in providing oral health care within the scope of general dentistry, as defined by the school, for the child, adolescent, adult, and geriatric patient, including: patient assessment and diagnosis, comprehensive treatment planning, health promotion and disease prevention, informed consent, anesthesia, and pain and anxiety control, restoration of teeth, replacement of teeth, periodontal therapy, pulpal therapy, oral mucosal disorders, hard and soft tissue surgery, dental emergencies, malocclusion and space management, and evaluation of the outcomes of treatment.”

Graduating over 4000 students per year who feel competent with pulpal therapy for children, adolescents, adults and geriatric patients is a seemingly insurmountable task, especially considering the other demands of dental education (3).

Competence is defined as ability to perform a specific task, action or function successfully. In a recent retrospective study which evaluated completed endodontic therapy in an U.S. subpopulation, technically satisfactory endodontic treatment was

performed in only 30% to 40% of the cases (15). Does this mean that dental schools are falling short of providing enough training for graduates to be capable of *competence* in the clinical subject area?

Dental schools in the United States are faced with a shortage of educators. The majority of these (75%) are in specialty education; therefore, some schools have decided to move toward a more comprehensive based clinical structure and away from specialists for predoctoral instruction (11,16). This model incorporates the presumption that general dentists serve as faculty more often than endodontists. An assumption could be made that, if this is true, we would have found fewer endodontists and more general dentists reported as faculty in this survey.

Question #6 asked, “Who routinely instructs the students in the predoctoral endodontic clinic (check all that apply)?” Of the responding schools, 100% reported endodontists routinely instruct the predoctoral students during root canal therapy. General dentists instruct in 19% of the predoctoral programs and post graduate residents in 54%. In retrospect, this question could have been written to elicit the percentage of total teaching done by any one of the three faculty types identified. While 100% of the respondents in this survey identified endodontists as teaching, we do not know whether 90% of the total teaching time is done by endodontists and 10% by general dentists or vice versa. If a respondent checked all three, there is no way to determine whether post graduate residents are teaching 75% of predoctoral didactic content and clinical skills, general dentists 20% and endodontists 5%, or some other combination. From this question, the only reliable result the study can report is that 100% of the respondents have

endodontists involvement in predoctoral teaching at some percentage.

In 2005, the specialty of endodontics and CODA agreed to incorporate magnification techniques as a requirement in graduate endodontic training (6). Residents increased their level of skill from competency to proficiency. No requirement for magnification exists for predoctoral training. Results from this survey showed that 62% of predoctoral endodontic programs have access to a microscope and 87% are using it for up to 5 cases per week. Are microscopes standard of care for endodontic therapy if 62% of predoctoral programs have adopted their use?

The long-term success of endodontic treatment is affected by several procedural steps, the primary two being instrumentation and obturation (17,18). Questions #8-12 in this survey were asked to gather information from the predoctoral programs about methods and materials used during instrumentation and obturation. Numerous studies have shown that nickel titanium instrumentation has advantages over hand instrumentation, both for experienced and for inexperienced operators. Rotary files typically stay more centered in the canal and are less likely to transport the apex, even with operators having different experience levels (17).

Dental schools began to introduce rotary instrumentation into their curriculum in 1999, and by 2002, it was shown in an unpublished Harvard study that 89% of predoctoral programs were incorporating rotary instrumentation into their curriculum (19). One hundred percent of the respondents to the current survey were teaching rotary to their dental students. It is unknown if the same schools responded to both surveys. It can be concluded, however, that there is growing interest in rotary endodontics as a way

to increase quality and predictability of root canal therapy.

Obturation methods and techniques also effect the long term success of root canal therapy. There are many different obturation techniques and materials used in endodontics. Gutta-percha has been used successfully as an obturation material since the 1800's. In 2004, synthetic polymers entered the market but have been met with some resistance. With the increased use of rotary instrumentation, there has been a move toward using single or formed cones, both in gutta-percha and synthetic polymer, to match the final file to instrument the canal. Carrier-based obturation with a heat delivery system has also gained popularity, especially among generalists. No matter what the material, endodontic educators are challenged with teaching their students to produce high quality root canal fillings including a good seal, no voids, and obturation within the radiographic apex to decrease post treatment failure.

Results from this survey showed that cold lateral obturation using gutta-percha is still used in 76% of predoctoral programs. With this technique, dental students diligently place a master cone followed by multiple accessory cones to ensure an appropriate seal at the root apex. The procedure is time consuming but has proven over many years to have excellent sealing abilities (20,21). Recent studies, however, have shown that the single, formed cone technique was comparable with lateral condensation in the amount of gutta-percha and sealer occupying a prepared canal (22,23).

Dental manufacturers have started offering more continuing education courses than ever before. The American Dental Association(ADA) and the Academy of General Dentistry(AGD) reach 34,000 general dentists per year through a combined total of 10

endodontic lectures and 8 hands-on workshops (24). Obturation is one of the topics most often covered in these courses and single cone techniques have been shown to save an operator 20 minutes per case. Considering the adage “time is money,” most dentists at least consider these more efficient techniques in their practices (23).

The actual cause of endodontic treatment failure is the persistence or introduction of microbes and their byproducts into the root canal system (15). Lack of obturation quality and apical seal can only facilitate this infection process more easily. Ideally, predoctoral students should gain exposure to obturation techniques and materials that they may introduce in their practices as a part of a predoctoral education, to avoid the misuse of these products after being instructed in their use by company representatives.

Predocutorial program directors from United States’ dental schools were surveyed to determine who is teaching the predoctoral dental students what methods of root canal instrumentation, irrigation and obturation. The shortage of endodontic educators is well documented, and many have proposed that it may lead to the elimination or consolidation of departments and more generalists teaching endodontics. Without specialists as role models, dental students may not develop an appreciation for the expertise of endodontists or the benefits of a referral relationship. Most dental schools begin their endodontic curriculum in the spring of the second year, and general dentists still consider universities as their most credible source of information. However, more and more education is provided by organizations, companies or individuals that may not represent the special interests of endodontics. Predocutorial endodontic programs must continue to provide a foundation from which graduating dentists can enter practice with enough knowledge to complete root canal therapy to the highest standards of patient care.

References

References

- (1) Mendel RW, Scheetz JP. Characteristics of predoctoral endodontic education in the United States and Canada. *J.Dent.Educ.* 1981 Nov;45(11):752-758.
- (2) "Current and Future Dental Students.". 2010; Available at: <http://www.ada.org/96.aspx>. Accessed April 15, 2010.
- (3) "Trends in Dental Education: Graduates.". 2010; Available at: <http://www.adea.org/publications/TrendsinDentalEducation/Pages/default.aspx>. Accessed April 5, 2010.
- (4) Formicola, AJ, Valachovic, RW, Chmar, JE. "New Opportunities for Dentistry in Diagnosis and Primary Health Care: Report of a Panel of the Macy Study.". 2006; Available at: <http://www.adea.org/publications/Documents/MACY%20REPORT%201.pdf>. Accessed April 15, 2010.
- (5) Qualtrough AJ, Dummer PM. Undergraduate endodontic teaching in the United Kingdom: an update. *Int.Endod.J.* 1997 Jul;30(4):234-239.
- (6) Rossman LE. American Association of Endodontists. *J.Am.Coll.Dent.* 2009 Spring;76(1):4-8.
- (7) Haj-Ali R, Walker MP, Petrie CS, Steven J. Educational necessities to compensate for faculty shortage. *J.Dent.Educ.* 2007 Apr;71(4):511-515.
- (8) Averbach RE, Kleier DJ. Endodontics in the 21st century: the rotary revolution. *Compend.Contin.Educ.Dent.* 2001;22(1):27.
- (9) Alley BS, Kitchens GG, Alley LW, Eleazer PD. A comparison of survival of teeth following endodontic treatment performed by general dentists or by specialists. *Oral Surg.Oral Med.Oral Pathol.Oral Radiol.Endod.* 2004 Jul;98(1):115-118.
- (10) Cheung GS. Survival of first-time nonsurgical root canal treatment performed in a dental teaching hospital. *Oral Surg.Oral Med.Oral Pathol.Oral Radiol.Endod.* 2002 May;93(5):596-604.
- (11) Glickman GN, Gluskin AH, Johnson WT, Lin J. The crisis in endodontic education: current perspectives and strategies for change. *J.Endod.* 2005 Apr;31(4):255-261.

- (12) Glickman GN, Meyers WJ, Mullaney TP. Is endodontics losing its identity in our dental schools? J.Endod. 1992 Feb;18(2):87-90.
- (13) Haden NK, Weaver RG, Valachovic RW. Meeting the demand for future dental school faculty: trends, challenges, and responses. J.Dent.Educ. 2002 Sep;66(9):1102-1113.
- (14) Commission on Dental Accreditation 2-25. "Self Study Guide for Dental Education Programs."
- (15) Buckley M, Spangberg LS. The prevalence and technical quality of endodontic treatment in an American subpopulation. Oral Surg.Oral Med.Oral Pathol.Oral Radiol.Endod. 1995 Jan;79(1):92-100.
- (16) McNally MA, Dunning DG, Lange BM, Gound TG. A survey of endodontic residents' attitudes about a career in dental education. J.Endod. 2002 Aug;28(8):592-594.
- (17) Luiten DJ, Morgan LA, Baugartner JC, Marshall JG. A comparison of four instrumentation techniques on apical canal transportation. J.Endod. 1995 Jan;21(1):26-32.
- (18) Lazarski MP, Walker WA,3rd, Flores CM, Schindler WG, Hargreaves KM. Epidemiological evaluation of the outcomes of nonsurgical root canal treatment in a large cohort of insured dental patients. J.Endod. 2001 Dec;27(12):791-796.
- (19) Lin J, Ratiner AY, J. Predoctoral Survey, Harvard University. 2002.
- (20) Abbey LM. Interactive multimedia patient simulations in dental and continuing dental education. Dent.Clin.North Am. 2002 Jul;46(3):575-87, vii-viii.
- (21) Hembrough MW, Steiman HR, Belanger KK. Lateral condensation in canals prepared with nickel titanium rotary instruments: an evaluation of the use of three different master cones. J.Endod. 2002 Jul;28(7):516-519.
- (22) Gound TG, Sather JP, Kong TS, Makkawy HA, Marx DB. Graduating dental students' ability to produce quality root canal fillings using single- or multiple-cone obturation techniques. J.Dent.Educ. 2009 Jun;73(6):696-705.
- (23) Gordon MP, Love RM, Chandler NP. An evaluation of .06 tapered gutta-percha cones for filling of .06 taper prepared curved root canals. Int.Endod.J. 2005 Feb;38(2):87-96.
- (24) Mattscheck D. "Educating Gneral Dentists: Audience Response Results. American Association of Endodontists Annual Meeting. 2010.

Appendix A

Survey

1. Type of Dental School
 - Private
 - Public/State supported

2. Region of Dental School
 - New England (ME, VT, NH, RI, MA, CT)
 - Middle Atlantic (NY, PA, NJ, DE, MD)
 - South Atlantic (WVA, VA, NC, SC, GA, FL)
 - East South Central (KY, TN, MO, KS, OK, AK)
 - East North Central (MI, OH, IN, IL, WI)
 - West North Central (MN, IA, NE, SD, ND)
 - West South Central (TX, LA, MS, AL)
 - Mountain (MT, ID, WY, UT, CO, AZ, NM)
 - Pacific (WA, OR, NV, CA, AK, HI)

3. Do you have a graduate endodontic program at your school?
 - Yes
 - No

4. What semester do students begin their endodontic predoctoral curriculum in the classroom?
 - Spring 1st year
 - Summer 1st year
 - Fall 2nd year
 - Spring 2nd year
 - Summer 2nd year
 - Fall 3rd year
 - Spring 3rd year
 - Other

5. What semester do students begin treating endodontic patients in the predoctoral clinics?
- Summer 1st year
 - Fall 2nd year
 - Spring 2nd year
 - Summer 2nd year
 - Fall 3rd year
 - Spring 3rd year
 - Summer 3rd year
 - Fall 4th year
 - Spring 4th year
6. Who routinely instructs the students in the predoctoral endodontic clinic (check all that apply)?
- Endodontists
 - General dentists
 - Post-graduate endodontic residents
 - Other
7. Do you have a microscope available for use in the predoctoral clinics?
- Yes
 - No
- **If yes, how often is it being used for cases in the predoctoral clinics?
- 1-2 cases/week
 - 2-5 cases/week
 - 5-10 cases/week
 - >10 cases/week
8. What rotary instrumentation system is used routinely by the predoctoral students for root canal treatment (choose all that apply)?
- None
 - Profile
 - K3
 - Protaper
 - Sequence
 - Light speed
 - GTX
 - Twisted files
 - Other

9. Which irrigation solution is used routinely during root canals performed in the predoctoral clinics?
Sodium Hypochlorite 5.25%
Sodium Hypochlorite 2.5%
Sodium Hypochlorite 1%
Sodium Hypochlorite 0.5%
Chlorhexidine 0.12%
Chlorhexidine 2%
Biopure MTAD
Saline
Other
10. In the predoctoral clinics, which intracanal medicament is used routinely between visits?
Calcium Hydroxide
Formocresol
Dexamethosone
Chlorhexidine Gel
Nothing
Other
11. In the predoctoral clinics, which of the following materials is used routinely to obturate canals?
Gutta Percha
Thermoplastic synthetic polymer
Other
12. In the predoctoral clinics, which method is used routinely to obturate canals?
Cold lateral
Single Cone
Carrier-based
Warm Vertical
Other

Appendix B

Letter to Program Directors

Dear Program Director:

My name is Paige Turner and I am a second year endodontic resident at Virginia Commonwealth University. I am conducting a survey entitled “Endodontic Education and Educators: Who is teaching our undergraduate dental students and what methods are being taught.

The survey is anonymous and totally voluntary. You do not have to participate in this survey. If you choose to participate, you may stop at any time without any penalty. You may also choose not to answer particular questions that are asked in the survey.

We greatly appreciate your help with this project and would be pleased to share the results with you when the study is completed. If you have any questions or comments regarding the survey, please email me at turnerep@vcu.edu.

Kindest regards,

Karan J. Replogle DDS, Program Chair Advanced Program in Endodontics

Karan J. Replogle

And

Paige Turner, DDS, Second Year Resident
Department of Endodontics
Virginia Commonwealth University School of Dentistry
Richmond, VA

VITA

E. Paige Turner, DDS, was born in Kinston, North Carolina. She is a citizen of the United States of America. She attended Furman University and obtained a BS in Biology in 1997 and then she received her DDS from the University of North Carolina at Chapel Hill. After dental school, she moved to Seattle, Washington and was granted a Certificate from the General Practice Residency at the University of Washington. Dr. Turner then entered private practice for 4 years before joining the Advanced Specialty Education Program in endodontics at Virginia Commonwealth School of Dentistry.

Upon completion of her program, she will receive a Master's of Science in Dentistry from VCU's School of Dentistry and a Certificate in Endodontics. She is currently planning a career in endodontic education in VCU's Department of Endodontics.