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# Evaluation of Post-Residency Treatment Protocol Changes: A Web-based Survey

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**Evaluation of Post-Residency Treatment Protocol  
Changes: A Web-based Survey**

John Brian Gilbreth

D.D.S., Marquette University, 2009

A Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

At the

University of Connecticut

2013

**APPROVAL PAGE**

Master of Dental Science Thesis

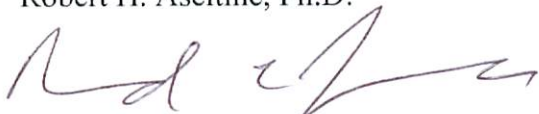
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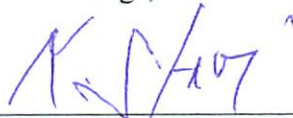
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University of Connecticut

2013

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## ABSTRACT

Clinical decision making in dentistry is multifactorial. Few studies have evaluated the influence of residency training on clinical treatment practices in dentistry. This study sought to explore the impact of resident training on post-graduate clinical protocol and the practitioner's rationale when making these decisions. Following Institutional Review Board approval, a survey of 87 graduates from the Endodontic Residency at the Division of Endodontology at the University of Connecticut Health Center from 1978 to 2012 was administered. The method of temporization following nonsurgical endodontic therapy, dilution of sodium hypochlorite, instrumentation, treatment planning and endodontic sealer choice were evaluated and compared to the respondent's residency training. The results of the survey included a 54% completion rate. The majority of graduates reported using the same endodontic sealer and treatment planning protocol as taught in residency. Most graduates did not report using the same dilution of sodium hypochlorite or instrumentation protocol. In general, graduates continue to practice theory-based protocols learned in their residency more often than technology-based protocols. Graduates chose clinical protocols identical to their residency training 52% of the time. The majority of graduates chose residency training, clinical experience and peer-reviewed articles when explaining their rationale for clinical decisions.

## INTRODUCTION

Recently the financial burden associated with higher education and for-profit schools has caught the attention of national media and the U.S. Senate.<sup>1</sup> There is deep concern about the quality of education and the graduate's ability to repay the thousands or hundreds of thousands of dollars in federal loans.<sup>2</sup> In exchange for tuition, an institution promises to provide quality instruction necessary for the student to be viable in his or her field.

Each year, dental graduates send over 35,000 applications for 1,589 post-graduate positions.<sup>3</sup> Each specialty program offers full-time clinical training and possible national board eligibility. Typically, a certificate is awarded after successful completion of the program. While the Senate is evaluating the economic viability of graduates in the workforce, a more compelling question is the educational viability of these specialty graduates. Specifically, to what degree is the school's methodology actually used in private practice? What is the practitioner's rationale if he or she discards the institution-based "textbook" instruction?

Endodontists have an obligation to lead their peers in the dental community with sound endodontic principles.<sup>4</sup> The national endodontic organization is responsible for the accreditation of each endodontic program and encourages the development of new educators in the field.<sup>5</sup> A practitioner's knowledge may increase as his/her career progresses, but the knowledge was first obtained

when he or she was a resident. The inception of endodontic knowledge and transformation into a specialist begins in the residency.<sup>9</sup> It would benefit our national professional society and educators to know the permanence of theory taught in postgraduate endodontics.

### **Clinical decision making**

Some efforts have been made in the medical field to evaluate the effect of specific randomized clinical trials on a physician's awareness and clinical behavior. In a systematic review of 28 articles addressing 19 different clinical trials, only two appear to have significantly influenced the physician's practice habits.<sup>6</sup> Another systematic review by Choudhry et al. in 2005 evaluated the number of years that a physician has been in practice and the quality of care that physician provides. Of the 62 studies reviewed, 32 (about 52%) suggested a physician's performance decreases with increasing years of practice. Thirteen studies (about 21%) found no association between age of the practitioner and decrease in clinical performance.<sup>7</sup> From this, the author further suggests that increased experience may have a paradoxical decrease in clinical performance. Both articles explore important questions about the physician's previous clinical training and the influence of clinical trials or continuing education on clinical behavior.

Practice habits have also been evaluated in dentistry, although far fewer articles have been published in comparison to the medical community. Dental research, or major publications, appear to highlight differences in treatment planning



among dental specialties or draw comparisons in decision making between general dentists and specialists.<sup>8,13</sup>

In past years, dental school instruction was designed to emanate from clinicians who oversee clinic operations and departmental instruction.<sup>9</sup> Masella et al. states, “Traditional practitioner faculty may see themselves as providing ‘expert’ experience delivered in a typical teacher-centered, passive learning environment, offering the prospect of maximum classroom control.” This reliance on a few central figures for instruction conditions the dental student to respond to an “expert” opinion, as opposed to teachings based on the latest evidence.<sup>9</sup> This seemingly small influence on treatment decisions may have a profound effect on the student’s post-graduation clinical paradigms and practice habits.<sup>44</sup>

A recent study of dental graduates in Iowa regarding the acquisition and utilization of scientific information to support clinical decision making found that “continuing education courses were the most frequently utilized and preferred information source by respondents, followed by print journals and consultation with other healthcare professionals.” When survey responses were grouped by date of graduation, a trend was discovered, as each cohort had a relatively similar scope of practice and protocols. The author also noted that graduates of specialty programs were more likely than general dentists to consult with Iowa dental school faculty when making clinical decisions.<sup>10</sup>

Several studies have evaluated the influence of specialty training on endodontic decision making. When compared to other specialties, endodontists have the highest level of agreement on endodontic treatment modalities.<sup>11,12</sup> Reit has extensively investigated clinical decision making regarding endodontically treated teeth and determined that most clinicians rely on “a few heuristic principles” (essentially relying on experiential learning or trial and error) to simplify the complex process of estimating probabilities and determining treatment modalities.<sup>13</sup> Van Velzen has suggested a purely analytical solution to the problem, suggesting that analysis of odds ratios and data points related to preoperative status and root filling quality could lead the practitioner away from heurism and toward more predictable outcomes.<sup>44</sup> Considering the experiential learning model, each practitioner will have a slightly different experience, and thus each new clinician progress toward a slightly different end-point or clinical approach. Certainly, Van Velzen’s approach would lead to less variation in the development of new clinicians, but it may also limit opportunities for the clinician to “self-teach” and clashes with the current trends of online “independent study.”<sup>34</sup>

In 2005 Haj-Ali et al. surveyed members of the Academy of General Dentistry regarding the resources used for clinical decision making related to posterior composite restorations. Overall, 13.9% of the respondents used evidence-based dentistry as their primary resource when making clinical decisions. Fifty-two percent used a combination of evidence-based dentistry and non-evidence based dentistry resources, while 34.1% used non-evidence based resources as

their primary resource. This study also concluded that more experienced clinicians were more likely to use evidence-based dentistry as their primary resource.<sup>14</sup>

Several years ago the American Dental Association began a campaign to raise awareness of “evidence-based dentistry.” They promoted a periodical that reviewed dental products and claimed that it would help the practitioner by “examining individual brand decisions, product comparisons, manufacturers’ claims, clinical relevance and product selection based on patient needs.” This is a guide for new clinical techniques and the use of new dental products based on a scientific foundation. Of the 1,278 general dentists surveyed, 91% said the journal influenced their purchasing decisions.<sup>15</sup>

The rate and volume of new information related to dentistry is increasing, and the methods through which this information is disseminated are also changing.<sup>33</sup>

Robbins et al. discussed the introduction of a new class of articles, the non-refereed journal. Clinical trials and independent data analysis of a new dental material typically requires several years. By the time the refereed journal has approved the publication, the material may no longer be on the market--or the manufacturer may have already changed the product’s composition.<sup>56</sup> Non-refereed journals attempt to fill that lag-time in dissemination of new product information. Robbins summarizes the aim of these publications: 1) Promote the sale of a product or device 2) Promote the career of the author. The scientific article promoting the new material or device is usually accompanied by a full-

page advertisement for that material or device.<sup>56</sup> Absent is the time-consuming and difficult clinical research.<sup>16</sup> The end-product is the discovery and rapid dissemination of “new” knowledge, which may potentially influence clinical practice patterns.

In many forms, research and technology expands our academic knowledge and increases the operator’s protocol treatment choices.<sup>34</sup> When compared to the modern day, it is not surprising that an endodontic resident in the 1980s (pre-rotary instrumentation and operating microscope) had vastly different instruction on canal preparation and obturation. A few biologic principles established in the infancy of endodontics have remained relatively unchanged, and they have remained relatively consistent at the University of Connecticut Division of Endodontology for the last 34 years (see annex 2).

In light of the variety of influences that drive clinical behavior, a focused survey of these biologic principles could shed some light on how the endodontic graduate’s clinical habits have changed or remained the same. The principles to be explored include the use of AH26 endodontic sealer (or AH Plus)<sup>19</sup>, the temporization of endodontically accessed teeth<sup>20</sup>, one-visit versus two-visit treatment of teeth with necrotic pulps<sup>21,45</sup>, the dilution of sodium hypochlorite (0.5%)<sup>17,18</sup>, and instrumentation protocol.<sup>35,36</sup>

### **Theoretical decision making**

Residents in the University Of Connecticut endodontic program were taught to use AH26 endodontic sealer (or AH Plus). Their clinical choice was a theoretical decision based on analysis of literature as taught to them by the clinical instructors.<sup>19</sup> The benefits of this endodontic sealer are compared to the attributes of other endodontic sealers, and ultimately a decision was made based on the theoretical merits of one material over another (i.e., epoxy resins have good bond strength<sup>66,67</sup> or ZOE-based endodontic sealers have good antimicrobial properties but are not dimensionally stable).<sup>68,69</sup> The use of these endodontic sealers have similar handling characteristics; the differences are primarily literature-based, and residents are taught the theoretical principles related to the use of this material during their residencies.

Another aspect of residency training that includes theoretical principles is treatment planning (one-visit or two-visit treatment of teeth with necrotic pulps).<sup>21</sup> Some have argued that one-visit endodontics is equally effective as two visits<sup>57,58</sup>, while others have asserted that two-visit endodontics with CaOH as an intracanal medicament significantly reduces the bacterial load.<sup>45,70</sup> Residents are taught the theoretical importance of canal disinfection and interappointment dressings.<sup>59</sup>

The third theoretical principle taught to students in residency training is the dilution of sodium hypochlorite used during canal irrigation. Sodium hypochlorite in a commercial form (household bleach) is highly alkaline.<sup>60</sup> Dakin proposed a sodium hypochlorite solution that has a lower alkaline content and a lower

sodium hypochlorite concentration (0.5%).<sup>61</sup> This preparation is buffered, so it is less toxic to the periapical tissue, but retains its antimicrobial qualities.<sup>62</sup> This theory-based rationale was taught to all residents who graduated from the University of Connecticut Division of Endodontology.

### **Technology-based decision making**

Temporary filling materials create a barrier to prevent bacteria and contaminants from entering the canal, and they also prevent intracanal medicaments from washing out of the canal space.<sup>63,20</sup> Fraser in 1929 was the first to discuss temporization of endodontically accessed teeth.<sup>64</sup> Since then, over 20 temporization materials have been introduced into the market. Important technical qualities of the temporization material include “ease of placement and removal, provide acceptable aesthetics, and protect tooth structure during treatment.”<sup>65</sup> As the ease of handling and other technical properties directly impact the clinician’s practice style, the choice in temporization is less theory-based and more technology-based.

For historical reference, Walia in 1988 was the first to discuss the use of NiTi hand files.<sup>35</sup> The first rotary instruments were available on the market in 1993.<sup>37</sup> Acceptance of rotary instrumentation was initially slow, and the first study of modern rotary instrumentation was published in 1995.<sup>38</sup> Rotary instrumentation caused a radical technological change to endodontics; some subjects in this study have graduated 15 years prior to the first rotary instrument and others have graduated almost 20 years after the fact.<sup>37</sup> Robbins et al. explained that the rate

at which new dental products are introduced to the market allows little time for peer-reviewed publications to report on their strengths or weaknesses.<sup>56</sup>

Residency training for each unique file system is primarily technology based (theory-based instruction has a lesser role) due to the constant change in endodontic products. Over the last 34 years, the University of Connecticut Division of Endodontology has taught seven different file systems. In comparison, during the same time span the dilution of sodium hypochlorite has changed only once (see appendix 2).

### **Historical data**

In 1997 the Endodontic department at the University of Connecticut developed a customized digital record keeping program. This program recorded the type of endodontic sealer, temporization material and dilution of sodium hypochlorite used during each patient encounter. Today the endodontic residents continue to enter the same data. From this, a timeline of theory and technology taught by year was established from 1997 to 2012. Changes to protocol were documented as the residents entered treatment notes and could be accounted for by the digital timestamp.

Prior to 1997, minutes were kept from an annual faculty meeting that reviewed the year's clinical protocol and any proposed changes. In addition, current faculty were available to review the records and verify the accuracy of the documents. For an exact timeline of the theory taught at the Department of Endodontology, see Appendix 2.

## **Research Questions**

What is the impact of resident education at the University of Connecticut Division of Endodontology on treatment planning in private practice? What is the practitioner's rationale if he or she discards the institution-based "textbook" instruction? What is the practitioner's rationale if he or she continues to follow the protocol taught at the graduate school?

## **Goal**

This study aims to define the clinical practice behaviors of University of Connecticut Endodontic graduates from 1978 to 2012 in five areas: the use AH26 endodontic sealer (or AH Plus)<sup>19</sup>, the temporization of endodontically accessed teeth<sup>20</sup>, one-visit versus two-visit treatment of teeth with necrotic pulps<sup>21,45</sup>, the dilution of sodium hypochlorite (0.5%)<sup>17,18</sup> and instrumentation protocol.<sup>35,36</sup> The study also compares the graduates' current practice behaviors to the clinical protocol taught while in residency and identifies what resources graduates use when determining treatment protocol.

## **MATERIALS AND METHODS**

Institutional Review Board approval was obtained prior to initiating the study. During the years 1978 to 2012 the Division of Endodontology documented the temporization method, dilution of sodium hypochlorite, instrumentation protocol, treatment planning and obturation technique taught each academic year. One



hundred and five residents have graduated from the division of Endodontology during this 34-year period. Of these graduates, eight residents will be excluded due to: retired/deceased status (n=6) or no contact information (n=2). Eighty-seven graduates had email addresses, primarily obtained through records of alumni correspondence (n=84) and secondarily obtained by online searches for business email addresses (n=3). For 10 graduates no email contact information was found. For this group, business addresses were located via an additional internet query.

Total Graduates: 1978 - 2012	105
Deceased/Retired	6
No contact information	2
Eligible respondents:	97

The survey was hosted by SurveyMonkey, a web service that manages data collection and email addresses. Through this service, email invitations were sent to the University of Connecticut Endodontic graduates (n=87). The content of the survey questions and the respondents' data were maintained on SurveyMonkey's servers during the duration of the study. Identical paper copies were sent to graduates who had only a business address (n=10). The software vendor (SurveyMonkey) provides a method to track which participant has responded to prevent sending that same individual a follow-up email for a study that he or she has already completed.<sup>22</sup> Two weeks after the initial email, a follow-up email was sent.

An example of the email invitation sent to the graduates:

Subject: UConn Endodontic Alumni Survey

Dear Dr. \_\_\_\_\_,

For my Master's research I am surveying graduates of UConn Endodontics from 1978 to 2012. I am interested in learning more about your clinical practices and protocols. Since I am collecting data from less than 100 graduates, every response counts. Your participation is appreciated.

Here is a link to the survey:  
[SurveyLink]

This link is uniquely tied to this survey and your email address. Please do not forward this message.

Thanks for your participation!

John Gilbreth  
[ContactInfo]

Please note: If you do not wish to receive further emails from us, please click the link below, and you will be automatically removed from our mailing list.  
[RemoveLink]

All communication with the graduates included a cover letter bearing the stamp of IRB approval. The letter explained the survey's purpose and that the subject's completion of the survey implied consent to participate in the study. In an attempt to encourage honesty in the graduates' responses, it was emphasized in the cover letter that the survey was anonymous and not to be perceived as a parental intrusion into how the respondents choose to practice.<sup>39</sup> The survey questions were primarily in multiple choice and checkbox format (n=16), with limited open-ended responses (n=1). Pre-determined responses accurately described the majority of potential responses, with the exception of rotary instrumentation.<sup>40</sup> Over 20 rotary systems or combinations thereof are available; listing all possible responses would make the survey instrument very

cumbersome and possibly lead to respondents skipping the question.<sup>41,42,43</sup>

Based on review of literature, the most common responses regarding decision-making rationale and most common clinical techniques were represented by multiple choice (radio buttons) and checkbox.<sup>46-54</sup> A fill-in-the-blank option was included to allow for responses not encompassed by checkbox or multiple choice. To maintain anonymity, the respondents were instructed to not leave identifying information in their remarks.

The first survey question was designed to affirm that the graduate was currently practicing endodontics. A negative response would disqualify the graduate, and the software program would skip ahead to final screen, concluding their participation in the study (and thanking them for their time). Demographic data regarding gender, age, practice setting and date of graduation were collected. More complex data (temporization, irrigation, one visit/two visit, instrumentation, endodontic sealer) were collected in the following format:

Primary question: What sealer do you usually use?  
(checkbox answers omitted)

Secondary question: What influences your decision to use this sealer?  
(checkbox answers omitted)

To view the complete survey see annex 1.

At the point of data collection, no identifying tags were linked to the content.

There were no timed responses or required login screens. No response was mandatory, i.e. the user could advance to the next screen, even if a question was

left unanswered. The data collected were only valuable if they could be compared to the corresponding theory taught during their three years as a resident. A simple open response textbox would effectively correlate the graduate to which temporization method, instrumentation protocol, etc., he or she was taught during residency. However, the graduating classes from 1978 to 2012 were typically small (two or three per year). If the respondent gave their exact date of graduation and gender it would be relatively easy to circumvent any researcher's efforts to maintain anonymity. To remedy this, demographic data collected (question 4) was generalized into five categories. This increased each cohort to approximately 20 graduates per era, conforming to IRB standards of anonymity. The survey contained 17 questions. To reduce the number of incomplete surveys, a progress bar displayed the number of remaining questions as the respondent advanced to the next question.

### **Data Analysis**

The software vendor (SurveyMonkey) compiled all response data into an Excel (Microsoft Corp, Redmond, WA) spreadsheet. From this spreadsheet, each row of responses was inspected and re-coded from text to numeric format. If write-in data matched one of the multiple choice or checkbox responses, they were moved to the correct category (i.e., if the respondent wrote "AH Plus" in the "Other" category, instead of clicking on the identical response listed above, this error was corrected). For question 17, an open-response format, each unique file system entered by the user was assigned a value (1-12).

Each age group was assigned a numerical value that corresponded to an era on the historical timeline 1978 - 2012 (see annex 2 for the complete timeline). Next, the five categories of endodontic sealer, irrigation, temporization, instrumentation and treatment planning were analyzed by graduation cohort (1-5). For example, if a respondent indicated he/she graduated in era 5, responses in questions 6, 8, 9, 11, 13 and 16 would be compared to what was taught in the Endodontic clinic from 1978 to 1992 (see Appendix 3, research flow diagram).

From this information, a new binary variable was created to signify “yes” (a graduate continues to practice a particular protocol taught during his/her era) or “no” (the graduate’s protocol deviates from what was taught). All respondents that were not disqualified in question 1 were analyzed in the five areas mentioned earlier and assigned a yes/no response (n=47). A second set of binary variables were created to evaluate the follow-up question that accompanied each clinical question. This checkbox data were recoded into “yes” (groups that cited residency as influential in their decision-making) and “no” (groups that did not cite residency training). In addition, using start/end timestamps, the survey duration of each individual respondent was calculated and recorded as a new variable category.

Upon the completion of coding and the introduction of new variable categories, the data were imported into SPSS (IBM Corporation, Armonk, New York) for final analysis. Frequency distribution analyses were performed for all responses.

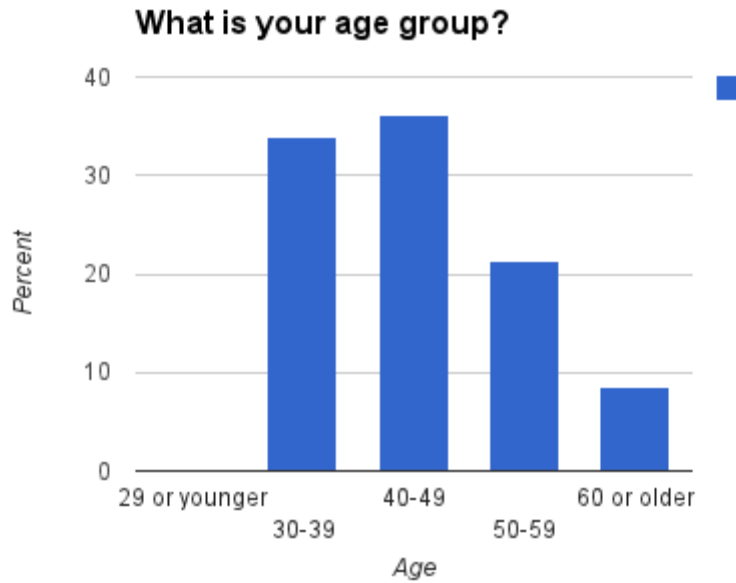
Correlation analysis using Pearson’s chi-square test and Fisher’s exact test were

also performed, set at a significance level of  $P \leq 0.05$ . In the first correlation analysis, the independent variables were: age, gender, graduation date, and practice setting, and the dependent variables were: endodontic sealer, temporization, NaOCl dilution, necrotic pulp, and instrumentation. In the second correlation analysis, the independent variables were: endodontic sealer, temporization, NaOCl dilution, necrotic pulp, and instrumentation, and the dependent variables were: residency, other, residency + other.

## RESULTS

### Demographic Data

The overall electronic response rate was 57% (n=50); the actual completion rate was 54% (n=47), as three subjects were disqualified for not currently practicing endodontics. The breakdown on gender was 26% female, 72% male, and 2% did not respond (n=47). In comparison to the actual population of graduates in the last 34 years (n=105), 26% were female (n=27). The majority of respondents were between 30 and 49 years of age (70%), and none were younger than 30.

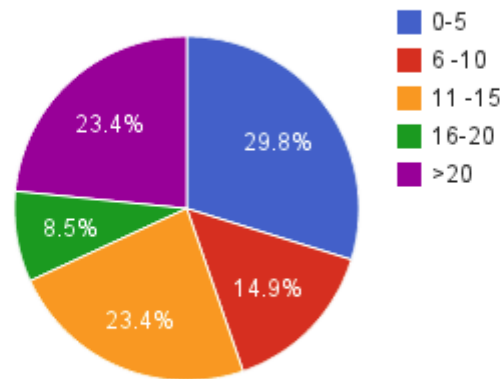


The largest group of respondents had graduated in the last 5 years (30%, n=14).

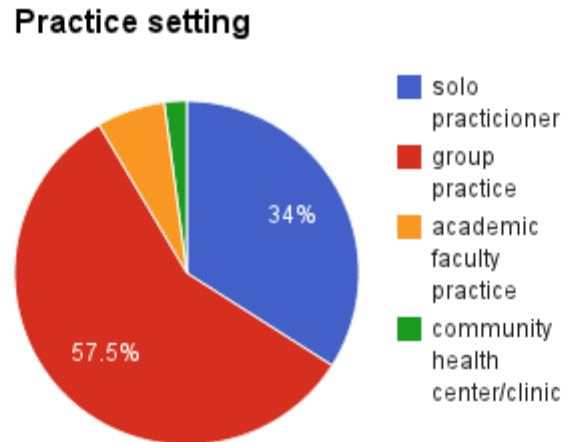
The smallest group of respondents had graduated 16-20 years ago (9% n=4).

Another group that accounted for 23% (n=11) had graduated over 20 years ago.

### Years since residency



When comparing clinical practice setting, 57% (n=27) reported group practice, while 34% (n=16) reported that he or she was a solo practitioner.



### Overview of results from clinical questions

In the population surveyed, the respondents' postgraduate clinical protocols were similar to residency training 52% of the time. University of Connecticut

Endodontic graduates are more likely to use the same endodontic sealer and treatment planning options as taught to them in residency. Graduates are less likely to use the instrumentation protocol or sodium hypochlorite (NaOCl) dilution taught during residency. Graduates appear to be evenly split between residency and non-residency temporization protocols.



Do graduates continue to practice as taught in residency?	Yes ▼	No
Q.6 Sealer	72%	28%
Q.11 Treatment planning (one visit/two visit)	72%	28%
Q.9 Temporization	53%	47%
Q.16 Instrumentation	39%	61%
Q.12 NaOCl dilution	24%	76%

### Endodontic Sealer

Due to the software configuration of SurveyMonkey, there were some obstacles encountered during data collection. For example, a list of radio buttons were created for each endodontic sealer type, but the “other” textbox was treated like checkbox data. Therefore, a respondent could select one of the radio buttons (options 1 through 5) and also enter data in the “other” category. Also, the percentage of respondents that chose AH plus/AH 26 was inflated, due to the fact that nine responses in the “other” category were not incorporated properly into the sum.

Sealer	Percentage ▼	Frequency (n)
AH plus/AH 26	81	34
Kerr Pulp Canal Sealer	21.4	9
Sealapex	2.4	1
Ketac	0	0
Epiphany	0	0
Other (please specify)		9

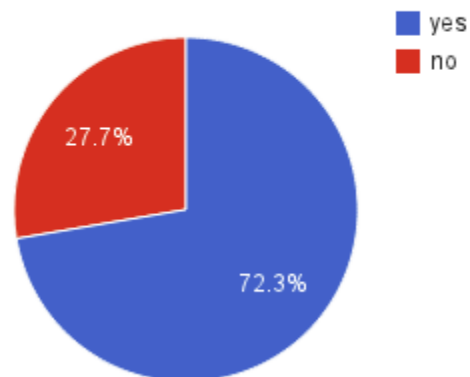
To resolve this, each response to this question was analyzed and coded into new variables; AH plus/AH 26, Other (Kerr, Sealapex, Ketac, Epiphany) and AH

plus/AH 26 + other. The most common write-in response was Roth Sealer (n=4).

Sealer (combined categories)	Percentage	Frequency (n)
AH plus/AH 26	63.8	30
Other	27.7	13
AH plus/AH 26 + other	8.5	4

The majority of respondents use the same endodontic sealer that was taught in residency (n=34), and the remaining respondents use a different sealer (n=13).

### Is your current sealer the same as residency?

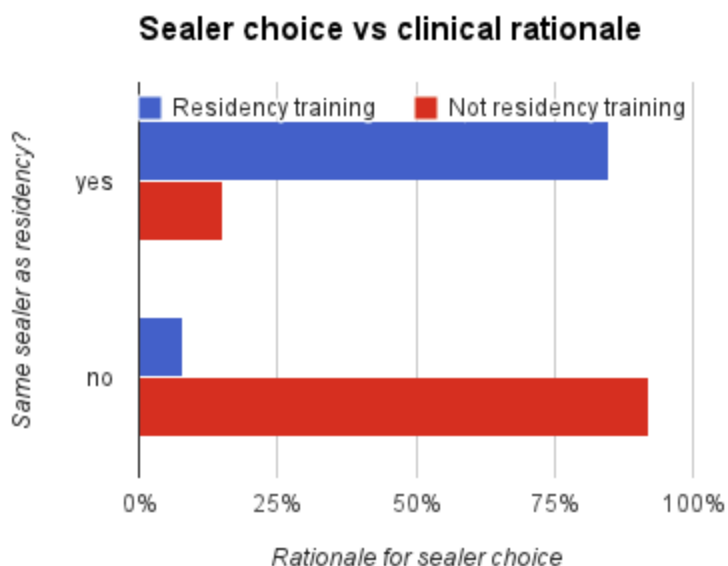


Each clinical question was paired with a secondary question that recorded the practitioner's rationale for making that decision. Results from the follow-up question that accompanied each clinical question were also analyzed. Each subject could choose more than one response for this group of questions, so the frequency count (N) in these tables can be misleading. When all responses were pooled regarding the use of endodontic sealer, residency training was cited as the most common rationale (28%), followed by clinical experience (27%) and continuing education (13%).

Rationale for sealer usage	Percent	Frequency (N)
Residency training	27.6%	29
Clinical experience	26.7%	28
Continuing Education (CE)	13.3%	14
Peer-Reviewed Articles	13.3%	14
Established protocol from an associate/partner	6.7%	7
Manufacturer's data	3.8%	4
Cost	2.9%	3
Trade Journals	2.9%	3
Other (please specify)	2.9%	3

The secondary question, “Q.7 What influences your decision to use this sealer?” was also compared to the clinician’s current protocol. In comparison of endodontic sealer choice versus sealer rationale, those that use the same sealer as taught in residency were much more likely to cite residency as an influencing factor (85%, n=34), while those who do not use the same sealer as residency were more likely to cite other factors, “clinical experience” (69% n=9) and “established protocol from an associate/partner” (30%, n=4)  $\chi^2(1, n=47) 24.5$ ,  $p<0.001$ .

The chart below simplifies the comparison of those that use the same endodontic sealer as residency and those that do not. Of those that do follow the protocol, 85% cite residency training as part of their rationale, and 15% do not cite residency training as part of their rationale. Of those that do not follow protocol, 92% cite factors other than residency training.



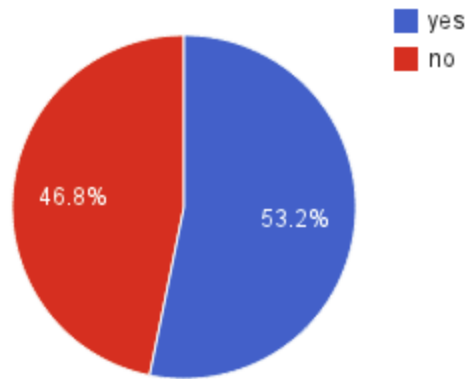
### Temporization

The majority of respondents use Cavit as their temporary of choice (66%). Other popular temporization methods include IRM (13%) and a variety of resin-based temporization methods grouped in the “other” category (11%).

Temporization	Percentage	Frequency (n)
Cavit	66	31
IRM	12.8	6
Other	10.6	5
Glass ionomer	6.4	3
Cavit + Glass ionomer	4.3	2

After comparison of the responses to historical data in Appendix 2, the proportion of those that follow residency-based temporization protocols to those that do not is fairly similar (53% versus 47%).

**Is your current temporization same as residency?**

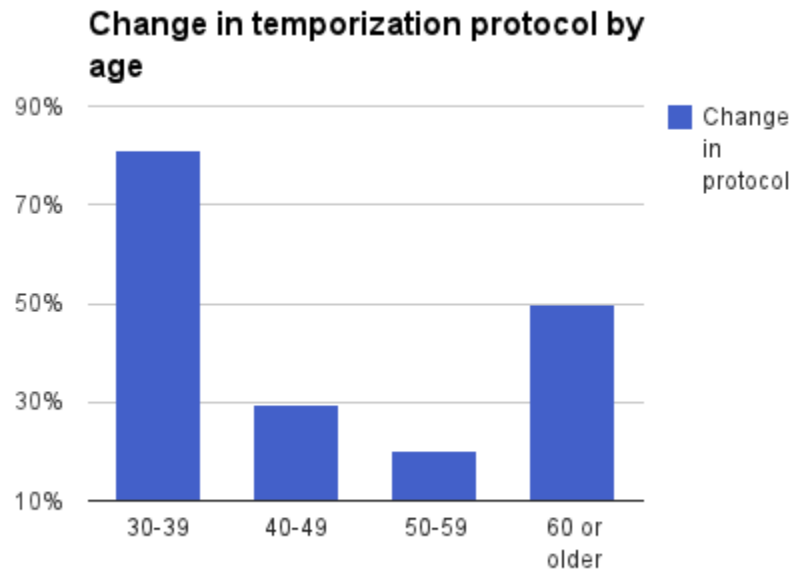


For the frequency analysis of all temporization rationale responses, clinical experience was cited most often as an influential factor (29%), followed by the referring dentist (19%) and residency training (18%).

Rationale for temporization material	Percent	Frequency (N)
Clinical experience	29%	27
The referring dentist	19.4%	18
Residency training	18.3%	17
Cost	12.9%	12
Established protocol from an associate/partner	7.5%	7
Peer-Reviewed Articles	6.5%	6
Continuing Education (CE)	3.2%	3
Other (please specify)	2.2%	2
Manufacturer's data	1.1%	1

During the chi-square analysis, a few factors appear to be statistically significant and may have some possible association. In comparison of age versus temporization: respondents in the age group 30-39 were more likely to change the temporization protocol taught in residency (81%), while respondents in the

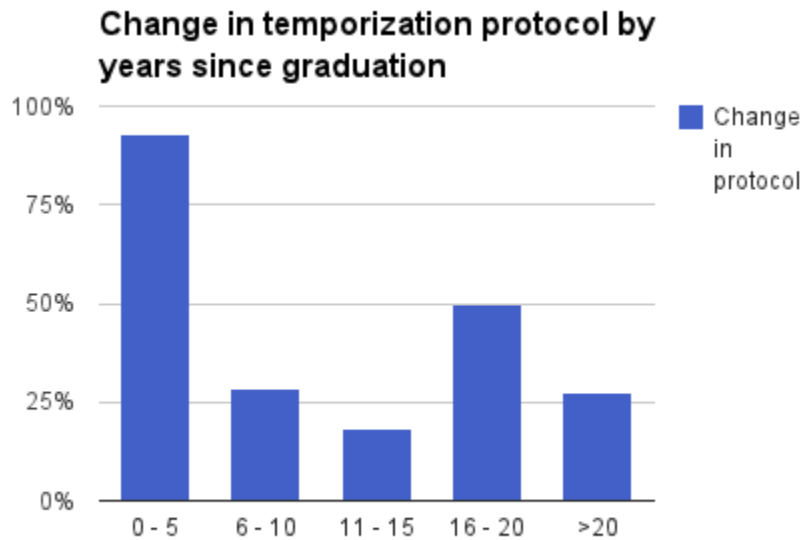
age groups 40-49 and 50-59 were less likely to change the temporization protocol  $\chi^2(3, n=47) 12.6, p=0.006$ .



In comparison of years since graduation versus whether graduates remember what temporization was taught during residency, subjects who graduated more than 11 years ago (11-15, 16-20, 20+ years) remembered what was taught 100% of the time, while subjects who graduated 0-5 years ago remembered 85% of the time, and subjects who graduated 6-10 years ago did not remember correctly 72% of the time (4, n=47) 22.2,  $p<0.001$ .

The next comparison is a slight variation of the previous analysis; years since graduation versus current temporization protocol. Subjects who graduated 0-5 years ago were more likely to change the temporization protocol taught in residency (93%), while subjects who graduated 6-10, 11-15, and over 20 years

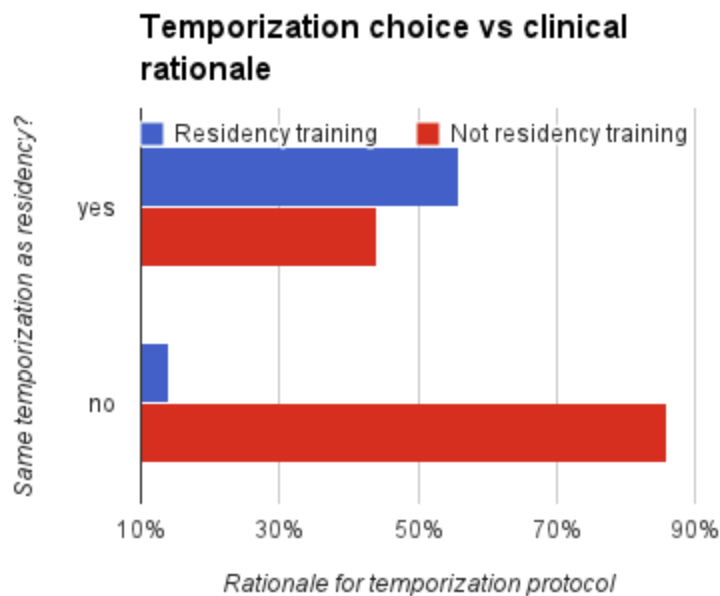
ago were less likely to change the protocol taught in residency  $\chi^2(4, n=47) 18.1, p=0.001$ .



The secondary question, “Q.10 What influences your decision to use this (temporary) material?” was compared to the clinician’s current protocol. In comparison of temporization choice versus temporization rationale, those who used the same temporization taught in residency chose “clinical experience” as the most likely reason (76% n=19), followed by residency training (56% n=14), and those that do not use the same protocol frequently cite the referring dentist (55% n=12), clinical experience (36% n=8) and cost (32% n=7)  $\chi^2(1, n=47) 9.1, p=0.003$ .

The chart below simplifies the comparison of those who do follow residency training temporization protocol and those who do not. In addition, it subdivides

the rationale for those who may or may not follow the protocol. Of those that do follow the protocol, 56% cite residency training as part of their rationale, and 44% do not cite residency training as part of their rationale. Of those who do not follow protocol, 86% cite factors other than residency that influence their temporization decision.

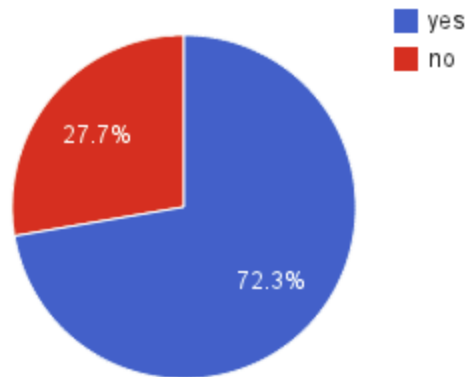


### Treatment Planning

In response to the question “Do you routinely treat teeth with necrotic pulps in one visit or more than one visit?” 28% (n=13) said they plan one visit, and 72% (n=34) said they plan on more than one visit. This section also allowed for write-in responses; one notable response recorded, “I know what the literature states, but referring dentists want one visit. I still medicate 20% of cases.”



**Do you treatment plan necrotic pulps the same as residency?**



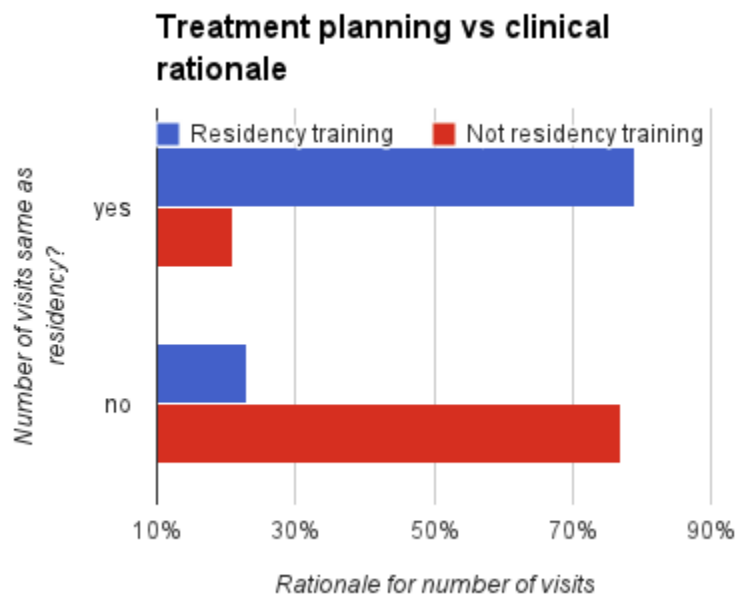
For the frequency analysis of all treatment planning rationale, clinical experience was cited most often as an influential factor (27%), followed by residency training (26%) and peer-reviewed articles (23%).

Rationale for one visit/two visit	Percent	Frequency (N)
Clinical experience	27%	30
Residency training	26.1%	29
Peer-Reviewed Articles	22.5%	25
Continuing Education (CE)	10.8%	12
Established protocol from an associate/partner	4.5%	5
Cost	4.5%	5
Other (please specify)	2.7%	3
Trade Journals	1.8%	2

The secondary question, “Q.12 How do you determine the number of appointments needed?” was compared to the clinician’s current protocol. In comparison of treatment planning (one visit/two visit) versus number of appointments, those who chose “two-visit” were much more likely to cite residency training (79% n=27), peer-reviewed articles (59% n=20) and clinical

experience (59% n=20), and those who chose one-visit treatment were likely to cite clinical experience (77% n=10) and peer-reviewed articles (39% n=5)  $\chi^2(1, n=47) 12.9, p<0.001$ .

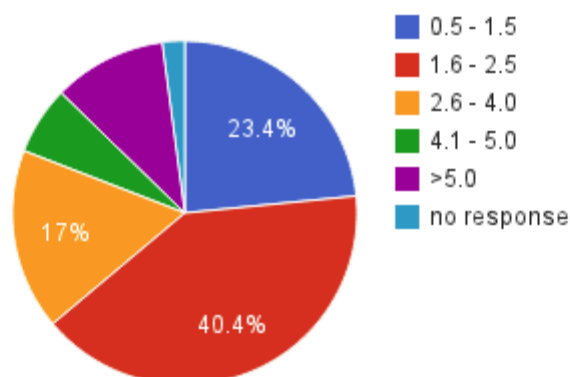
Of those who do follow the protocol, 79% cite residency training as part of their rationale, and 21% do not cite residency training as part of their rationale. Of those who do not follow protocol, 77% cite factors other than residency training.



### NaOCl Dilution

When querying the dilution of sodium hypochlorite, 23% continued to use a concentration of 0.5-1.5% (n=11), and 11% use full-strength bleach (n=5). The majority report using half-strength NaOCl (40%,n=19). Seventy-six percent of all respondents use a concentration different than in residency (n=35).

### Dilution of sodium hypochlorite



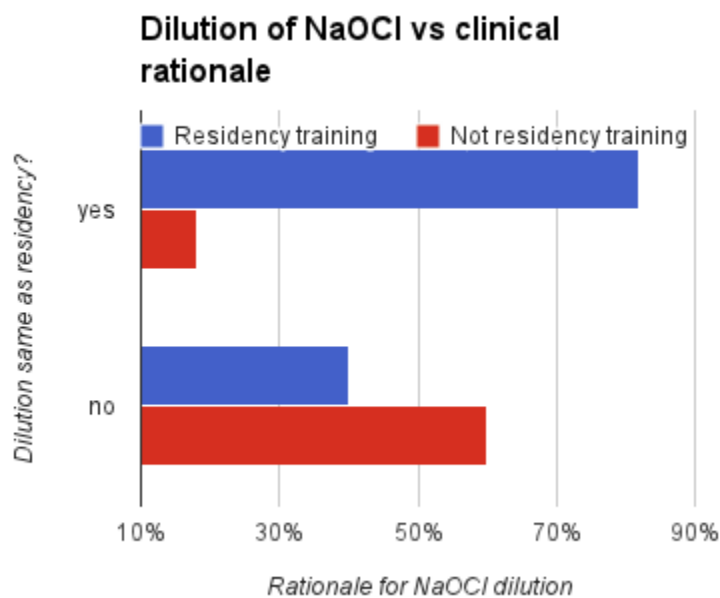
For the frequency analysis of all sodium hypochlorite rationale, peer-reviewed articles were cited most often as an influential factor (26%), followed by residency training (23%) and clinical experience (23%).

Rationale for NaOCl dilution	Percent	Frequency (N)
Peer-Reviewed Articles	25.7%	27
Residency training	22.9%	24
Clinical experience	22.9%	24
Continuing Education (CE)	11.4%	12
Established protocol from an associate/partner	7.6%	8
Cost	2.9%	3
Trade Journals	2.9%	3
Manufacturer's data	1.9%	2
Other (please specify)	1.9%	2

The secondary question, “Q.12 What influences your decision on the dilution?” was compared to the clinician’s current protocol. In the final comparison of sodium hypochlorite dilution versus dilution rationale, those who chose dilutions similar to what was taught in residency chose residency training (82% n=9), peer-reviewed articles (73% n=8) and continuing education (36% n=4), while those

who chose dilutions dissimilar to residency cited clinical experience (60% n=21), peer-reviewed articles (51% n=18) and residency training (40% n=14)  $\chi^2(2, n=47) 6.8, p=0.03$ , Fisher's exact test  $p=0.03$ .

The chart below simplifies the comparison of those who use the same sodium hypochlorite dilution as residency and those who do not. Of those who do follow the protocol, 82% cite residency training as part of their rationale, and 18% do not cite residency training as part of their rationale. Of those who do not follow protocol 60%, cite factors other than residency training.



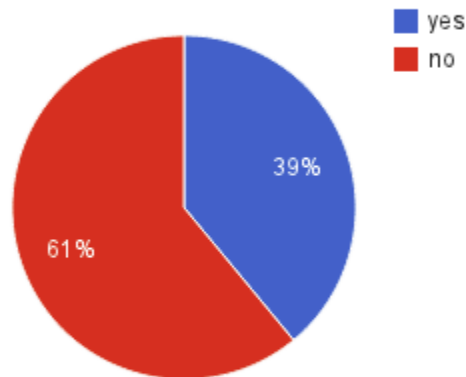
## Instrumentation

The most popular file systems are best described as follows:

Filesystem	Percentage	Frequency (N)
Protaper	23.4	11
Sequence	21.3	10
Protaper + Vortex/Vortex Blue	10.6	5
hybrid	10.6	5
Vortex	8.5	4
GT	6.4	3
K3	6.4	3
Profile	6.4	3
Twisted	4.3	2
no response	2.1	1
Total	100	47

The majority of respondents do not use the same file system as was taught in residency (n=28), and the remaining respondents use the same file system as residency (n=18).

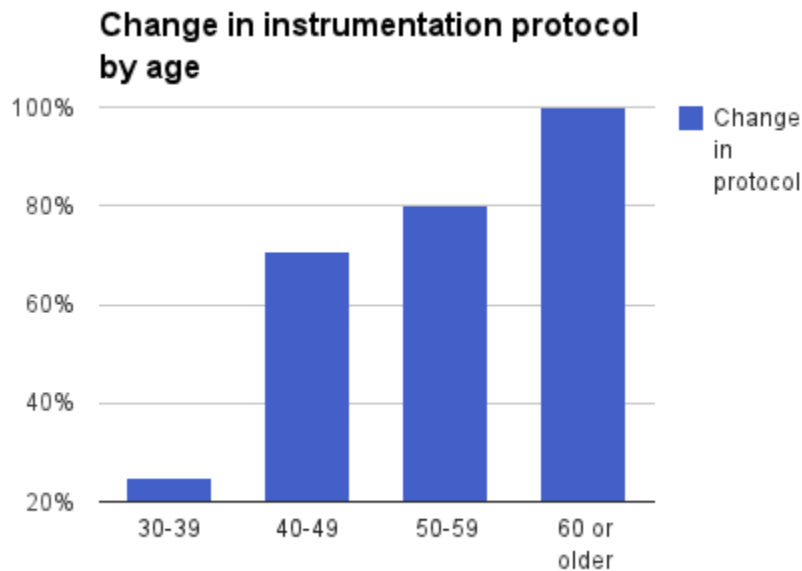
**Is your instrumentation protocol the same as residency?**



For instrumentation decisions, practitioners overwhelmingly chose clinical experience (43%), followed by peer-reviewed articles (15%). This is the only sample where two subjects did not give a rationale for their clinical protocol; it was the final question in the survey (n=45).

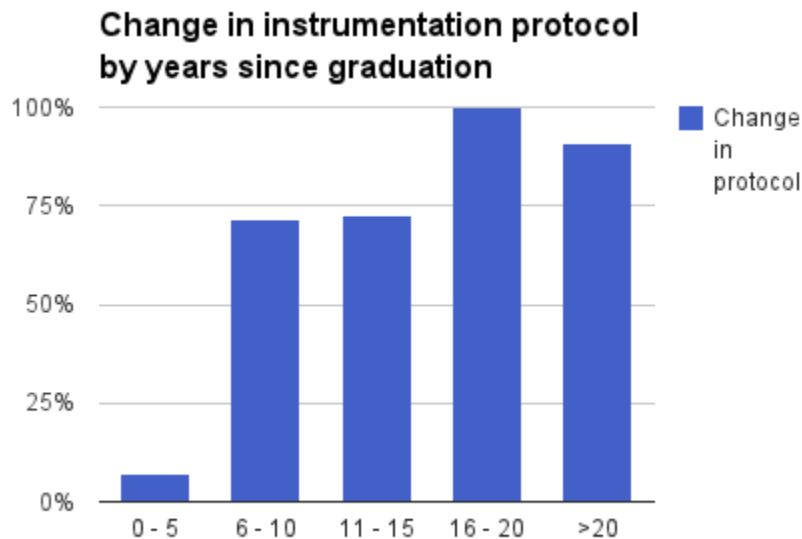
Rationale for instrumentation decision	Percent	Frequency (N)
Clinical experience	42.7%	41
Peer-Reviewed Articles	14.6%	14
Continuing Education (CE)	10.4%	10
Residency training	10.4%	10
Manufacturer's data	8.3%	8
Established protocol from an associate/partner	8.3%	8
Cost	3.1%	3
Trade Journals	1%	1
Other (please specify)	1%	1

In comparison of age versus instrumentation, respondents in the age group 30-39 were less likely to change instrumentation protocol taught in residency (25%), while all other age groups (40-49, 50-59, 60 and older) were more likely to change instrumentation protocol taught in residency  $\chi^2(6, n=47) 18.7, p=0.005$ . Analyzing the same data (age versus instrumentation) with Fisher's exact test yields a similar result ( $p=0.001$ ).



The final comparison in this category is years since graduation versus instrumentation protocol: subjects who graduated 0-5 years ago were less likely

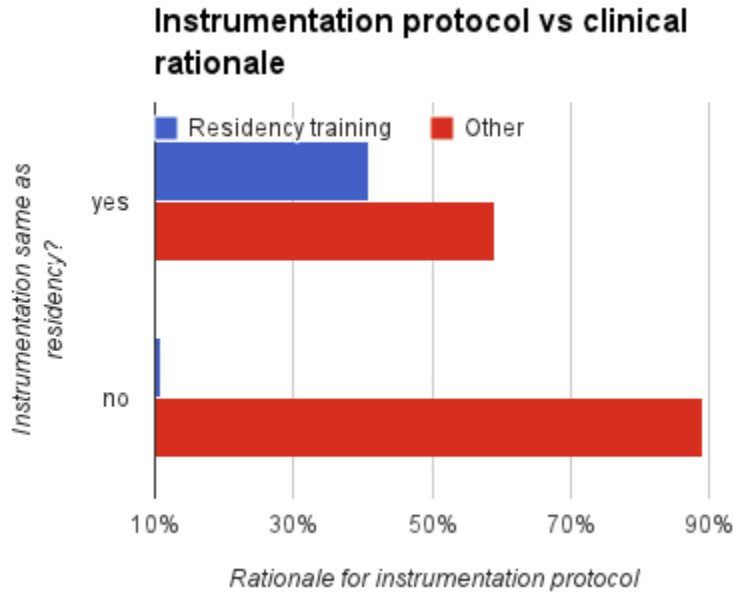
to change the instrumentation protocol taught in residency (7%), while all other groups were more likely to change the instrumentation protocol taught in residency  $\chi^2$  (8, n=47) 30.3,  $p < 0.001$ ; Fisher's exact test  $p < 0.001$ .



The secondary question, “What influences your decision to use this rotary file?” was compared to the clinician’s current protocol. In comparison of instrumentation protocol versus instrumentation rationale, those who chose rotary files similar to what was taught in residency were most likely to cite clinical experience (94% n=16), while the majority of those who chose systems dissimilar to residency training also indicated clinical experience (89% n=25) as the most influential factor  $\chi^2$ (14, n=47) 33.6,  $p = 0.002$ , Fisher’s exact test  $p = 0.03$ .

The chart below simplifies the comparison of those who use the same instrumentation protocol as residency and those who do not. Of those who do follow the protocol, 41% cite residency training as part of their rationale, and 59%

do not cite residency training as part of their rationale. Of those who do not follow protocol, 89% cite factors other than residency training.



### Other Data

The average time to complete the survey was 4.8 minutes, with the minimum time being 2 minutes and the maximum was over 60 minutes. When the two extreme outliers were excluded (58 and 78 minutes), the average subject spent less than 18 seconds on each question (n=45).

Question 8 is neither a demographic nor a question regarding current clinical protocol--it asks the graduate what temporization protocol was taught during his or her residency. Initially, it was designed as an aid to increase the precision of the protocol taught during the cohorts' era. Also, the responses provided a means by which to compare what they were taught to what they remember being taught. Based on information the respondents gave in question 4, the

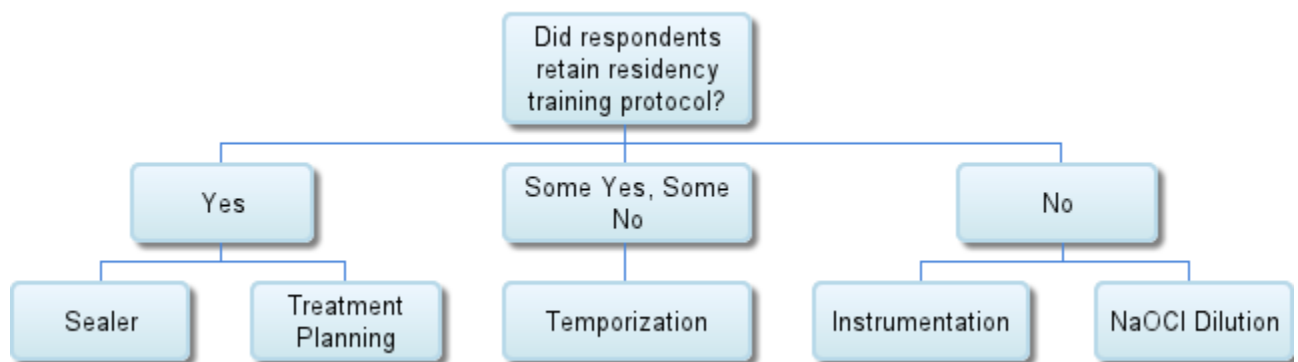


respondents correctly identified the temporization protocol taught during their residency 85% of the time (n=40) and incorrectly 15% of the time (n=7).

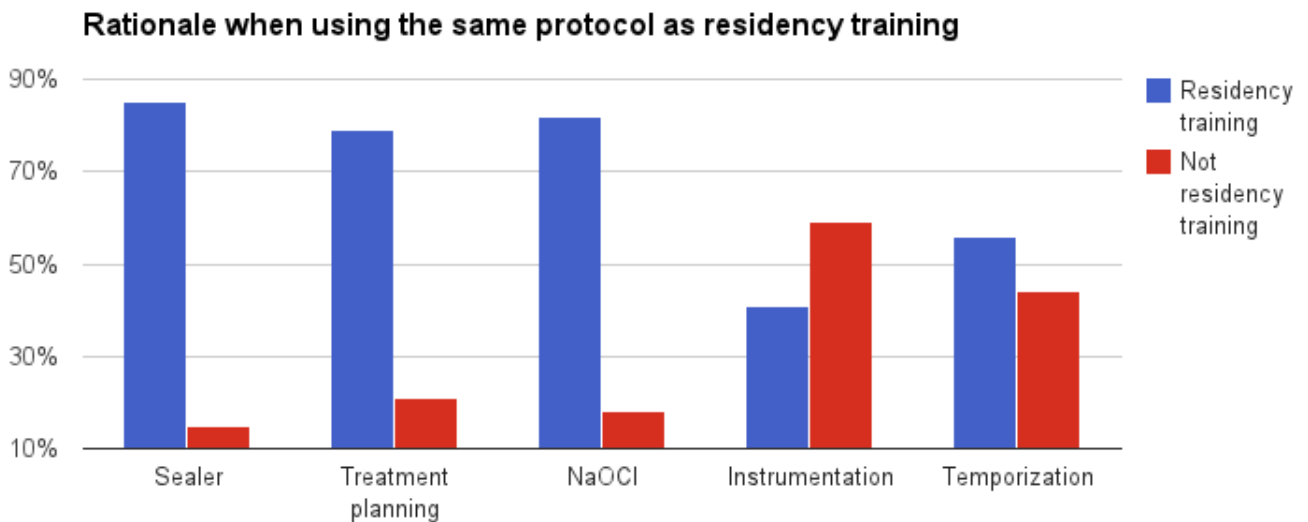
Gender and practice setting appear to have no measurable relationship to endodontic sealer, temporization, instrumentation, treatment planning or dilution of sodium hypochlorite at this sample size. Age and time since graduation are the only demographic factors that influenced the respondent's choice in treatment protocol.

### Summary

There were mixed results as to whether respondents of this survey retained and utilized their residency training. Respondents were more likely to use the same endodontic sealer and treatment planning options as taught to them in residency. Respondents were less likely to use the instrumentation protocol or sodium hypochlorite (NaOCl) dilution taught during residency. Respondents appear to be evenly split between residency and non-residency temporization protocols. Respondents tended to retain the theory-based protocols (sealer, treatment planning).



When graduates used the same protocol as residency training for endodontic sealer, treatment planning and sodium hypochlorite dilution, they indicated that residency training was more likely to influence their treatment decisions. When graduates used the same protocol as residency training for instrumentation and temporization, other factors had an equal impact on treatment decisions.



## DISCUSSION

### Theory-based versus technology-based decisions

For theoretical treatment decisions, residency training was of greater importance. When the respondent chose the same endodontic sealer, sodium hypochlorite dilution or treatment protocol as residency training, he or she invariably linked the decision back to residency training.

Residency training has a lesser role in treatment decisions that relate to technology. When the respondent chose the same instrumentation protocol or

temporization method as residency training, he or she was less likely to link the decision to residency training. It appears that the permanence of technological instruction post residency is much lower than theory based instruction.

### **Demographic data**

Data analysis would be better if exact graduation dates were known; due to privacy concerns, this could not be improved upon. By indicating both gender and exact year of graduation, the respondent could have been easily identified. The accuracy of question 4 was relied upon heavily for the analysis of responses in question 16 and question 8. If the respondent did not correctly remember how long it had been since graduation, he or she could be placed in the wrong group, and incorrect assumptions about what he/she had been taught would have been made. For example, if the respondent said he/she graduated 10 years ago, assigning him/her to group 2, the respondent would have been taught the temporization protocol Cavit + glass ionomer. If, in reality, he or she had graduated 12 years ago, the respondent would have been assigned to group 3, and this cohort was taught a different temporization protocol: Cavit and IRM.

At the beginning of the study, it was clear that the small sample size could present serious problems. A high completion rate was needed, as the entire population was less than 100 graduates. Another factor to consider is that no sample randomization was possible, and no responses were obtained via the paper survey. Despite these challenges, the majority of the graduates completed the survey (54%, n=47), and limited data analysis was possible.

Confounding factors that could have caused problems during analysis include a low response rate for the group that graduated 16-20 years ago, leading to inconclusive results for this cohort when performing correlation analyses and chi-square tests (n=4). Misinterpretation of the question is another factor in such a small sample size, as two or three unintended responses could significantly change frequency counts and other results. Since the survey was emailed from the Division of Endodontology, the respondents were acutely aware that their alma mater would be reviewing the results. This may have created some bias that is difficult to control for and may have altered some responses.

### **Temporization**

In comparison of years since graduation versus whether graduates remember what temporization was taught during their residency, subjects who graduated more than 11 years ago remembered what was taught 100% of the time, while subjects who graduated 0-5 years ago remembered 85% of the time, and subjects who graduated 6-10 years ago did not remember correctly 72% of the time. While these data seem significant, a reference to appendix 2 will demonstrate that the transition year from Cavit and IRM to Cavit/Glass Ionomer was in 2002, approximately 10 years ago. For this reason, any comparison of the cohort 6-10 years may be inaccurate.

However, it is remarkable that older respondents were better at remembering the treatment protocols taught during their residencies. This contrasts common

research that suggests deteriorating recall as time progresses.<sup>71</sup> There doesn't seem to be a clear explanation for these findings.

### **NaOCl dilution**

The secondary question, "Q.12 What influences your decision on the dilution?" was compared to the clinician's current protocol. In the final comparison of sodium hypochlorite dilution versus dilution rationale, those who chose dilutions similar to what was taught in residency chose residency training, peer-reviewed articles and continuing education. Those who chose dilutions dissimilar to residency also cited clinical experience, peer-reviewed articles and residency training. It is interesting to note that those who do not follow residency protocol (using a higher concentration of NaOCl) cited residency training as their rationale for doing so 40% of the time. It could be that their exposure to it during residency had a negative impact (i.e., they may have disliked using this dilution during residency and therefore clicked on the checkbox "residency training," even though they were not following the protocol taught during residency). Another explanation may be that the graduates felt pressure to give the University of Connecticut Division of Endodontology some recognition for all clinical behaviors, even if it was contrary to what was taught.

### **Instrumentation**

The final comparison in this category is years since graduation versus instrumentation protocol. Subjects who graduated 0-5 years ago are more likely to use the same instrumentation protocol taught in residency, while all other

groups are less likely to use the instrumentation protocol taught in residency. Again, while this may seem significant, modern rotary instrumentation was not commercially available until 1993.<sup>37</sup> Deviation from protocol in older cohorts in the last two examples might be explained by the advancement of better dental material or possibly an evolution of clinical protocol as the practitioner gains experience. The subject of being a perpetual learner will be investigated further when the secondary (rationale) question is analyzed.

### **Comparison to similar published literature**

In 2008 Lee et al. sent email invitations to 636 diplomates of the ABE using the same software vendor (SurveyMonkey) as our study.<sup>47</sup> Their response rate was 35% (n=232). During this study, all data were analyzed by SurveyMonkey's in-house software. A significant difference in survey design was that all responses included checkbox data. It was possible for the respondent to choose multiple responses for varying concentrations of sodium hypochlorite or multiple instrumentation methods. Only frequency analysis was performed; as the authors state, "The results did not lend themselves to any type of statistical analysis."<sup>47</sup> Regarding instrumentation preferences Lee et al found that hand filing was the most common response (82.1%) followed by ProTaper (33.6%), Profile (30.9%), Profile GT (21.1%), K3 (18.8%), Sequence (15.3%), Profile Series 29 (14.4%) and Light Speed (5.8%).

From these data, some of the difficulties of exclusively using checkbox data are evident, as 82% stated they used hand files during instrumentation. It is more

likely that nearly 100% use hand files during some portion of the procedure, but when multiple responses can be selected, it is easy to misinterpret the actual, but implied question, “What is your primary file system utilized while cleaning and shaping the root canal system?” The authors admit that:

“Upon reviewing the results from question seven, it was noted that most diplomates were using hand instrumentation . . . It was impossible from the way the question was worded to determine if the hand instruments were being used alone or in combination with one of the rotary systems. Most likely, they were being used in combination with a rotary system because most of these systems recommend establishing root canal patency to a size #15 or #20 before introducing the rotary files into the canal”<sup>47</sup>

To be fair, our study was no more specific; instead of presenting the respondent with a grid of checkboxes, we simply inserted a blank text box. To handle the data analysis challenge in our study, the responses were analyzed line by line, and each unique file system was coded numerically, converting it to a usable dataset. This was a reasonable task, as our sample size was less than 100, but for a sample that was potentially greater than 600 (Lee et al. 2008), it would have been somewhat more difficult to perform such an analysis.<sup>47</sup>

Lee et al. also gathered data on endodontic sealer usage, with ZOE-based sealer the most common response (74.6%), followed by AH Plus (18.9%) and AH 26 (6.5%). In comparison to our findings, AH Plus and AH 26 were combined into one category (72% n=34), and it may have been beneficial to make these two endodontic sealers separate options in the survey. Our list of answers included AH plus/AH 26, Kerr, Sealapex, Ketac, and Epiphany. The intent was to have a broad spectrum of choices from each category, but it may have been better to list

more popular ZOE-based sealers<sup>55</sup> and remove options like Sealapex (n=1), Ketac (n=0) and Epiphany (n=0), as they failed to collect any useful data.

The final comparison to Lee et al. is the temporization method commonly utilized by ABE diplomates: Cavit (68.1%), IRM (40.5%), glass ionomer (10.5%) and zinc oxide eugenol (3.8%) (n=232) to the temporization methods used by University of Connecticut graduates: Cavit (66%), IRM (12.8%), other (10.6%), glass ionomer (6.4%) and Cavit + glass ionomer (4.3%). When compared to the ABE examiners, cavit utilization percentages are relatively similar, and IRM is utilized much less frequently by University of Connecticut graduates. When comparing temporization to the results of another online survey of AAE members in 2002, some similarities are also found (n=156).<sup>51</sup> Inamoto et al. found that the majority used Cavit (68%) and ZOE (58%), and a minority used glass ionomer (8.2%).<sup>51</sup> In this comparison, Cavit and glass ionomer utilization were similar to our findings (66%, 6.4%).

Dutner et al. in 2012 conducted a survey regarding irrigation trends among AAE members and found that 57% use a concentration of 5% NaOCl or greater.<sup>48</sup> In our study most respondents (40%) used concentrations of 1.6 to 2.5%. Only 11% in our population used greater than 5% NaOCl. The dissonance between the two studies could be related to residency training or our study's small sample size.

Comparing treatment planning (one visit/two visit) Inamoto et al. found that the minority of respondents completed infected root canals in one visit (34%).<sup>51</sup> In



our study, the minority chose to treat necrotic pulps in one visit (28%). However, it should be noted that Inamoto subdivided the answers in a unique way:

Q2. In infected root canal cases, how many visits of patients do you think are usually required to carry out root canal obturation?

(1) First visit:	a. 0%	31 (20.5%) of 151
	b. 25%	18 (11.9%) of 151
	c. 50%	17 (11.3%) of 151
	d. 75%	33 (21.9%) of 151
	e. 100%	52 (34.4%) of 151
(2) Second visit:	a. 0%	52 (34.7%) of 150
	b. 25%	34 (22.7%) of 150
	c. 50%	21 (14.0%) of 150
	d. 75%	22 (14.7%) of 150
	e. 100%	21 (14.0%) of 150
(3) Third visit or later:	a. 0%	131 (87.9%) of 149
	b. 25%	15 (10.1%) of 149
	c. 50%	1 (0.7%) of 149
	d. 75%	1 (0.7%) of 149
	e. 100%	1 (0.7%) of 149

Our question regarding treatment planning for necrotic pulps was formatted very differently, as we were looking for the respondent's typical protocol and made no attempt to subdivide one visit or two visit. Due to this factor, direct comparison is questionable. One respondent wrote that his or her number of visits was determined by the "time and level of infection or resorption," and this response is similar to the aims of survey questions in Inamoto et al., i.e., the number of treatment sessions required to treat necrotic pulps depend on factors other than pulp necrosis.

Questions that could have been included in the study:

- 1 What is the percentage of surgical endodontic treatment performed in your practice?
  - a 0%
  - b 1% - 10%
  - c 11% - 20%
  - d >20%
- 2 Do you usually prescribe antibiotics to patients that undergo routine endodontic treatment?
  - a Yes

b No

Several studies including Lee 2008, have included questions similar to those listed above.<sup>46,47,50</sup> Future studies of the University of Connecticut Endodontic graduates or similar cohorts should include these data points to make the survey more complete and improve the ability to compare results to previous studies. In addition, a follow-up question to antibiotic usage would be consistent, as it deals with understanding clinical decision-making. As mentioned in the results, the average respondent spent 18 seconds on each question. Adding these questions could have increased the total survey time from 4.8 to approximately 5.8 minutes. This may have reduced survey completion rates, as the respondent might feel that the survey is too long and exit prematurely.<sup>25</sup>

## CONCLUSION

This introspective analysis of protocol-following should not give the impression that the institution's aim is complete indoctrination.<sup>29,32</sup> Several authors have explored the correlation between public education and attempts at indoctrination.<sup>30,31</sup> Each resident is encouraged to be a perpetual learner; during the post-graduation years, as new technology or research are introduced, a natural evolution of the clinician's theory and protocol is expected. All respondents that chose "residency training" as a clinical rationale also chose supporting reasons for their decision, like "clinical experience" and "continuing education." The data collected by this survey can serve as a measure of lifelong learning.<sup>26,27,28</sup> Lifelong learning can be described as a "development of self-

directed learners that are capable of serving as active agents of their own education.”<sup>26</sup> Metrics related to this study allow us to measure this change and evaluate permanence of protocol taught to 105 residents in the last 34 years.

In summary, graduates tend to retain theory-based protocols that they are taught in residency. Graduates are less likely to retain technology-based protocols. Graduates chose clinical protocols similar to residency training 52% of the time. Graduates chose residency training, clinical experience and peer-reviewed articles most often when explaining their rationale for clinical decisions.

# APPENDIX 1

- 1 Are you currently practicing endodontics?
  - a Yes
  - b No

**If your response was No:** Thank you for your willingness to participate in our study. Your survey is complete.

- 2 What is your gender?
  - a Male
  - b Female
- 3 What is your age group?
  - a 29 or younger
  - b 30-39
  - c 40-49
  - d 50-59
  - e 60 or older
- 4 How many years has it been since you completed your residency training?
  - a 0-5
  - b 6-10
  - c 11-15
  - d 16-20
  - e >20
- 5 At what practice setting do you spend the majority of your time?
  - a Private Practice - Solo Practitioner
  - b Private Practice - Group Practice
  - c Academic Faculty Practice
  - d Military
  - e Community Health Center/Clinic

- 6 What sealer do you usually use? (Check all that apply)
- AH plus/AH 26
  - Ketac
  - Kerr Pulp Canal Sealer
  - Sealapex
  - Epiphany
  - Other\_\_\_\_\_
- 7 What influences your decision to use this sealer? (Check all that apply)
- Continuing Education (CE)
  - Manufacturer's data
  - Peer-Reviewed Articles
  - Established protocol from an associate/partner
  - Cost
  - Residency training
  - Clinical experience
  - Trade Journals
  - Other\_\_\_\_\_
- 8 What was the preferred temporization method during your residency?
- a IRM
  - b Cavit
  - c Glass Ionomer (such as Fuji IX)
  - d Cavit covered by Glass Ionomer
  - e TERM
  - f Other\_\_\_\_\_
- 9 At your current practice, what type of a temporary restoration do you place over your access preparation?
- a IRM
  - b Cavit
  - c Glass Ionomer (such as Fuji IX)
  - d Cavit covered by Glass Ionomer
  - e TERM
  - f Other\_\_\_\_\_

- 10 What influences your decision to use this material? (Check all that apply)
- The referring dentist
  - Continuing Education (CE)
  - Manufacturer's data
  - Peer-Reviewed Articles
  - Established protocol from an associate/partner
  - Cost
  - Residency training
  - Clinical experience
  - Trade Journals
  - Other \_\_\_\_\_
- 11 Do you routinely treat teeth with necrotic pulps in one visit or more than one visit?
- a Usually one visit
  - b Usually more than one visit
- 12 How do you determine the number of appointments needed for endodontic treatment of teeth with necrotic pulps? (Check all that apply)
- Continuing Education (CE)
  - Peer-Reviewed Articles
  - Established protocol from an associate/partner
  - Cost
  - Residency training
  - Clinical experience
  - Trade Journals
  - Other \_\_\_\_\_
- 13 What dilution of sodium hypochlorite do you usually use in your practice?
- a <0.5%
  - b 0.5% - 1.5%
  - c 1.6% - 2.5%
  - d 2.6% - 4.0%
  - e 4.1% - 5.0%
  - f >5.0%
  - g I do not use sodium hypochlorite

14 If you use sodium hypochlorite, what influences your decision on the concentration? (Check all that apply)

- Continuing Education (CE)
- Manufacturer's data
- Peer-Reviewed Articles
- Established protocol from an associate/partner
- Cost
- Residency training
- Clinical experience
- Trade Journals
- Other \_\_\_\_\_

15 If you use sodium hypochlorite, is the solution buffered?

- a Yes
- b No
- c I don't know
- d

16 What type of rotary file do you currently use?

\_\_\_\_\_

17 What influences your decision to use this rotary file? (Check all that apply)

- Continuing Education (CE)
- Manufacturer's data
- Peer-Reviewed Articles
- Established protocol from an associate/partner
- Cost
- Residency training
- Clinical experience
- Trade Journals
- Other \_\_\_\_\_

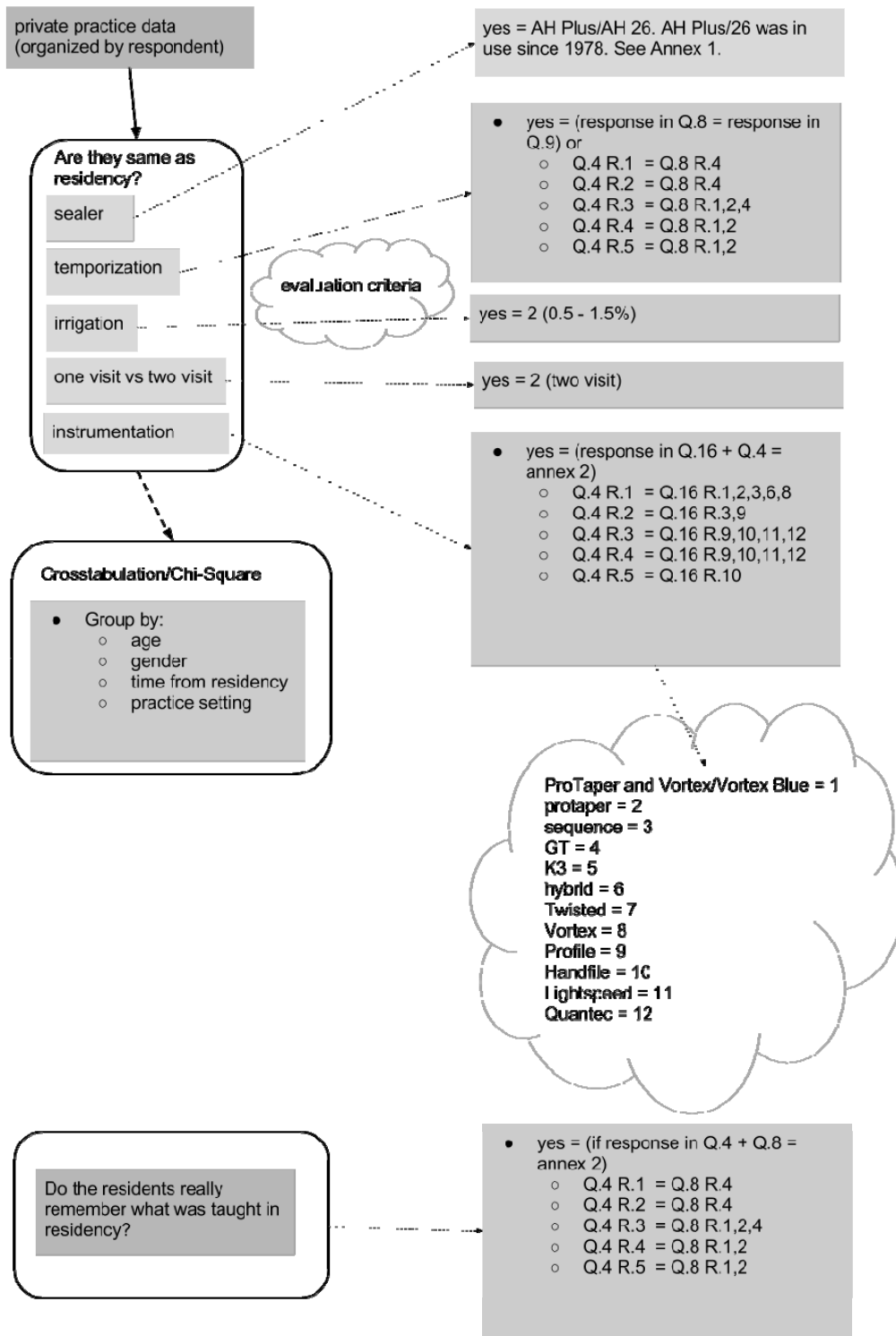
# APPENDIX 2

Protocol taught during the years 1978 to 2012

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012			
<b>Irrigation</b>																																						
Q.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
1% Buffered NaOCl																																						
0.5% Buffered NaOCl																																						
Sealer AH 26/ AH Plus																																						
<b>Obturation</b>																																						
Cavit																																						
Cavit/Glass Ionomer																																						
IRM																																						
Handfile																																						
Light speed																																						
Quanteq																																						
Profile																																						
<b>Instrumentation</b>																																						
Sequence																																						
Vortex																																						
Protaper																																						



# APPENDIX 3



## REFERENCES

- 1 "ECPI - Senate Committee on Health, Education, Labor & Pensions."  
2012. 4 Sep. 2012.  
<[http://www.help.senate.gov/imo/media/for\\_profit\\_report/PartII/ECPI.pdf](http://www.help.senate.gov/imo/media/for_profit_report/PartII/ECPI.pdf)>
- 2 "Executive Summary - Senate Committee on Health, Education ..."  
2012.  
4 Sep 2012.  
<[http://www.help.senate.gov/imo/media/for\\_profit\\_report/ExecutiveSummary.pdf](http://www.help.senate.gov/imo/media/for_profit_report/ExecutiveSummary.pdf)>
- 3 "2010-11 Survey of Dental Education - American Dental Association."  
2010. 4 Sep. 2012  
<[http://www.ada.org/sections/professionalResources/pdfs/survey\\_ed\\_vol1.pdf](http://www.ada.org/sections/professionalResources/pdfs/survey_ed_vol1.pdf)> p. 21.
- 4 Neumann LM, Nix JA. Trends in dental specialty education and practice,  
1990-99. J Dent Educ, 2002. 66(12): p. 1338-1347.
- 5 "Accreditation Standards for Advanced Specialty Education ..."  
2010. 4  
Sep. 2012.  
<[http://www.aae.org/ManagedFiles/pub/0/Pulp/endostandards\\_2008.pdf](http://www.aae.org/ManagedFiles/pub/0/Pulp/endostandards_2008.pdf)>
- 6 Fineberg HV. Clinical evaluation: how does it influence medical practice?  
Bull Cancer, 1987. 74(3): p. 333-346.
- 7 Choudhry NK, Fletcher RH, Soumerai SB. Systematic review: the  
relationship between clinical experience and quality of health care. Ann  
Intern Med, 2005. 15;142(4): p. 260-273. Review.

- 8 Zadik Y, Levin L. Clinical decision making in restorative dentistry, endodontics, and antibiotic prescription. J Dent Educ, 2008. 72(1): p. 81-86.
- 9 Masella RS, Thompson TJ. Dental education and evidence-based educational best practices: bridging the great divide. J Dent Educ, 2004. 68(12): p. 1266-1271.
- 10 Straub-Morarend CL, Marshall TA, Holmes DC, Finkelstein MW. Informational resources utilized in clinical decision making: common practices in dentistry. J Dent Educ, 2011. 75(4): p. 441-452.
- 11 George Dechouniotis, Xenos M. Petridis, Influence of Specialty Training and Experience on Endodontic Decision Making. J Endod, 2010. 36:7 p 1130–1134.
- 12 L. K. McCaul, S. McHugh, W. P. Saunders. The influence of specialty training and experience on decision making in endodontic diagnosis and treatment planning. Int Endod. J, 2001. 34(8): p. 594 –606.
- 13 Reit C. Endodontic treatment decisions: A study of the clinical decision-making process. Dent Traumatology. 1985. 1: p. 235–241.
- 14 Haj-Ali RN, Walker MP, Petrie CS, Williams K, Strain T. Utilization of evidence-based informational resources for clinical decisions related to posterior composite restorations. J Dent Educ, 2005. 69(11): p. 1251-1256.

- 15 "2008 Survey Results\*." 2010. 30 Aug.  
2012 [http://www.ada.org/sections/scienceAndResearch/pdfs/ppr\\_reader\\_survey.pdf](http://www.ada.org/sections/scienceAndResearch/pdfs/ppr_reader_survey.pdf)
- 16 Niederman R. Evidence-based dentistry: what is it, and what does it have to do with practice? The methods of evidence-based dentistry. *QI*, 1998. 29(12): p. 811-817.
- 17 Spangberg L, Langeland K. Biologic effects of dental materials. 1. Toxicity of root canal filling materials on HeLa cells in vitro. *Oral Surg Oral Med Oral Pathol*, 1973. 35(3): p. 402-414.
- 18 Shih M, Marshall FJ, Rosen S. The bactericidal efficiency of sodium hypochlorite as an endodontic irrigant. *Oral Surg Oral Med Oral Pathol*, 1970. 29(4): p. 613-619.
- 19 Orstavik D & Mjor IA. Histopathology and X-ray Microanalysis of the Subcutaneous Tissue Response to Endodontic Sealers. *J Endod*, 1988. 14: p. 13-23.
- 20 Anderson RW, Powell BJ, Pashley DH. Microleakage of three temporary endodontic restorations. *J Endod*, 1988. 14(10): p. 497-501.
- 21 Nair PN, Henry S, Cano V, Vera J. Microbial status of apical root canal system of human mandibular first molars with primary apical periodontitis after "one-visit" endodontic treatment. *Oral Surg*, 2005. 99: p. 231.
- 22 "Privacy best practices and collecting secure ... - Help - SurveyMonkey." 2010. 30 Aug.

- 2012 [http://help.surveymonkey.com/app/answers/detail/a\\_id/3951/~/privacy-best-practices-and-collecting-secure-data-for-survey-creators](http://help.surveymonkey.com/app/answers/detail/a_id/3951/~/privacy-best-practices-and-collecting-secure-data-for-survey-creators).
- 23 "Privacy Policy | SurveyMonkey." 2012. 30 Aug.  
2012 <http://www.surveymonkey.com/mp/policy/privacy-policy/>
- 24 "Privacy Policy | SurveyMonkey." 2012. 30 Aug.  
2012 [http://help.surveymonkey.com/app/answers/detail/a\\_id/3950/kw/anonymity?q=anonymity](http://help.surveymonkey.com/app/answers/detail/a_id/3950/kw/anonymity?q=anonymity)
- 25 Iarossi G. "The Power of Survey Design." 2006, 89.
- 26 Cross, K. Patricia. "Adults as Learners. Increasing Participation and Facilitating Learning." 1981.
- 27 Candy, Philip C. Self-Direction for Lifelong Learning. A Comprehensive Guide to Theory and Practice. 1991.
- 28 Mocker, Donald W. Lifelong Learning: Formal, Nonformal, Informal, and Self-Directed. Information Series No. 241. 1982.
- 29 Schein, Edgar H. The Chinese indoctrination program for prisoners of war. Psychiatry, 1956. Vol 19: p. 149-172.
- 30 Lott Jr, John R. "Explanation for Public Provision of Schooling: The Importance of Indoctrination, An." JL & Econ, 1990. 33: p. 199.
- 31 Ingber, Stanley. "Socialization, Indoctrination, or the Pall of Orthodoxy: Value Training in the Public Schools." U. Ill. L. Rev, 1987. p. 15.
- 32 Vardeman, Stephen B., and Max D. Morris. "Statistics and ethics: some advice for young statisticians." Am Stat. 2003. 57(1): p. 21-26.

- 33 Grimes, Ellen B. "Student perceptions of an online dental terminology course." J Dent Educ. 2002. 66(1): p. 100-107.
- 34 Schleyer, Titus KL, and Tuan Pham. "Online continuing dental education." J Am Dent Assoc, 1999. 130(6): p. 848-854.
- 35 Walia, Harmeet, William A. Brantley, and Harold Gerstein. "An initial investigation of the bending and torsional properties of Nitinol root canal files." J Endod, 1988. 14(7): p. 346-351.
- 36 Serene, Thomas P., J. David Adams, and Ashok Saxena. Nickel-titanium instruments: applications in endodontics. Ishiyaku EuroAmerica, 1995.
- 37 Peters, Ove A. "Rotary Instrumentation" Endodontics: Colleagues for Excellence (Winter, 2008).
- 38 Esposito, Peter T., and Charles J. Cunningham. "A comparison of canal preparation with nickel-titanium and stainless steel instruments." J Endod, 1995. 21(4): p. 173-176.
- 39 O'Malley, Patrick M., et al. "A comparison of confidential versus anonymous survey procedures: Effects on reporting of drug use and related attitudes and beliefs in a national study of students." J Drug Issues, 2000.
- 40 Couper, Mick P., Michael W. Traugott, and Mark J. Lamias. "Web survey design and administration." Public Opinion Quarterly, 2001. 65(2): p. 230-253.

- 41 Alapati, Satish B., et al. "SEM observations of nickel-titanium rotary endodontic instruments that fractured during clinical use." J Endod , 2005. 31(1): p. 40-43.
- 42 Miyai, K., et al. "Influence of phase transformation on the torsional and bending properties of nickel–titanium rotary endodontic instruments." Int Endod J, 2006. 39(2): p. 119-126.
- 43 Larsen, C. Michael, et al. "Cyclic fatigue analysis of a new generation of nickel titanium rotary instruments." J Endod, 2009. 35(3): p. 401-403.
- 44 van Velzen, S. K., H. J. Duivenvoorden, and A. H. B. Schuurs. "Probabilities of success and failure in endodontic treatment: a Bayesian approach." Oral Surg Oral Med Oral Pathol, 1981. 52(1): p. 85-90.
- 45 Byström, Anders, Rolf Claesson, and Göran Sundqvist. "The antibacterial effect of camphorated paramonochlorophenol, camphorated phenol and calcium hydroxide in the treatment of infected root canals." Dent Traumatol, 1985. 1(5): p. 170-175.
- 46 Yingling, Nicole M., B. Ellen Byrne, and Gary R. Hartwell. "Antibiotic use by members of the American Association of Endodontists in the year 2000: report of a national survey." J Endod, 2002. 28(5): 396-404.
- 47 Lee, Michelle, et al. "Current trends in endodontic practice: emergency treatments and technological armamentarium." J Endod, 2009. 35(1): p. 35-39.

- 48 Dutner, Joseph, Pete Mines, and Alfred Anderson. "Irrigation trends among American Association of Endodontists members: a web-based survey." J Endod, 2012. 38(1): p. 37-40.
- 49 Moss, H. Dwight, John D. Allemang, and James D. Johnson. "Philosophies and practices regarding the management of the endodontic smear layer: results from two surveys." J Endod, 2001. 27(8): p. 537-539.
- 50 Creasy, Joseph E., Pete Mines, and Mark Sweet. "Surgical trends among endodontists: the results of a web-based survey." J Endod, 2009. 35(1): p. 30-34.
- 51 Inamoto, Kyoko, et al. "A survey of the incidence of single-visit endodontics." J Endod, 2002. 28(5): p. 371-374.
- 52 Abbott, James A., et al. "Survey of General Dentists to Identify Characteristics Associated with Increased Referrals to Endodontists." J Endod, 2011. 37(9): p. 1191-1196.
- 53 Kleier, Donald J., Robert E. Averbach, and Omid Mehdipour. "The sodium hypochlorite accident: experience of diplomates of the American Board of Endodontics." J Endod, 2008. 34(11): p. 1346-1350.
- 54 Naylor, Justin, et al. "The use of guided tissue regeneration techniques among endodontists: a web-based survey." J Endod, 2011. 37(11): p. 1495-1498.
- 55 Tronstad, Leif. Clinical endodontics: a textbook. Thieme Medical Pub, 2009.



- 56 Robbins, J. W. "Evidence-based dentistry: what is it, and what does it have to do with practice? Anecdote vs. data--a case for evidence-based decision making." *QI* (Berlin, Germany: 1985), 1998. 29(12): p. 796.
- 57 Peters, L. B., and P. R. Wesselink. "Periapical healing of endodontically treated teeth in one and two visits obturated in the presence or absence of detectable microorganisms." *Int Endod J*, 2002. 35(8): p. 660-667.
- 58 Paredes-Vieyra, Jorge, and Francisco Javier Jimenez Enriquez. "Success rate of single-versus two-visit root canal treatment of teeth with apical periodontitis: a randomized controlled trial." *J Endod*, 2012. 38(9): p. 1164-1169.
- 59 Bergenholtz, Gunnar, and L. Spångberg. "Controversies in endodontics." *Crit Rev Oral Biol M*, 2004. 15(2): p. 99-114.
- 60 Pashley, E. L., et al. "Cytotoxic effects of NaOCl on vital tissue." *J Endod*, 1985. 11(12): p. 525-528.
- 61 Dakin, Henry Drysdale. "THE ANTISEPTIC ACTION OF HYPOCHLORITES: The Ancient History of the "Néw Antiseptic."." *Brit Med J*, 1915. 2(2866): p. 809.
- 62 Baumgartner, J. Craig, and Paul R. Cuenin. "Efficacy of several concentrations of sodium hypochlorite for root canal irrigation." *J Endod*, 1992. 18(12): p. 605-612.
- 63 Parris L, Kapsimalis P. The effect of temperature change on the sealing properties of temporary filling materials. Part I. *Oral Surg*, 1960. 13: p. 982.

- 64 Fraser CJ A study of the efficiency of dental fillings. J Dent Res, 1929, 9: p. 507-517.
- 65 Naoum, H. J., and N. P. Chandler. "Temporization for endodontics." Int Endod J, 2002. 35(12): p. 964-978.
- 66 Zmener, O., et al. "Sealing properties of a new epoxy resin-based root-canal sealer." Int Endod J, 1997. 30(5): p. 332-334.
- 67 Skidmore, Lance J., David W. Berzins, and James K. Bahcall. "An in vitro comparison of the intraradicular dentin bond strength of Resilon and gutta-percha." J Endod, 2006. 32(10): p. 963-966.
- 68 Mickel, André K., Tuan H. Nguyen, and Sami Chogle. "Antimicrobial Activity of Endodontic Sealers on Enterococcus faecalis." J Endod, 2003. 29(4): p. 257-258.
- 69 Kazemi, Reza B., Kamran E. Safavi, and Larz SW Spångberg. "Dimensional changes of endodontic sealers." Oral Surg Oral Med Oral Pathol, 1993. 76(6): p. 766-771.
- 70 Sjögren, U., et al. "The antimicrobial effect of calcium hydroxide as a short-term intracanal dressing." Int Endod J, 1991. 24(3): p. 119-125.
- 71 Craik, Fergus I., and Joan M. McDowd. "Age differences in recall and recognition." J Exp Psychol Learn, 1987. 13(3): p.474.