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Presence/absence of an endodontic specialty program during dental education compared to general dentist attitudes toward treating or referring patients requiring endodontic therapy.

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PRESENCE/ ABSENCE OF AN ENDODONTIC SPECIALTY PROGRAM DURING DENTAL EDUCATION COMPARED TO GENERAL DENTIST ATTITUDES TOWARD TREATING OR REFERRING PATIENTS REQUIRING ENDODONTIC THERAPY

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DEDICATION

I dedicate this thesis to Gail, Spencer, Marybeth, and Katie. Your support and love sustains me.

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ABSTRACT

PRESENCE/ ABSENCE OF AN ENDODONTIC SPECIALTY PROGRAM DURING DENTAL EDUCATION AND GENERAL DENTIST OPINIONS IN TREATING/ REFERRING PATIENTS REQUIRING ENDODONTIC THERAPY

Gregory Alan Carman

June 25, 2010

The decision by a general dentist to treat or refer a patient needing endodontic therapy may be based on multiple variables. Students attending dental schools with endodontic specialty programs could be exposed to a referral system with endodontic residents managing difficult cases and they could have patients transferred to residents for completion of treatment if complications occur. Whereas, students at schools without endodontic programs may have to treat more difficult cases due to a more limited ability to refer cases. The primary aim of this study was to compare the opinion of general dentist graduates trained with and without endodontic programs as to whether they would be inclined to treat or refer to a specialist their patients requiring specific endodontic procedures.

After IRB approval, a survey was electronically distributed to the members of the Kentucky Dental Association using the online survey tool Surveygizmo®. General dentists were asked their gender, dental school attended, year of

graduation, history of any GPR/AEGD training, and presented a list of 18 specific endodontic procedures or possible complications. They were asked whether they (1) would likely treat the patient, (2) would likely refer the patient, or (3) were neutral. Presence/absence of an endodontic graduate program during the years of their dental education and the number of years of practice were calculated from the data provided. Odds ratio was used to assess statistical significance.

Surveys were electronically distributed to 955 members of the Kentucky Dental Association. 230 dentists (24%) responded with 191 general dentists completing the survey. 137 respondents (71.7%) were male and 54 (28.3%) were female. 92 (48.2%) trained at a dental school without an endodontic program and 95 (49.7%) trained at a school with an endodontic program. Dentists trained at a school without an endodontic program were significantly more likely to treat rather than refer (1) teeth with calcified canals (23.9% vs 9.5%, $p = .017$), (2) teeth with significantly curved canals (28.3% vs 9.5%, $p = .001$), (3) periapical surgery on anterior teeth (16.3% vs 6.3%, $p = .037$), and (4) endodontic treatment on patients with traumatic injuries such as avulsion (52.2% vs 34.7%, $p = .019$).

The results of this study indicate the presence or absence of an endodontic graduate program during a student's dental education may influence subsequent decisions in private practice to either refer to a specialist or to treat patients requiring endodontic therapy.

Keywords: Decision to refer, Surveygizmo, Kentucky Dental Association, Post-graduate Endodontic Program

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CHAPTER I

INTRODUCTION AND BACKGROUND

Endodontics is the branch of dentistry concerned with the morphology, physiology, and pathology of the human dental pulp and periradicular tissues. Its study and practice encompass the basic and clinical sciences including the biology of the normal pulp and the etiology, diagnosis, prevention and treatment of diseases and injuries of the pulp and associated periradicular conditions.

The scope of endodontics includes, but is not limited to: the differential diagnosis and treatment of oral pains of pulpal and/or periapical origin, vital pulp therapy such as pulp capping and pulpotomy, non-surgical treatment of root canal systems with or without periradicular pathosis of pulpal origin, and the obturation of these root canal systems, selective surgical removal of pathological tissues resulting from pulpal pathosis, intentional replantation and replantation of avulsed teeth, surgical removal of tooth structure such as in root-end resection, bicuspidization, hemisection and root resection, bleaching of discolored dentin and enamel, retreatment of teeth previously treated endodontically, and treatment procedures related to coronal restorations using post and/cores involving the root canal space. [1]

Evidence exists that endodontics may have been practiced as early as the second or third century B.C. A skull found in the Negev Desert in Israel had a bronze wire located in one of the root canals. Researchers believe the wire may have been used to treat an infected pulp. Other evidence shows that pulp chambers were drained to relieve pain and pressure in the first century A.D. Over the next few centuries, early dentists increased their understanding of the role of the tooth pulp in dental health and developed numerous methods of treating it, including cauterizing and removing the pulp or covering it with protective coatings made of everything from gold foil to asbestos. Root canal therapy is the procedure used to alleviate dental pain or to treat infection that results when the tissue inside the pulp and canal systems becomes necrotic. Root canal therapy is performed by making a small opening in the crown of the tooth, locating the pulp and the root canals, cleaning and shaping the canals, and then filling the canals with an inert filling material. Afterwards, the tooth has a restoration or crown placed and functions normally.

Interest in endodontics grew quickly as researchers began to evaluate endodontic treatment. Their efforts and simultaneous scientific and technological advances, such as identification of endodontic pathogens and advances in the treatment of the root canal system allowed many patients to save teeth that otherwise would have been lost to extraction.

In December 1942, because of the growing interest in endodontics, a small group of dentists, practitioners and educators, sent invitations to their colleagues to form an organization in which they could share common

endodontic experiences and interests. The American Association of Endodontists was founded in February 1943 at the Palmer House in Chicago. Twenty years later in 1963, the American Dental Association officially recognized endodontics as a dental specialty

An Endodontist is a dentist with two or more years of advanced training in the scope of endodontics who has received a certificate in endodontics from an advanced education program accredited by the ADA Commission on Dental Accreditation and who limits his or her practice to endodontics. Dentists who limited their practice to endodontics prior to recognition of the specialty in 1963 are also recognized as endodontists. The endodontic specialist is responsible for the advancement of endodontic knowledge through research, the transmission of information concerning the most recent advances in biologically acceptable procedures and materials, and the education of the public as to the importance of endodontics in retaining the dentition in a physiologically functional state for the maintenance of oral and systemic health. [1]

There are 57 schools of dentistry in the United States and 50 postdoctoral endodontic training programs. Endodontics is a core component of the general dentist's education and the teaching of basic endodontic procedures is a requirement for accreditation. The Council on Dental Accreditation's (CODA) educational standards state that pre-doctoral students should be able to perform pulpal therapy upon completion of their training. Therefore, all dental students are taught the principles of basic root canal therapy.

Many factors may affect the decision of a general practitioner to perform endodontic treatment or to refer endodontic procedure to an endodontist. These factors can consist of: proximity of the general dentist to an endodontist, the dentist's experience in endodontics in pre-doctoral education, years of practice experience, difficulty of the diagnosis or treatment for the specific case, concerns over malpractice issues if treatment fails, patient attitudes toward referral to a specialist, and the dynamics of the referral process between the general dentist and the endodontist.

In an early study by Dietz and Dietz [2] it was noted that referrals to an endodontist are quite different than referrals to other specialties such as orthodontics, periodontics, pedodontics, and prosthodontics. The process is different because many endodontic cases are sent as emergencies and often need immediate attention. The authors noted that an endodontic practice is much like a dental emergency room. Therefore, it is imperative that the endodontist and the general dentist work closely together for the patient's best interest. The authors also noted that 15% of the general dentists referring to an endodontic practice refer 50% of the total patient volume. The other 50% of the endodontists patients come from the remaining 85% of referring dentists. The authors also stated that 79% of endodontics performed is completed by general dentists, 20% is completed by endodontists, and the other 1% by other specialists. They also noted that older, well-established dentists may not perform root canal therapy as they may have a larger patient base and stay busy with other dental procedures, whereas many younger dentists or new practitioners may have a smaller patient

pool and treat more of their patients' root canals. According to the authors, 20% of dentists refer all root canal treatment and 20% of dentists never refer patients for root canal treatment. The remaining 60% of dentists will selectively pick and choose the cases to treat and the cases to refer. General dentists may refer few cases for endodontic treatment because they perceive endodontics to be within their skill level. Attempting treatment before referral is relatively unique to endodontics as compared to other dental specialties. The authors noted that once a case is diagnosed by the general dentist as difficult, or there is a procedural mishap after initiation of treatment, it is more difficult for the endodontist to assume the case and maintain patient confidence in the general dentist. Only in endodontics and oral surgery are patients often transferred with acute symptoms, extreme discomfort, and the need for immediate attention. General dentists are essentially "gate keepers" because they make the decision to treat or refer to the specialist. The decision to treat or refer may be based on the dentists perceived level of training, skill, and experience doing the endodontic procedure, as well as the complexity of the diagnosis and actual mechanical difficulties in performing the root canal therapy. [2]

Hazelkorn and Robins [3] further investigated the referral relationship between the general dentist and the endodontist. Specifically, they studied the reasons why the general dentist may elect to refer endodontic care to the specialist. They found that there were many situations that could cause the general dentist to refer the patient to the endodontist. The authors felt that the general dentist might make a diagnosis but not wish to treat the patient for

several possible reasons. The general dentist might: not like to treat certain conditions, not have the time to properly treat the case, not be adequately trained to treat the case, perceive the treatment as too difficult, or fear the legal consequences from problems that could develop after treatment. In some cases the general dentist may not be certain of the diagnosis and may refer the patient to a specialist for diagnosis and treatment. [3]

Cohen and Swartz [4] studied the effect of malpractice claims on when and how endodontic procedures are performed. They found that endodontic malpractice claims were the most frequent dental malpractice claims filed. They also found that malpractice claims are most often centered on standard of care issues. Cohen defined standard of care as the care that a reasonable and prudent practitioner would perform under the same or similar circumstances. They noted that all practitioners, whether generalist or specialist are judged by the same criteria as there is only one standard of care in endodontics. The authors listed the following as examples of departures from standard of care: inability to arrive at a correct diagnosis, failure to perform correct diagnostic testing procedures, failure to use the rubber dam during endodontic treatment resulting in swallowing or aspiration of an endodontic file, and separation of an endodontic file and failing to notify the patient. The authors noted that when the endodontic diagnosis, root canal treatment, or patient management appeared too difficult for the general practitioner, it would be prudent for the general dentist to refer the patient to an endodontist. [4]

Abbott [5] evaluated the typical range of treatment provided by a private practicing endodontist in Perth, Western Australia. This study found that of 1688 patients having treatment on 2221 teeth, routine treatment without complications was provided to 313 teeth (14%) while a total of 451 teeth (20.3%) had calcified or blocked canals. Endodontic retreatment was necessary in 815 teeth (36.7%). 210 teeth (9.4%) had posts removed, and 236 (10.6%) had endodontic surgery. Perforations of the pulp chamber or canals were present in 119 teeth (5.4%) and these were treated either non-surgically (81 teeth, 3.6%) or surgically (38 teeth, 1.7%). Dental trauma was the reason for referral of 258 patients who required treatment on 217 teeth (9.8%). The study also found that the wide range of treatment procedures required indicated that endodontists must be highly skilled in all aspects of endodontics and the authors noted that general dentists may not have adequate training to perform the same procedures. [5] If the general dentist chooses to attempt to treat and not to refer to a specialist, they must judiciously choose cases that they are competent to treat or the outcome may become compromised.

Buckley and Spangberg [6] found that technically satisfactory root canal treatment was done only 42% of the time. They suggested that "clinicians are inadequately trained or are not practicing endodontics at the level of competence at which they should be capable". They also recommended that "more time should be devoted to clinical and didactic endodontic training in both dental school and continuing-education courses". [6]

Alley et al.[7] found that the survival rate of endodontic treatment performed by an endodontic specialist (98.1%) was significantly higher than for endodontic treatment provided by the general dentist (89.7%). The authors felt that the endodontists' higher survival rate was because of additional experience and a higher level of didactic and clinical training by the endodontist. [7]

The general dentist and the endodontist may not agree on the indications for referral. Caplan et al. [8] found that 100% of endodontists surveyed considered the presence of a radiographically calcified canal to be a condition in which referral is often indicated. Only 61% of general dentists considered that referral was indicated for this complication. Another difference in the decision to treat or refer the patient was difficulty in locating the patients' source of pain. 100% of endodontists considered this to be a condition in which the general dentist always, or almost always, should refer to the specialist. Of the general dentists surveyed, only 37% agreed. The authors noted that more than 75% of surveyed general dentists tended to refer teeth with separated instruments or ledged canals because they felt that endodontists have special skills and/or equipment to overcome these problems. The authors also noted that referral patterns could influence outcomes through several mechanisms. They felt that if dentists treated cases beyond their level of expertise, there may be a greater likelihood of procedural mishaps and that may result eventual tooth loss. The authors felt this study provided information that could help improve the quality of endodontic care by describing variation among providers' perceived indications for endodontic referral. [8]

Ree et al. [9] studied a group of general dentists in the Netherlands who participated in advanced endodontic training or study groups, but were not endodontists. The authors asked the general dentists to respond to a questionnaire regarding their decision to treat or to refer patients needing endodontic therapy. The dentists were chosen because they possessed a similar degree of general dental knowledge and were well acquainted with the requirements of endodontic treatment. The study found that 93% of this group felt that the general dentist needed to refer to the endodontic specialist. The primary reasons for referral of a patient needing endodontic therapy in this study included: the presence of an obstruction in the canal, perforation, resorption, and persistent signs and symptoms. The study concluded that among a group of experienced general dentists with a specific interest in endodontics, there was a substantial perceived need to refer endodontic cases to specialists. [9]

Hommez et al. [10] studied a group of Flemish general dentists and evaluated the endodontic procedures that the general dentists performed and how often they referred to the endodontist. The study found that retrieval of silver points was the most frequent reason for referral (56.7%), followed by surgical closure of perforations (47.6%) and surgical interventions (45.9%). Other reasons for referral in descending order of frequency were: post removal (39.4%), dens invaginatus (38.4%), trauma (37.1%), mutilated canal (36.2%), canal dividing in the apical third (34.9%), internal root resorption (33.9%), S-shaped (bayonet shaped) root canal (33.6%), calcified canal (33.2%), curved root canal (32.9%), missed canal (32.2%), external resorption (31.6%), root perforation (28.3%),

large periapical lesion (25.1%), endodontic retreatment (15.6%), apexification procedure (15.3%), endodontic treatment of deciduous teeth (7.5%) and endodontic treatment of molar teeth (5.5%). [10]

Reit and Kvist [11] further attempted to explain the decision making process used by general dentists and how they decide which cases to treat and which cases to refer to the endodontic specialist. They evaluated the influence of personal values on the decision by the general dentist to treat or refer the patient. They developed a praxis concept (PC), that assumes that the practitioners operate along a health continuum and that various periapical conditions are perceived as different stages of health based on their radiographic appearance. The PC suggests that an individual's placement of a cut-off point for retreatment on the health continuum is to a large extent dependent on the dentists' personal values. In this study, value judgments (utilities) concerning two periapical health states in endodontically treated teeth were investigated using 82 dental students. The two methods used a Visual Analogue Scale (VAS) and the Standard Gamble (SG), produced large inter- and intra-rater variations. The VAS frequently generated lower utility values. The variability in findings from this study concluded that the general dentist may base endodontic treatment decisions on personal values as much as they do clinical presentation. [11]

A study by Balto and Al-Madi [12] evaluated the influence of decision making differences between general dentists and endodontists. The study specifically evaluated decision making regarding retreatment of endodontically treated teeth. Using undergraduate records, thirty radiographs of failed

endodontically treated teeth with respective case descriptions were submitted to fifteen endodontists and fifteen general dentists for review. Seven treatment alternatives were given as choices. Reasons for retreatment, if chosen, were also requested. The results revealed statistically different decisions among these two groups regarding retreatment cases. More endodontists opted for retreatment of cases, while higher percentages of general dentists recommended observation, no treatment, or extraction. The study concluded that in order to prevent misdiagnosis, and possible mistreatment, endodontic decision-making should be taught. At the time of the study, there were no specific guidelines for management of failed root canal retreatment. The study also suggested that guidelines generated by evidence-based dentistry might produce less variation in clinical decision making. [12]

Pagonis et al. [13] also examined the variation in decision making regarding the retreatment of teeth with previous endodontic treatment. This study focused on the dental radiograph and how general dentists and endodontic specialists differ in their interpretation of the dental radiograph and their treatment decisions. One of the most subjective areas with regard to interexaminer variations is the dental radiograph. Variations in radiographic interpretation may lead to differences in treatment planning decisions. This study specifically evaluated the decision making process between 12 general practitioners and 12 endodontic postgraduate students. Utilizing dental radiographs of completed cases both groups were asked to make treatment choices based on two hypothetical ages of a case, 1 or 3 years postoperatively.

The study found general practitioners chose to initiate retreatment at an earlier date and also chose more extensive treatment modalities. The age of the root filling was looked on as more important in treatment-planning by the endodontic post-graduates. The study underscored the subjectivity by which general dentists and endodontic specialists approach treatment decisions and the need for standardization in decision-making. [13]

A study by Rotstein et al. [14] evaluated the referral process and the effect that the perception of endodontic outcome would have on the general dentist. The study found that endodontic outcome is related to treatment expectations of the clinician and can influence case selection and choice of treatment. Knowledge and assessment of endodontic treatment outcome by the clinician can play an important role in a rational evidence-based case selection and endodontic treatment decision-making. In certain clinical situations, this may even determine whether patients will retain their natural dentition or select another alternative. The results of this study revealed several interesting patterns of knowledge and opinions among the participating oral health care professionals regarding the predictability of initial endodontic treatment, expected long-term outcome, and the importance of placing coronal coverage after completion of treatment. The majority of participants expected untoward events such as retreatment, apical surgery, or extraction to occur within the first 3 years after initial endodontic treatment. One of the most significant findings in the study was that the vast majority of oral health professionals (92%) expressed the opinion that, overall, endodontic treatment was a predictable procedure with long-term

tooth retention rates. The authors felt that this finding may reflect the opinion that exists among professionals that endodontic treatment can provide excellent service to patients by preserving the natural dentition for prolonged periods of time. This study underscored the importance to use uniform criteria and provide supporting evidence to aid the clinician in their clinical decision-making process. [14]

Caplan et al. [8] evaluated the influence of practice experience, or years of practice experience, in the decision to treat or to refer. This study found that when general dentists with more than 10 years of experience are compared to general dentists with less than 10 years of experience, those with more experience were more likely to recommend referring difficult cases rather than performing endodontic therapy themselves. It was also found that when looking at "endodontic success" and "the loss of root filled teeth" as related to the timing of referrals by the general dentist, outcome may be compromised if treatment was rendered by the general dentist on more complicated cases. General dentists were most likely to recommend referral for teeth they felt needed surgical retreatment. However, general dentists and endodontists did not always agree on indications for referral. Endodontists were more likely to recommend referral for patients with complex problems, but not necessarily technically difficult teeth. [8]

A study by Lee et al. [15] evaluated the relationship to the general dentist's perception of the quality of their dental school education and their subsequent decision to treat or to refer certain endodontic procedures.

Interestingly, this study found that general dentists who perceived that they received an inadequate education in the specialty areas were more likely to refer these patients in their own practices. [15]

De Cleen et al. [16] evaluated general dentists in the Dutch population and examined the effect that pre-doctoral or advanced education has on the referral relationship. They found that in order to improve the endodontic success rate in the general dental practice, it was important to emphasize pre-doctoral and continuing education in endodontics. The study also found that the referral of difficult cases to dentists with advanced knowledge and training in endodontics should be made possible for the benefit of patients and for the best treatment outcome. [16]

Cobb et al. [17] in a study of periodontal referral patterns in 1980 and 2000 found that while there had been a significant increase in the knowledge base of inflammatory periodontal disease that patients exhibited a greater loss of teeth, had more severe disease, and required extraction of a greater number of teeth than twenty years previously. The authors postulated that when new dental graduates received significantly less of their clinical education conducted by specialists and received more instruction from faculty that were general dentists, or non-specialists, there was a significant effect on their method of practice. This study also noted that young graduates have to repay higher education loans and the authors felt that this loan debt could lead younger dentists to try to treat more patients in their own practices as opposed to referring to the specialist. The

authors also felt that the end result could be less experienced and less trained dentists treating patients needing specialty treatment. [17]

Rich [18] looked at undergraduate dental students and their referral patterns after graduation. He/she noted that undergraduate dental education affects general dentists' practice characteristics, attitudes, and professional behavior connected with their treatment. The findings strongly suggested that educational experiences determined the future dental care provider's attitudes and professional behavior. [18]

Mayhew [19] suggested that only about 60% of endodontic therapy meets current technical standards and that endodontic treatment by general dentists may be making a significant contribution to this compromised care. The study evaluated where in the continuum of dental education the lack of quality begins. The study looked at the quality of canal obturation in mandibular molars provided by 3rd year dental students and instructed by endodontic faculty and compared it to treatment by 4^{th} year students supervised by general dentistry faculty. The quality of canal obturation in mandibular molars achieved by beginning endodontic residents served as a control for both groups. Final radiographs were used from students in all three groups so that there were 22 samples per group. Three evaluators rank-ordered the radiographs and determined an order of excellence for the treatment provided. The study concluded the following: beginning endodontic residents produced the best results, followed by 3rd year students, and then 4th year students. However, there was no significant difference between the treatment provided by the 3rd year students and the beginning

endodontic residents. There was a significant difference between beginning endodontic residents and 4th year students supervised by general dentist faculty ($p < 0.05$). The results suggested that it may be appropriate to have endodontists instructing students throughout all of their undergraduate endodontic clinical experience in order to refine and reinforce the skills necessary for a continuing high technical standard of care. This study also noted that the results may have been site-specific and not applicable to other institutions where 4th year clinical experiences are instructed by general dentistry faculty. The study concluded that concentrating on the basics of endodontic therapy (such as access, and cleaning and shaping techniques) may be the essential factor and noted that this instruction could be provided by general dentists, with additional training in endodontics. [19]

It is obvious from these studies that many variables have been evaluated relating to the general dentist's decision to perform endodontic procedures or to refer them to an endodontist. One area that has not been explored is the effect that the presence of an endodontic post-graduate program during a student's education has on their subsequent decision to perform or to refer endodontic procedures in their private practices.

The aim of this study was to compare the presence or absence of an endodontic specialty program during dental education with the general dentist resulting attitudes toward treating or referring patients requiring endodontic therapy.

CHAPTER II

NULL HYPOTHESIS

The null hypothesis for this study is that there is no significant difference in the decision to treat or refer patients needing endodontic procedures who attended a dental school with an endodontic post-graduate program and those dentists who attended a dental school without an endodontic post-graduate program.

An alternative hypothesis would be there is a significant difference in the decision to treat or refer endodontic patients when comparing general dentists who attended a dental school with an endodontic post-graduate program and those who attended a dental school without an endodontic post-graduate program.

CHAPTER III

MATERIALS AND METHODS

The University of Louisville Human Studies Committee/ Institutional Review Board (IRB) approved the investigation protocol for this study.

The study was conducted as a survey, which was electronically distributed to members of the Kentucky Dental Association. Surveys were distributed utilizing the online survey tool Surveygizmo®. General dentists were asked to report their gender, dental school attended, year of graduation from dental school,, and whether they had completed a General Practice Residency (GPR) or Advanced Education in General Dentistry (AEGD) program.

The general dentists were provided a list of 18 specific endodontic procedures or complications that could be encountered while providing endodontic therapy. The procedures or complications included: non-surgical root canal therapy on anterior teeth, premolars, or molars, treatment of teeth with calcified canals, treatment of teeth with significant canal curvature, non-surgical retreatment of anterior teeth, premolars, or molars, periapical surgery on anterior teeth, premolars, or molars, endodontic treatment of traumatic injuries such as avulsion, repair of perforations, treatment of patients with severe endodontic infections, endodontic treatment of fearful or phobic patients,

endodontic treatment of patients with limited opening, endodontic treatment of patients with difficulty in obtaining local anesthesia, non-surgical root canal therapy on permanent teeth in pediatric patients, management of the open or incompletely developed root apex, and non-surgical root canal therapy involving the management of the medically compromised patient.

Each dentist was asked to rate on a scale of 1 to 5 the likelihood they would treat or refer the specific endodontic therapies. The rating scale was: (1) very likely to refer treatment, (2) somewhat likely to refer treatment, (3) neutral, or no predominant opinion of whether to treat or refer the patient, (4) somewhat likely to treat the patient, or (5) very likely to treat the patient.

During assessment of the data the categories (1) very likely to refer treatment and (2) somewhat likely to refer treatment were combined into one category which was Refer, and (4) somewhat likely to treat and (5) very likely to treat were also combined into one category which was titled Treat.

Presence or absence of an endodontic post-graduate program at each dental school listed by respondents was assessed by determining whether each listed dental school had a current post-graduate endodontic program from the American Association of Endodontists 2010 directory. Each listed school was contacted to determine the year in which the program began. Those listed schools that did not have an endodontic program were contacted to verify that one had never existed. If a program had been in existence but had closed, the years that it was present were noted.

The number of practice years and its effect on likelihood to refer or to treat were analyzed using regression analysis. The years of practice were combined into the following groups based on year of graduation: (1) less than, or equal to, 5 years experience, (2) 6 to 15 years of experience, (3) 16 to 25 years of experience, and (4) greater than 25 years of experience.

Odds Ratio was used to test for statistical significance when evaluating effect on the dentists' treat or refer decisions of presence of an endodontic graduate program, the dentist's gender, or history of participation in an Advanced Education in General Dentistry program (AEGD) or a General Practice Residency (GPR).

CHAPTER IV

RESULTS

Nine hundred and fifty five surveys were electronically distributed. 230 dentists (24%) responded with191 general dentists completing the survey of which 92 general dentists (48.2%) trained at a dental school without an endodontic program and 95 (49.7%) trained at a school with an endodontic program (Figure 1). Four dentists did not list the dental school attended.137 respondents (71.7%) were male and 54 (28.3%) were female (Figure 2). 113 (59%) of the respondents had attended the University of Louisville School of Dentistry (ULSD), 68 (35%) the University of Kentucky College of Dentistry (UKCD), and 10 (6%) attended other dental schools (Figure 3). 44 dentists (23%) had completed a General Practice Residency (GPR) or an Advanced Education in General Dentistry (AEGD) program. (Figure 3)

The respondents' year of graduation ranged from 1955 through 2008 with the median year of graduation being 1988, or more specifically in the 16 to 25 years of practice group. 27 (14%) of the respondents had 5 years or less experience, 37 (19%) had 6 to 15 years of experience, 41 (21%) had 16-25 years of experience, and 86 (45%) had greater than 25 years of practice.

Using odds ratio to determine any effect of the dentist's gender on the decision to refer patients requiring endodontic therapy or to treat them for each of the specific situations surveyed, no significant differences were found. (Table 1)

Comparing dentists trained at a school without an endodontic post-graduate program to those trained at a school with an endodontic post-graduate program, this study found that dentists trained at a school without an endodontic residency program were significantly more likely to treat than refer the following procedures/ complications: (1) teeth with calcified canals ($p = .01$), (2) teeth with significantly curved canals ($p = .001$), (3) periapical surgery on anterior teeth ($p = .03$), and (4) endodontic treatment on patients with traumatic injuries such as avulsion ($p = .01$) (Table 2). There was no significant difference between the two groups for routine nonsurgical root canal therapy on anterior teeth, premolars, or molars, nonsurgical retreatment, periapical surgery on premolars or molars, perforation repair, treatment of patients with severe infection, treatment of phobic patients, patients with limited jaw opening, patients with difficulty obtaining local anesthesia, non-surgical root canal therapy on permanent teeth on pediatric patients, management of the open apex, and endodontic treatment of medically complicated patients.

The results showed that those dentists with GPR or AEGD training were more likely to treat than to refer the following procedures/ complications: (1) non-surgical retreatment ($p = .03$), (2) periapical surgery on anterior teeth ($p = .001$) and endodontic treatment of medically compromised patients ($p = .007$) (Table 3)

Regression analysis evaluating the influence of practice years on the dentists' decision to treat/refer patients requiring endodontic therapy found that as the group's years of experience increased, there was a trend towards referral versus treatment for non-surgical root canal therapy (NSRCT) on anterior teeth ($p = .03$) (Table 4) and premolars ($p = .04$) (Table 5). For molar NSRCT, the trend was not statistically significant ($p = .06$) but dentists with 16-25 years of experience were significantly more likely to refer than the other experience groups. (Table 6)

When analyzing the decision to refer or to treat in relation to endodontic treatment of permanent teeth on pediatric patients, the study found a trend towards referral as the years of practice experience increased (P value trend, $p = .02$). The 25 years and greater group was significantly more likely to refer pediatric patients than the other years of experience groups ($p = .03$). (Table 8)

The category of periapical surgery on anterior teeth demonstrated a statistically significant trend of a decrease in likelihood of referral as years of practice experience increased (P value trend, $p = .03$). Interestingly, general dentists were more inclined to perform periapical surgery on anterior teeth as their years of practice experience increased (Table 7).

CHAPTER V

DISCUSSION

The results of this study suggest that the presence or absence of an endodontic graduate program during a student's dental education may influence treatment decisions regarding endodontic therapy.

In particular, the study found that dentists trained at a dental school without an endodontic program were significantly more likely to treat rather than refer to specialists' teeth with calcified canals, teeth with significantly curved canals, periapical surgery on anterior teeth, and endodontic treatment of traumatic injuries such as avulsion. Although exposure to a post-graduate endodontic program during dental education does not predict whether a general dentist will approach endodontic care differently, the findings of this study indicate that exposure to a post-graduate program, or lack thereof, does influence treatment decisions regarding some cases considered technically more difficult. The results of this study are consistent with other studies that have similar findings. [15-19]

It appears that dental students exposed to an endodontic pre-doctoral program may approach treatment decisions differently when they enter private practice than those students not exposed to a post-graduate endodontic

program. Dentists who are not exposed to an endodontic post-graduate program during their education could develop a heightened sense of competency concerning treatment decisions since an internal referral system is not available to them. They may have to treat more difficult cases as referral options may be more limited for patients at dental schools without an endodontic graduate program. Faculty practice or private practice endodontists could be the only option available and patients with a limited income may not be able to financially afford these options. It is conceivable that this additional clinical experience for pre-doctoral students at schools without an endodontic graduate program results in a more confident clinician. Because they have the opportunity to interact with endodontic residents and additional post-graduate faculty, students trained at schools with a post-graduate program may be afforded a greater opportunity to consult with endodontists and endodontic residents. With a greater opportunity to refer complicated cases, these students may be more prone to utilize specialists in their private practice. If there is a shortage of patients requiring root canal therapy, there could be less opportunity for endodontic patient treatment for pre-doctoral students at a school with a graduate program as endodontic residents could draw patients out of the pre-doctoral patient pool resulting in fewer patients available for pre-doctoral treatment. This lack of experience could lead to a lack of confidence in treating patients with endodontic problems. These students could then be more reluctant to attempt to treat difficult cases as they have the option to refer the case.

It appears that graduates of schools with exposure to an endodontic post-graduate program were less likely to perform treatment on teeth with calcified canals or curved canals. This could be explained by the ease of access to expert opinion. Additionally, anterior periapical surgery and treatment of traumatic injuries may rarely be provided by pre-doctoral students at schools with endodontic post-graduate programs. These types of cases could often be referred due to the complexity of the treatment involved and the immediate access to care a post-graduate program affords.

The majority of the respondents in this study were graduates of the University Of Louisville School Of Dentistry (ULSD), or the University of Kentucky College of Dentistry (UKCD). These two dental schools are geographically similar but ULSD currently has an endodontic post-graduate program and UKCD currently does not. However, prior to 1984 ULSD did not have an endodontic post-graduate program and UKCD did have a post-graduate program from 1972-1977. It should be noted that a small percentage of the respondents did not attend ULSD or UKCD, but other pre-doctoral programs. These responses were also included since the authors were able to determine the presence or absence of a post-graduate endodontic program at each named school.

Gender of the general dentist did not appear to be a significant factor in the decision to treat or refer for any of the surveyed scenarios or clinical situations. While the percentage of referrals was slightly higher for female dentists for most of the eighteen surveyed clinical scenarios, there was no

significant difference between male and female dentists in decisions to treat patients requiring endodontic therapy or to refer to an endodontist.

This study also evaluated the effect of advanced training in general dentistry (AEGD or GPR) on the treat or refer decision and found that general dentists with AEGD or GPR training were significantly more likely to perform non-surgical retreatment, periapical surgery on anterior teeth, and endodontic therapy on medically compromised patients than the dentists without advanced training in general dentistry. Certainly, these training programs generally offer their residents the opportunity to obtain additional experience in dealing with more medically compromised patients.

Another area this study examined was the influence of years of practice on treatment decisions. This study found the number of practice years, or experience, had a significant influence on the decision to refer rather than treat non-surgical root canal therapy on anterior teeth, premolars, molars, and the endodontic treatment of pediatric patients. This is in agreement with the study by Dietz and Dietz, which concluded that "demographically, many older, well-established dentists do not perform root canal therapy, whereas many younger dentists who are less busy and presumably less financially secure do all or most of their own root canals." [2] Interestingly in this study, a reverse trend seemed to be true for periapical surgery on anterior teeth as there was a small but significant increase in the trend toward treatment rather than referral to a specialist as years of practice increased.

Although this study provides some insight into the impact of education on decision-making, it should be noted that it was conducted in only one state, Kentucky. One important variable that is not known is the effect on the general dentist's treat or refer decision compared to the proximity of the dentist or patient to an endodontist. This is an important variable that should be evaluated in future studies. Obviously if an endodontist is not locally available, then referral is often not an easily accomplished option.

Additionally, the respondents surveyed were members of the Kentucky Dental Association, a subunit of the American Dental Association (ADA). It could be postulated that membership in the ADA, or organized dentistry, may introduce a different element of decision-making. Therefore, future studies should seek to survey larger populations or regions, and include both participants and non-participants of organized dentistry.

It should also be noted that this study was conducted in the United States, whereas many of the other studies cited are from Europe, where socialized care is more prevalent. Treatment decisions or conclusions from these studies may provide conflicting results since the financial motive may be absent from the decision-making process.

Nonetheless, the results of this study indicate the presence or absence of an endodontic graduate program during a student's dental education may influence subsequent decisions in practice to either refer to a specialist or to treat patients requiring endodontic therapy.

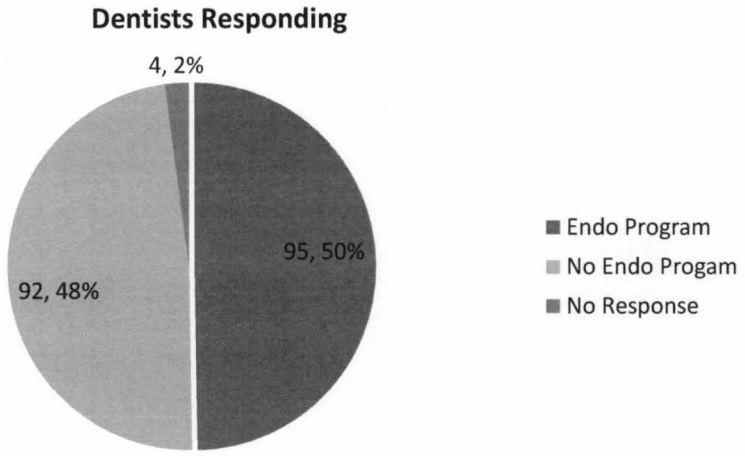

Figure 1: General Dentist's Exposure to an Endodontic Post-Graduate Program

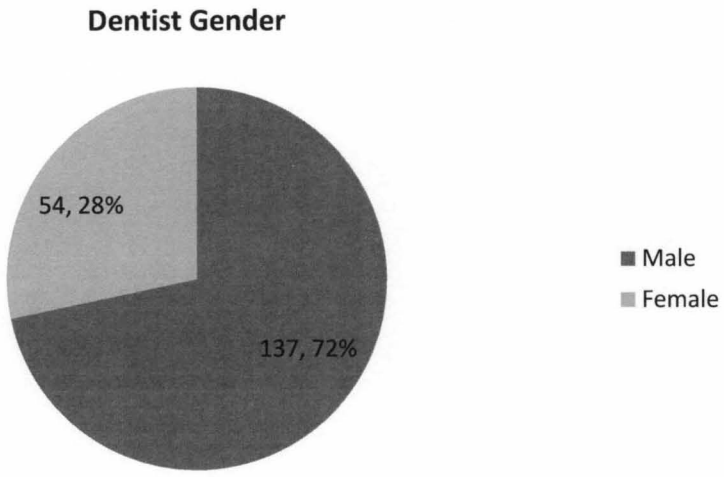

Figure 2: Gender of Surveyed General Dentists

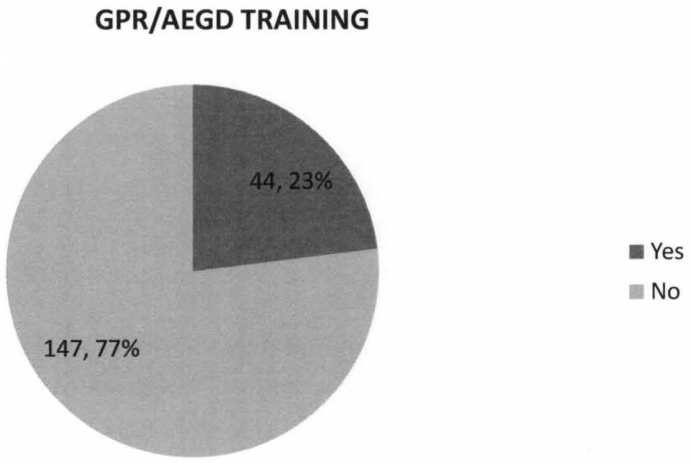

Figure 3: General Dentist's With GPR/ AEGD Training

	FEMALE Refer/Treat	Male Refer/Treat	P Value	CI Lower	CI Upper
NSRCT ANTERIOR	8/44	24/113	.83	.48	2.79
NSRCT PREMOLAR	15/37	25/111	.16	.26	1.16
NSRCT MOLAR	30/22	60/65	.25	.35	1.3
CALCIFIED CANALS	44/7	102/26	.39	.25	1.5
SIGNIFICANT CURVATURE	45/7	98/30	.15	.20	1.24
RETREAT	48/3	113/14	.40	.13	1.83
SRCT ANTERIOR	52/2	116/19	.06	.05	1.0
SRCT PREMOLAR	53/1	126/9	.28	.03	2.13
SRCT MOLAR	53/1	128/5	.67	.05	4.2

	FEMALE Refer/Treat	Male Refer/Treat	P Value	CI Lower	CI Upper
AVULSION	28/18	57/65	.12	.28	1.12
PERFORATION REPAIR	49/3	113/15	.28	.12	1.66
SEVERE INFECTION	24/24	42/77	.08	.27	1.07
PHOBIC PATIENT	18/30	48/66	.60	.60	2.4
LIMITED OPENING	29/17	80/40	.71	.57	2.38
LOCAL ANESTHESIA	26/19	62/50	.85	.45	1.8
PEDIATRIC PATIENT	33/18	74/47	.73	.43	1.69
OPEN APEX	40/10	109/19	.49	.61	3.34
MEDICALLY COMPROMISED	28/15	72/43	.85	.43	1.86

Table 1. Decision to Refer/ Treat Based On Gender

	No Post-Grad Refer/Treat	Post-Grad Refer/Treat	P Value	CI Lower	CI Upper
NSRCT ANTERIOR	14/78	16/77	.84	.52	2.53
NSRCT PREMOLAR	17/75	21/71	.58	.63	2.67
NSRCT MOLAR	38/45	49/41	.28	.77	2.57
CALCIFIED CANALS	66/22	78/9	.01	1.24	6.70
SIGNIFICANT CURVATURE	61/26	80/9	.001	1.65	8.67
RETREAT	77/8	81/8	1	.37	2.9
SRCT ANTERIOR	76/15	88/6	.03	1.07	7.8
SRCT PREMOLAR	84/7	91/3	.20	.63	10.09
SRCT MOLAR	83/5	94/1	.10	.64	49.46

	No Post-Grad Refer/Treat	Post-Grad Refer/Treat	P Value	CI Lower	CI Upper
AVULSION	33/48	50/33	.01	1.18	4.11
PERFORATION REPAIR	78/8	81/9	1	.33	2.51
SEVERE INFECTION	27/50	38/48	.26	.77	2.76
PHOBIC PATIENT	32/46	33/47	1	.53	1.90
LIMITED OPENING	49/34	58/22	.09	.94	3.53
LOCAL ANESTHESIA	34/37	52/30	.07	.98	3.60
PEDIATRIC PATIENT	53/26	52/37	.26	.36	1.29
OPEN APEX	72/13	75/15	.83	.40	2.02
MEDICALLY COMPROMISED	45/29	53/27	.50	.65	2.44

Table 2: Decision to Refer/ Treat Based On Presence of Post-Grad Program

	No GPR/AEGD Refer/Treat	GPR/ AEGD Refer/Treat	P Value	CI Lower	CI Upper
NSRCT ANTERIOR	25/120	7/37	1	.363	2.26
NSRCT PREMOLAR	33/112	7/36	.40	.26	1.61
NSRCT MOLAR	71/64	19/23	.48	.37	1.49
CALCIFIED CANALS	114/21	32/12	.11	.21	1.10
SIGNIFICANT CURVATURE	113/25	30/12	.189	.24	1.22
RETREAT	126/9	35/8	.03	.11	.86
SRCT ANTERIOR	136/10	32/11	.001	.08	.54
SRCT PREMOLAR	140/5	39/5	.05	.07	1.01
SRCT MOLAR	139/4	42/2	.62	.10	3.4

	No GPR/AEGD Refer/Treat	GPR/ AEGD Refer/Treat	P Value	CI Lower	CI Upper
AVULSION	63/64	22/19	.72	.058	2.38
PERFORATION REPAIR	125/14	37/4	1	.32	3.33
SEVERE INFECTION	50/77	16/24	1	.49	2.12
PHOBIC PATIENT	50/77	16/23	1	.48	2.11
LIMITED OPENING	80/46	29/11	.34	.69	3.31
LOCAL ANESTHESIA	63/53	25/16	.47	.63	2.7
PEDIATRIC PATIENT	85/47	22/18	.35	.32	1.3
OPEN APEX	117/21	32/8	.62	.29	1.77
MEDICALLY COMPROMISED	83/37	17/21	.007	.17	.76

Table 3: Decision to Refer/ Treat Based On Advanced Training (GPR/ AEGD)

	Refer/Treat Range	P-Value	Percentage Referred	P-Value Trend
< 5 Years	1/26		3.7	.03
6- 15 Years	5/32	.21	13.5	
16 – 25 Years	7/32	.11	17.1	
25> Years	19/67	.06	22.1	

Table 4: Regression Analysis of Practice Years (NSRCT-Anterior)

	Refer/Treat Range	P-Value	Percentage Referred	P-Value Trend
< 5 Years	1/25		3.7	.04
6- 15 Years	7/30	.11	18.9	
16 – 25 Years	11/28	.03	26.8	
25> Years	21/65	.05	24.4	

Table 5: Regression Analysis of Practice Years (NSRCT- Premolar)

	Refer/Treat Range	P-Value	Percentage Referred	P-Value Trend
< 5 Years	7/16		25.9	.06
6- 15 Years	7/30	.23	45.9	
16 – 25 Years	11/28	.03	58.5	
25> Years	21/65	.05	48.8	

Table 6: Regression Analysis of Practice Years (NSRCT- Molar)

	Refer/Treat Range	P-Value	Percentage Referred	P-Value Trend
< 5 Years	26/1		96.3	.03
6- 15 Years	32/3	.82	97.3	
16 – 25 Years	35/5	.18	85.4	
25> Years	70/8	.14	82.6	

Table 7: Regression Analysis of Practice Years (Anterior Periapical Surgery)

	Refer/Treat Range	P-Value	Percentage Referred	P-Value Trend
< 5 Years	11/14		40.7	.02
6- 15 Years	18/15	.43	48.6	
16 – 25 Years	26/12	.06	63.4	
25> Years	52/24	.03	60.5	

Table 8: Regression Analysis of Practice Years (Pediatric Patients)

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VISA STATUS	NON APPLICABLE
SEX	MALE
MARITAL STATUS	MARRIED (18 YEARS TO GAIL CARMAN)
CHILDREN	3 (SPENCER 10, MARYBETH 8, KATIE GRACE 5)

EDUCATION

UNDERGRADUATE	EASTERN KENTUCKY UNIVERSITY. B.A. (CUM LAUDE) 1985-1989
POST-DOCTORAL	UNIVERSITY OF KENTUCKY COLLEGE OF DENTISTRY (D.M.D) 1992-1996
POST-DOCTORAL	UNIVERSITY OF KENTUCKY COLLEGE OF DENTISTRY (GPR CERTIFICATE) 1997-1998
POST-DOCTORAL	UNIVERSITY OF LOUSIVLLE SCHOOL OF DENTISTRY (ENDODONTIC CERT.) 2008-PRESENT

OTHER

COMMISSIONED OFFICER U.S. ARMY 1989-1997 (CAPTAIN)

ADJUTANT GENERAL OFFICER BASIC COURSE GRADUATE (1989)

U.S. ARMY AIRBORNE SCHOOL GRADUATE, FT. BENNING, GA (1988)

U.S. ARMY AIR ASSAULT SCHOOL GRADUATE (1990) FINALIST FOR TOP GRADUATE

AWARDED TWO U.S. ARMY COMMENDATION MEDALS

AWARDED TWO U.S. ARMY ACHEIVEMENT MEDALS

U.S. ARMY VETERAN- OPERATION DESERT SHIELD/ DESERT STORM (1990-1991)

DENTAL SCHOOL AWARDS/ HONORS

PRESIDENT OF DENTAL SCHOOL CLASS (THIRD AND FOURTH YEARS)

TREASURER OF DENTAL SCHOOL CLASS (FIRST AND SECOND YEARS)

EXCELLENCE IN ORAL DIAGNOSIS AWARD AS TOP STUDENT IN ORAL DIAGNOSIS (SECOND YEAR)

EXCELLENCE IN PERIODONTICS AWARD FOR TOP GRADUATE IN PERIODONTICS (1996)

EXCELLENCE IN ENDODONTICS AWARD FOR TOP GRADUATE IN ENDODONTICS (1996)

EXCELLENCE IN PROSTODONTICS AWARD FOR TOP GRADUATE IN PROSTODONTICS (1996)

OTHER HONORS

SELECTED AS TOP THREE DENTAL OFFICES IN CENTRAL KENTUCKY BY LEXINGTON HERALD-LEADER READERS (2008)