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The Perceived Prognosis of Endodontic Treatment and Implant Therapy Among Dental Practitioners

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**The Perceived Prognosis of Endodontic Treatment and
Implant Therapy Among Dental Practitioners**

Rachel Margaret Stockhausen

D.D.S., University of Detroit-Mercy, 2002

A Thesis

Submitted in Partial Fulfillment of the

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Master of Dental Science

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APPROVAL PAGE

Master of Dental Science Thesis

**The Perceived Prognosis of Endodontic Treatment and Implant
Therapy among Dental Practitioners**

Presented by

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ABSTRACT

Little data concerning the perceived success of implant therapy in comparison with endodontic treatment exists. While the criteria used to measure the outcome of each modality are not the same, it is not clear if this is appreciated by practicing dentists. The purpose of the study was to evaluate the perceived outcome of implant therapy in comparison to endodontic treatment. A 23 question Web-based survey was distributed to 648 dentists who matriculated from the University of Connecticut School Of Dental Medicine over the past 30 years. The response rate was 47%. Sixty-seven percent of respondents were general dentists. Forty-nine percent of respondents did not know different criteria exist in the literature and are used to evaluate implant and root canal treatment. Fifty-four percent of dentists felt the prognosis of implant therapy was the same as or better than endodontic treatment of teeth with vital pulps. Thirty percent of responders thought root canal treatment of teeth with necrotic pulp was superior to implants and only 16% thought retreatment was preferable. Treatment planning for implant placement vs. retreatment of a restorable tooth was 46% and 32%, respectively. A third of the respondents felt that the role of endodontics will decline in the future. Dentists' primary source of information regarding implant therapy was continuing education; however, their primary source of information regarding endodontic treatment was their dental program. Dentists felt the prognosis of implant therapy was as good or superior to endodontic treatment of teeth with vital, necrotic or previously treated pulps.

INTRODUCTION

A dentist's personal database of information, contributes to a dentist judging a treatment as being in the best interest of the patient.^{1,2} The assimilation of training, discussions, continuing education and reading shape how dentists recommend treatment options. Little is known as to what area is most integral to a dentist's database. Given the advent of a relatively new treatment modality, implants, it is critical that we evaluate the source of information shaping dentists' treatment decisions regarding implant and endodontic treatment.

Reit and others have looked at how practitioners make clinical decisions such as whether an endodontically treated tooth with a persistent rarefaction should be retreated.³ Reit cites a two step process for making diagnostic decisions, which was first described by Wulff in 1981³, these include: knowledge of the manifestations of different diseases and secondly knowledge of the prognosis of the disease and the effect of different instituted treatments.³ The former has been the subject of numerous studies.^{4,5} However, the latter component of the diagnostic decision making process has not been studied extensively. The American Association of Endodontics (AAE) recently published the results of a survey examining the perceptions that dental students and dental educators have of endodontics.⁶ While this survey provides important insights into the decision making process of dental educators and students a more broad based survey of practicing clinicians is missing.

In addition, information specific to practitioners within their respective specialties is also important given that certain groups have a more optimistic view of particular treatment modalities.³ Data on what factors dentists consider when making endodontic treatment decisions is missing.⁷

Dentists must compare the prognosis of each treatment modality published in the literature. Both outcome measures for survival in the endodontic and implant literature are the same: retention of the tooth within the mouth. However, a difference exists in the definition of success between the endodontic and implant literature. Endodontic studies traditionally define success as an asymptomatic tooth with normal periodontal architecture and no clinical signs of infection.⁸ Implant studies define success as absence of functional signs of pain or discomfort, absence of mobility, and an absence of radiolucency. However, implants with signs of peri-implant infection maintained by adaptive anti-microbial treatment were considered successful.⁹

If endodontic treatment were compared based on survival, which has a more universally accepted definition, then a more accurate comparison between treatment outcomes of each modalities can be made. A recent Meta Analysis of implant and endodontic treatment outcomes found that no significant difference exists between survivals of root canal treated teeth and single-tooth implants. It also concluded that treatment decisions should be made according to other factors besides outcome when deciding between implant and endodontic treatment.¹⁰

In comparing literature of the predictability of endodontics and implants,¹¹ lack of standardized outcome evaluations and broadly conceived dimensions of implant performance make it hard to compare endodontics and implants.¹² The less stringent criteria in implant studies translates to higher success rates for implants.¹³ In reviewing the literature the quality of root canal treatment studies were found to be superior to implant studies.¹⁴ Direct comparisons of success rates are futile.¹⁴ It is not known whether this difference in outcome measures between the implant and endodontic literature is appreciated by practicing dentists. Furthermore, if treatment options are presented in a biased manner the patient is more likely to choose the option that is favored.¹⁵

A published study of 1.5 million endodontically treated teeth found a 97% survival rate at 8 years¹⁶ while a prospective clinical study of 635 teeth with an 8-10 year follow up found root canal treatments with necrotic pulps to have an 86% success rate.¹⁷ Looking at implant literature a multicenter implant study with 1022 implants reported a survival rate of 92%, and a success rate of 83.4%.⁹

Another factor that complicates the outcome assessment of implants and endodontics is the experience levels of the providers. Most implant studies are done by specialists¹⁸ while success rates for endodontics done by specialists are found to be between 70-95%¹⁹ and success rates for general practitioners can be lower in the range of 64-75%.²⁰

Most failures of endodontically treated teeth are not endodontic in nature. Endodontic treatment alone does not guarantee success.^{21,22,17} Teeth that are

not restored with a coronal restoration have 6 times the extraction rate as teeth that are restored with a coronal restoration.^{16,23,24} Salehrabi agrees that most extractions occur within 3 years from completion of the endodontic treatment and those mostly affected were the teeth without full coronal coverage.¹⁶ Periodontal disease, recurrent dental caries, root fractures and non-restorability contribute more frequently than endodontic failure itself.^{17,21,22} Caplan found that reasons for extraction were periodontal disease (22%), vertical root fractures (20%), dental caries (16%), nonrestorable tooth fracture (10%) and unknown (32%).²¹ Vire found that prosthetic reasons contributed to the majority of the failures at 60%, which included crown fractures, root fractures and traumatic fractures. He found that 32% failed from periodontal reasons while only 10% failed because of endodontic reasons. These included root resorption and instrumentation failures.²⁵ Although, these are not endodontic failures necessarily they negatively impact endodontic survival and success rates.

Endodontic causes of failure include true cysts, vertical root fractures, foreign body reactions due to overfills, residual intracanal infection from areas that were inaccessible and periapical infections due to persisting microbiota.^{17,26,27} Nonendodontic reasons include improper restorations, coronal leakage, severe periodontal disease and recurrent caries.^{24,28,29}

A similar 5 year survival rate for 2-stage and 1-stage implants at 5 years was seen, 97% and 94%, respectively.³⁰ However, the 10 year survival of 1-stage single implants had a much lower rate of 78%. Rarely do outcome studies of implant treatment report on survival over 10 years which is a significant short

coming. Endodontic treatment and in particular retreatment cases have been followed for 27 years with a success rate of greater than 95%.³¹ While insurance studies have found revision of endodontic treatment usually occurs within the first three years after initial endodontic treatment¹⁶ this is not true for implants.⁹ Failures beyond 7 years are more common than within the first few years after placement. Therefore, studies reporting on the success or survival of implants within the first 5 years following placement may convey a more optimistic view of their outcome than longer term studies. This is even more apparent when early implant losses are not included in the failure rates.¹³

Hannahan's study evaluated 143 endodontically treated teeth for an average of 22 months. He found a success rate of 99.3%. When uncertain findings were combined with the failures the endodontic success dropped to 90.2% and the implant success declined to 87.6%. Looking at overall intervention for complication rates, they found that 12.4% of implants required interventions which were statistically different from the 1.3% of endodontically treated teeth requiring interventions.³² Findings of implants needing more postoperative care than endodontics have been documented in other studies as well. Doyle found complications for implants to be 5 times greater for implants than endodontically treated teeth.³³ Eighteen percent of the implant cases had complications compared to 4% of the endodontic cases.³³ In an implant review by Pjetursson, 39% of the patients had complications or failures in a 5 year period.³⁴ In Salehrabi's large insurance study of 1.4 million endodontically treated teeth only

.47% required retreatment and only .45% required apical surgery. These low percentage rates indicate that endodontic complications are uncommon.¹⁶

A functional period of 5 years is often needed before peri-implantitis is established and detected.¹³ It has been shown that without systemic support, peri-implantitis is common.³⁵ Although Ruskin believes implants are superior to endodontically treated teeth due to their ability to resist dental caries, periodontal disease and structural deficiencies, implants with peri-implantitis do not seem to be very successful at resisting complications.¹¹ The treatment protocol for an implant that has peri-implantitis is to obtain a subgingival bacterial culture and then do a microbiological analysis of the culture. Then the correct systemic antibiotic is taken by the patient. The implant is surgically exposed and cleaned with 10% hydrogen peroxide and the abutment is sterilized. After this treatment the success rate is only 58%.³⁶ Albrektsson states that there is no treatment to save a mobile implant.³⁷

As the disease progresses, alveolar ridge defects occur and the implant will need to be extracted. This can cause a need for bone augmentation for the new future implant.³⁸ In contrast to a failed endodontic treatment, this can be retreated and surgically treated without any damages to the future treatment.³⁹ The chance of having a tooth extracted after failure from initial treatment, retreatment and apical surgery is only 1 in 500 cases.³⁹ Despite these findings, Ruskin states that implants are a predictable and widely accepted treatment for missing teeth, it is possible to consider early removal of teeth and placing

implants as a favorable treatment option compared to having an endodontically treated tooth.¹¹

According to Ruskin, implants cost less when you consider the inevitable failure of the initial root canal treatment, the retreatment and apicoectomy.¹¹ However, Christensen found that an implant supported crown costs twice the amount of an endodontically treated tooth.⁴⁰

Implants can also have technical complications. These can consist of implant fractures, abutment or screw loosening or fracture, loss of retention of cemented restorations or fracture of the framework.¹³ Also patients who experienced an implant failure had a 30% increased risk of further failure.⁴¹ In looking at retreatments, endodontists were more inclined to retreat a tooth and take action when a peri-apical radiolucency was noted regardless of size compared to general dentists.⁷ Kvist shows us that the choice for retreatment is affected by the cost, the technical quality of the initial treatment and the dentists values.⁴² It has also been shown that the odds of choosing an implant over retreatment is lower in dentists who do not place their own implants compared to dentists that do.⁴³ Unfortunately implant surgeons do not see the retreatments that are successful, they only see the retreatments that fail so consequently their outlook on the treatment is skewed negatively.⁴⁴ This leads them to the belief that endodontic treatment is just a space maintainer for implants.⁴⁵ Retreated teeth may need a longer time period to be deemed successful. Fristad found a 95.5% success rate for retreated teeth with a 20-27 year follow up. However, these same teeth had a 85.7% success rate 10 years previously.³¹

Iqbal reviewed 55 single-tooth implant studies and 13 studies related to the endodontically treated tooth with a coronal restoration. These are included as Table I and II¹⁰ He has found that there is no long term difference in prognosis between the two modalities. The decision must be based on patient preferences, cost-benefit ratio, quality of the bone, esthetics, prosthetic restorability, systemic factors and the potential for adverse effects.⁴⁶ Along with these factors the strategic value of the tooth within the dentition and the extent of previous restorations should also be taken into account.¹³ The condition of the adjacent teeth and the entire dentition must be taken into consideration in treatment planning.¹³

While some believe that full deliberation should first be given to “traditional” dental interventions, such as preserving and restoring the natural dentition before extraction and implant placement,¹² others believe that given implants high predictability their use should be considered routine and that implant treatments are superior to heroic measures taken to save a natural tooth.⁴⁷ However, there is concern that this initial excitement surrounding implants could compromise patient care especially since it has not been agreed upon as to what the best course of treatment is for a compromised tooth.⁴⁸ Until a tooth is judged non restorable a root canal treatment or retreatment should be performed before an implant is considered.¹³ The final results whether choosing an implant or endodontic treatment should be a high level of esthetics, function, longevity and comfort.⁴⁹

Table I

| Author | Year | Type of Study | N | Recall (mo) | Survival (%) |
|-----------------------------|------|---------------|--------|-------------|--------------|
| Alley ⁵⁰ | 2004 | Retrospective | 297 | 60 | 94.6 |
| Aquilino ²⁴ | 2002 | Retrospective | 157 | 120 | 89.0 |
| Bergman ⁵¹ | 1989 | Retrospective | 96 | 72 | 96.876 |
| Dammaschke ⁵² | 2003 | Retrospective | 190 | 120 | 92.2 |
| Doyle ³³ | 2006 | Retrospective | 196 | 120 | 93.9 |
| Hatzikyriakos ⁵³ | 1992 | Retrospective | 154 | 36 | 95.45 |
| Lazarski ⁵⁴ | 2001 | Retrospective | 19,817 | 72 | 97.34 |
| Linde ⁵⁵ | 1984 | Retrospective | 51 | 120 | 81.2 |
| Lynch ⁵⁶ | 2004 | Retrospective | 48 | 60 | 91.9 |
| Mannocci ⁵⁷ | 2002 | Retrospective | 117 | 36 | 100 |
| Mentink ⁵⁸ | 1993 | Retrospective | 516 | 58 | 98.26 |
| Sorensen ²² | 1985 | Retrospective | 1,273 | 300 | 97.55 |
| Tilashalski ⁵⁹ | 2004 | Retrospective | 59 | 48 | 88.0 |

Survival rate of endodontically treated teeth with a coronal restoration.

From: Iqbal et al., 2007, p 100.

Table II

| Author | Year | Type of Study | N | Recall (mo) | Survival (%) |
|--------------------------|------|----------------|------|-------------|--------------|
| Andersson ⁶⁰ | 1995 | Prospective | 38 | 36 | 100 |
| Andersson ⁶¹ | 1998 | Prospective | 65 | 60 | 98.5 |
| Andersson ⁶² | 1998 | Prospective | 38 | 60 | 94.4 |
| Becker ⁶³ | 1995 | Retrospective | 23 | 24 | 95.7 |
| Becker ⁶⁴ | 1998 | Clinical Trial | 134 | 96 | 93.3 |
| Becker ⁶⁵ | 1999 | Prospective | 282 | 72 | 89.5 |
| Bianco ⁶⁶ | 2000 | Retrospective | 252 | 96 | 95.9 |
| Brocard ⁹ | 2000 | Prospective | 1022 | 84 | 92.2 |
| Cordioli ⁶⁷ | 1994 | Retrospective | 67 | 60 | 95.4 |
| Cosci ⁶⁸ | 1997 | Retrospective | 423 | 84 | 99.53 |
| Deporter ⁶⁹ | 1998 | Retrospective | 20 | 24 | 100 |
| Dhanrajani ⁷⁰ | 2005 | Retrospective | 11 | 72 | 96.0 |
| Doyle ³³ | 2006 | Retrospective | 96 | 12 | 93.9 |
| Ekfeldt ⁷¹ | 1994 | Retrospective | 93 | 55 | - |

| | | | | | |
|---------------------------|------|----------------|-----|-----|-------|
| Engquist ⁷² | 1995 | Retrospective | 82 | 36 | 97.6 |
| Gibbard ⁷³ | 2002 | Prospective | 30 | 70 | 96.66 |
| Gomez-Roman ⁷⁴ | 1997 | Case Study | 696 | 54 | 96.0 |
| Gomez-Roman ⁷⁵ | 2001 | Retrospective | 124 | 60 | 97.0 |
| Haas ⁷⁶ | 2002 | Retrospective | 76 | 120 | 93.0 |
| Henry ⁷⁷ | 1996 | Prospective | 107 | 60 | 98.3 |
| Jemt ⁷⁸ | 1993 | Retrospective | 70 | 36 | 98.5 |
| Johnson ⁷⁹ | 2000 | Prospective | 59 | 36 | 98.3 |
| Kemppainen ⁸⁰ | 1997 | Clinical Trial | 102 | 12 | 99.0 |
| Laney ⁸¹ | 1994 | Prospective | 95 | 36 | 97.2 |
| Ledermann ⁸² | 1993 | Prospective | 42 | 36 | 0.0 |
| Levine ⁸³ | 1997 | Retrospective | 174 | 40 | 95.5 |
| Levine ⁸⁴ | 2002 | Retrospective | 675 | 78 | 99.1 |
| Malevez ⁸⁵ | 1996 | Retrospective | 97 | 60 | 97.6 |
| McMillan ⁸⁶ | 1998 | Retrospective | 76 | 60 | 96.0 |

| | | | | | |
|----------------------------------|------|---------------|------|-----|-------|
| Morris ⁸⁷ | 2001 | Prospective | 351 | 48 | 95.2 |
| Nentwig ⁸⁸ | 2004 | Prospective | 943 | 144 | 98.7 |
| Norton ⁸⁹ | 2001 | Retrospective | 14 | 84 | 100 |
| Orenstein ⁹⁰ | 2000 | Prospective | 247 | 36 | 97.3 |
| Palmer ⁹¹ | 2000 | Retrospective | 15 | 36 | 100 |
| Pecora ⁹² | 1996 | Retrospective | 32 | 16 | 96.8 |
| Polizzi ⁹³ | 1999 | Case Study | 30 | 84 | 93.3 |
| Priest ⁹⁴ | 1999 | Retrospective | 119 | 120 | 97.5 |
| Rodriguez ⁹⁵ | 2000 | Prospective | 2900 | 36 | 98.1 |
| Rosenquist ⁹⁶ | 1996 | Retrospective | 109 | 35 | 93.6 |
| Scheller ⁹⁷ | 1998 | Prospective | 99 | 60 | 95.95 |
| Schmitt ⁹⁸ | 1993 | Retrospective | 40 | 72 | 100 |
| Schropp ⁹⁹ | 2005 | Prospective | 23 | 24 | 91.0 |
| | | | 23 | 24 | 96.0 |
| Schwartz- Arad ¹⁰⁰ | 1999 | Retrospective | 78 | 60 | 92.3 |
| Schwartz- | 2000 | Retrospective | 56 | 96 | 89.0 |

| | | | | | |
|--------------------------|------|---------------|-----|----|-------|
| Arad ¹⁰¹ | | | | | |
| Simon ¹⁰² | 2003 | Retrospective | 126 | 10 | 96.0 |
| Smith ¹⁰³ | 1992 | Retrospective | 313 | 54 | 94.25 |
| Taylor ¹⁰⁴ | 2004 | Retrospective | 39 | 60 | 97.4 |
| Thilander ¹⁰⁵ | 1999 | Retrospective | 15 | 96 | 100 |
| Tolman ¹⁰⁶ | 1991 | Case Study | 303 | 60 | 99.34 |
| Vehemente ¹⁰⁷ | 2002 | Retrospective | 677 | 60 | 99.20 |
| Vermeylen ¹⁰⁸ | 2003 | Retrospective | 43 | 84 | 100 |
| Vigolo ¹⁰⁹ | 2000 | Retrospective | 52 | 60 | 94.2 |
| Watson ¹¹⁰ | 1999 | Prospective | 33 | 48 | 100 |
| Wennstrom ¹¹¹ | 2005 | Prospective | 45 | 60 | 97.7 |
| Zinsli ¹¹² | 2004 | Retrospective | 298 | 72 | 94.1 |

Survival rate of single tooth implants. From Iqbal et al. 2007 p 99

Concern exists regarding the future of endodontics, although little literature exists on the current and projected utilization of endodontic treatment compared to implants. It is because of this reason that I wanted to obtain information not only on the dentist's perceptions but their utilization as well.

The goal of a survey is to produce a numerical value of an aspect of a study population.¹¹³ Information cannot typically be collected from every member of the population so instead a fraction of the population, or a sample, is used.¹¹³ Therefore, our study design will involve a survey of a sample of practicing dentists in the United States. This sample will be limited to graduates of the University of Connecticut, School of Dental Medicine who may reside anywhere in the United States. The completion of this survey will seek to understand the current and projected utilization of endodontic and implant treatment. In addition an appreciation of dentist's perception of prognosis of these two modalities will be evaluated.

HYPOTHESIS

The hypothesis of this study is that utilization patterns are shifting from endodontic treatment and tooth conservation to tooth replacement with implants due to a perceived superior outcome.

SPECIFIC AIMS

The purpose of this study was three-fold: To evaluate their perceptions of endodontic and implant treatment, to review their current and projected utilization, and to assess the sources of information upon which these opinions are based.

MATERIALS AND METHODS

DESIGN AND DISTRIBUTION OF THE SURVEY

After obtaining approval from the University of Connecticut Institutional Review Board a sixteen question survey and informed consent was developed and distributed to dentists who matriculated from the University of Connecticut School of Dental Medicine between the years 1977 -1985, 1990 and 1995-2003 (n=740). Questions evaluated both their perceptions of endodontic and implant treatment prognosis as well as their current and projected utilization. Also the sources of information upon which these opinions are based were assessed. A pilot questionnaire was sent out to non-surveyed dentists from the same survey population and feedback was incorporated into the final questionnaire.

Graduation rosters were obtained from the dental school but contact information could not be released, therefore the Principal Investigator (PI) had to independently research this information. Mailing addresses, phone numbers and occasionally email addresses were located online. Phone calls were made to each dentist to obtain their preferred form of communication: fax, email or postal mail. Contact information was not obtained for 61 dentists. Twenty-nine dentists were retired from dentistry and 2 were deceased. The final number of dentists surveyed was thus: 648. The web interface www.surveymonkey.com was the central form of distribution with 527 dentists choosing to be emailed; the other 90 were faxed and 31 mailed.

COLLECTION OF SURVEY DATA

The data was collected during a 1-month period. Two reminder emails, after a two week interval, were sent to the dentists who chose to be emailed. To facilitate collecting unbiased data respondents were informed that the survey was completely anonymous and identification of the participant was not linked to the individual responses. The survey was formatted so that participants were allowed to skip questions and give partial answers. Any emails that were returned as undeliverable were resent with amended correct contact information. A message was sent to pediatric dentists and orthodontists indicating that if they did not feel that this was in their realm of dentistry they have the option to not complete the survey and respond citing this reason.

DATA ANALYSIS

Raw data was entered into an Excel (Microsoft Corp, Redmond, WA) spreadsheet. Data analysis was performed using SAS version 9.1 software (SAS Institute Inc., Cary, NC). Since most of the orthodontists and pediatric dentists chose not to complete the questionnaire both groups were eliminated from statistical analysis. To analyze the data from question number 11 the Z-test was used and the level of significance was set at $P < .05$. Multinomial logistic regression and linear odds ratios were used to evaluate significant differences among groups at the 95% confidence interval. Frequency distribution analysis was used to analyze the data sets in many of the questions. Dependant variables were implant therapy versus root canal treatment of a vital pulp, implant

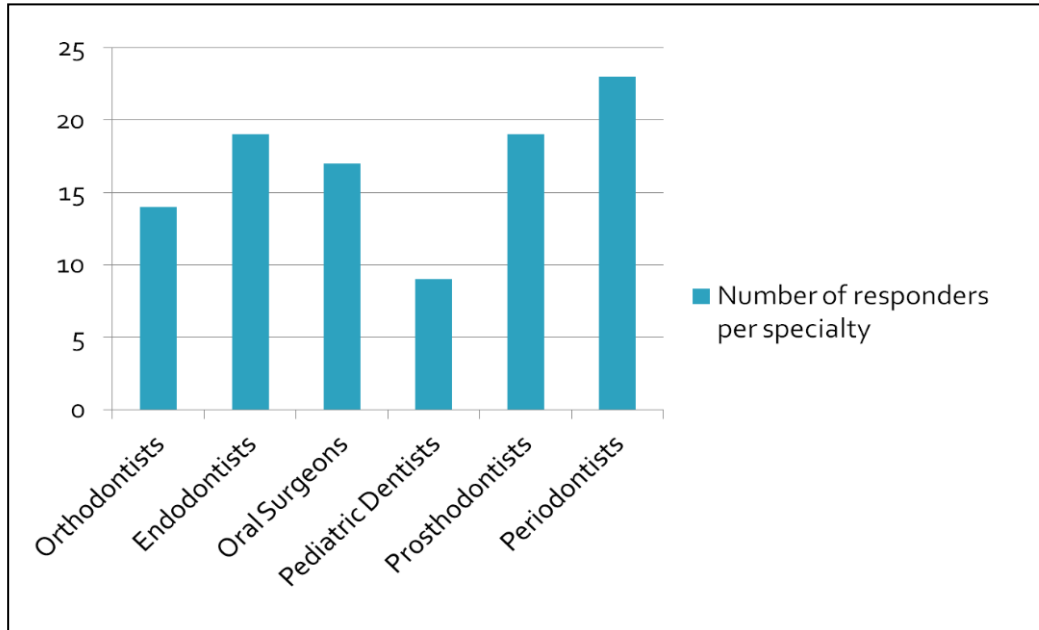
therapy versus root canal treatment of a necrotic pulp, implant therapy versus a retreatment, endodontic treatment of a salvageable or restorable tooth versus an extraction and implant, endodontic retreatment of a failing root canal treatment versus extraction and implant. Independent variables were years since graduation, sources of information and specialist versus general dentist.

RESULTS

An overall 47% response rate was obtained (n=306); 272 from email, 9 from postal mail and 25 faxed. Two hundred and six (67%) responders were general dentists and 101 (32.8%) were specialists. The specialist responders consisted of 14 orthodontists, 19 endodontists, 17 oral surgeons, 9 pediatric dentists, 19 prosthodontists, and 23 periodontists. Many of the orthodontists and pediatric dentists responded that they were not going to complete the survey since it was not in their realm of dentistry. (See Figure I)

Two hundred and fifty-four (90.7%) responders were in private practice. One hundred and thirty-three responders (47.8%) were from 1977- 1985 (Senior), 130 responders (46.8%) were from the years 1995-2003 (Junior) and 15 responders (5.4%) from 1990.

Figure 1



This figure illustrates the number of responders per specialty.

PROGNOSIS

Dentists were asked, “Compared to implant therapy, do they feel the prognosis of a vital pulp is much better, better, same, worse, or much worse”. For statistical analysis the 5 groupings were combined to three: better, same and worse. (See Table III) Frequency analysis revealed that forty-five percent of respondents felt root canal treatment of a vital pulp had a better prognosis than implant therapy. When asked, “Compared to implant therapy do they feel the prognosis of a necrotic pulp is better, same or worse”, 36% answered worse. Finally, when asked, “Compared to implant therapy do they feel the prognosis of a retreatment is better, same or worse”, 62% answered worse.

Table III

| | | Percentage that felt RCT was better than implants | Percentage that felt RCT was the same as implants | Percentage that felt RCT was worse than implants |
|-------------|---------------|---|---|--|
| Question #5 | Vital Pulp | 44.8% | 41.6% | 13.6% |
| Question #6 | Necrotic Pulp | 29% | 35.3% | 35.7% |
| Question #7 | Retreatment | 14.5% | 23.4% | 62.1% |

This is a frequency analysis comparing the prognosis of a vital pulp, necrotic pulp and a retreatment to an implant. The most common answer is in bold.

Dentists were asked to strongly agree, agree, undecided, disagree or strongly disagree with the following statement: Does endodontic treatment of a salvageable or restorable tooth provide a better outcome than extraction and a dental implant. For statistical analysis the 5 groupings were combined to three: agree, undecided, and disagree. (See Table IV) Frequency analysis revealed that 65% of respondents agreed with this statement. When asked, "Is endodontic retreatment of a failing root canal in a restorable tooth preferable to extraction and a dental implant", 47% were undecided. When asked, "In published studies criteria used to determine a successful root canal treatment are the same as criteria used to determine a successful implant", 46% were again undecided.

Table IV

| | | Agree | Undecided | Disagree |
|--------------|---|--------------|--------------|----------|
| Question #12 | Endodontic treatment of a salvageable or restorable tooth provides a better outcome than extraction and a dental implant | 64.9% | 16.3% | 18.8% |
| Question #13 | Endodontic retreatment of a failing root canal in a restorable tooth is preferable to extraction and a dental implant | 31.9% | 47.3% | 20.8% |
| Question #14 | In published studies criteria used to determine a successful root canal treatment are the same as criteria used to determine a successful implant | 8.8% | 45.8% | 45.4% |

This is a frequency analysis asking the responders to choose agree, disagree or undecided with the following questions. The most common answer is in bold.

SOURCES OF INFORMATION

The source of information was found to be predictive of survey responses among dentists. The more information dentists obtain from trade journals and dental sales representatives the less likely they were to answer the prognosis of root canal treatment of a necrotic pulp was the same or better than implant therapy. These findings were significant with a p value of .0112.

GENERAL DENTIST VS SPECIALIST

To determine whether there were differences in the responses between general dentists and specialists regarding the question that root canal treatment of a vital pulp was better, the same, or worse than an implant, a multi-nominal

logistic regression was used. Specialists were significantly more likely to feel RCT of a vital pulp had a worse prognosis than implant treatment compared to their general dentist counterparts ($p=0.048$). The multinomial logistic regression revealed an odds ratio of 2.45 indicating that general dentists have twice the odds to pick same over worse compared to specialists.

CRITERIA FOR SUCCESS

In an effort to understand whether dentists appreciate the difference in criteria used to determine outcome among implant and endodontic prognosis studies, dentists were asked if they agree or disagree that criteria used to determine success are the same in endodontic and implant studies: 8% agreed, 49% were undecided and 43% disagreed.

YEARS SINCE GRADUATION

When the criteria for success were linked to years since graduation an effect was found on responses. The odds of agreeing that criteria to determine success are the same increases as years since graduation increases ($p=0.004$). Stated another way, older dentists were the least likely to appreciate the difference in criteria.

UTILIZATION

When looking at their utilization, dentists were asked where they would refer a patient for implant placement. The results of the frequency analysis are outlined in Table V. Periodontists were chosen 53% of the time, oral surgeons

38% of time, and general dentists and the remaining specialists comprised only 9% collectively.

Table V

| Question #10 | # of responses | |
|-----------------|----------------|-------|
| General Dentist | 14 | 5.0% |
| Orthodontist | 0 | 0 |
| Endodontist | 1 | 0.3% |
| Oral Surgeon | 100 | 38.7% |
| Pedodontist | 5 | 2.0% |
| Prosthodontist | 3 | 1.0% |
| Periodontist | 139 | 53.0% |

This table indicates where the dentist would refer a patient for implant placement.

THREE - YEAR INTERVAL EVALUATION

Evaluating utilization patterns between 2004 and 2007, four areas of treatment were surveyed: root canal treatments completed by survey respondents, endodontic referrals, implants placed by survey respondents and implant referrals. The Z-test revealed no significant difference between root canal treatments completed by survey respondents between 2004 and 2007. However, endodontic referral, implants placed by survey respondents and implant referrals all significantly increased over the three year interval.

FUTURE OF ENDODONTICS

Looking to the future of endodontics, we asked the survey respondents, “Compared to present times, what do you think that the importance of the role of endodontics in dentistry will be in the future”. Thirty-two percent answered less (85 respondents), 60% (160) answered the same and only 8% (19) answered more. Also, we inquired about how the amount of information they received on endodontics compares to the amount of information they receive on implants. The majority, 68% (179) answered less and out of that group 25% (66) of them had answered much less. The other 26% (68) had found the amount of information to be the same and only 1% (17) thought that it was more.

DISCUSSION

A focus group of 8 individuals was performed in order to understand how survey questions will be perceived by respondents. This process advocated by Fowler is a valuable tool to refine question wording and refine the objectives. It is also important to determine what assumptions can be made about respondent’s knowledge base. After reviewing the results of our focus group design changes were made to the lay out to decrease the number of questions per page. The literature also suggests that photoreduction (putting many questions on a page) reduces the response rate compared to when the questions are spaced more esthetically over more pages¹¹⁴.

We chose to keep the survey at 16 questions. Many people assume using common sense that increasing the length of the survey decreases the response rate. People studying questionnaires have accepted this belief without empirical evidence because few actual studies have actually examined this correlation.¹¹⁵ Respondents will look at the length of the questionnaire to gauge an approximate time of how long the survey will take.¹¹⁶ Yu and Cooper find a negative correlation with the amount of questions and response rate.¹¹⁷ Looking at a study by Burchall and March, they attempted to analyze why people failed to participate in a survey.¹¹⁸ They found that 61% could have been influenced by the survey length. Love and Turner with the US Census Bureau speculate that increasing length makes a high response rate hard to achieve.¹¹⁹

Most of our respondents chose the electronic form of their preferred method of communication. A number of researchers have suggested that e-mail surveys cost less than mail surveys.^{120,121,122,123,124} Another positive is that electronic surveys reduce paper waste. Electronic surveys provide a faster reaction time than mail surveys. Many studies have reported that most of their e-mail responses arrive within two to three days following the initial e-mail contact.^{120,123,124,125,126} Although we found email to be a fast and cost effective method of distributing our survey, Kittleson feels that email is inferior to postal mail due to the fact that individuals can discard these messages very easily and because email surveys do not physically show up on recipient's desks they are less likely to get the receiver's attention.¹²⁶

Individuals surveyed were contacted two weeks after the initial mailing of the survey as a first reminder and then a second reminder was emailed two weeks after the first reminder. This is somewhat consistent with Dillman's protocol for follow up. He stated that mail follow-up should be sent at one, three, and seven weeks from the initial mailing date.¹²⁷ However, now with the much faster delivery speed of e-mail, Andreson recommends that researchers should send follow-up e-mail one week earlier than recommended for traditional mail surveys.¹²⁸ Kittleson found that e-mail survey response rates may only reach 25% to 30% without follow-up e-mails.¹²⁶ It has been shown that the most important difference between a good survey and a poor survey is the amount of repeated contact made with the non-respondents.¹²⁹

A response rate of 47% was obtained by this method of survey. Although some find that response rates for e-mail surveys are somewhat lower than paper and pencil surveys^{126,128}, others find that e-mail surveys with pre-notice and follow-up reminders can generally achieve higher response rates.¹²⁵ While there is no agreed upon standard for an acceptable minimum response rate, 47% is considered above average. It is well known, that a higher response rate can be obtained from a sample composed of motivated, well educated individuals¹²⁹.

According to this survey, dentists feel the prognosis of root canal therapy of a tooth with a vital pulp is still superior to that of an implant. However, prognosis of implant treatment was felt to be better than root canal treatment of a necrotic pulp or retreatment. This is in contrast to a survey of dentists in Virginia completed in 2007 where respondents preferred endodontic retreatment 66% of

the time over implant treatment.⁴³ These differences might be explained by regional variations in perceptions as our study was limited to dentists in Connecticut. Additionally, our study surveyed dentists two years later than those in Virginia and may represent shifting perceptions.

In the same survey, it was found that the odds of choosing an implant were higher with practitioners who placed implants and those with 10 years or less of experience.⁴³ Our results showed that 41% of the junior dentists disagree that retreatment is preferable to extraction and an implant versus 50% of the senior dentists disagreeing. So our results contradicted these findings by reporting that the older dentists choose the implant more frequently.

Survey respondents overwhelmingly chose periodontists as their preferred referral choice for placing dental implants. Endodontists were the least likely to receive referrals for implant placement, representing .3% of the responses. This is in contrast to a recent survey by Potter where they found 57% of their respondents support endodontists placing implants and that currently 5.7% of endodontists place implants.¹³⁰ In a survey by Creasy he found that 6.6% of endodontists are currently placing implants¹³¹. Since both surveys were distributed in 2009 the percentages they found are very similar. It appears clear that endodontists currently represent a small percentage of the specialists placing implants. However, it is unclear whether general dentists would change their referral patterns in the future.

Quantifying utilization of each treatment option could indirectly measure perceived prognosis. However, complete and unbiased data on utilization does not exist. Insurance surveys only incorporate reimbursed procedures which do not include implants. The recent AAE survey in part addressed this dilemma by assessing understanding of outcomes among dental educators and students. Our study complemented this data by broadening the scope of surveyed individuals to include all types of practitioners.

The self reported utilization of implant treatment and referrals as well as endodontic treatment by respondents and referrals was quantified in our study. It showed an increase in endodontic referrals, implant placement by respondents and implant referrals. The only area that did not increase was endodontic treatment completed by respondents. The increase in implant treatment and referrals may be a result of an increase in insurance reimbursements by some carriers for implant treatment. The interval of time surveyed represented a time of economic prosperity. As general dentists in the Connecticut area were overwhelmed by patient's restorative needs, their response in most cases was to increase referrals including the less complex endodontic cases.¹³²

Over half of the survey respondents did not appreciate the difference in criteria for measuring outcome between endodontic and implant prognosis studies. In addition, dentists reported receiving less information on endodontics compared to implants. This represents an area for endodontists to educate the dental community.

CONCLUSION

- The majority of respondents were unaware that a difference in criteria for success exists between the endodontic and implant literature.
- Older dentists were the least likely to appreciate this difference.
- Dentists feel the prognosis of a vital pulp is still superior to implant treatment. However, they viewed implant prognosis to be superior to RCT of necrotic pulps and retreatments.
- General Dentists have a more positive outlook on the prognosis of root canal treatment of a vital pulp than specialists.

SUMMARY

The initial hypothesis was that utilization patterns are shifting from endodontic treatment and tooth conservation to tooth replacement with implants due to a perceived superior outcome. Although it was found that root canal treatments completed by respondents did not increase over time, root canal treatment referrals, implant placements, and implant referrals all increased over the three year interval. So there does not appear to be a shift in utilization, however, a perceived superior outcome of implant treatment compared to root canal therapy does exist among the dental community.

The results of this study can help target future educational efforts among referring dentists, especially older dentists. Increasing awareness of the differences in criteria for success in the implant and endodontic literature appears necessary. Additionally there is a need to educate dentists on endodontic prognosis. As we can see from the results, the respondents are receiving quite a bit more literature on implants than endodontics. Without getting knowledge on both treatment modalities they will not be able to make the best educated treatment decisions. Other possibilities for the future could be a national study or a meta-analysis combining the results of several past studies. It has been said that implants are not a threat to endodontics as a specialty, but what is a threat is not educating the general dentists on the good of endodontics and how it can benefit their patients.¹³³

APPENDIX

ENDODONTIC AND IMPLANT PROGNOSIS
SURVEY



This study is conducted by:

**Department of Oral Health and Diagnostic Sciences School
of Dental Medicine**

University of Connecticut Health Center

If there is any question regarding this study:

Please contact:

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This study and its contents was reviewed and approved by the University of Connecticut Health Center Institutional Review Board

For UCONN IRB's use only: (please place the approval seal here)

If you have questions regarding the conduct of this study please contact the UCONN IRB
Phone number: 860-679-3054

| | |
|----------|--|
| Survey # | |
|----------|--|

Please check the box that represents your response or write in the space provided.

Your suggestions are invaluable for this study. We would appreciate it if you could answer all of the questions; however, you may skip any that you do not want to answer. Please provide your frank opinion and feel free to give your suggestions wherever you think appropriate.

1) What best describes your area of specialty?

- ₁ General Dentist _____ Subspecialty (If applicable)
- ₂ Orthodontist
- ₃ Endodontist
- ₄ Oral Surgeon
- ₅ Pedodontist
- ₆ Prosthodontist
- ₇ Periodontist
- ₈ Resident _____ (specialty if applicable)
- ₉ Other _____ (specify)
- ₁₀ Not in practice (skip remaining questionnaire, but please return the questionnaire)

2) At what practice setting do you spend the majority of your time?

- ₁ Private Practice
- ₂ Hospital setting
- ₃ Full time faculty at a Dental School
- ₄ Part time faculty at a Dental School
- ₅ Community health center/clinic

3) At what practice setting do you spend your secondary amount of time?

- ₁ Private Practice
- ₂ Hospital setting
- ₃ Full time faculty at a Dental School
- ₄ Part time faculty at a Dental School
- ₅ Community health center/clinic
- ₅ Not applicable; I practice in only one clinical setting

4) In what year did you graduate?

- ₁ Dental School _____
- ₂ Most recent specialty program (If applicable) _____

Complete the following statements:

| | Much Better | Better | Same | Worse | Much Worse |
|---|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| 5) Compared to implant therapy, do you feel the <i>prognosis of root canal treatment with a vital pulp is</i> | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| 6) Compared to implant therapy, do you feel the <i>prognosis of root canal treatment with a necrotic pulp is</i> | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| 7) Compared to implant therapy, do you feel the <i>prognosis of root canal <u>retreatment</u> is</i> | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |

8) Please rank by percentage where you obtain information regarding implant treatment outcomes:

Dental school

Trade Journals

Peer -reviewed Journals

ADA/AAE/AAOMS/AAP

CE Classes

Dental Specialists

Dental Sales Representatives

Total 100%

9) Please rank by percentage where you obtain information regarding root canal treatment outcomes:

₁ Dental school

₂ Trade Journals

₃ Peer -reviewed Journals

₄ ADA/AAE/AAOMS/AAP

₅ CE Classes

₆ Dental Specialists

₇ Dental Sales Representatives

Total 100%

UTILIZATION

10) If you decided that a patient needed an implant, who would you prefer place the implant? Please choose only one response:

- ₁ General Dentist
- ₂ Orthodontist
- ₃ Endodontist
- ₄ Oral Surgeon
- ₅ Pedodontist
- ₆ Prosthodontist
- ₇ Periodontist

11) To the best of your ability, please estimate the number of completed procedures per month during the following two years.

| | 2004 | 2007 |
|--|----------------------|----------------------|
| a) The number of root canal procedures you have performed | <input type="text"/> | <input type="text"/> |
| b) The number of root canal referrals you have made to other providers | <input type="text"/> | <input type="text"/> |
| c) The number of implant placements you have performed | <input type="text"/> | <input type="text"/> |
| d) The number of implant referrals you have made to other providers | <input type="text"/> | <input type="text"/> |

Indicate the extent to which you agree with the following statements:

| | Strongly agree | Agree | Undecided | Disagree | Strongly disagree |
|--|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| 12) Endodontic <i>treatment of a salvageable or restorable tooth</i> would provide a better outcome than an extraction and a dental implant. | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |

| | Strongly agree | Agree | Undecided | Disagree | Strongly disagree |
|---|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| 13) Endodontic <i>retreatment of a failing root canal</i> in a restorable tooth is preferable to extraction and a dental implant. | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |

| | | | | | |
|---|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| 14) In published studies, criteria used to determine a successful root canal treatment are the same as criteria used to determine a successful implant treatment. | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
|---|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|

Complete the following statements:

| | Much Less | Less | About the same | More | Much more |
|--|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| 15) Compared to present times, what do you think the importance of the role of endodontics in dentistry will be in the future. | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |

**Much
Less**

Less

**About the
Same**

More

**Much
More**

16) How does the amount of information you receive on endodontics compare to the amount of information you receive on implants.

_1_2_3_4_5

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