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Root canal treatment in a population-based adult sample: differences in patient factors and types of teeth treated between endodontists and general dentists

Ken R. Tilashalski[1], Gregg H. Gilbert[1], Michael J. Boykin[1] and Brent J. Shelton[2]

[1]Department of Diagnostic Sciences, School of Dentistry, University of Alabama at Birmingham; [2]Departments of Internal Medicine & Biostatistics, University of Kentucky

Objective The purpose of this study was to identify in a population-based study the differences between general dentists and endodontists with regard to types of teeth treated, fees, and patient characteristics. ***Basic research design*** The "Florida Dental Care Study" was a prospective cohort study using a representative baseline sample of 873 dentate adults. In-person interviews and clinical examinations were conducted at baseline, 24 months, and 48 months, with 6-monthly telephone interviews between those times. Dental record information was abstracted afterward. ***Results*** A total of 100 root canals were performed in participants during the study period. While generalists performed the majority of endodontic procedures in all teeth, the percentage of molars treated by endodontists was significantly higher than the percentage of anterior teeth and bicuspids treated by endodontists. Data on fees were available in 85 of the cases. The trend was for endodontists fees to be higher, but the difference in fees was statistically significant only for molars. There were no statistically significant differences between generalist and specialist patients with regard to income, fear of pain, and frustration from previous dental care. However, a significantly higher percentage of patients treated by endodontists had dental insurance. ***Conclusions*** Although the number of teeth ultimately treated in this representative sample of a dentate population was small, results do suggest that endodontists' fees were higher, they performed a higher percentage of molar root canals, and their patients were more likely to have dental insurance, as compared to general dentists who did root canals.

Key words: endodontics, epidemiology, root canal therapy

Introduction

The literature regarding the epidemiology of endodontic treatment is sparse (Eriksen, 1991; Lazarski *et al.*, 2001). However, epidemiologic studies are important in broadening concepts of health and disease, and lead to results that are closer to real life conditions than controlled clinical trials (Eriksen *et al.,* 2002). Although several reports have recommended when a general dentist should refer a patient to an endodontic specialist (American Association of Endodontics, 1997; Curtis and Simon, 1999; Dietz and Dietz, 1992; Rosenberg and Goodis, 1992), few studies have evaluated the differences between the endodontic treatment that is actually provided by generalists and endodontists (Lazarski *et al.*, 2001; Dugas *et al.*, 2002). Recommendations for referral have included technically difficult cases and potential patient management problems. However, there is very little published information on whether these recommendations are actually being implemented in private practice.

A recently-completed population-based longitudinal study, called the Florida Dental Care Study (FDCS), allows a rare opportunity to quantify dental treatment received during a four-year period by a representative sample of dentate adults, treatment which may or may not have included root canal treatment (RCT). The objectives for this report are to address these questions: 1) are endodontic specialists providing most of the RCT for molars? 2) are endodontic fees significantly different between generalists and endodontists? 3) if the specialists have higher fees, are they treating a more affluent subset of patients? 4) are generalists more likely to treat the patients without dental insurance?, and 5) are patients with potential management problems (more fearful, more dissatisfied with past dental treatment) more likely to be treated by endodontists?

Methods

Sampling methods of the parent study

The FDCS was a longitudinal observational cohort study of oral health and dental care use. The 873 subjects who participated at baseline resulted in a representative sample of the population (Gilbert *et al.*, 1997b), defined as persons 45 years old or older, who had a telephone, did not reside in an institutional setting, resided in one of four counties in north Florida, could engage in a coherent telephone conversation, and had at least one tooth (one study objective was to investigate tooth loss). This sample had a baseline dental care usage that was very similar to National Health Interview Survey (NHIS) data, and conclusions regarding socio-demographic determinants of receipt of recent dental care were the same (Gilbert *et al.*, 1997b; Bloom *et al.*, 1992). Ad-

Correspondence to: Dr. Ken R. Tilashalski, Department of Diagnostic Sciences, UAB School of Dentistry, SDB Room 107, 1530 3rd Avenue South, Birmingham, AL 35294-0007, USA. Email: drt@uab.edu

ditionally, the percentage of the sample that had one or more dental visits in the first two years of the FDCS, 77%, was very similar to the figure, 75%, among the comparable group of NHIS respondents (Gilbert *et al.*, 1997b; Bloom *et al.*, 1992). The study protocol received approval by the Institutional Review Board for Human Use at the University of Alabama at Birmingham and at the University of Florida.

Data gathering stages of the parent study

An in-person interview was conducted at baseline, which was immediately followed by a clinical dental examination. The financial and socio-demographic circumstance of the FDCS sample, its prevalence of dental conditions at baseline, and its incident dental care use have been described previously (Dolan *et al.*, 1997; Foerster *et al.,* 1998; Gilbert *et al.*, 1997a; Gilbert *et al.*, 1998a; Gilbert *et al.*, 1998b; Gilbert *et al.*, 1998c).

Baseline characteristics included dental health attitudes. Dissatisfaction with dental care was evaluated by the question, "Have you ever had dental treatment that has not lasted as long as you thought it should have?". Fear was measured by having participants rank their response to "I am afraid of dental visits because of possible pain" on a four-point scale from strongly agree, somewhat agree, somewhat disagree, to strongly disagree. Other baseline questions included several financial characteristics (e.g., total annual household income and poverty status relative to the U.S. poverty level as specified by the U.S. Bureau of the Census).

The baseline interview and clinical examination were followed by a telephone interview at 6, 12, 18, 30, 36, and 42 months following baseline. Participants were asked at each interview whether or not they had been to a dentist since the last interview. If so, they were asked how many times they had been, and the name of each dentist and/or dental practice that had provided treatment. For each visit, they were asked why they went, and what dental procedures were done. The actual wording and response categories of all questionnaire items can be found on the Internet at http://nersp.nerdc.ufl.edu/~gilbert/.

At 24 and 48 months, interviews were done in-person instead of by telephone, and were followed by the clinical examination. During the 24-month interview, participants were asked for written permission to review and abstract information from their dental records, which was done by approaching each of the dentists whom participants had seen since baseline. Of the 764 persons who participated for the 24-month interview, all but four gave that permission.

Although the study began at baseline from August 1993 to April 1994 with 873 participants, by 48 months 85% (weighted n = 743) remained in the study. Persons who did not participate through 48 months comprised 55 who were deceased, 33 who were unreachable, 35 who had refused, and 7 who were medically unable to participate.

To evaluate the potential for bias as a result of subject attrition, characteristics of those who participated at 48 months for the interview were compared with those who did not. Persons who participated were more likely to have been regular dental care attenders, in better self-rated general health, white, have graduated high school, were above the 100% poverty threshold, free of severe loss of periodontal attachment at baseline (7 or more millimeters on at least one tooth), free of root fragments at baseline, free of severely mobile teeth at baseline, able to pay an unexpected $500 dental bill as reported at baseline, and to have had a household income at or above USD $20,000 ($\chi^2$ tests and Mantel-Haenszel χ^2 tests, $p < 0.05$). No differences in participation were observed with respect to age group, gender, rural or urban area of residence, whether or not the participant was above the 150% poverty threshold, present financial situation (income meets expenses), presence of active dental caries at baseline, or whether or not they had dental insurance. The mean (S.D.) number of teeth present at baseline among the 743 persons who participated through 48 months was 22.2 (7.0); for the non-participants it was 21.2 (7.6). This difference was not statistically significant. As an example of the typical magnitude of this bias due to attrition, of the persons at baseline (n = 873), 47% reported that they had been to a dentist in the previous six months. If the baseline had only included persons who ultimately participated for the 48-month interview (n = 743), then that figure would have been 49%.

Chart abstraction procedures

Dental hygienist research assistants abstracted from each chart the dates of visit, teeth/areas treated, and American Dental Association procedure codes. Detailed methods used during chart abstraction have been previously reported (Gilbert *et al.*, 2002). The ADA "Current Dental Terminology CDT-2" codes that went into effect in 1995 were used (American Dental Association, 1994). A more recent version was released for use in 2000, although the endodontic codes relevant for this report did not change.

The dates of participants' dental visits since their FDCS baseline session were recorded, as well as the name of the dentist for a given visit, teeth or areas treated, ADA procedure codes, a description of the ADA procedure code (to ensure that the code matched its description), the actual or typical fee charged for those procedures, as well as the name of the participant, date of data entry, and the name of the research assistant doing the data entry.

Of the 286 practices named by FDCS subjects, all but 10 practices participated. Eight practices allowed access to records, but did not allow us to record fees. Fees were unavailable at another 13 practices. Of the 764 persons who participated for the 24-month interview, 677 ultimately reported at least one dental visit during the first 48 months of the study. Of those 677, we located dental records on 619. Records on 10 of the 111 persons who reported no dental visits were found by querying practices while recording information on other participants, of whom four actually had a documented dental visit during the 48-months of follow-up. Charts varied in comprehensiveness, but in conjunction with office staff consultation, all practices had adequate records of what procedures were performed. Procedures relevant to the present paper include anterior, bicuspid, and molar RCT. The American Dental Association procedure codes are 3310, 3320, and 3330, respectively.

Other than those described in this report, more details

on the study are provided at the Internet site listed in the Acknowledgments section.

Statistical methods

Analyses were done using SAS software version 8 (SAS Institute, Inc., Cary, NC). Clustering of RCT-treated teeth within individuals and treatment of more than one tooth by dentists in the study was accounted for statistically, although clustering was rare. Comments about statistical significance refer to probabilities of less than 0.05. Results were weighted using the sampling proportions in order to reflect the population in the counties studied (Gilbert *et al.*, 1997b).

Results

Distribution of root canal treated teeth

A total of 100 RCTs were performed during the study period of 48 months. Of these 73% were performed by a general dentist, and the remaining 27% by an endodontic specialist. Of the 34 anterior teeth treated, 26 (76%) were completed by a general dentist and 8 (24%) by an endodontist. The ratio for premolar teeth was 26 (87%) to 4 (13%), and 21 (58%) to 15 (42%) for molars. The percentage of molars treated by an endodontist was significantly higher than the percentage of anterior teeth and bicuspids ($\chi^2 = 7.0$; 2 df; $p < 0.05$).

Differences in fees

Data on the fees charged for RCT were available in 85 of the 100 cases completed during the study period. The mean (S.D.) charge for anterior teeth completed by a general dentist (n = 23) was $243 ($87), bicuspids (n = 23) had a mean (S.D.) fee of $275 ($94), and the mean (S.D.) fee for molars (n = 17) was $345 ($95). In contrast, the fees charged by the endodontic specialists were $293 ($130) for anteriors (n=6), $371 ($100) for bicuspids (n=3), and $503 ($78) for molars (n=13). The difference in fees between endodontists and generalists was statistically significant only for the molar teeth (Wilcoxon rank sum test; two-sided $p = 0.0003$).

Differences in patient characteristics

Differences in certain patient characteristics were analysed between persons who had RCT done by a generalist or a specialist. Of the total study population 36% had dental insurance, and 26% had insurance that specifically covered endodontics. Analysis of the 100 treated teeth revealed that 27% of the patients who had their RCT completed by a generalist had dental insurance, compared to 53% of the patients who were treated by an endodontist ($\chi^2 = 6.0$; 2 df; $p < 0.05$). An even higher percentage (49%) of patients whose dental insurance specifically covered RCT were seen by endodontists, as compared to the general dentists (16%) ($\chi^2 = 10.7$; 2 df; $p < 0.01$).

Baseline questions concerning dissatisfaction from previous dental experiences were analysed. Of the 873 study participants, 19% reported being dissatisfied with previous dental care. When analysing only the individuals who received RCT, 16% of patients who had their treatment performed by a general dentist reported dental dissatisfaction, while 24% of patients seen by an endodontist reported a history of dissatisfaction. This difference was not statistically significant.

A total of 95% of the patients who had their endodontic treatment completed by a generalist had a history of previous RCT, compared to 84% of those seen by a specialist. This difference was not statistically significant.

Another baseline question asked if the patient was afraid to visit the dentist because of possible pain. 26% of the patients subsequently treated with RCT by general dentists reported fear of dental visits as a result of possible pain, compared to 41% of the endodontist's patients who reported fear. This difference was not statistically significant.

Analysis of the incidence of endodontic treatment by general dentists and endodontists in relation to two measures of patients' financial circumstance (annual household income and poverty status) was made. Generalists performed the RCT on 78% of the participants who had an annual household income below $20,000, and performed 69% of the endodontic treatment on those at or above that income. Examination of RCT among persons whose income was at or above 150% of the U.S. poverty level revealed that generalists performed 73% of the treatment and performed 68% of the treatment on persons whose income was below this figure. Differences in treatment based on participants' income were not statistically significant.

Discussion

We are only aware of one study, which was limited to persons with dental insurance, that reported the percentage of RCT done by generalists and specialists (Lazarski *et al.*, 2001). One contribution to the current report lies in its confirmation that most RCT in a population selected without regard to its dental insurance status is done by generalists, not endodontists.

The Endodontic Case Difficulty Assessment Form published by the American Association of Endodontists (1997) considers both patient characteristics and objective clinical conditions as to when to refer (Curtis and Simon, 1999). Although it is not surprising that generalists would refer the more technically difficult cases, this report adds credence to that assumption. A consistent criterion for case difficulty is the number of canals present within a tooth (Grembowski *et al.*, 1991). Although general dentists treated the majority of all teeth in the present study, including the molar teeth, judging from our findings, generalists are more likely to refer molars, which are generally more technically difficult.

We are not aware of any studies that have systematically evaluated differences between patients seen by generalists and endodontists with regard to the patient's financial circumstance, fear of dental procedures, or dissatisfaction with past dental care. Our findings are consistent with the notion that generalists are not systematically referring financially advantaged or disadvantaged patients.

Also, generalists do not seem to systematically refer fearful patients. We hypothesised that fear of dentistry and subsequent potential difficulties in patient management would be a predictor for referral. It has been shown

that patients are significantly more satisfied with the treatment received by endodontists than patients treated by generalists (Dugas *et al.*, 2002), and it can be hypothesized that knowledge of this information may lead to increased referrals to give a more satisfactory experience for the fearful patient. Patient factors of self-reported dissatisfaction from previous dental care and fear of pain were examined, but there were no systematic statistical differences between generalists and specialists. In addition, a history of a previous endodontic procedure was postulated to be a measure of lack of fear or trepidation with the root canal procedure. However, no statistically significant differences were noted between patients seen by the general dentists and the endodontists.

The trend was for the endodontists' patients to have more dissatisfaction from previous dental care, and to be more fearful, and also to have less experience with RCT, all of which could translate into a more difficult patient encounter. However, due to the small sample size, a lack of power may have impacted these results and ultimately led to statistical non-significance.

Cost has been established as a major influence on whether to save a tooth with RCT versus alternative treatments (Gilbert *et al.*, 2002). Although referral patterns based on income were not observed, evaluation of insurance coverage revealed significant results. Endodontists were much more likely to see patients who had dental insurance that offset treatment costs.

Although the endodontists in the present study had higher mean fees than did generalists, the difference was only statistically significant for molar RCT. The dollar difference in charges for anteriors and bicuspids appeared large (approximately $50 and $94), but due to large variations in fees and the small number of non-molar teeth treated by the endodontists, these differences were not statistically significant. Although this is not a new finding, it does suggest that this sample has much in common with what has been found in a U.S. national study of root canal fees (American Dental Association, 1996).

When compared to U.S. trends for fees, the mean charges by generalists for anterior RCT is near the 25th percentile, and for bicuspids and molars the fees are near the 10th percentile. When examining the mean fees charged by endodontists, they were near the 10th percentile of U.S. endodontists, regardless of tooth type (American Dental Association, 1996). These comparably low fees may be a function of the large sampling of practitioners from rural areas in the FDCS.

The FDCS has allowed prospective, longitudinal examination of dental care patterns in a well-defined dentate population over a 4-year period, using a representative sample. This has allowed a rare look into endodontic epidemiology. Within this study, the general dentists did most of the RCT, and endodontists treated a higher percentage of molars than other teeth. The specialists charged significantly more for treatment of these molars, but their patients were more likely to have dental insurance. No differences in treatment based on patient income were found. The trend was for endodonists to see patients with a greater fear of pain and dissatisfaction from previous dental care although these differences were not significant, and further study into these areas would be enlightening.

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References

American Association of Endodontics (1997): Colleagues for excellence: Evaluating endodontic treatment risk factors. Endodontics: Colleagues for excellence. Spring/Summer 1997.

American Dental Association (1994): Current Dental Terminology Second Edition – CDT 2 User's Manual, version 1995. Chicago.

American Dental Association (1996): 1995 Survey of Dental Fees. Chicago.

Bloom, B., Gift, H.C. and Jack, S.S. (1992): Dental services and oral health: United States, 1989. National Center for Health Statistics, Vital and Health Statistics Series 10, No. 183, Table 5, p. 31.

Curtis, E.K. and Simon, D.C. (1999): Endodontic case difficulty assessment: the team approach. *General Dentistry* **July–August**, 340–344.

Dietz, G.C. Sr. and Dietz, G.C. Jr. (1992): The endodontist and the general dentist. *Dental Clinics of North America* **36**, 459–471.

Dolan, T.A., Gilbert, G.H., Ringelberg, M.L., Legler, D.W., Antonson, D.E., Foerster, U. and Heft, M.W. (1997): Behavioral risk indicators of attachment loss in adult Floridians. *Journal of Clinical Periodontology* **24**, 223– 232.

Dugas, N.N., Lawrence, H.P., Teplitsky, P. and Friedman, S. (2002): Quality of life and satisfaction outcomes of endodontic treatment. *Journal of Endodontics* **28**, 819–827.

Eriksen, H.M. (1991): Endodontology – epidemiologic considerations. *Endodontic Dentistry and Traumatology* **7**, 189–195.

Eriksen, H.M., Kirkevang, L.L. and Petersson, K. (2002): Endodontic epidemiology and treatment outcome: general considerations. *Endododontic Topics* **2**, 1–9.

Foerster, U., Gilbert, G.H. and Duncan, R.P. (1998): Oral functional limitation among dentate adults. *Journal of Public Health Dentistry* **58**, 202–209.

Gilbert, G.H., Duncan, R.P., Heft, M.W., Dolan, T.A. and Vogel, W.B. (1997a): Oral disadvantage among dentate adults. *Community Dentistry and Oral Epidemiology* **25**, 301–313.

Gilbert, G.H., Duncan, R.P., Kulley, A.M., Coward, R.T. and Heft, M.W. (1997b): Evaluation of bias and logistics in a survey of adults at increased risk for oral health decrements. *Journal of Public Health Dentistry* **57**, 48–58.

Gilbert, G.H., Duncan, R.P. and Campbell, A.M. (1998a): Evaluation for an observation effect in a prospective cohort study of oral health outcomes. *Community Dentistry and Oral Epidemiology* **26,** 233–240.

Gilbert, G.H., Duncan, R.P., Heft, M.W., Dolan, T.A. and Vogel,

W.B. (1998b): Multi-dimensionality of oral health in dentate adults. *Medical Care* **36**, 988–1001.

Gilbert, G.H., Foerster, U. and Duncan, R.P. (1998c): Satisfaction with chewing ability in a diverse sample of dentate adults. *Journal of Oral Rehabilitation* **25**, 15–27.

Gilbert, G.H., Rose, J.S., Cantey, E.D., Earls, J.L., Eiford, E.I., Eldreth, M.A. and Shelton, B.J. (2002): On adding a dental practice component to an ongoing longitudinal population-based study of oral health. *Journal of Public Health Dentistry* **62**, 32–37.

Grembowski, D., Milgrom, P. and Fiset, L. (1991): Dental decision making and variation in dentist service rates. *Social Sciences in Medicine* **32**, 287–294.

Lazarski, M.P., Walker, W.A., Flores, C.M., Schindler, W.F. and Hargreaves, K.M. (2001): Epidemiological evaluation of the outcomes of nonsurgical root canal treatment in a large cohort of insured dental patients. *Journal of Endodontics* **27**, 791–796.

Rosenberg, R.J. and Goodis, H.E. (1992): Endodontic case selection: to treat or to refer. *Journal of the American Dental Association* **123**, 57–63.