Contribution of Dentist Anesthesiologists to Dental Anesthesiology Research

Steven Ganzberg, DMD, MS,* Robert G. Rashid, DDS, MAS,† and Edward Davidian, DDS‡

*Professor of Clinical Anesthesiology, College of Dentistry, College of Medicine, Dental/Maxillofacial Anesthesiology Residency Director, The Ohio State University, †Professor - Clinical, Restorative and Prosthetic Dentistry, College of Dentistry, The Ohio State University, Columbus, Ohio, and ‡Private Practice, Anesthesiology, Raleigh, North Carolina

In order to determine if dentist anesthesiologists (DAs) actively contribute to research in the field of anesthesiology, and thus contribute new knowledge to the field, an extensive literature search was accomplished. DAs make up only 1.5% of dentists who actively contribute to anesthesia research but account for 10% of publications. To determine if the impact of DA research was similar to the American Dental Association (ADA) recognized specialties, h-indices of noted researchers in other specialties were compared to the h-indices of noted DA researchers. The results show that the impact of top DA researchers in dental anesthesiology is similar to the impact of top dental specialty researchers, despite lack of academic departments in dental schools where a large percentage of dental research is completed. Dentist anesthesiologists actively contribute to the research in anesthesiology for dentistry and thus, actively contribute to new knowledge in the field.

Key Words: H-index; Dental research; Anesthesia, dental.

The delivery of anesthesia for dentistry has a long and, at times, controversial history. Even though for some there is still a debate over who is the true discoverer of general anesthesia, there is no doubt that dentists did make significant contributions to the early development of the art and science of anesthesia. Since the birth of anesthesia in the 1840s, it has remained an integral part of the practice of dentistry.¹ Over the next few decades, dentists remained active in the evolution of general anesthesia techniques and the development of new equipment to make general anesthesia delivery safer and more effective.

Although dentists and physicians both contributed to early developments in the field of anesthesiology, each profession progressed differently. Advances in medical anesthesiology evolved slowly until 1923 when a few physicians had the novel idea of creating a separate department of anesthesia in medical schools. This advance allowed all teaching, training, and research endeavors to be organized and supervised by one department head.²

This event marked the beginning of medical anesthesiology as a scientific discipline. Subsequently, the American Board of Anesthesiology was created in 1941.² This board, like all specialty boards, has as its mission to continue setting new educational and clinical standards that maintain and upgrade the specialty.

The practice of anesthesiology in dentistry took a different path, which was fraught with many difficulties. Arguably, the most infamous of these was the use of hypoxic mixtures of nitrous oxide.³ The use of nitrous oxide by dentists to provide general anesthesia was merely employed as a technique without a full understanding of its scientific basis. This approach to training did not allow for a complete appreciation for the intricacies of providing anesthesia and did not foster an environment that allowed this special area of the profession to grow. Even though there was some morbidity and mortality associated with its use, it was clearly established that nitrous oxide was very useful in pain and anxiety control in dentistry.

Anesthesia techniques developed specifically for dentistry blossomed in the middle of the 20th century. Drs Morgan Allison, Adrian Hubbell, and Leonard Monheim were among the first pioneers to become noted for advancing the training of dentists in the practice of general anesthesia for dentistry. Around

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Address correspondence to Dr Steven Ganzberg, OSU College of Dentistry, 305 West 12th Avenue, Columbus, OH 43210-1267; ganzberg.1@osu.edu.

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this same time, other dentists, including Drs Niels Jorgensen, Ed Driscoll, and Norman Trieger developed what was then a new technique, termed “conscious sedation.” Conscious sedation used subanesthetic doses of general anesthetic drugs, along with good local anesthesia, to provide a comfortable and safe form of anesthesia. These new anesthesia concepts and ideas led to the establishment of the American Dental Society of Anesthesiology (ADSA) in 1953. The incipient ADSA comprised a small group of dentists who were dedicated to the idea that treating a patient’s psychological and physiological needs associated with the delivery of dental care was just as important as treating their oral health needs. Among the chief goals of these pioneer dentist anesthesiologists was to further the educational needs of all dentists in advanced pain and anxiety control techniques and to obtain specialty status for anesthesiology within dentistry.

The American Dental Association (ADA) developed guidelines in the 1970s for training of dentists, other than oral surgeons, in specialized anesthesiology residencies (ADA Guidelines for Teaching the Comprehensive Control of Pain and Anxiety in Dentistry, Part II). Until 1993, 1 year of full-time hospital-based general anesthesia residency was considered sufficient to train the dentist in general anesthesia techniques. However, with the increasing complexity of anesthesia practice, as well as the increased need and demand for the treatment of very young children, the medically complex patients, and patients with intellectual or physical disabilities, a minimum of 2 years of training was required after July 1, 1993 to satisfy the revised ADA Guidelines. The Commission on Dental Accreditation (CODA) began formally accrediting 2-year dental anesthesiology residency programs in 2007 and is now considering implementing new standards that would mandate a minimum of 3 years for these programs since several programs are already more than 2 years in duration.

In order to recognize the de facto anesthesia specialists in dentistry, a new professional organization was formed in 1980, the American Society of Dentist Anesthesiologists (ASDA), which included only 2-year anesthesiology trained dentists. The vast majority of these dentist anesthesiologists provided only anesthesia services for patients of other dentists who completed the needed dental procedure, a model similar to the practice of hospital-based physician anesthesiologists, but in the dental office.

Throughout this period, advances and research in sedation and general anesthesia for dentistry came predominantly from a number of dental disciplines: dental anesthesiology, oral and maxillofacial surgery, endodontics, and pediatric dentistry. The contribution of dentist anesthesiologists was and continues to be important. In order to determine the contribution of dentist anesthesiologists

(DAs) to anesthesia research, we attempted to compare the role of DAs in anesthesia research in dentistry with formally recognized dental specialties.

OBJECTIVE

The purpose of this study is to determine if dentists who have completed a dedicated anesthesiology residency (DAs) actively contribute to the research needs of the profession and thus, actively contribute to new knowledge in the field. This paper will look at the amount of research that DAs produce in the field of anesthesia and assess the impact of that research relative to other specialists in dentistry. The h-index was chosen as a means of comparing the impact of research by DAs versus that of other dental specialists.

h-index

The h-index was suggested by Jorge E. Hirsch, PhD, a physicist at the University of California, San Diego, as a tool for determining the relative quality of a physicist and is also referred to as the Hirsch index or number.⁴ The h-index attempts to objectively measure individual scientific achievement by providing a bibliometric measure of productivity and the impact of scientific research. The index is based on the set of the scientist’s most cited papers and the number of citations that they have received in other publications. According to Hirsch, a scientist has an index of “h” if h of his N_p papers (total number of papers published) have at least h citations each, and the other ($N_p - h$) papers have at most h citations each. Thus, the h-index reflects both the number of publications and the number of associated citations per publication. This index tries to improve upon the other measures of scientific achievement that are commonly used to measure the quality and impact of a particular researcher, those being the total number of papers published (N_p), the total number of citations garnered (N_c), and the mean number of citations per paper $n_c = N_c/N_p$.

MATERIALS AND METHODS

To establish the amount of anesthesiology research accomplished by dentists, a search of all articles relating to anesthesia where dentistry was used as a key word in the article was searched using the MEDLINE (medical literature analysis and online retrieval system) database. MEDLINE is the US National Library of Medicine’s primary bibliographic database and consists of 18 million references to journal articles in life sciences with a focus on biomedicine. To ensure that all articles

Table 1. Listing of Medical Subject Headings

<i>Anesthesia and Analgesia</i>
Analgesia
Acupuncture analgesia
Analgesia, epidural
Analgesia, obstetrical
Analgesia, patient-controlled
Audioanalgesia
Interpleural analgesia
Neuroleptanalgesia
Transcutaneous electric nerve stimulation (TENS) +
Anesthesia
Anesthesia, conduction +
Anesthesia, dental +
Anesthesia, general +
Anesthesia, intratracheal
Anesthesia, intravenous
Anesthesia, obstetrical
Cryoanesthesia
Electroacupuncture
Hypnosis, anesthetic +
Anesthesia recovery period
Conscious sedation
Deep sedation
Electronarcosis
Hypotension, controlled
Neuromuscular blockade
Preanesthetic medication

* + indicates the existence of additional subheadings under the main subject heading.

relating to anesthesia and dentistry were captured, the search strategy used the broadest subject headings possible. The medical subject heading (MeSH) “anesthesia and analgesia” combined with “dentistry” (MeSH) was used. This search criterion includes all topics related to anesthesia (eg, local anesthesia, conscious sedation, deep sedation, general anesthesia, dental anesthesia, preanesthetic medications, and recovery period) and analgesia (eg, TENS, acupuncture, and oral analgesics). The dentistry topic includes every aspect of dentistry including all specialties and terms relating to those specialties. For a complete list, Table 1 shows all of the topics that the MeSH for “anesthesia and analgesia” encompasses. The MeSH search combined “anesthesia and analgesia” and “dentistry” limited to the English language from 1979 to the present. Two additional databases were searched, the SI Web of Knowledge, an online academic database provided by Thompson Reuters, and Ovid Cochrane reviews. Neither database gave any additional research that was not in the original MEDLINE search.

To determine the number of DAs in the United States, a list of all current members and past members of the ASDA was obtained. The ASDA requires a 2-year anesthesiology residency for dentists in its

active membership. Also, any other DAs that were known within the community that were not included on the list but met the criteria for membership in the ASDA were included. Additionally, dentists who had 1 year of dedicated general anesthesia training prior to 1993, when the ADA Teaching Guidelines for Pain and Anxiety Control in Dentistry, Part II were changed to 2 years, and were exclusively practicing anesthesiology were included.

The number of professionally active dentists, broken down by either the individual specialty or general practice, was obtained from the Survey Center of the ADA, which periodically conducts a census of all known dentists in the United States and its territories. The information is then published in the Distribution of Dentists database.

To determine the h-index for each author, the Web of Knowledge database was utilized (http://thomsonreuters.com/products_services/science/science_products/a-z/isi_web_of_knowledge/). Using the “author finder” to identify a list of publications by a specific author, a citation report was generated which lists the h-index for that author for the time interval indicated. To determine if dentists with a dedicated anesthesiology residency (DAs) actively contribute to the research needs of the profession, and thus actively contribute to new knowledge in the field, a comparison between DAs and formally-recognized specialist dentists was undertaken. To provide this comparison, a list of 3 researchers from each clinically oriented dental specialty (orthodontics and dentofacial orthopedics, pediatric dentistry, periodontics, endodontics, oral and maxillofacial surgery, and oral and maxillofacial radiology) was obtained by asking the department head of the respective specialty at The Ohio State University College of Dentistry which 3 researchers “have made the greatest contribution to your specialty through their research and the active contribution of new knowledge to the field, both in terms of quantity and quality of research.” The Ohio State University College of Dentistry does not have an Oral and Maxillofacial Radiology (OMFR) program, so the same question was asked of the chair of OMFR at University of North Carolina School of Dentistry. Prosthodontics was not included in the clinically-oriented specialties that were compared because it became clear that there were so many sub-specialty areas in prosthodontics (e.g., material science, temporomandibular disorders, adhesives, occlusion, fixed, removable, restorative), that it was impossible to pick only three researchers in this “one” field. The relative impact of the top researchers in the field of dental anesthesiology and those of six clinically-oriented recognized specialties in dentistry described above were then compared using the h-indices for the previous four decades as well as the cumulative period of 1979–2009, as ob-

Table 2. Number of Dentists in Each Specialty and Percentage of Total Dentists in the United States, 2006

Specialty*	Number in Specialty**	% of Total Dentists
Orthodontics	10,277	5.72
OMF surgery	6650	3.70
Pediatric dentistry	5263	2.93
Periodontics	5014	2.79
Endodontics	4658	2.59
Prosthodontics	2951	1.64
Dental public health	498	0.28
OMF pathology	236	0.13
OMF radiology	89	0.05
Anesthesiology	247	0.14

* OMF indicates oral and maxillofacial surgery.

** The ADA Survey gives only the percentage of the practitioners in each specialty relative to the total number of specialists. Due to rounding of percentages (e.g., 18.7% for OMFS may have been 18.74%), totals do not exactly equal 38,040.

tained using the Web of Knowledge database. Note that when referring hereafter to “other recognized specialties in dentistry,” we are referring to the clinically oriented specialties minus prosthodontics.

Comparisons were then made between DA researchers and researchers from each of six clinically-oriented specialties cumulatively and by decade. The nonparametric Wilcoxon rank sum test with a 2-sided Monte Carlo estimate for the exact *P* value was used to determine if any statistically significant difference was found between groups in h-index.

RESULTS

According to the most recently published ADA census data, in 2006 there were 179,594 professionally active dentists, which are those whose primary and/or secondary occupation is one of the following: (1) private practice, full or part-time; (2) dental school faculty/staff member; (3) armed forces; (4) federal service (e.g., Veterans Administration, Public Health Service); (5) state or local government employee; (6) hospital staff dentist; (7) graduate student/intern/resident; or (8) health/dental organization staff member. Of those professionally active dentists, 38,040 were practicing an ADA recognized specialty (Table 2).⁵ Due to incomplete data from the ADA survey and variations due to rounding, total number of specialists per ADA survey is 38,040 while the table totals are slightly less.

There are approximately 247 dentists with a dedicated anesthesiology residency in the United States based on estimates described above from the ASDA membership list of active and inactive members and others. Currently, there are 159 active US members of the ASDA with a 2-year anesthesiology residency. Additionally, almost 100

Figure 1. Number of “anesthesia and analgesia” articles by decade.

other dentists who are known within the field to be practicing anesthesia, many with 1 year of training prior to 1993 when the ADA Guidelines were changed to require 2 years of anesthesia training, and who do not meet membership criteria of the ASDA, were also included in the numbers for dentist anesthesiologists. This represents 0.14% of all dentists who are unofficially recognized as “anesthesia specialists” within dentistry. This then represents 0.65% of practicing dental specialists.

The search for articles relating to “anesthesia and analgesia” during the time 1979 to the present yielded 61,481 articles. When this was combined with the 213,733 articles relating to “dentistry” during the same time period, the result yielded 3709 articles that were included in both searches. This compilation of articles represents the complete list of articles in dentistry that relate to anesthesia and analgesia. There was no way to limit the search to research done exclusively by dentists, so this list may include physician research that used dental models, such as studies by physician anesthesiologists on young children undergoing dental treatment under general anesthesia. Conversely, it could also have excluded any work done by dentists in the field of anesthesia that did not specifically relate to dentistry such as work in the basic sciences of anesthesiology, sedation, and pain control, in which “dentistry” was not chosen as an associated subject heading.

Dentists with a dedicated anesthesiology residency have authored or coauthored 377 of the 3709 papers on anesthesiology as it relates to dentistry. This represents 10% of the research output in “anesthesia and analgesia” as it relates to “dentistry.”

Output of articles involving “anesthesiology” and “anesthesiology and dentistry” were also evaluated by decade starting from 1950–1959, 1960–1969, and so forth (Figures 1 and 2). Output of articles from “anesthesiology and dentistry” in which DAs were contributors was also stratified by decade (Figure 3 and Table 3).

Figure 2. Number of “anesthesia and analgesia” and “dentistry” articles by decade.

There has been a steady increase in output of anesthesia-related articles by dentist anesthesiologists that has mirrored rather closely the output for anesthesiology in general (Figure 1). A small dip in output in the 1990s mirrors the time when the Anesthesia Steering Committee of the Accreditation Council on Graduate Medical Education (ACGME) no longer allowed dentists who were not part of a dental residency program to be trained in medical anesthesiology programs. This caused a decline in the numbers of DAs trained during this period until more dental anesthesia residencies, and eventually more Commission on Dental Accreditation accredited dental anesthesia, were developed.

Figure 3. Number of articles published by dentist anesthesiologist by decade.

The h-indices by decade for the previous 4 decades for the 3 top researchers in each field obtained using the Web of Knowledge database are listed in Table 3. The cumulative h-index for each author is also provided for comparison. The h-indices of the top 3 dentist anesthesiologist researchers are listed in Table 4.

Comparisons between groups were then evaluated and listed in Tables 5 through 9 with the *P* values listed for the cumulative period of 1970–2009 and then for each decade of the 1970s, 1980s, 1990s, and

Table 3. H-indices for Top 3 Researches in Each Specialty

	1970–1979	1980–1989	1990–1999	2000–2009	Cumulative
<i>Orthodontics</i>					
Bill Profit	10	16	12	10	25
Jim McNamara	9	19	17	15	31
Tim Wheeler	0	2	10	4	11
<i>OMFS</i>					
Ray White	6	4	5	11	16
Edward Ellis	0	18	25	13	31
Tom Dodson	0	5	13	12	17
<i>Periodontics</i>					
Bob Genco	11	36	38	16	58
Roy Page	14	23	21	12	35
Jan Linde	33	43	36	24	69
<i>Endodontics</i>					
Al Reader	0	10	12	11	18
Ken Hargreaves	0	3	12	22	16
J Craig Baumgartner	0	7	16	15	22
<i>Pediatric dentistry</i>					
Kevin Donley	0	2	15	5	17
Anna Fukes	4	7	6	4	10
Steven Wei	13	8	21	10	27
<i>Radiology</i>					
Donald Tyndall	0	4	15	8	16
Stuart White	9	11	10	6	19
Paul van der Stelt	0	0	10	11	13

* OMFS indicates oral and maxillofacial surgery.

Table 4. h-indices for Top 3 Researches in Dental Anesthesiology

Anesthesiology	1970–1979	1980–1989	1990–1999	2000–2009	Cumulative
Weaver J	1	5	7	9	13
Moore P	2	7	6	11	13
Yagiela J	2	4	2	4	7

Table 5. h-index Comparisons, Cumulative 1970–2009; *P* Values

	Anes	Endo	OMFS	Ortho	Pediatric	Perio	Radio
Anes							
Endo	.0997						
OMFS	.1009	.9011					
Ortho	.3019	.5994	1.0000				
Pediatric	.3001	.9001	.6987	.6990			
Perio	.1025	.1000	.1022	.0990	.0993		
Radio	.2986	.4980	.4989	.4008	.7991	.1010	

Table 6. h-index Comparisons 2000–2009; *P* Values

	Anes	Endo	OMFS	Ortho	Pediatric	Perio	Radio
Anes							
Endo	.2007						
OMFS	.1983	.4013					
Ortho	.8012	.2992	.7018				
Pediatric	.8006	.1004	.1003	.6986			
Perio	.1008	.7016	.3006	.2006	.1006		
Radio	1.0000	.2017	.1984	.9022	.5011	.0997	

Table 7. h-index Comparisons 1990–1999; *P* Values

	Anes	Endo	OMFS	Ortho	Pediatric	Perio	Radio
Anes							
Endo	.1016						
OMFS	.3024	.8016					
Ortho	.0992	1.0000	.8021				
Pediatric	.2979	1.0000	1.0000	1.0000			
Perio	.1003	.0999	.2033	.0997	.2000		
Radio	.0993	.4981	.8004	.7019	.6977	.0989	

Table 8. h-index Comparisons 1980–1989; *P* Values

	Anes	Endo	OMFS	Ortho	Pediatric	Perio	Radio
Anes							
Endo	.7011						
OMFS	.9003	.7992					
Ortho	.4000	.4006	.8988				
Pediatric	1.0000	.8001	.8009	.4000			
Perio	.1001	.1001	.1000	.0993	.0994		
Radio	1.0000	.7985	.5985	.3010	1.0000	.0997	

Table 9. h-index Comparisons 1970–1979; *P* Values

	<i>Anes</i>	<i>Endo</i>	<i>OMFS</i>	<i>Ortho</i>	<i>Pediatric</i>	<i>Perio</i>	<i>Radio</i>
Anes							
Endo	.1013						
OMFS	1.0000	1.0000					
Ortho	.3996	.4003	.4014				
Pediatric	.5027	.3999	.6997	1.0000			
Perio	.1005	.1005	.0997	.1018	.1993		
Radio	1.0000	1.0000	1.0000	.6994	.6989	.0993	

2000s. There were no significant differences in h-indices between DA researchers and researchers of six clinically-oriented specialties for any decade since the 1970s or for the cumulative period of 1970–2009.

DISCUSSION

The purpose of this study is to determine if dentists with a dedicated anesthesiology residency (DAs) actively contribute to the research needs of the dental profession and thus actively contribute to new knowledge in the field. What constitutes an “active contribution to the research needs of the profession” is difficult to define. One seminal paper provided by a dentist anesthesiologist on, for instance, a novel local anesthetic reversal agent, would indicate a significant contribution to the research needs of, and new knowledge for, the dental profession. In fact, this has occurred.⁶ This alone would meet the above criteria, especially considering its potential direct application to all dental practitioners who administer local anesthetics.

In a larger sense, however, it was felt that to truly compare the research output of dentist anesthesiologists, they should be compared to other specialists in the profession in terms of quantity and quality of research, hence the use of the h-index. It is clear that specialization leads to formal departments within dental schools and thus, the nurturing of a research enterprise to support and advance that specialty. Therefore, to compare dental anesthesiology, which is not a recognized ADA specialty and in which there are only 2 dental schools with true anesthesiology departments, with the recognized dental specialties is an inherently unfair comparison favoring the specialties. Lack of ADA specialty recognition and thus lack of formal departments within dental schools is a major impediment to active research endeavors. If it turned out that DA research was similar to that of the ADA specialties in impact, then it could be inferred that DA actively contribute to research and acquisition of new knowledge in their field, similar to other specialists in their respective fields.

It became clear that it would be impossible to determine via standard research methodology whether the output of research by DAs, and thus the active contribution to new knowledge in the field, was “similar” to that of other specialties over the past 4 decades. What could be determined was that the impact of DA research was “not different” or “noninferior” to that of the official specialties at the various time intervals studied. One can certainly look at this as a semantic difference, and in a sense, it is one, but research methodology does not allow us to say that one sample is similar to another. The *P* value from each comparison indicates the likelihood we are wrong if we state that the 2 groups are different, a type I error. The error we would make when we state that the 2 groups are the same when they are in fact different is a type II error and is not measured by the Wilcoxon test *P* value. Therefore, as we discuss the results, the term “not different” will be used, rather than the more colloquial “similar” in order to be rigorous in our terminology.

In terms of quantity, DAs make up approximately 0.14% of practicing dentists, while comparisons were made with other specialties where the proportion of specialists was much, much higher (eg, 3.70% for oral surgeons and 2.93% for pediatric dentists). Presumably, this increased number of practitioners in the specialties should have led to an increased research output. The other specialties most involved in anesthesiology for dentistry and its research endeavor (oral and maxillofacial surgery, endodontics and pediatric dentistry) make up 9.2% of all dentists. This is more than 65 times more dentists than in the DA group. It might be presumed, then, that these other specialties should contribute 65 times the research output.

In fact, DAs have authored or coauthored 377 of the 3709 papers on anesthesiology as it relates to dentistry. This is almost 10%, which for such a small group, 65 times less in number than the other specialties represented, constitutes a major contribution to the literature in the field, based only on raw number of papers published. Put another way, the percentage of DAs involved in anesthesia research in the specialties noted above is 1.5%, yet they account for 10% of the research output.

In regard to h-indices, a measure of impact of research, it is impossible to compare all research from all authors in a given field with all authors in another field. What we attempted to determine, therefore, was whether the top 3 authors in each field displayed a significantly different research impact from that of the top 3 researchers in the field of dental anesthesiology. It was felt that these authors were also the ones who contributed the greatest amount of new knowledge to the field, based on expert judgment from the recommendations of academic specialists primarily from The Ohio State University. Tables 5 through 9 demonstrate that at no time interval, whether a particular decade or cumulatively from 1970–2009, or between any of the six clinically-oriented specialties, did the impact of dentist anesthesiologist research, as based on the h-index, differ statistically (or significantly) from that of the six recognized clinically-oriented specialties studied. This is particularly noteworthy because for the most part DAs have not had the benefit of recognized academic departments within dental schools. What this indicates is that, despite the impediments to the field based on lack of ADA specialty recognition, dentist anesthesiologists contribute to the research endeavors of the profession, and thus the acquisition of new knowledge for the profession, at a level that is not different from that of the other six currently recognized clinically-oriented dental specialties examined.

CONCLUSIONS

Dentist anesthesiologists actively contribute to the research needs of the dental profession and thus actively contribute to new knowledge in the field at a level that is not significantly different from that of the six recognized clinically-oriented dental specialties examined for each decade from 1970–2009 and cumulatively over this same period.

REFERENCES

1. Dionne RA, Kaneko Y. Overcoming pain and anxiety in dentistry. In Dionne RA, Phero JC, Becker DE, eds. *Management of Pain & Anxiety in the Dental Office*. Philadelphia: Saunders; 2002.
2. Larson MD. History of anesthetic practice. In: Miller RD, ed. *Anesthesia*. 7th ed. New York: Elsevier; 2009.
3. Malamed SF. *Sedation: A Guide to Patient Management*. 5th ed. St. Louis: Mosby; 2010.
4. Hirsch JE. An index to quantify an individual's scientific research output. *Proc Natl Acad Sci U S A*. 2005;102:16569–16572.
5. Distribution of Dentists in the United States by Region and State, 2006. ADA Publishing 2008. Available at: <http://www.ada.org/goto/surveyresearch>. Accessed August 24, 2010.
6. Hersh EV, Moore PA, Papas AS, et al. Reversal of soft tissue local anesthesia with phentolamine mesylate in adolescents and adults. *J Am Dent Assoc*. 2008;139:1080–1093.