COUNCIL ON DENTAL EDUCATION AND LICENSURE
2011 PERIODIC REVIEW
OF DENTAL SPECIALTY EDUCATION AND PRACTICE

ENDODONTICS

AMERICAN DENTAL ASSOCIATION
Chicago, Illinois

ADA American Dental Association®
America's leading advocate for oral health

NAME OF RECOGNIZED DENTAL SPECIALTY:

ENDODONTICS

NAME OF SPONSORING DENTAL SPECIALTY ORGANIZATION:

American Association of Endodontists

NAME OF RECOGNIZED CERTIFYING BOARD:

American Board of Endodontics

Information submitted by:
American Association of Endodontists
211 E. Chicago Ave., Suite 1100
Chicago, IL 60611

Name: **Clara M. Spatafore**

Title: **President**

Address: **Ste 304**
2593 Wexford Bayne Rd
Sewickley, PA 15143-8608

Email address: **cmswvu@msn.com**

Phone number: **724/940-3963**

Fax: **724/940-3965**

Clara M. Spatafore **April 30, 2010**

(Signature – Organization's President) Date of Submission

Purpose of the Review

In 1992, the ADA House of Delegates adopted Resolution 144H-1992 which directed the periodic (every 10 years) review of dental specialty education and practice beginning in 2001. In 2001, the Council on Dental Education and Licensure forwarded its recommendations from this review to the House of Delegates for its consideration. The 2001 House accepted the report and adopted the following resolutions:

> **20H-2001**
> **Resolved,** that the appropriate Association agency continue to conduct a periodic review of dental specialty education and practice at ten-year intervals, and be it further
> **Resolved**, that the next periodic review of dental specialty education and practice be presented to the 2011 ADA House of Delegates.
>
> **21H-2001**
> **Resolved**, that the sponsoring dental specialty organizations and ADA recognized dental specialty certifying boards be urged to continue to monitor the number of specialists who are board certified and identify ways to increase the percentage of specialists who see and achieve board certification in light of dental specialty faculty shortages and the Commission on Dental Accreditation's standard requiring that program directors of advanced dental specialty education programs be board certified.

In carrying out the House directive for such periodic reviews, the Council hopes to gather strategic information that will be of value to the Association, the specialty organizations, the profession and the pubic. The review should clearly focus on changes occurring within the specialty education and practice environments, e.g., disease trends, technology, scope of practice, program enrollments, and demographics. It should address the current environment as well as potential trends for the future and how these will impact the public and the profession. The Council believes that the input and self-assessment of each of the specialty organizations is essential in providing an accurate report to the House of Delegates.

Instructions to the Specialty Organizations: Each specialty organization is being provided with all information and data available from ADA agencies relevant to the review. A copy of the organization's 2001 submission is also provided for reference. Where existing data is available, specialty organizations are asked to analyze the data and comment on trends that have and/or may impact the specialty and the profession. The Council seeks succinct but thoughtful responses to study items to provide a broad assessment of key issues. Each item includes a suggested length for a response. However, the length and nature of responses may vary according to the unique characteristics of the specialty.

The current environment as well as potential trends for the future and how these may impact the public, the profession and practice should be addressed.

A. General Information

1. Provide a copy of the sponsoring organization's strategic plan. Provide a brief summary highlighting specific areas of the strategic plan that the specialty wishes to call to the Council's attention as it relates to this review. Briefly comment on efforts the specialty has undertaken to promote quality in the discipline over the past 10 years (e.g., continuing competence, parameters of care, continuing education). (*suggested response - up to one page)*

Since the 2001 Study of Specialty Education and Practice, the AAE has moved from a strategic planning process that brought together a committee every few years to a real-time, ongoing knowledge-based governance system. The AAE's strategic plan is a document that with mega-issues and objectives added, reviewed, and updated is continually modified by the Board of Directors, which functions as the Strategic Planning Committee. The AAE conducted member needs surveys in 2002 and 2009, and used the results in the strategic planning process. Issues addressed in the AAE strategic plan include: enhancement of international activities; education for predoctoral students, endodontic residents, general dentists, and various specialty groups; changes in member demographics; access to care; the impact of implant dentistry on endodontics; recruitment and retention of endodontic educators; and regenerative endodontics.

The AAE promotes better patient care through education of dental students, residents, general dentists, and other specialists about endodontics, publication of the AAE's *Case Difficulty Assessment Form*, co-development of educational products for general dentists, encouragement of members to teach in dental schools, and publication of the *Colleagues for Excellence* newsletter, which highlights current endodontic information for general dentists. A treatment planning tool for use by dental students and general practitioners is in development.

Part the efforts of the AAE to be a worldwide endodontic resource, includes international membership which provides for participation in continuing education and research. Explorations into developing standardized training programs and international board certification are also under way.

The AAE's *Guide to Clinical Endodontics* (2004) reflects current practice considerations in endodontics that enhance quality of care and assists endodontists and dentists in professional development. The 2003 *Glossary of Endodontics* continues to serve as an important reference on the terminology related to the specialty. In 2008 a consensus conference on endodontic diagnostic terminology was held with world-wide participation.

The AAE has launched a distance learning platform that gives endodontists and other dentists access to reliable endodontic education. This resource provides recordings of presentations given at AAE meetings, as well as other material, with CE credits.

Since 2001, the AAE's Foundation has funded $2.6 million in research grants. In addition, the Foundation has granted $1.2 million in endodontic educator fellowships to improve recruitment and retention of endodontic educators. This program has produced 11 new endodontic educators to date. The Foundation funds an annual national workshop for educators to discuss common issues.

Regenerative endodontics and its role in treating endodontic problems is an exciting new area in which the AAE has supports research, lectures and hands-on workshops, articles in the *Journal of Endodontics*, and a database for members. Cooperation with the scientific community resulted in a symposium on pulp biology and regeneration at the 2009 IADR meeting.

2. Complete the table below and provide overview comments on past and future membership trends forecast for the next 10 years. Comment on how changes in membership will impact public and the profession. (*suggested response – up to two pages including the table*)

MEMBERSHIP CATEGORIES
(Endodontics)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Active	3596	3694	3792	3871	3898	3915	4004	4038	4150	4165
Associate	770	795	798	841	858	887	904	924	899	807
Auxiliary	79	240	516	566	485	437	639	545	447	497
Educator	n/a	n/a	n/a	n/a	123	140	144	164	164	168
Honorary	8	8	8	8	9	9	9	9	9	9
International	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	37	117
Life	370	437	464	516	567	635	636	678	713	790
Predoctoral Student	n/a	n/a	61	92	115	128	112	131	117	123
Retired	102	80	76	70	57	49	52	51	59	61
Student	412	464	489	504	474	465	447	468	468	482
TOTAL	**5337**	**5718**	**6204**	**6468**	**6586**	**6665**	**6947**	**7008**	**7063**	**7219**

The aging of the large "Baby Boomer" population has contributed to growth in the number of educated patients who are both willing and able to afford endodontic treatments to save their natural dentition. The nation's dental schools have responded to this increased demand for endodontic services by increasing the number of graduating endodontists from 2002 to 2008 by six percent. This increase has translated into an increased Active membership in the AAE each year. In fact, membership in the AAE across all membership categories has increased by one to eight percent each year over the last 10-year period, and by an average of two percent in the last five years.

From 2000-2009, the AAE created three new membership categories to meet the needs of dental professionals with an interest in the specialty. The Predoctoral Student membership category was added in 2002 for predoctoral students with a special interest in endodontics. In 2004, the Educator membership category was added for specialists who are full-time faculty in a predoctoral department or advanced specialty education program in endodontics.

The introduction of the International membership category in 2008 addressed the growing interest in collaboration among endodontists worldwide, and allowed the AAE to continue to meet the needs of specialists outside the U.S. who look to the Association as the premier source of up-to-date information on scientific, clinical and technical endodontic issues. This has caused the

Associate membership numbers to drop slightly, as many qualifying members transitioned to the International category to take advantage of those member benefits.

The number of Auxiliary members increased significantly in the last decade since its inception in 1999. Though the number of dental staff entering this category fluctuates from year to year, numerous efforts have been made to offer high-quality continuing education programs to this group of members at AAE Annual Sessions, and otherwise enhance the value of their membership.

A steady growth at a rate of one to two percent annually is anticipated for the next 10 years as the membership continues to expand internationally and new endodontic graduates continue to join the workforce. The Association is also studying the anticipated trend of more members reaching retirement age and transitioning into the Life and Retired membership categories in the next decade.

The increase in number of practicing endodontists has, and will continue to have, a positive impact on the public and dental profession. Surveys conducted by the AAE from 2003-2009 show that 80 percent of people who have had a root canal treatment by an endodontist are very likely to say they would again use a specialist in a similar situation, and most use positive words to describe their experience. General dentists also hold endodontists in high regard, with 94 percent having positive or very positive perceptions of their specialist colleagues, and nine out of 10 general dentists reporting that endodontists are partners in delivering patient care.

A 2009 member needs survey indicates that 83 percent of endodontists provide charitable care to underserved populations, with the average specialist typically performing 10 or more such procedures per year. Endodontists regularly organize and participate in charitable events organized by local endodontic societies, dental schools and other national programs to improve access to quality endodontic care.

If available, please provide information on the gender and ethnicity of members.

MEMBERSHIP / Gender and Ethnicity
(Endodontics)

YEAR	Male	Female	Unknown
2006	4830	1025	2
2007	4991	1119	4
2008	5197	1192	7
2009	5404	1335	6

The AAE began regular collection of gender data via membership applications in 2006. This, together with demographic analysis of member needs survey data from 2002 and 2009 indicates that the gender composition of the AAE membership is rapidly changing to reflect a much higher female population. Female membership grew at a rate of 7 to 12 percent over the last five years, and male respondents to the 2009 member needs survey comprised only 79 percent of members under age 35, compared to 100 percent of members age 65 and older. Data regarding members' ethnicity has not been routinely collected by the AAE.

3. Review the following summary of certification and examination data from the CDEL's Annual Reports of the ADA-Recognized Dental Specialty Certifying Boards, 2000-2008. In collaboration with the recognized certifying board, provide overview comments on significant trends for the future. (*suggested response - up to one page including the table*)

The number of certified endodontists continues to steadily increase. The American Board of Endodontics has focused on further improving that trend by facilitating the certification process while maintaining the integrity and increasing the acuity of the exams. Recent changes implemented by the ABE to achieve the goal of increased board certification include elimination of the 4-year identity requirement, allowing residents/graduate students to sit for the written examination in the last year of their educational program, provision of a second track that enables seasoned clinicians to initiate the certification process by submitting their case portfolios before taking the written component, extension of eligibility to permit the re-establishment of eligibility to two times for qualified candidates, and utilization of multi-site testing centers for electronic administration of the written examination. All of these modifications are expected to increase both the number of candidates going through the certification process and the number of Active Diplomates. It should be noted that the slight decrease in the number of acceptable applications is due to a change in the submission date for the Final Application. Candidates who began the certification process in 2006 or later do not submit their Final Application until they have completed both Parts I and II. Candidates who began the process before 2006 submitted the Final Application after completing Part I and obtaining the then required 4-year identity with endodontics. The CDEL data do not distinguish between preliminary and final applications. This is significant since the preliminary applications have increased 150% since 2002. The ultimate fate of those applications cannot be assessed until their eligibility expires 9 years later. The adjustment in the data should be apparent in 2011. The dramatic increase in preliminary applications as well as those for prospective candidates holds promise for an eventual significant gain in the numbers of Diplomates.

Further efforts designed to facilitate the process and make it more accessible to interested endodontists are being explored. They include online submission of case portfolios as well as distance technology to conduct the oral examination.

CERTIFICATION AND EXAMINATION DATA

NAME OF SPECIALTY ENDODONTICS	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number Certified By Examination Through 2000-2009	1102	1121	1152	1194	1220	1243	1282	1304	1339	1378
Number of Active Diplomates 2000-2009	725	744	707	739	762	776	792	788	815	840
Number of Acceptable Applications Received 2000-09	119	105	94	100	175	165	303	267	278	248

4. In collaboration with the recognized certifying board, provide overview comments on the board eligibility requirements from the CDEL's Annual Reports of the ADA-Recognized Dental Specialty Certifying Boards, 2000-2008. Please note or any changes and the impact on the specialty. If an eligibility pathway for internationally trained specialists is available, explain the process. (*suggested response – up to two pages)*

After successful completion of a 2 or 3 year advanced education program in endodontics in an institution accredited by the Commission on Dental Accreditation of the ADA, an endodontist may submit an application to the American Board of Endodontics for certification. After the application and credentials are approved the candidate is considered Board Eligible. In 2006 a new category of Prospective Board Candidate was added and is defined as a student enrolled in the final year of an advanced education program in endodontics and whose application and payment of the Written Examination fee have been accepted and approved.

Two tracks are available to candidates seeking Board Certification in endodontics. Track I is the traditional sequence wherein the candidate completes the written, the case portfolio and the oral examinations in that order. A Prospective Board Candidate may begin the process by submitting an application to the Board in the final residency year. After the candidate has completed the residency and has passed the written examination, a Preliminary Application must be submitted by December 31 of that year. The candidate then has 6 years to complete and submit a case portfolio. Once that is accepted by the Board, the candidate has 1 year to submit the Final Application. After approval of the Final Application the oral examination must be completed within 2 years.

Track II was specifically designed for the seasoned practitioner who wants to enter the certification process. After the preliminary application has been made and the candidate has chosen track II, the candidate has 3 years to submit the case portfolio following acceptance of which the candidate will proceed to the written examination. That must be successfully completed within 6 years, after which the candidate has one year to submit the final application. Once approved, the candidate has 2 years to successfully complete the oral examination to become a Diplomate of the American Board of Endodontics. Presently there is no alternate pathway for board certification for internationally trained specialists.

The result of allowing residents in their final year to take the written examination has resulted in increased numbers of candidates initiating the certification process. This, combined with the elimination of the 4-year experience requirement, allows a candidate to complete the process in a shorter period of time. It is anticipated that these changes will result in an increase in the number of Diplomates.

The ABE is dedicated to maintaining the integrity and acuity of the examination process at every point. The written and oral examinations are constantly updated to reflect the current standard of practice based on best evidence supported by the literature. Test construction is conducted with the help of psychometricians. Measurement Research Associates, Inc. has been contracted to aid in test construction and in interpretation of candidate performance in each part of the examination process. The written examination is a criterion-referenced examination that is constructed by the Board and based on a comprehensive test matrix. Evaluation of the case

history portfolio and the oral examinations is based on an extension of the Rasch model. This model employs algorithms that account for question difficulty and/or examiner grading severity to insure fairness for all candidates in the case portfolio and oral examinations while still insuring testing accuracy. This model seeks to ascertain the abilities of the candidate to a high level of certainty. The mission of the ABE is to assure the public and our colleagues that Diplomates of the Board have demonstrated that they possess the defined skill set and knowledge base to practice as an endodontic specialist.

The American Board of Endodontics supports life-long learning and has implemented a requirement for recertification of Diplomates. Those candidates who applied for Board Certification on or after January 1, 1997 are required to recertify every 10 years by providing documentation of at least 25 CE credits as defined in the Policy and Procedures manual. Diplomates may undertake the recertification process as early as 3 years prior to the expiration date of their certificate. In addition to having demonstrated a level of accomplishment, becoming a Diplomate of the American Board of Endodontics signifies a commitment to the art and science of *current* clinical practice. Presently there are 220 Diplomates who are required to recertify and 7 have successfully completed the process.

BOARD ELIGIBILITY REQUIREMENTS
Endodontics

PROFESSIONAL	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
ADA or NDA Membership	No	No	No	No	No	No	No	No	No	No
Specialty Society Membership	No	No	No	No	No	No	No	No	No	No
Education										
Years of Advanced Education in Addition to DDS or DMD Degree	2	2	2	2	2	2	2-3	2-3	2-3	2-3
Experience										
Total Years of Specialty Experience Including Advanced Education	4	4	4	4	4	4	4	4	4	2-3
Other										
Citizenship	Any	Any	Any	Any	Any	Any	Any	Any	Any	Any
State Licensure	No	No	No	No	No	No	No	No	No	No
Alternate Pathway to Certification (New Question beginning 2008)									No	No

5. List areas of major research changes and major technology advances over the last 10 years. Provide an overview comment on how these changes and advances have affected the practice of the specialty. (*suggested response – up to three pages*)

Research is an important part of the mission of endodontics to promote maintenance of the natural dentition. The American Association of Endodontists has taken on the role of being a global resource in endodontic knowledge and education for the profession and the public. This is accomplished through research in the biology of teeth and supporting structure in health and disease; in the diagnosis and treatment of endodontic disease; and in measurements of treatment outcomes. The past decade has been one of continued growth in endodontic research projects resulting in an increase in publications in the specialty's peer-reviewed journal, the *Journal of Endodontics* and other scientific journals. The annual session sponsored by the Association features numerous oral and poster presentations on research conducted by dental students, graduate students, faculty members, and endodontists in private practice.
It is important in this context to point out that a major factor contributing to the growing research production in endodontics has been the solid growth the Association's Foundation, which fund doubled in value during the past decade. Sixty percent of active Association members have made pledges of $2000 or more. Research funding grants over the time period have totaled more than $2,700,000. Represented below are scientific and technological innovations that have advanced the specialty during the last 10 years.

Major Research Changes

1. *Dental materials.* Probably no endodontic material has generated as much interest world-wide as mineral trioxide aggregate (MTA), developed in the 1900s. Its uses were recognized from the beginning - root end fillings, perforation repairs, apical plugs for open apices, and vital pulp protection - but the properties and characteristics have only recently been more clearly understood. Recognized now as a bioinductive material, its role in stimulating hard tissue development (bone, cementum, dentin) has been elucidated with more clarity. Its application in vital pulp therapy is gaining momentum, to the extent that previous concepts regarding the pulp's ability to recover from bacterial exposure (e.g. carious and accidental exposures) is being re-evaluated. With the protection provided against bacterial penetration - probably from deposition of a hydroxylapatite layer in the interface between the material and dentin – pulp tissue appears to have a better potential for recovery than previously considered. In addition to MTA, other advances in root canal filling materials have been made, particularly with respect to the use of dentin bonding agents in combination with the filling core.
2. *Pain management.* An important area of concern has been, and continues to be, the management of pain during endodontic procedures, and providing relief of pain associated with pulpitis and periapical disease. Significant data has emerged with respect to the value of supplemental intraosseous anesthesia, use of articaine for infiltration along with nerve blocks, and development of strategies for improvements in local anesthetic administration. We are on the threshold of seeing the development of liposomal-encapsulated anesthetic agents to better control the length of anesthesia time, and development of terminal receptor-potential vanilloid agonists and antagonists for controlling pain of inflammatory origin. Along the same line of pain management, increased knowledge about mediators of pulpal and periapical pathosis will improve

such efforts. The understanding that has been generated regarding pulpal inflammation and peripheral and central sensitization of pulpal nociceptors has led to modification of analgesic regimens. The role of tooth infraction and referred pain and chronic orofacial pain has resulted in better diagnostic outcomes.

3. *Endodontic microbiology.* The growing understanding of the diversity of endodontic microflora has been aided by extensive research in molecular biology. This has resulted in more effective biomechanical debridement protocols with expectations of improved clinical outcomes. Further, such research has also increased the knowledge base of bacterial-host interaction, with emphasis on microbial identification, susceptibility and treatment modalities, and increased knowledge of immune reactions of apical periodontitis. A specific problem in endodontics is that teeth with infected pulps and associated apical lesions have a lesser treatment success than teeth treated before extensive infection has occurred. It has now become clear that the nature of organism populating infected root canal spaces is more diverse than expected and that re-infection of previously treated teeth involve yet additional varieties of microorganisms. For instance, spirochetes such as the genus *Treponema* are now recognized as important members of the endodontic pathogens previously considered rare. From this increased knowledge, more effective ways of reducing the presence of endodontic pathogens have been introduced, e.g. intracanal antibiotics and antiseptics, ultrasonic intracanal dissemination of antimicrobials to disrupt microbial biofilms, and the use of laser-activated generation of potent oxygen radicals for microbial elimination. The full breadth of endodontic microbiota, and its dissemination, spreading and support of infection through virulence determinants and proteomic profiles will further improve endodontic therapy outcome.
4. *Clinical research.* Widely recognized for its importance, clinical research incorporating randomized clinical trials and systematic reviews of clinical outcomes (e.g. single v. multiple-visit therapy, antibiotic effectiveness in odontogenic pain management) has grown markedly during the past 10 years. Other concerns have been addressed such as modulating systemic risk factors (e.g. smoking) affecting periapical healing, and possible interactions between dental condition and systemic health. Additional systemic factors that are currently under study are diabetes, HIV/AIDS, and bisphosphonate therapy and their impact on healing of endodontic disease. The life-time maintenance of a healthy, natural dentition in strongly supported through this important line of research. Finally, an important area of investigation has been to compare outcomes of single dental implants to that of teeth with endodontic treatment, and to look at long term outcome of endodontics. The results of such studies have confirmed that endodontic therapy is a predictable treatment with a high rate of success.
5. *Regenerative endodontics and revascularization*. The fact that uninfected necrotic pulps (coagulation necrosis) can regain vascularity through apical ingrowth of blood vessels has been recognized and relied upon for some time in the treatment of traumatized teeth. Early in the 2000s, reports appeared that teeth with infected pulps had potential for continued growth and development following removal of necrotic pulp tissue, elimination of bacteria from the root canal, formation of a blood clot in the canal, and prevention of re-infection by placement of a leak-proof coronal restoration. MTA soon became recognized as a preferred material for such coronal seal. Combined with the discovery and characterization of dental pulp stem cells, apical papilla stem cells, and human exfoliated teeth stem cells, an exciting new approach to managing immature teeth with necrotic pulps was visualized. Numerous case reports and some preliminary basic

research reports support the notion that indeed teeth previously condemned to treatment options that would leave these not fully-developed teeth weak and prone to fracture could in fact be given the opportunity to develop into teeth with normal root structure. The research on pulpal regeneration has opened the possibility for reprogramming stem cells into pluripotent stem cells that can be guided to form any type of cell, similar to embryonic stem cells. Of particular value in this line of research is the potential for better treatment of trauma induced dental defects in children.

6. *Dental trauma.* Management of teeth with traumatic injuries is a multidisciplinary effort.. The discipline of endodontics will frequently be involved since tooth pulps are regularly involved in such teeth. A major clinical change resulting from research has been the efforts to preserve pulp vitality whenever possible (or regenerate pulp tissue as described above). Other situations that have greatly benefitted from research has been the management of avulsed teeth (e.g. transport media for preserving periodontal ligament tissue attached to the avulsed tooth), treatment of pulp necrosis in immature teeth, and the management of root fractures and intrusive luxations. It has been reported that about 30% of the population experiences dental trauma at least once in a lifetime; improved treatment through research has provided many patients with availability of treatment to maintain their natural dentition.
7. *Endodontic diagnosis.* Spurred on by the observation that new vital pulp treatment procedures appeared to question long held notions about pulpal status and survivability potential following carious and traumatic exposure, the Association's leadership sponsored the first consensus conference on endodontic terminology in 2008. It was attended by invited experts and resulted in some agreements, but mostly the recognition that research is needed to develop biologically based diagnostic procedures leading to metric-based clinical diagnostic categories

Major Technology Advances

The discipline of endodontics has always been dependent on the availability of special instruments, materials and clinical procedures. The past decade has seen continued research and developments and the exploration of new treatment avenues. In the area of instruments, improvements have been made in nickel-titanium (NiTi) rotary instruments, development of special instruments for removal and retrieval of broken instruments and posts from root canals, and new ultrasonic instruments for surgical endodontics. Canal irrigation has been aided by development of various modalities and disinfecting solutions. Two additional advances in technology have been the improvement in the operatory microscope and the application of cone-beam volumetric tomography for more accurate diagnosis. The former has greatly increased the ability to see clinical aspects of teeth, and the latter has opened up the imaging of dental condition (e.g. root resorption) in a remarkable manner.

Summary

The changes and advances described above have powerfully impacted endodontics in several areas: More predictable endodontic clinical procedures; better outcomes for endodontic surgical and reparative procedures; better management of pain both during clinical treatment and associated with pulpitis and periapical disease; improved understanding and treatment of traumatic dental injuries; enhanced treatment options related to better understanding of pulp revascularization and endodontic regeneration; and improved diagnostic and treatment modalities, all of which allows the specialty to provide ways of saving natural dentitions.

Trends in Education

6. Review the summary data collected from the ADA Survey Center's *Survey of Advanced Dental Education Annual Reports* over the past ten years regarding the number of programs and program enrollments. Provide overview comments on past or future trends regarding this information. (*suggested response - one page*)

Endodontics	Number of Programs	Total Enrollment
2000-01	48	406
2001-02	50	415
2002-03	51	406
2003-04	52	420
2004-05	52	430
2005-06	53	432
2006-07	53	445
2007-08	53	443

The number of programs increased by five (11%) and the total enrollment by 37 (9%). This indicates both a relatively stable enrollment and a modest program increase. The total enrollment increase has significantly slowed from the previous decade's 30% increase. Although there was an increase in enrollment numbers, the number of applicants per first year slot decreased by 32% for the time period between 2003 and 2008. The recent trends indicate the number of programs and total enrollment has stabilized.

Challenges in the recruitment and retention of qualified educators continue and the AAE has strongly prioritized this issue in its strategic plan. The shortage of educators has not reduced program enrollments over the past two decades, but has the potential to negatively impact enrollment numbers in the future.

7. Review the summary data collected from the ADA Survey Center's *Survey of Advanced Dental Education Annual Reports* over the past ten years regarding the number of full-time and board certified program directors. Provide overview comments on past or future trends regarding this information. (*suggested response - one page*)

Endodontics	Director is Full-Time		Director is Board Certified	
	Yes	No	Yes	% certified
2000-01	46	2	39	81
2001-02	49	1	43	86
2002-03	49	2	44	86
2003-04	51	1	45	87
2004-05	50	2	45	87
2005-06	49	3	44	83
2006-07	50	3	49	93
2007-08	53	0	46	87

As of 2007-08 all program directors in endodontics were full time. In the past ten years most of the directors were full time with slight variations from year to year. Since 2000, the number of board certified program directors has significantly increased. Of the six current program directors that are not board certified, four are not required to comply with the standard because they were appointed before January 1, 1997. The other two non board certified directors are serving in vacant positions while the programs search for a board certified director.

The shortage of endodontic full time board certified faculty members could have a significant impact on endodontic programs meeting the accreditation standard requiring the appointment of full time board certified directors in the future.

Both the AAE and the ABE are aware of this problem and have developed multiple programs intended to increase the number of full time and board certified faculty. In addition to the efforts by the ABE to increase diplomats as described in Question 3, since 2006, the AAE Foundation has provided a $2000 award to full-time educators who become board certified. Recruitment and retention of endodontic faculty has been identified as a Mega Issue in the AAE Strategic Plan and the AAE continues to create and implement activities specifically dedicated to educators (e.g., educator courses, AAE Foundation grants and awards, networking opportunities).

8. Review the summary information attached as Appendix 1 and 2. This information has been provided by the Commission on Dental Accreditation regarding general changes in the language common to all advanced specialty education standards and changes in the specialty's discipline-specific accreditation standards. Please provide an overview comment on future trends regarding this information. (*suggested response - up to one page*)

Minor revisions were made to the Standards for Advanced Education Programs in Endodontics between 2000 and 2003. In July 2003, the AAE conducted a comprehensive review of the endodontic Standards in order to reflect contemporary endodontic education and practice and address future educational goals for advanced education programs. At its July 2005 meeting CODA approved the revised Standards for implementation January 2006. The major revisions at that time included: editorial and format changes for conciseness and consistency; adding definitions specific to endodontics, as well as a definition of evidence-based endodontics; clarification of program directors' commitment to the program; placing an emphasis on preparation for Board certification;, clinical supervision of advanced education students and incorporation of evidence-based methodology; clarification of knowledge and skill levels, and examples of evidence to demonstrate compliance; incorporation of neuroscience into biomedical sciences; and biomedical science integration with clinical practice. In the clinical sciences section, additional emphasis was placed on endodontic-specific areas (e.g., management of dental trauma, vital pulp therapy, management of traumatized developing permanent teeth, and pain diagnosis and management.)

Subsequent changes to that major revision included the addition of intent statements on magnification technologies, the development of new theories and techniques, traumatic injuries to teeth, and the role of endodontists in the extraction of teeth. In addition "*ethical conduct*" was added to the evaluation of students and the ABE's definition of "Prospective Board Candidate"

was also added. It should be noted that the Validation and Reliability Study completed by all specialties in 2006, resulted in no revisions to the endodontic Standards.

Current revisions undergoing review and comment include revisions to the definitions of knowledge and skill levels, ethical considerations, and enrollment changes.

The Standards are essential to the future of endodontics and represent the fundamentals of the discipline and criteria to maintain high-quality education. The AAE will continue to conduct reviews on trends in technology and changes in the scope of practice of endodontics. As research provides new information on the various aspects of the discipline, changes may be made to the Standards; currently, one expects advances in regard to implant dentistry and regenerative endodontics.

Changes in Scope of Practice

9. Highlight recent epidemiological data or studies that establish the incidence and/or prevalence of major conditions routinely diagnosed and/or treated by practitioners in the specialty. Please provide overview comments on how these changes have affected the practice of the specialty and the future practice of the specialty. (*suggested response - up to five pages*)

The principle major conditions treated routinely in clinical practice by endodontists continue to be pulpal and periapical disease. These conditions are the result of caries, dental trauma, periodontal disease, extensive restorations, tooth fractures, or compromised host factors. There has been no change over the last 10 years with regards to major conditions and routine treatment.

Two recent retrospective epidemiologic studies reinforce this statement about conditions and practice. Mindiola et al. reported on 5,460 patients treated in the Indian Health Service showing that patients with multiple systemic diseases including diabetes experienced decreased retention of endodontically treated teeth and increased need for retreatment by endodontists (1). This reference to increased retreatments by endodontists is a trend found throughout the membership of the specialty. Another epidemiologic study by Salehrabi and Rotstein reported that 97% of endodontically treated teeth were retained in the oral cavity eight years after initial treatment. This was a study of nearly 1.5 million teeth. Their conclusion was that non-surgical endodontic treatment is a predictable procedure with a high incidence of tooth retention after eight years (2).

Impact of Bisphosphonates

There are several types of cases that are becoming a routine part of endodontic practice, even though they are not the major disorders that endodontists treat. One such condition is the result of bisphosphonate therapy first reported in 2003 by Marx (3). Bisphosphonates are an important class of drugs that have widespread use in managing osteoporosis and treating certain cancers. A recently recognized adverse effect, bisphosphonate - associated osteonecrosis of the jaws (ONJ), has significant medical and dental implications (4).

It appears that the pathogenesis of osteonecrosis of the jaws (ONJ) is related to the profound inhibition of osteoclast function brought on by the bisphosphonates, and the current recommendation is to avoid any invasive dental procedures (extractions and other alveolar surgeries) in patients on IV bisphosphonates (5). Therefore, treating teeth with pulp necrosis

endodontically appears to be preferable to extraction. In a recent report the outcome of endodontic treatment in patients taking the oral type of medication was very favorable for healing and it suggests that endodontic treatment can be done with predictable outcome (6). The role of endodontics in the management of bisphosphonate patients is one of growing importance. The Association has published both a position paper (2006) and a *Colleagues for Excellence* (Winter 2007) addressing this issue.

Improved Magnification and New Materials

The operating microscope, first used in the 1990s, has had a significant impact on the quality and outcomes of endodontic care. Endodontists have increased their use of the microscope from 52% in 1999 to 90% in 2007 (7). Surgical endodontics, specifically root end surgery, has been greatly enhanced by improved root end filling materials. Mineral trioxide aggregate (MTA), which has bioinductive potential, is now used for root end fillings as compared to just sealing the root ends with silver amalgam or zinc oxide eugenol cements as was previously the case (8). These changes have increased endodontists involvement in surgery and improved the ability to maintain those teeth that do not respond favorably to non-surgical therapy. It is anticipated that additional research into bioactive ceramics and other materials will enhance the future practice of endodontics.

The operating microscope has also become useful in many aspects of endodontic practice. For instance, recognition of tooth infractions, which can be enhanced with magnification and improved illumination, can allow for better diagnosis of a condition in which associated pain symptoms are often mistaken for neuralgia (9). While predictable treatment for tooth infractions has not yet been developed, making the correct diagnosis is certainly a step in the right direction (10). The operating microscope has also become the essential aid in locating otherwise difficult to find root canals (11).

Advancements in endodontic materials continue to improve endodontic outcomes. The use of MTA has been broadened since its development in the 1990s. One application with promising possibilities for preserving pulp tissue in teeth with minor carious exposure in young patients was convincingly presented by Bogen et al. They reported on the very successful use of MTA in teeth that previously would have routinely been treatment planned for root canal therapy or extraction (12). Other materials such as bioceramics also show promise for endodontic application (13).

Traumatic Dental Injuries

As reported by Glendor in 2008 the prevalence of traumatic dental injuries (TDI) reported worldwide (1994-2007) varies between single digits up to over 40% of populations depending on age ranges and sample sizes (14). It is recognized that a high percentage of patients with TDI require some type of endodontic treatment, from revascularization of necrotic pulps, and vital pulp therapy, to conventional endodontic therapy. Endodontists have become increasingly involved in the management of TDI, most often on the secondary level, after the initial emergency treatment. At the secondary level, concern frequently involves prevention and treatment of trauma-related root resorption, which routinely is related to pulpal injury. In cooperation with the International Association of Dental Traumatology (IADT), the AAE has supported the development of guidelines for management of TDI. The guidelines are posted on the website of the IADT (www.iadt-dentaltrauma.org) and available to everyone interested in this issue.

As a result of dissemination of information about traumatic dental injuries (such as the Spring 2006 issue of *Colleagues for Excellence: Endodontic Considerations in the Management of Traumatic Dental Injuries*) endodontic procedures are contributing to saving natural dentition which is of great benefit for the population group most often affected by such injuries: children and young teen agers (15).

Another important area of traumatic dental injuries is the management of ankylosis-related resorption of immature teeth. Decoronation of such teeth has been shown to offer an advantageous approach to save the ridge contour, the loss of which is associated with removal of these resorbing teeth (16). Endodontists have become very active in providing this valuable service to the community (17).

Implant Dentistry and Endodontics

Endodontists were involved in implant dentistry as far back as the 1960s. These were endodontic implants (posts extending through the apices of teeth to stabilize them). When root form implants became commonly acceptable, a legitimate concern arose that dentists would choose to recommend implants rather than endodontic therapy for pulpally involved teeth. This happened in many cases, and in the past few years endodontists have become increasingly involved with implant dentistry as it relates to diagnosis, treatment planning, and treatment of complex dental situations. This issue was addressed by Torabinejad and Goodacre in 2006 (18). More recently, a systematic review comparing endodontics and various other procedures supported the value of including endodontic options in complex treatment plans (19). Other outcome studies have been done and a good example is one by Laird et al. who showed that endodontically treated teeth and implants can be successful adjacent to each other and should be maintained (20). A recent web based survey of endodontists indicates that 6.6% of respondents are placing implants (21). This is a significant change from 2000, when less than 1% of endodontists were placing them.

References

1. Mindiola MJ, Mickel AK, Sami C, Jones JJ, Lalumandier JA, Nelson SS. Endodontic treatment in an American Indian population: a 10-year retrospective study. J Endod 2006; 32: 828-32.

2. Salehrabi R, Rotstein I. Endodontic treatment outcomes in a large patient population in the USA: an epidemiological study. J Endod 2004; 30: 846-50.

3. Marx, RE, Sawatari Y, Fortin M., Broumand V. Bisphosphonate-induced exposed bone (osteonecrosis/osteopetrosis) of the jaws: risk factors, recognition, prevention, and treatment. J Oral Maxillofac Surg 2005; 63: 1567-75.

4. Carter G, Goss AN, Doecke C. Bisphosphonates and avascular necrosis of the jaw: A possible association. Med J Aust 2005; 182: 413-5.

5. Ruggiebo SL, Drew SJ. Osteonecrosis of the jaws and bisphosphonate therapy. J Dent Res 2007; 86: 1013-1021.

6. Hsiao A, et al. A retrospective clinical and radiographic study on healing of periradicular lesions in patients taking oral bisphosphonates. J Endod 2009; 35: 1525-1528.

7. Kersten D, Mines P, Sweet M. Use of the microscope in endodontics: Results of a questionnaire. J Endod 2007; 32: 804 –7.

8. Chong BS, Pitt Ford TR, Hudson MB. A prospective clinical study of mineral trioxide aggregate and IRM when used as root-end filling materials in endodontic surgery. Int Endod J 2003; 36: 520–6.

9. Brynjulfsen A, Fristad I, Grevstad T, Hals-Kvinsland I. Incompletely fractured teeth associated with diffuse longstanding orofacial pain: diagnosis and treatment outcome. Int Endod J 2002; 35: 461-466.

10. Roh BD, Lee YE. Analysis of 154 cases of teeth with cracks. Dent Traumatol 2006; 22: 118-123.

11. Buhrley LJ, Barrows MJ, BeGole EA, Wenkus CS. Effect of magnification on locating the MB2 canal in maxillary molars. J Endod 2002; 28: 324-327.

12. Bogen G, Kim JS, Bakland LK. Direct pulp capping with MTA: An observational study. J Am Dent Assoc 2008; 139: 305-315.

13. De-Deus G, Canabarro A, Gutemberg A, Linhares A, Senne M, Granjeiro, J. Optimal cytocompatibility of a bioceramic nanoparticulate cement in primary human mesenchymal cells. J Endod 2009; 35: 1387.

14. Glendor U. Epidemiology of traumatic dental injuries – a 12 year review of the literature. Dent Traumatol 2008; 24: 603-611

15. Trope M. Treatment of immature teeth with non-vital pulps and apical periodontitis. Endod Topics 2006; 14: 51-59.

16. Malmgren B, Malmgren O, Andreasen JO. Alveolar bone development after decoronation of ankylosed teeth. Endod Topics 2006; 14: 35-40.

17. Cohenca N, Stabholz A. Decoronation – a conservative method to treat ankylosed teeth for preservation of alveolar ridge prior to permanent prosthetic reconstruction: Literature review and case presentations. Dent Traumatol 2007; 23: 87-94.

18 Torabinejad M, Goodacre C. Endodontic or dental implant therapy: the factors affecting treatment planning. J Am Dent Assoc 2006; 137: 973-7.

19. Torabinejad M, Anderson P, Bader J, Brown LJ, Chen LH, Goodacre CJ, Kattadiyil MT, Kutsenko D, Lozada J, Patel R, Petersen F, Puterman I, White SN. Outcomes of root canal treatment and restoration, implant-supported single crowns, fixed partial dentures, and extraction without replacement: A systematic review. J Prosthet Dent 2007; 98: 285-311.

20. Laird BS, Hermsen MS, Gound TG, Al Salleeh F, Byarlay MR, Vogt M, Marx DB. Incidence of endodontic implantitis and implant endodontitis occurring with single-tooth implants: a retrospective study. J Endod 2008; 34: 1316-24.

21. Creasy J, Mines P, Sweet M. Surgical Trends among Endodontists: The Results of a Web-based Survey, DDS; 35: 30-34.

10. According to the 2007 *Survey of Dental Practice*, responding specialists (includes all specialties) reported that general practitioners provided most of their referrals (57.5%), followed by their patients (25.3%). Describe referral patterns and who normally refers patients to practitioners in this specialty and how this might have changed in the past ten years.

The AAE has not conducted a workforce assessment or similar study to thoroughly assess the source of referrals to endodontists in the last 10-year period. However, several AAE studies of consumers and general dentists provide insight into referral dynamics.

Nationwide consumer surveys conducted by the Association in 2003, 2007 and 2008 consistently show that of respondents who have personal experience with root canal treatment, most (60%) had the treatment performed by a general dentist. A much smaller percentage (19-24%) of the procedures was performed by endodontists, with remaining patients crediting other specialists or unknown sources with the procedure. Nearly four in 10 (38%) of people who know what an endodontist does learned that from their dentists, a significant increase from only one in five (22%) individuals in 2007 and one-quarter (24%) of respondents in 2003.

Results from similar AAE surveys of general dentists conducted in 2005 and 2007 reinforce these findings and underline the role of the general dentist as gatekeeper of referral to endodontists. One-half of general dentists report doing most (42%) or all (8%) of the root canal procedures in their offices. The other one-half of general dentists refer half (22%) or most (20%) or all (8%) of the cases to specialists. Almost all of the general dentists surveyed say that they have consulted with an endodontist over the past 12 months (94%), and two-thirds of general dentists say referral to endodontists makes good business sense (68%). Market research into the referral dynamics conducted by the AAE in 2009 reveals that general dentists with more than 10 years in practice, solo practitioners, and female dentists refer a higher percentage of patients to endodontists than the rest of practicing dentists.

A comparison of data from the 1999 and 2006 *ADA Survey of Dental Services Rendered* shows the following data regarding root canal treatments performed annually:

	1999	2006	Variance
General Dentist	11,700,000	10,870,000	- 830,000
Endodontist	4,100,000	4,200,000	+ 100,000
Other Specialists	23,000	5,900	- 17,100
Total	**15,823,000**	**15,075,900**	**- 747,100**

While it is difficult to compare the data because the ADA changed the way it collected and reported information in the 1999 and 2006 surveys, it is clear that endodontists did 100,000 more root canal treatments in 2006 than in 1999 (an increase of about 3%), and general dentists

performed 830,000 fewer root canal treatments in 2006 than in 1999 (a decrease of about 6%). General dentists performed 74% of all root canal treatments in 1999, compared with 72% in 2006.

11. Identify the principal health services provided to the public by individuals in this area of practice and whether this has changed in the past ten years. If this has changed, what has been the impact on profession and public?

The accumulated clinical knowledge and judgment of the practitioner supported by published scientific research is the basis for endodontic treatment. Endodontists provide health services to the public within four principal categories: diagnostic, preventive, emergency and nonemergency treatment of diseases of the dental pulp and periradicular tissues. The following health services now include:

Diagnosis, prognosis and treatment planning for conditions that require endodontic treatment in support of patients' total oral health (1); Appropriate emergency treatment to relieve pain and eliminate infection of endodontic origin; Recognition and management of endodontic pain and associated anxiety (2); Vital pulp therapy: indirect pulp cap (3), direct pulp cap (4-7), and pulpotomy (8,9); Non-surgical endodontic treatment: expertise in pulp system anatomy, recognition of anomalies, team work in dealing with complex restorations, and management of patients with complicated medical histories, (10-12); Endodontic retreatment (13,14); Surgical endodontic treatment: root-end resection (15,16), biopsy (17), root resection/amputations, perforation repair (18), intentional replantation (19) and implant dentistry (20,21); Post removal; Apexification/Apexogenesis (22,23); Dental trauma management (24-26); Intracoronal bleaching (27); Restoration of endodontically treated teeth (28); Cracked tooth management (29,30); Pulp regeneration 31,32); Biocompatible regenerative materials: Mineral trioxide aggregate (8,33) and Bioceramics (34,35)

Changes over the past ten years

Advancements in contemporary endodontics result from a dynamic body of work, with substantial studies that have modified and altered diagnostic and treatment perspectives. An exciting development over the past 10-15 years is in the area of pulpal regeneration. Materials, instruments and medication, coupled with knowledge from trauma and tissue engineering fields can be applied to regeneration of a functional pulp-dentin complex. Equally remarkable are the new cases of necrotic immature permanent teeth that show biologically-based endodontic treatments resulting in continued root development, increased thickness in the dentinal walls and apical closure. Mineral trioxide aggregate (MTA) is an integral part of this process. MTA has an increasing literature base expanding its possibilities. It has been shown to be biocompatible in diverse and extraordinary uses. MTA is used as a direct pulp capping agent, root end preparation filling, material for perforation repair, as well as a root filling in cases of immature teeth with necrotic pulps.

Bioceramics is another new and versatile material for endodontic treatment. Shown to be biocompatible, bioceramics have been proposed in several applications that mirror the uses of MTA, as well as being used as an endodontic root canal cement. Ongoing research can be expected to further show clinical applications.

The application and advances in radiographic visualization to augment endodontic diagnosis and detection has been greatly increased by the integration of cone-beam computed tomography. Textbooks and scientific journals, including those in the endodontic discipline, show more and more applicable situations in which this new technique can provide valuable information about patients' conditions and in preparation for oral surgical procedures.

As members of the dental treatment team, endodontists have an important role in helping patients maintain their natural dentition; situations do, however, arise in which teeth cannot be maintained for a number of reasons. In such situations endodontists are increasingly becoming involved in the treatment planning and providing of implant dentistry services. Historically, endodontists were involved in implant dentistry's development by performing endodontic implants (implants placed through the roots of teeth). Through their specialty training, endodontists are very familiar with the surgical anatomy as it relates to the roots of teeth and surrounding supporting structures. Thus implant dentistry surgery is a natural extension of endodontists' treatment skills and many endodontists are currently pursuing training in this area.

A major change in the delivery of endodontic health services has been the near universal adoption by endodontists in all practice settings of the operating microscope. Studies over the past decade have shown the microscope's advantages in locating internal anatomy, detecting cracks, and in apical surgery visualization.

Impact of endodontic advances

Endodontic advances have had a positive impact on our patients, who have benefitted from the advantages of the use of magnification and illumination. It is now possible to detect tooth infractions and locate internal anatomical structures that were not predictably detectable in years past, leading to better outcomes. Treatments benefitting from these improvements include MTA apexification, internal perforation repair, pulp capping, apical surgery, separated instrument retrieval, determination of anatomical variations, post removal and other procedures. Advancements in dental materials have increased the ability to retain the natural dentition as never before; continued development of materials and procedures can be expected to increase the possibilities for preserving natural dentitions.

Regenerative endodontics continues to have a promising impact on efforts to retain the natural dentition. Advantages are numerous, such as in the adolescent population, where tooth retention is paramount to normal dental arch development and facial proportions.

The full impact of the diagnostic implementation using cone beam volumetric tomography is yet to be determined, though the AAE is working with the AAOMR to ensure accurate procedural steps for various situations. The projected future based upon improvements in anatomical reconstruction promise to be very valuable in many aspects of endodontics and dentistry in general. Advances in this field are expected to provide dentists with a powerful new tool for diagnosis and to dramatically improve patient care and disease detection.

Implant dentistry has had a major impact in managing the problem of tooth loss. It must be recognized, however, that in many situations, teeth with complex problems do not automatically require extraction and replacement with implants, though the latter may be an option. Endodontists are uniquely qualified to provide patients with information in helping them choose

the best treatment option for teeth with complex problems. This important development will continue to progress as endodontists become more involved in implant dentistry.

References

1. Nesari R, Rossman LE, Kratchman SI. Cone-beam computed tomography in endodontics: are we there yet? Compend Contin Educ Dent. 2009; 30): 312-4, 316, 318 passim.
2. Nixdorf DR, Moana-Filho EJ, Law AS, McGuire LA, Hodges JS, John MT. Frequency of persistent tooth pain after root canal therapy: A systematic review and meta-analysis. J Endod. 2010; 36: 224-230.
3. Gutmann JL (Guest editor). Evidenced-based review of clinical studies on indirect pulp capping. J Endod 2009; 35: 1147-51.
4. Ji YM, Jeon SH, Park JY, Chung JH, Choung YH, Choung PH. Dental stem cell therapy with calcium hydroxide in dental pulp capping. Tissue Eng Part A. 2010; Jan 7.
5. Bogen G, Kim J, Bakland LK. Direct pulp capping with mineral trioxide aggregate: An observational study. J Am Dent Assoc 2008; 305-315.
6. Modena KC, Casas-Apayco LC, Atta MT, Costa CA, Hebling J, Sipert CR, Navarro MF, Santos CF. Cytotoxicity and biocompatibility of direct and indirect pulp capping materials. J Appl Oral Sci. 2009; 17: 544-54.
7. Shinkai K, Taira Y, Suzuki M, Kato C, Ebihara T, Wakaki S, Seki H, Shirono M, Ogisu T, Yamauchi J, Suzuki S, Katoh Y. Dentin bond strength of a new adhesive system containing calcium phosphate experimentally developed for direct pulp capping. Dent Mater J. 2009; 28: 743-749.
8. Parirokh M, Torabinejad M. Mineral trioxide aggregate: a comprehensive literature review--Part I: chemical, physical, and antibacterial properties. J Endod. 2010; 36: 16-27.
9. Subramaniam P, Konde S, Mathew S, Sugnani S. Mineral trioxide aggregate as pulp capping agent for primary teeth pulpotomy: 2 year follow up study. J Clin Pediatr Dent. 2009; 33: 311-4.
10. Endodontic Case Difficulty Assessment and Referral, Endodontics, Colleagues for Excellence, Spring/Summer, 2005.
11. Kontakiotis EG. The operating microscope: a unique tool in endodontology. Pract Proced Aesthet Dent 2008; 20: suppl 8-9.
12. Wolcott J, Ishley D, Kennedy W, Johnson S, Minnich S, Meyers J. A 5 yr clinical investigation of second mesiobuccal canals in endodontically treated and retreated maxillary molars. J Endod 2005; 31: 262-4.
13. Karabucak B, Setzer FC. Conventional and surgical retreatment of complex periradicular lesions with periodontal involvement. J Endod 2009; 35: 1310-5.
14. Torabinejad M, Corr R, Handysides R, Shabahang S. Outcomes of nonsurgical retreatment and endodontic surgery: a systematic review. J Endod 2009; 35: 930-7.
15. Tsesis I, Faivishevsky V, Kfir A, Rosen E. Outcome of surgical endodontic treatment performed by a modern technique: a meta-analysis of literature. J Endod 2009; 35: 1505-11.
16. Ricucci D, Lin LM, Spångberg LS. Wound healing of apical tissues after root canal therapy: a long-term clinical, radiographic, and histopathologic observation study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009; 108: 609-21.
17. Love RM, Firth N. Histopathological profile of surgically removed persistent periapical radiolucent lesions of endodontic origin. Int Endod J 2009; 42: 198-202.

18. Mente J, Hage N, Pfefferle T, Koch MJ, Geletneky B, Dreyhaupt J, Martin N, Staehle HJ. Treatment outcome of mineral trioxide aggregate: Repair of root perforations. J Endod 2010; 36: 208-213.
19. Al-Hezaimi K, Naghshbandi J, Simon JH, Rotstein I. Successful treatment of a radicular groove by intentional replantation and Emdogain therapy: four years follow-up. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009; 107: e82-5.
20. Naves Mde M, Horbylon BZ, Gomes Cde F, Menezes HH, Bataglion C, Magalhães D. Immediate implants placed into infected sockets: a case report with 3-year follow-up. Braz Dent J 2009; 20: 254-8.
21. Hannahan JP, Eleazer PD. Comparison of success of implants versus endodontically treated teeth. J Endod 2008; 34: 1302-5.
22. Kvinnsland SR, Bårdsen A, Fristad I. Apexogenesis after initial root canal treatment of an immature maxillary incisor - a case report. Int Endod J 2010; 43: 76-83.
23. Bose R, Nummikoski P, Hargreaves K. A retrospective evaluation of radiographic outcomes in immature teeth with necrotic root canal systems treated with regenerative endodontic procedures. J Endod 2009; 35: 1343-9.
24. Jaramillo DE, Bakland LK. Trauma kits for the dental office. Dent Clin North Am 2009; 53 751-60,
25. Elias H, Baur DA. Management of trauma to supporting dental structures. Dent Clin North Am 2009; 53: 675-89.
26. Subramanian K, Chogle SM. Medical and orofacial considerations in traumatic dental injuries. Dent Clin North Am 2009; 53: 617-26.
27. Camps J, de Franceschi H, Idir F, Roland C, About I. Time-course diffusion of hydrogen peroxide through human dentin: clinical significance for young tooth internal bleaching. J Endod 2007; 33: 455-9.
28. Baba NZ, Goodacre CJ, Daher T. Restoration of endodontically treated teeth: the seven keys to success. Gen Dent 2009; 57:596-603.
29. Nguyen V, Palmer G. A review of the diagnosis and management of the cracked tooth. Dent Update 2009: 36: 338-40, 342, 345-6
30. Krell KV, Rivera EM. A six year evaluation of cracked teeth diagnosed with reversible pulpitis: treatment and prognosis. J Endod 2007; 33: 1405-7.
31. Bose R, Nummikoski P, Hargreaves K. A retrospective evaluation of radiographic outcomes in immature teeth with necrotic root canal systems treated with regenerative endodontic procedures. J Endod 2009; 35: 1343-9.
32. Takahashi C, Yoshida H, Komine A, Nakao K, Tsuji T, Tomooka Y. Newly established cell lines from mouse oral epithelium regenerate teeth when combined with dental mesenchyme. In Vitro Cell Dev Biol Anim. 2009; Dec 24.
33. Torabinejad M, Parirokh M. Mineral trioxide aggregate: A comprehensive literature review - Part II: leakage and biocompatibility investigations. J Endod 2010; 36: 190-202.
34. De-Deus G, Canabarro A, Alves G, Linhares A, Senne MI, Granjeiro JM. Optimal cytocompatibility of a bioceramic nanoparticulate cement in primary human mesenchymal cells. J Endod 2009; 35: 1387-90.
35. Park JW, Hong SH, Kim JH, Lee SJ, Shin SJ. X-Ray diffraction analysis of white ProRoot MTA and Diadent BioAggregate. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2010; 109: 155-15

12. Identify the setting(s) in which these services are customarily provided and whether this has changed in the past ten years. If this has changed, what has been the impact on profession and public?

Data on Practice Settings

AAE member surveys were conducted in 2002 and 2009, and received a response rate of more than 40%, with a margin of error of approximately 3%. More than 90% of the eligible endodontists in the U.S. are members of the AAE, and so, member survey results are fairly reflective of the specialty as a whole.

The surveys showed some changes in that the proportion of endodontists in private practice rose from 87% to 89% over seven years. The number in solo private practice increased from 48% to 60%, while that of private practitioners in a group practice decreased from 39% to 29%. Endodontists in multidisciplinary practices went from 3% to 4% from 2002 to 2009, and those in other practice settings went from 3% to 5% between 2002 and 2009. "Other practice settings" include hospitals, community and dental school clinics and faculty practices.

For the past decade, difficulties in recruitment and retention of educators have been a significant challenge for endodontics, as it has been for other specialties. The best data available, however, indicates that vacancies in dental school endodontic positions have decreased from 25 to less than 20 over the past 10 years. Currently, there are 248 full-time endodontic educators, 415 part-time educators who are compensated, and 347 part-time volunteers.

There are currently an estimated 4,600 active practicing endodontists in the U.S. Approximately 200 of them are in the federal dental health services, and about 250 are full-time educators, leaving around 4,150 in private practices.. Approximately 800 private practitioners are also part-time educators. In 2001, there were about 4,000 endodontists in active practice in the United States, with 300-400 in the federal dental health services and education, resulting in about 3,500 in active private practice in the U.S. at that time. (American Dental Association, Survey Center, 1999 Distribution of Dentists in the United States by Region and State.)

Impact

The increase in the total number of endodontists means that more practitioners are available to provide patient care, thus improving access to care. Although the data is not definitive, the increased number of endodontists, combined with the significant increase in the percentage and number in solo (as opposed to group) practice suggests a greater geographic distribution of endodontists, which should improve access to care for patients, and enhanced interaction with general dentists and other members of the oral health team. Between 1995 and 2006, the ratio of endodontists to adults increased in 48 states (Waldman HB, Bruder III GA. Update on imbalanced distribution of endodontists: 1995-2006. J Endod 2009; 35: 646-650.)

Another result of the increase in the number of specialists is that there are more endodontists available to teach endodontics to in dental schools. The increase in volunteer teachers provides valuable assistance to full-time educators to do their jobs. The AAE promotes volunteerism through targeted programs ("Step Up"), and a variety of recognition and reward mechanisms.

13. Provide any other information that the specialty believes may be relevant to the study of the specialty area of practice. (*suggested response - one page)*

Endodontists are involved on many levels of organizational activities. In addition to the professional membership association, the American Association of Endodontists (AAE) and the specialty certification board, the American Board of Endodontics (ABE), endodontists participate on local levels through seven district organizations, numerous study clubs, the College of Diplomates of the ABE, the American Association of Endodontists Foundation (AAEF), and the Endodontic Section of the American Dental Education Association (ADEA). These various organizations allow individual endodontists to participate in all aspects of the discipline: Association politics; adoption of new materials and techniques in private practice; incorporation of advances in to advanced and pre-doctoral education; and interaction in local situations (e.g. state board decisions affecting endodontics).

In terms of dental education the AAE encourages endodontists to volunteer on faculties of dental schools; the AAEF provides funding for educator fellowships and travel grants and registration stipends to annual sessions.

An important issue currently in medicine and dentistry is access to care. Proposals to enhance access to endodontic services are progressing through the various levels of the Association, but much has already been done. For instance many advanced education programs in dental schools accept Medicaid plans improving access for care for the underserved as well as participating in community outreach programs.

The AAE has provided opportunities for various endodontic entities to work together to enhance the quality of the specialty's service to the public. Examples include:

- A consensus conference was held in Chicago in September 2008 to examine the current terminology used in endodontic diagnosis. The conference was attended by invited endodontic practitioners, dental school faculty, and researchers. The results were published in the December 2009 issue of Journal of Endodontics.

- Endodontic program directors and department chairs are invited to yearly conferences held in Chicago to work out how the AAE can better assist in the education of both advanced education and pre-doctoral students.

- The AAE publishes on topics to be shared with colleagues in general dentistry and other specialties; these have included descriptions, techniques, diagnosis, and common areas of concern such as antibiotics and bisphosphonate-related osteonecrosis of the jaw. Also of importance have been the publication of guidelines and position statements; the former include dental trauma guidelines in cooperation with the International Association of Dental Traumatology, and the latter addressing such issues as chloroform alternatives and natural rubber latex allergy.