LLU ■ UCLA ■ UCSF ■ UOP ■ USC

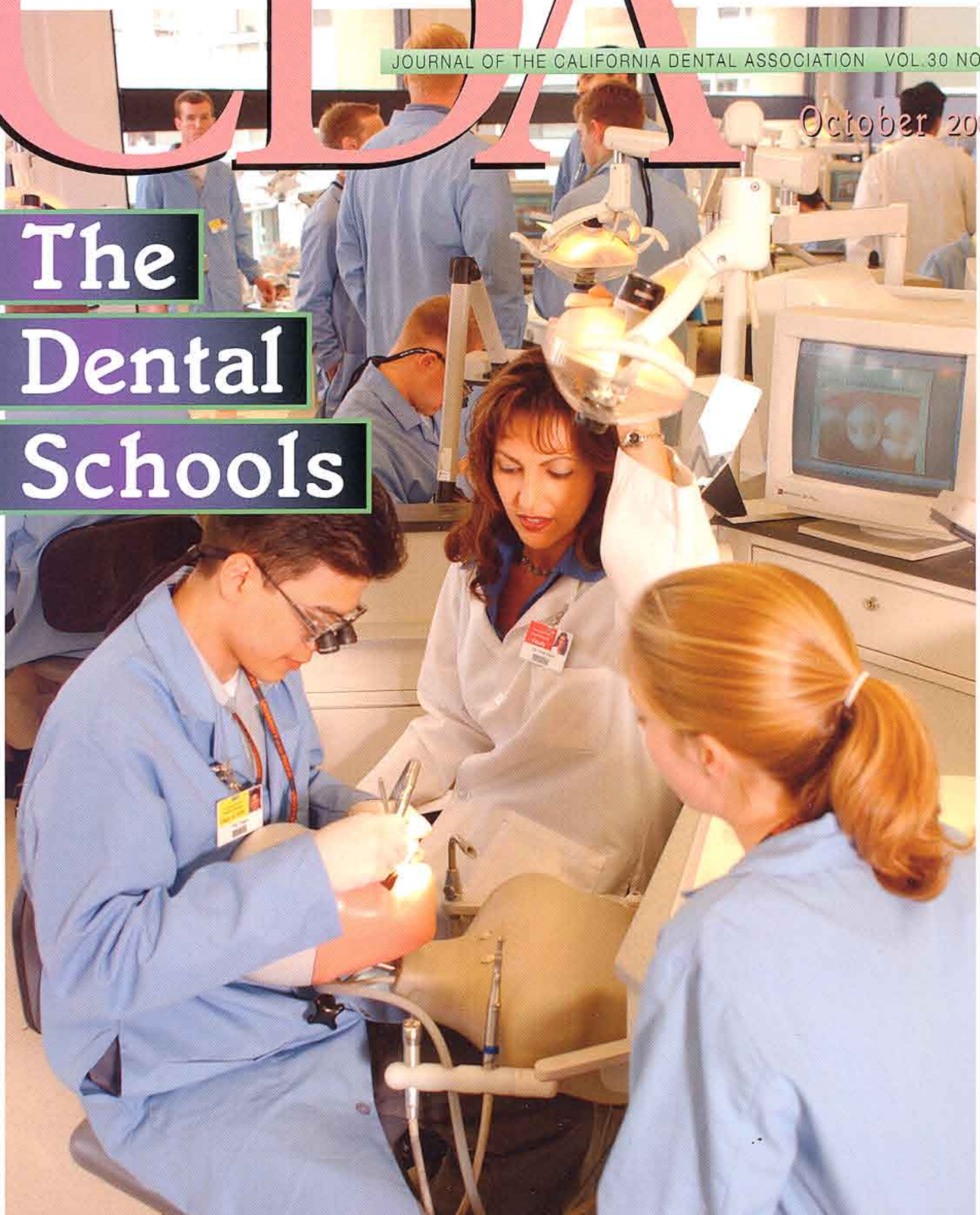
CDA

Waterlines Invisalign
Infant Care Saliva

JOURNAL OF THE CALIFORNIA DENTAL ASSOCIATION VOL.30 NO.10

October 2002

The Dental Schools



OF THE CALIFORNIA DENTAL ASSOCIATION
Journal
CDA Journal
Volume 30, Number 10
October 2002

DEPARTMENTS

FEATURES

CDA JOURNAL, VOL 30, Nº10

Nourishing Our Roots

Steven A. Gold, DDS

Dentists comprise a diverse population, yet there is one common denominator we all share: We are all the products of dental education. Dental schools are the foundation of dentistry. They are the institutions that mold and train future dentists, and they contribute to the body of dental knowledge through research. They provide the community at large with valuable dental services and improve access to dental care for a significant segment of the underserved population. While dental schools collectively contribute to the profession at large, it is through our own personal experiences that we are most closely and forever bound to those solemn halls (and clinics and labs) of dental education.

True, we can readily recall the numerous challenges we all faced during that seemingly interminable creep toward graduation. Yet in spite of the hardships, it seems most dentists do look back fondly on their days in dental school. I believe that, although we rarely admit it, most of us rely daily on our dental school education as we treat patients. We may modify our individual techniques and favorite materials throughout our careers, but our formative education has etched something more indelible on our brains. For me, it was a standard of excellence and the motivation to endlessly pursue that standard that was instilled in me by teachers such as Richard Kahn and Terry Donovan. For that brief yet unforgettable glimpse at excellence, I will be forever grateful to them. I believe everyone who is so motivated has his or her own great teachers who have given similar inspiration.

This issue of the *Journal of the California Dental Association* is both a showcase for the California dental schools as well as a tribute to them. We are fortunate not only to have five dental schools in California, but also to have schools, administrators, and faculty that rival the best in the world. We owe a debt of gratitude to everyone who works to make our schools such benchmarks of excellence: from the deans, through the ranks of the faculty, and to a sometimes forgotten group -- the staff and employees who make the day-to-day running of the schools possible.

Recently, we have heard that there is a crisis looming in dental education. In fact, according to some, it is here. Schools report difficulty attracting enough faculty to meet the current and projected demand. In particular, there seems to be a lack of young, career-minded dental educators crucial to replenishing the faculty ranks as the more experienced teachers inch closer to retirement. There are two suspected reasons for this. First, new dentists are more in debt from their education than ever before; and second, salaries in private practice are higher than for starting dental school faculty positions. How then can we encourage young dentists to pursue careers in dental education?

CDA JOURNAL, VOL 30, Nº10

For starters, I will go out on a limb and project that dental school salaries will never match those that can be earned by capable private practicing dentists. At the same time, I do not believe that dentists, on the whole, enter the profession for purely financial reasons. Surely there are other careers that offer a greater return on investment for the amount of time and expense dental education demands. Dentists tend to be giving. We have a large number of dentists who volunteer time to organized dentistry and other endeavors with little to no monetary compensation. Whether serving organized dentistry or dental education, there is some degree of sacrifice involved. But being a teacher can bring the rewards of shaping and inspiring future dentists and making a tangible difference in the quality of dentistry we are able to provide our patients. There is a value and a reward gained from teaching that a paycheck can never provide.

This is a message that everyone in dentistry can help promote whether inside or outside of the dental education system. It is also a message that young dentists and new graduates should heed as they consider career choices and how they would like to give back to a profession as rich with opportunity as ours. If we all work together to address our education crisis, we will continue to keep dental schools, the very roots of our profession, strong and ensure a bright future for dentistry.

CDA JOURNAL, VOL 30, Nº10

Dentistry for People With Special Needs

By Collette Knittel

Efforts to expand access and improve the delivery of dental health services to Californians with special needs are under way. The University of the Pacific School of Dentistry has selected eight regional centers as partners to expand oral health care programs for people with special needs. The project is funded in part with a $2 million grant from the California Endowment, the state's largest health foundation.

"The California Endowment is committed to expanding access to health-related services to persons with special needs," said Marion Standish, senior program officer with the California Endowment. "We are pleased to support the UOP School of Dentistry in this statewide effort that will have a significant and positive impact on the dental health outcomes for people living with developmental disabilities."

There are 21 regional centers throughout the state of California. A regional center is a social service agency for people with developmental disabilities. They are under contract with the state Department of Developmental Services and perform triage, referral, and advocacy services. Each center has a case manager, who is responsible for seeing that individuals receive the services they need.

UOP's grant program, called the Statewide Task Force on Oral Health for Persons with Special Needs, focuses on eight regional centers throughout the state: the Alta California Regional Center in Sacramento, Central Valley Regional Center in Fresno, East Bay Regional Center in Oakland, Lanterman Regional Center in Los Angeles, Harbor Regional Center in Long Beach, Inland Regional Center in San Bernardino, North Bay Regional Center in Napa, and San Gabriel/Pomona Regional Center in Pomona.

UOP has helped facilitate the establishment of eight community-based networks that implement local oral health treatment and prevention delivery networks that link people with developmental disabilities to locally available dental screening, treatment, and preventive services.

"Because of the difficulty in accessing dental services, many individuals with disabilities have significantly poorer oral hygiene and higher rates of dental disease than the rest of the population," said Paul Glassman, DDS, MA, MBA, project co-chair and director of UOP's advanced education and general dentistry program.

Without regular dental care and preventive practices, people with disabilities generally see a dentist only in emergency situations, when visits are not only painful and stressful, but also expensive and may require extensive travel to dental schools or local hospitals.

"With the cooperation of these centers, we are mounting a statewide effort to improve access to local dental services for people with disabilities," said Christine Miller, RDH, MHS, MA, project co-chair and UOP's director of community services.

Now finishing the second year of a three-year grant project, a number of goals and objectives have been implemented. Dental coordinators have been hired and trained in all eight regional centers. The part-time coordinators provide case management, assessment, and referrals for the clients of the regional centers. The coordinators also provide oral health education, dental care resource development, and education for professionals, caregivers, and consumers.

Additionally, an electronic oral health tracking system has been established in the eight regional centers to monitor the progress of clients they are serving in rural and urban communities throughout the state.

UOP also hosts a popular one-day continuing education course for interested volunteer dentists, titled Dentistry for People with Special Needs, in various cities in California several times throughout the year that are funded by the California Endowment.

For information online, UOP, through its Center for Oral Health, has developed a resource guide for materials related to prevention and treatment of dental disease for people with special needs. This resource guide lists books, pamphlets, videotapes, prevention supplies, treatment materials, and other resources useful in preventing or treating dental disease for people with special needs. It is available at www.dental.uop.edu/resource. Materials can be displayed for a particular category, audience, subject, or format.

E-News Alerts Can Bring in More Patients

By Dell Richards

Generally, there are three ways to generate more profit from a dental practice: Cut costs, recruit new patients, or encourage existing patients to use more services. Since many dentists already are doing everything they can to pare down costs, finding ways to bring patients into the office is the only alternative.

E-newsletters and alerts not only cut the cost of traditional newsletters, but also are a perfect tool for reminding current and prospective patients how valuable their dental health is. Yet few dentists use them -- or any other material -- to follow up on initial contacts.

Statistics shows that 20 percent of all leads are never followed up on. And, 90 percent of businesses give up after the first attempt -- even for people who have shown interest by contacting them.

In addition, the average response time

between the initial contact and the first piece of information is 58 days, with 12 percent taking up to six months to respond.

In 1995, Performark, a leads closing firm, calculated from a six-year study of 10,000 marketers that the loss in advertising dollars from lack of timely follow-through was 82 percent.

Understandably, sending out literature or asking staff to make phone calls is a huge expense. Brochures are costly, as are envelopes, postage, and mail house prices.

All that changed with the advent of e-mail, however. Literature in the form of e-newsletters and e-news alerts can go out for much lower costs. Once a database is set up for patient groups, the only costs are research, writing, and "mailing" time.

To do e-newsletters, set up a template with your company logo at the top. Break text into 2/3 and 1/3 columns. That way, you can get in one "feature article" and a related "sidebar" with statistics -- or another shortie. The equivalent of one printed page (single-spaced) usually is enough, less than 500 words.

However, the trick is to use the "news" in newsletter. Trite, self-serving articles that do not show concrete benefits to the patient will only be seen as more spam, dumped faster than junk mail.

Newsletters must have easy-to-read, but not chatty, content that uses current health news as the basis for the articles. Those 500 words must be chock full of facts and figures that tell the reader important information. Quirky stats also can work, if they fall into the "Wow, I didn't know that" category.

Be honest with yourself on this score. If you don't have the time or the ability to write journalist-style news, farm it out. There are many companies that do e-newsletters and alerts for dentists and other health care professionals.

E-newletters generally go out more often than traditional newsletters. Because e-newsletters are scanned so easily, some companies send them out two or three times a week. Once or twice a month, however, is enough to keep your practice in the person's mind, reminding them that they would be healthier if took care of their teeth better -- and came into your office more often.

The best system is to personalize the address and include the name of the recipient in the heading so that it seems like a personal letter. If you do not have that capability, send mass emails by blind copy. Never list names or email addresses.

Although it may take time to motivate patients and prospects to act, you will get more business if you make contact on a regular basis rather than wait for them to do so.

The Sacramento public relations firm Dell Richards Publicity specializes in health care clients.

Injectable Gel Effective in Treating Head and Neck Cancer

An injectable gel combining cisplatin, a chemotherapy drug, and epinephrine is effective in treating cancers of the head and neck, according to a new study published in the Archives of Otolaryngology and Head and Neck Surgery.

Squamous cell carcinoma originates in a particular type of cell found in many different parts of the body. Head and neck squamous cell carcinoma refers to this type of cancer in the head or neck.

Head and neck squamous cell carcinoma is diagnosed in about 40,000 Americans each year and more than 600,000 people worldwide. Barry L. Wenig, MD, MPH, of Northwestern Medical School, Evanston, Ill., and colleagues investigated the use of cisplatin/epinephrine gel injected directly into the tumor in patients with such cancer. Cisplatin given intravenously has been shown to be a potent agent for treatment, but because it affects the entire body when given intravenously, it can have serious adverse effects.

The authors wrote, "Therapeutic options for advanced head and neck squamous cell carcinoma are limited. These patients generally have undergone extensive surgery, have received near-maximum tolerated doses of radiation, and are often poor candidates for aggressive combination therapy. Therefore, for more effective local and regional control of head and neck squamous cell carcinoma and to minimize systemic exposure and toxicity, locally injectable therapies have been investigated."

Scientists Map DNA Segment Associated With Oral Cancer

Researchers from the University of Pittsburgh Graduate School of Public Health have produced the first detailed map of a segment of DNA associated with poor outcomes in oral cancer treatment and discovered a new gene they suspect may play a key role in cells becoming malignant.

The DNA segment, known as 11q13, contains at least nine different genes and is "amplified" -- found in excess -- in almost half of all head and neck cancers, the researchers said in an Aug. 6 report in the Pittsburgh Post-Gazette.

Using the 11q13 map developed at the university's Oral Cancer Center, scientists will be able to quickly compare the 11q13 segments that are amplified in different cancers, possibly speeding the development of molecular markers to help them diagnose cancers and choose proper treatments.

The researchers said they don't yet know what the newly discovered gene, called TAOS1, does but its activity increases with the number of copies of 11q13. Extra copies of the 11q13 segment are associated with poor response to treatment in oral cancer patients.

The map could also prove useful for research into other cancers associated with multiple copies of the DNA segment, including breast, bladder, and esophageal cancers, the researchers said.

The National Institute of Dental and Craniofacial Research has given the University of Pittsburgh scientists a $1.6 million grant to continue studying the 11q13 segment.

Scientists Report New Resin Matrix Passes Initial Tests

Scientists report in the July issue of the journal Dental Materials that two synthetic molecules designed in their laboratory to improve the durability of composite fillings had acceptable strength and good biocompatibility during initial tests.

According to the scientists, these results suggest the structure of these so-called oxirane, or epoxy, molecules can be further refined in the laboratory to produce a nonshrinking resin matrix, the chemical backbone of a composite filling.

"There has been a need in restorative dentistry for a safe, nonshrinking composite matrix," said Dr. David Eick, a scientist at the University of Missouri at Kansas City and lead author on the study. "These results mark a small, but important, research step toward meeting this need."

To eliminate the shrinkage problem, scientists need to improve the chemistry of the composite's matrix backbone, the main source of the shrinkage. One hope is to develop a suitable synthetic molecule, or monomer, that polymerizes without losing volume as it forms chemical bonds with other monomers.

According to Eick, a strong candidate is oxirane, which polymerizes cationically. Its monomers open their aromatic rings and expand to form chemical bonds. Current composites are based on free-radical chemistry, in which their rings contract during bond formation, resulting in a slight loss of volume.

Taste Receptor for Amino Acids Discovered

Scientists recently reported the discovery of a new taste receptor that recognizes most of the 20 naturally occurring amino acids, leading them to speculate that it evolved to help humans select foods rich in these essential nutrients.

Published in Nature, the report is the latest in a series of articles resulting from a five-year collaboration between investigators jointly led by Dr. Nicholas Ryba at the National Institute of Dental and Craniofacial Research and Dr. Charles Zuker of the Howard Hughes Medical Institute at the University of California at San Diego.

According to Ryba, "The amino acid receptor is related to the sweet taste receptor that we identified and characterized last year: Both are combinations of a family of taste receptors referred to as T1R."

They made this new discovery by inserting mouse T1R genes into cells engineered to respond to and report receptor activation. Surprisingly, the investigators found that different combinations of the T1R receptors resulted in either a sweet taste receptor or an amino acid taste receptor.

The scientists note that in mice, the same taste receptor recognizes nearly all amino acids, but that the human receptor is much more specifically tuned to recognize one in particular -- glutamate.

Glutamate occurs naturally in certain foods, such as seafood, and is often added to processed food as the flavor enhancer monosodium glutamate. It has a unique flavor known as "umami," a Japanese word meaning delicious. According to Ryba, "the human receptor is far more sensitive to glutamate than other amino acids and is very likely to be a major receptor for the umami taste."

There are benefits to deciphering the umami taste pathway, Ryba noted. He pointed out that while many associate the umami taste of MSG with processed or snack foods, some researchers are using MSG to stimulate consumption of nutritious foods by those with poor appetites, such as the elderly and people with diabetes.

Travelers Guide to Safe Dental Care Available

A new brochure designed to assist individuals on how to receive safe dental care when traveling outside the United States is now available from the Centers for Disease Control and Prevention and the Organization for Safety and Asepsis Procedures Foundation. The Traveler's Guide to Safe Dental Care provides tips for people when selecting a dental provider abroad and identifies basic infection control principles and practices that help travelers avoid unnecessary risks.

"In many areas, items such as gloves, sterile instruments, disposable needles, and safe water are not routine elements of dental practice," said Dr. Jennifer L. Cleveland, who manages the infection control activities of CDC's oral health program. "This new resource can help international travelers obtain safe dental care when traveling and avoid potential situations that could lead to exposure to microorganisms or other contaminants."

The guide provides a series of steps people can take before leaving home to minimize the potential for a dental emergency. It also offers suggestions for finding a dentist, choosing medications, and assessing infection control practices in a dental office. A checklist provides a series of questions for the overseas dental office to ensure that it uses appropriate precautions to prevent disease transmission. Some questions include:

- Do staff wash their hands with soap between patients?
- Do staff wear gloves for all procedures?

- Are new needles used for each patient?
- Is sterile water used for surgical procedures?

To obtain a free copy of the Traveler's Guide to Safe Dental Care, contact OSAP at (800) 298-OSAP. To view the brochure online, go to http://www.osap.org/patients/articles/travelguide.htm

CDA Officer Slate Forwarded to House

The Board of Trustees, acting as the Nominating Committee, has forwarded to the House of Delegates its slate of nominations for Executive Committee positions.

Per Bylaws Chapter IX, Section 30 B (c), this slate of officer candidates is being published to notify members of the slate at least 45 days prior to the House. The House of Delegates will be held Nov. 22 through 24 in San Diego, Calif.

The slate is as follows:

President Elect: Debra S. Finney, DDS
Vice President: Russell I. Webb, DDS
Treasurer: Dennis W. Hobby, DDS
Secretary: Ronald B. Mead, DDS
Speaker of the House: Matthew J. Campbell, Jr., DDS

Honors

William Lundergan, DDS, MA, professor and chair of the Department of Periodontics at the University of the Pacific School of Dentistry, has received the 2002 Pacific Distinguished Faculty Award. The award, given annually, recognizes one faculty member from the university who fulfills the highest aspirations of faculty service to students, colleagues, the profession and the community.

CDA JOURNAL, VOL 30, Nº10

Loma Linda University School of Dentistry – From Dream to Reality

CHARLES J. GOODACRE, DDS, MSD

AUTHOR

Charles J. Goodacre, DDS, MSD, is dean of the Loma Linda University School of Dentistry.

In 1953, the Seventh-day Adventist Church established Loma Linda University School of Dentistry in response to a need. Seventh-day Adventist dentists from across the country, who had attended many prestigious universities, dreamed of establishing a dental school that scheduled no classes or academic requirements on Friday night or Saturday, our day of worship. The founders also envisioned a curriculum openly incorporating spiritual values into the educational program. Over the years, students and faculty of many faiths have found the mission of Loma Linda University to be compatible with their beliefs and lifestyles. Currently, 27 nationalities and 28 religious faiths are represented in the student body. Approximately 50 percent of the faculty are Seventh-day Adventists and 50 percent come from other faiths. This diversity enhances our programs and strengthens our values.

The educational process at Loma Linda's dental school has always included a special focus on spiritual values, religion, and the behavioral sciences. Therefore, when highlighting the characteristics of the School of Dentistry, these components of the curriculum serve as an appropriate beginning.

Spiritual Values, Religion, Behavioral Sciences

Courses in this aspect of the curriculum include the heritage of the Adventist church and its focus upon health, personal development, ethics, personal and family wholeness, the art of integrative care, interpersonal relationships, and community leadership. The personal development course includes developing communication skills, managing stress, marriage and family relationships, financial management, and substance abuse prevention and management. A foundational ethics course in the first year explores the central values that undergird the practice of dentistry, and a Web-based ethics course is in the process of being developed for predoctoral students in their clinical years. The University's Faculty of Religion and Center for Bioethics provide strong curricular support and develop practical applications of ethical principles. Formal coursework is supplemented by multiple opportunities whereby students can apply their coursework through experiential activities.

In addition, an objective structured clinical examination has been developed that utilizes standardized patients to evaluate students during phone conversations and personal interactions. The standardized patients evaluate communication skills, the student's preparation for the clinical

appointment, and interactions occurring during the measurement of vital signs and completion of the medical history.

Service Learning

Local Community Service

In 1955, two years after the School of Dentistry opened, a program of off-campus community service was initiated in the community of Mecca, Calif., near Indio, using mobile dental equipment. In 1998, a permanent clinical facility opened in the Saul Martinez Elementary School in Mecca; and over the past four years, School of Dentistry students at this clinic have provided approximately 2,500 children with dental care.

In 1966, the school established its first permanent facility at Monument Valley, Utah. This clinic served the needs of Native Americans for the ensuing 30 years. More than 43,000 patients received dental care that otherwise would not have been available.

In addition to the elementary school in Mecca, the School of Dentistry currently provides dental care at two other local elementary schools as well as in two volunteer clinics. Local service activity will be expanded this year through the addition of a new mobile dental clinic.

International Service at LLU

International service has also been a long-standing tradition of the School of Dentistry. In 1961, an alumnus from the dental class of 1957 went to Seoul, Korea, as the first missionary from the dental school. In 1964, a new graduate became the second missionary by traveling to Blantyre, Malawi, and establishing a dental clinic. These alumni engaged in long-term mission service. The School of Dentistry in conjunction with the Seventh-day Adventist Church currently operates and manages more than 70 mission dental clinics throughout the world. Many Loma Linda students have the opportunity to work in some of these clinics. More than 260 graduates of the School of Dentistry have served in one or more of the overseas mission clinics.

In 1958, the school started a summer student outreach program in Chiapas, Mexico, and it has grown to encompass many parts of the world. In 2000, 11 summer experiences were provided to 11 countries -- Armenia, Bolivia, Dominican Republic, Belize, Pakistan, Nicaragua, Peru, Philippines, Korea, and Thailand/Burma. Students and faculty participated in service trips. In 2001, there were 12 international service learning trips to Africa, Armenia, Bangladesh, Belize, Costa Rica, Fiji, Mexico, Nepal, Nicaragua, Peru, and the Ukraine involving 70 students and 17 faculty.

Faculty Development

The initial faculty for the School of Dentistry were recruited using a relatively unique model. Drs. M. Webster Prince (first dean of the School of Dentistry), Claudis Ray, Al Burns, and others traveled throughout the United States in search of successful, experienced Seventh-day Adventist practitioners who were willing to make a commitment to a career in dental education. The School of Dentistry provided advanced education for these practitioners at multiple dental schools where special expertise was available in the various dental disciplines. After completing graduate training, these recruits became the original faculty of the School of Dentistry.

This tradition of developing faculty through educational and professional growth opportunities has been sustained. During the 50 years of Loma Linda's existence, the School of Dentistry has educated 106 faculty. Sixty-one of these recruits received their advanced training at other universities and 45 at Loma Linda University. Twenty-nine of our current full-time faculty were educated through this system, 15 of them within the past 10 years.

The Alumni Association provides the school with substantial financial support for the specific purpose of reducing or eliminating the indebtedness of young faculty who are making a commitment to a career in academic dentistry. Young faculty are provided with up to $20,000 per year for five years to help pay off educational loans.

Clinical Education and Patient Care

Since the original faculty were experienced practitioners who then made a commitment to dental education, substantial clinical patient treatment experience has always been one of the means by which student competence is achieved.

The School of Dentistry maintains an active program of patient care in which an average of 750 patients is seen each day. However, numbers of patients and numbers of experiences do not represent a complete education. In addition to multiple clinical competency examinations, patient perceptions regarding the care they receive is important. A patient survey taken in 2001 indicates that more than 70 percent of the patients "strongly agreed" with statements indicating their student dentist or hygienist was caring, honest, polite, cheerful, and sought to produce excellent dental work. Another 20 percent "agreed" with these statements. A total of 94 percent of patients "strongly agreed" or "agreed" with the following statement: "I would trust my student dentist or hygienist to treat another member of my family."

Treating the whole person is the most important aspect of dental care, and the School of Dentistry sees this data as evidence that students have captured this vision.

Implant Dentistry

Loma Linda University became the first School of Dentistry to offer advanced education in the discipline of implant dentistry. Dr. Robert James started this program in 1976. The first students observed and assisted Dr. James as he placed implants.

Subsequently, the program transitioned to a three-year master's degree program in which students learn both the prosthodontic and surgical aspects of care, including advanced surgical procedures. Up to three students are accepted into this program each year. During the past 10 years,

faculty and students from this program have contributed substantially to the profession through research, publications, presentations, and the development of new clinical procedures that have enhanced the quality of life for patients.

Dental Anesthesiology

In 1976, the Schools of Dentistry and Medicine at Loma Linda University jointly sponsored Health Manpower Pilot Project #110. This legislation provided for the training of dentists in anesthesiology and their subsequent employment in academic medical institutions. In 1978, two School of Dentistry faculty members (Drs. David Anderson and Russell Scheult) completed a 24-month residency training program in medical anesthesiology. Their training, along with the subsequent training of Dr. John Leyman, led to the establishment of a Department of Dental Anesthesiology and the development of a graduate program in Dental Anesthesiology, which opened in 1984. Forty-four dentists have been trained thus far, and eight are currently enrolled. It is the largest program in the country training dentist anesthesiologists.

Information Technology

In 1985, the School of Dentistry developed and implemented a computer program to more effectively monitor student clinical progress, clinical experience, and patient finances. In 1999, a commercially produced program replaced the initial program developed by the school.

The first "on-line" continuing education program was offered in 1998. In addition, for the past two years, the third-year course in implant dentistry has been based upon a CD-ROM program developed at the School of Dentistry. This year, the CD-ROM will be made available to all dental students, advanced education students, and full-time faculty throughout North America at no charge through an educational grant from Nobel Biocare. Additional CD-ROM programs have also been developed -- The Principles of Tooth Preparation and a four-part financial management series. Other programs are in the developmental stages. Online courses are currently used in biochemistry, nutrition, caries management, and orthodontics.

The Department of Orthodontics began the process of transitioning to a paperless, digital clinic in 1998. The modules of clinic management and diagnostic records were completed in 2001. This year, the final phase of patient charting will be completed. In 2001, the first NewTom 9000 unit to be installed in a dental school was placed in the Department of Orthodontics for the purpose of volumetric imaging. With this unit, it is possible to obtain more dimensional information about the orofacial complex with lower doses of radiation than is currently available through other technologies.

The school is committed to an ongoing program of developing and analyzing a variety of electronic tools for providing education. The goal is to develop an electronic core curriculum that will make available curriculum time less focused on information dissemination and more focused on subject mastery.

Motto, Vision, and Mission

The School of Dentistry's motto, vision, and mission statements guide our educational focus and direct our plans for the future.

Motto

"Service is our calling."

Vision

A vision statement is about the best that an organization can imagine becoming at some point in the future. Although it is about the future, the most powerful visions are written in the present tense as though we are standing at that point in the future describing what we have become. It is in this sense that the School of Dentistry developed its Vision 2005.

- LLUSD is a pre-eminent health care organization seeking to represent God in all we do. We are enthusiastically committed to excellent, innovative, comprehensive education of students and whole-person care of our patients.
- Our students, staff, and faculty are empowered through an enabling environment that honors the dignity, diversity, and worth of everyone.
- Our graduates are exemplary professionals and progressive clinicians of integrity.
- Our Lord's example inspires us to enrich our local and global communities through service. This is our calling.

Mission

A mission statement serves as the pathway to the vision describing what the organization intends to become, whom it is here to serve, and how it intends to serve.

LLUSD seeks to further the healing and teaching ministry of Jesus Christ wherein:

- Students learn to provide high quality oral health care, based on sound biologic principles.
- Patients receive competent care, which is preventive in purpose and comprehensive in scope, provided with compassion and respect.
- Faculty, students and staff value the patient relationship, respect diversity and share responsibility by working together toward academic, professional, spiritual, and personal growth.
- Scholarly activity and research provide a foundation for evidence-based learning and enhance whole-person care.
- The workplace environment attracts and retains a superior and diverse faculty and staff who motivate, educate, and serve.
- Our communities -- local, global, and professional -- benefit from our service, stewardship, and commitment to lifelong learning.

As Loma Linda University School of Dentistry charts its course for the future, we will endeavor to have our aspirations and accomplishments exceed our limitations.

CDA JOURNAL, VOL 30, Nº10

Reducing Bacterial Counts in Dental Unit Waterlines: Distilled Water vs. Antimicrobial Agents

James D. Kettering, PhD; Carlos A. Muñoz-Viveros, DDS, MSD; Joni A. Stephens, RDH, EdS; W. Patrick Naylor, DDS, MPH, MS; Wu Zhang, MD

ABSTRACT Background. This study evaluated five chemical disinfectants to compare their abilities to improve dental unit waterline quality and assess their effects, if any, on the biofilm layer. Methods. Sixty new dental units, with a closed-circuit water system, were used to compare microbial levels in DUWLs treated with five antimicrobials: Listerine, Bio 2000, Rembrandt, Dentosept, and sodium fluoride to a control group of sterile distilled water alone over a six-week period. For all units, the waterlines were filled with solution, left overnight, and then flushed for 30 seconds with sterile distilled water the following morning prior to patient treatment. Waterlines were examined for biofilm buildup using scanning electron microscopy and colony-forming-unit counts. Results. The sodium fluoride and the four chemical antimicrobials reduced the microbial count to 200 cfu/ml or less. Only samples taken from dental units receiving the control treatment (distilled water with no added antimicrobial) failed to meet ADA's stated goal. Examination of the SEMs revealed an apparent decrease in the biofilm mass but not elimination, despite repeated treatment with the four antimicrobial materials. Conclusions. Even in a closed-circuit water system, distilled water alone cannot reduce microbial contamination of dental treatment water from dental unit waterlines to the 200 cfu/ml ADA stated goal. However, water treated with Listerine mouthrinse, Rembrandt mouthrinse, Bio 2000, 0.5 percent sodium fluoride, and Dentosept, it did meet microbial reduction goal. The biofilm apparently was reduced in volume, but not entirely eliminated. Clinical Significance. The ADA goal of a maximum of 200 cfu/ml was achieved using any of five chemical antimicrobials and distilled water in a closed-water system. Despite the successful reduction in microbial contamination of the dental treatment water, the biofilm was not completely eliminated. Biofilm elimination and prevention would be needed through some other means.

AUTHORS

James D. Kettering, PhD, is professor of microbiology and molecular genetics at the Schools of Medicine and Dentistry at Loma Linda University.

Carlos A. Muñoz-Viveros, DDS, MSD, is professor and director of the Center for Dental Research at LLU School of Dentistry.

Joni A. Stephens, RDH, EdS, is a professor of dental hygiene at LLU School of Dentistry.

W. Patrick Naylor, DDS, MPH, MS, is an adjunct professor in the Department of Restorative Dentistry at LLU School of Dentistry.

Wu Zhang, MD, is an assistant professor in the Department of Dental Educational Services at LLU School of Dentistry

CDA JOURNAL, VOL 30, Nº10

A number of reports have been published on the issues surrounding microbial contamination of dental unit waterlines and techniques to achieve the American Dental Association stated goal of 200 colony forming units for dental treatment water.1-16 Kettering and colleagues15 demonstrated the critical role water source selection plays in achieving this 200 cfu/ml goal. In this study, bacterial contamination of dental unit waterlines was affected by water source selection (tap water vs. sterile distilled water), the system design (open system drawing tap water vs. a closed system using bottled, sterile distilled water), and whether the waterlines were treated with chemical disinfectants.16

Unfortunately, the actual mechanics for consistently obtaining and maintaining dental unit waterline quality have been left to the research community to determine. It has even been argued that dental unit manufacturers should provide the profession with remedies to meet the waterline quality standards rather than dental clinicians doing so.18 Regardless of where the answers to this problem might come from, the costs and responsibilities for addressing this multifaceted subject remain with the end user -- the clinician.

Even if dental units were redesigned to prevent microbial contamination of dental treatment water, conversion to these new systems would be both slow and costly. So research must continue to evaluate techniques and products that can provide water quality with existing dental equipment that meets or exceeds the ADA goal. Achieving this goal reduction will not only benefit the dental profession but also reassure patients as to the quality and safety of dental treatment water.

In Kettering and colleagues, 16 0.12 percent chlorhexidine gluconate (Bio2000, now marketed under the name of BioBLUE, manufactured by Micrylium Laboratories, Inc, Phoenix, Ariz.) was found to be effective in achieving the recommended reduction of microbial contaminants to 200 cfu/ml in dental unit waterlines while a 5.25 percent sodium hypochlorite (0.31 percent dilution of household bleach) was not. But several questions remained. Do differences exist between antimicrobial products? If so, which products can be used for DUWL treatment? What effects, if any, do these chemical products have on the biofilm that forms over time in dental unit waterlines? This study was undertaken to assess the effectiveness of sodium fluoride and four commercially available materials marketed as antimicrobial agents.

Materials and Methods

Sixty new dental units with a closed-circuit water system (Adec, model Decade 1021) were used in this study. Water samples were collected from the air/water syringe and the high-speed handpiece waterlines at baseline and two, four, and six weeks. Prior to the initiation of the study, the dental units were used with tap water for two weeks without any other treatment. At the start of the study, the water bottle containers of each dental unit were sterilized. The day the samples were collected from the waterlines, the lines were flushed for 30 seconds, and approximately 50 ml of water was collected in a sterile, plastic container. All the samples were collected at noon. When the collection was completed, no handpiece or syringe tip was used because the authors did not want to introduce another potential source of contamination and/or variable. For all units, the waterlines were filled with solution, left overnight, and then flushed for 30 seconds with sterile distilled water the following morning prior to patient

CDA JOURNAL, VOL 30, Nº10

treatment. During the day, all the dental units used sterile distilled water in the bottle containers. No municipal tap water was used at any time during this portion of the investigation. Careful attention was paid to avoid possible contamination of the water when the samples were collected. After collection, the water samples were immediately sent to the microbiology laboratory. The specimens were stored at 4 degrees Celsius and cultured within 24 hours.

The dental units were randomly assigned to one of the following six groups (TABLE 1) with 10 units in each group:

- Group 1 -- sterile distilled water with no antimicrobial (control group);
- Group 2 -- original Listerine mouthrinse;
- Group 3 -- 0.5 percent sodium fluoride;
- Group 4 -- Rembrandt mouthrinse;
- Group 5 -- Bio2000 (Now called BioBLUE) (0.12 percent chlorhexidine gluconate); and
- Group 6 -- Dentosept.

Table 1.

Products Used in this Study

Groups	Name	Manufacturer	Composition
1	Distilled water	Arrowhead Mountain Water Spring	sterile distilled water
2	Listerine mouthrinse	Warner Lambert	Ethanol 0.22mL, benzoic acid 1.5 mg, thymol 0.64 mg, cineole (eucalyptol) 0.92 mg
3	0.5% sodium fluoride	Generic	0.5% sodium fluoride
4	Rembrandt mouthrinse	DenMat	
5	Bio 2000 (Now BioBLUE)	Micrylium Laboratories, Inc.	0.12% chlorhexidine gluconate
6	Dentosept	Sirona USA	1.4% hydrogen perioxide

Table 2.

Air/Water Syringe and High-Speed Handpiece Waterline Counts (cfu/ml)

		Baseline		Week 2		Week 4		Week 6	
Groups	Air/water syringe	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	Distilled water	178,100	166,801	61,800	41,956	20,004	9,162	1,289	3,487
2	Listerine	322,000	322,414	68	64	108	249	14	16
3	Sodium fluoride	206,784	190,906	84	225	26	31	22	37
4	Rembrandt	278,000	115,643	6	13	14	13	68	142
5	Bio2000	392,000	707,998	46,348	12,141	22	24	56	125
6	Dentosept	275,200	356,774	10	19	6	13	2	6
	Handpiece								
1	Distilled water	350,130	123,865	48,000	5,498	2,014	3,416	2,014	2,014
2	Listerine	376,000	392,349	28	30	88	250	4	8
3	Sodium fluoride	352,042	311,531	20	38	22	27	12	17
4	Rembrandt	390,000	232,139	2	6	6	10	10	25
5	Bio2000	326,240	288,459	8,060	2,577	22	29	76	178
6	Dentosept	306,000	251,228	6	10	142	449	2	6

CDA JOURNAL, VOL 30, Nº10

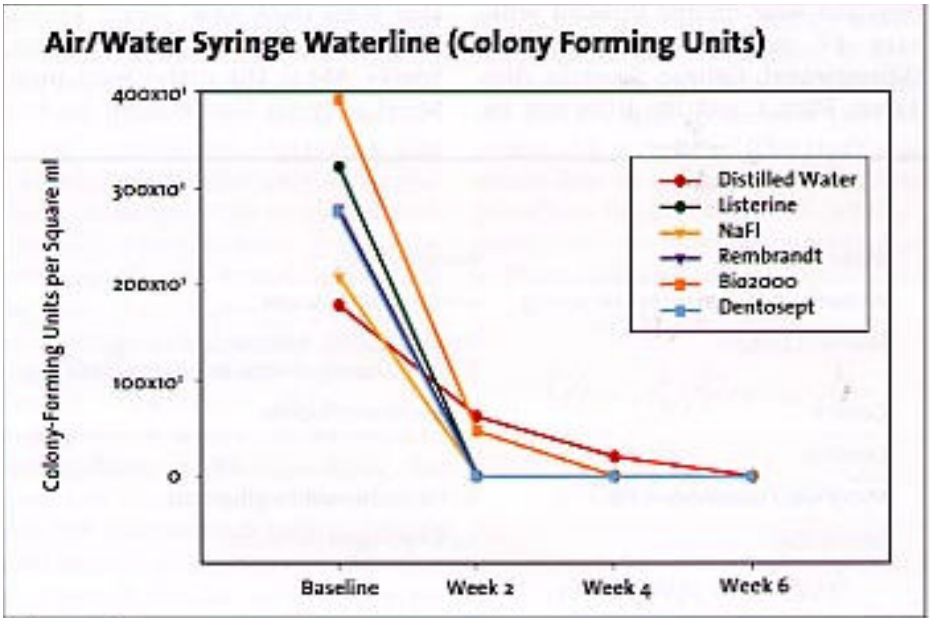


Figure 1. Air/Water Syringe Waterline (Colony Forming Units)

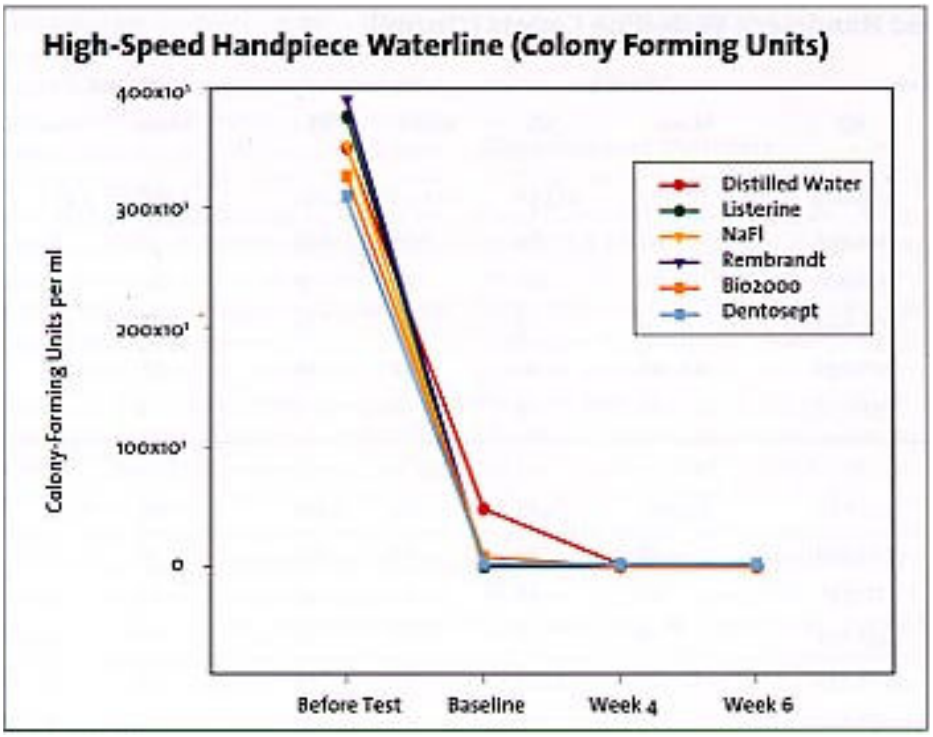


Figure 2. High-Speed Handpiece Waterline (Colony Forming Units)

Microbial Culturing Protocol

Each water container was labeled but coded so the evaluators were blind to its contents. The labeled water samples were mixed by vortexing for 30 seconds. Fifty µl of liquid was removed and added to 100 ml of sterile, deionized water (Suspension 1). One hundred µl was removed from suspension 1 and added to a second 100 milliliters of sterile water (Suspension 2). Each addition was mixed thoroughly. The 100 ml suspensions were filtered through separate 47 mm membrane filters (MicroFunnel, Gelman Sciences, Ann Arbor, Mich.), and the filter was removed aseptically to a sterile R2A agar plate (R2A Agar, Difco, Becton Dickinson Microbiology Systems, Sparks, Md.). The plates were incubated at room temperature for five days. Bacterial colonies were counted by one investigator and dilution factors applied (20 for Suspension 1 and 2000 for Suspension 2) to obtain cfu/ml values.

In an effort to evaluate the presence or absence of a biofilm, 2 cm sections of waterline were removed from two samples from each group, air dried for 24 hours, and sputter-coated with gold for viewing in a scanning electron microscope. The samples were examined in a Phillips scanning electron microscope XL30, and photomicrographs were taken at 8000x magnification.

Statistical Methods

A one-way analysis of variance was performed to evaluate the change in cfu/ml over time for each of the five treatment groups ($p<0.05$). When differences were found, a Student-Newman-Kuels all pairwise multiple comparison was used to identify those differences.

Results

The study results for the comparison of outcomes for Groups 1 to 6 are presented in **Table 2** and illustrated graphically in Figures 1 and 2 for the dental handpiece and the air/water syringe waterlines, respectively. All three mouthrinses

Figure 3. Scanning electron micrograph of new tubing prior to placement in the dental unit (8000x magnification).

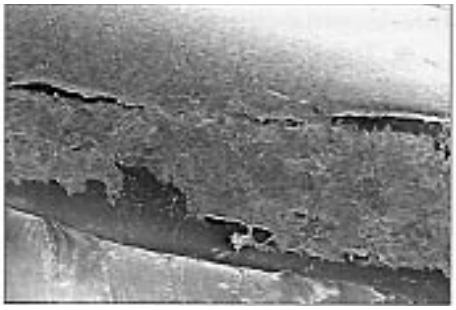


Figure 4. SEM of biofilm buildup in the dental unit waterline after four weeks of use with tap water (50x magnification).

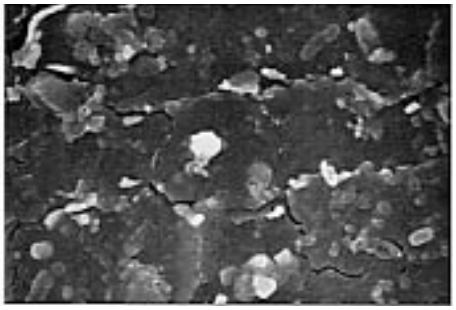


Figure 5. Biofilm buildup in the air/water syringe waterline tubing at baseline (8000x magnification).

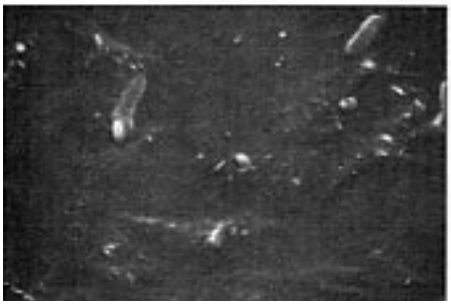


Figure 6. Biofilm buildup in the handpiece waterline tubing after six weeks of treatment with Bio 2000 (8000x magnification).

Figure 7. Biofilm buildup in the handpiece waterline tubing after six weeks of treatment with distilled water (8000x magnification).

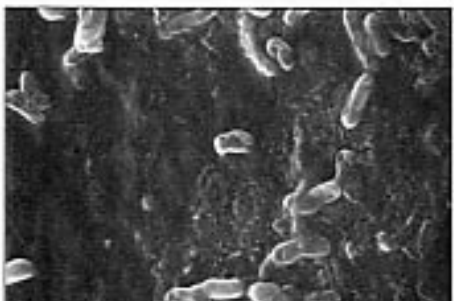


Figure 8. Biofilm buildup in the handpiece waterline tubing after six weeks of treatment with Listerine (8000x magnification).

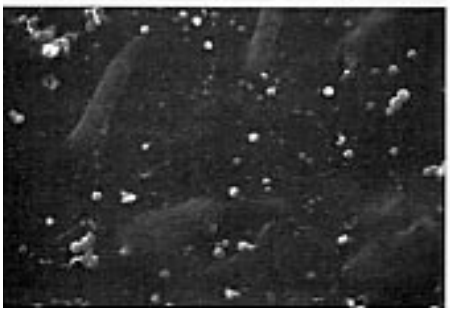


Figure 9. Biofilm buildup in the handpiece waterline tubing after six weeks of treatment with Rembrandt (8000x magnification).

(Listerine, sodium fluoride, and Rembrandt) and the two antimicrobials (Bio2000 and Dentosept) reduced the bacterial count to 200 cfu/ml or less. All values were well within the American Dental Association recommended level of 200 cfu/ml (**Table 1**). Only samples taken from dental units receiving the control treatment of distilled water with no added antimicrobial (Group 1) failed to meet the ADA goal. At the end of six weeks, the cfu count for Group 1 declined substantially, but the count was well more than the ADA standard.

Over the course of the entire six-week test period, all scores for the test groups were at or near zero cfu's, except for Week 2 and Week 4 for the Bio2000. This anomaly during Week 2 for the Bio2000 resulted in a microbial count of 46,348 cfu/ml for the air/water syringe and 8,060 cfu/ml for the handpiece after two weeks. In contrast, all of the other samples for the other four test groups had essentially zero colony counts. This outcome was believed to be due to a lapse in sterile technique rather than a breakdown of the chemical product. All five treatment group samples essentially returned to zero bacteria counts from Week 3 to Week 6.

Examination of the SEMs revealed an apparent decrease in the biofilm mass, but a portion of the biofilm remained intact despite repeated treatment with the four chemical antimicrobials (Figures 3 through 9).

There did not appear to be any correlation between the amount of biofilm present and the number of viable microorganisms for any of the groups. All the SEM indicated a significant amount of biofilm in the water lines, despite the reduction in colony forming units (Figures 3 through 9). **Figure 3** illustrates what the intaglio surface of new tubing received directly from the manufacturer should look like. At magnification of 8000x, this area of the tube is not smooth but has a rather an undulating surface, which might contribute to biofilm accumulation

Discussion

It is apparent that water source selection played a vital role in achieving consistent disinfection of water run through dental unit waterlines. Sterile distilled water in combination with a chemical antimicrobial was found to be an effective combination for achieving

the ADA waterline quality goal of 200 cfu/ml or less. Results from this investigation indicated that all five products tested achieved the desired level of microbial decrease for both air/water syringe and dental handpiece waterlines. Moreover, the reductions were dramatic. Bacterial counts were maintained at the near zero level during this six-week period with the sole exception of Week 6. The high colony counts in Week 2 were believed to be due to a handling error that resulted in the contamination of the water sample. The source of the contamination was not known, but the authors presumed that it occurred during water collection or because someone may have touched the tube that goes in the bottle reservoir, accidentally contaminating the sample.

These findings provide additional support for the conclusion that water source selection may play a pivotal role in the disinfection of dental unit waterlines. It is believed that the American Dental Association recommended goal of 200 cfu/ml can, in fact, be achieved for dental treatment water with existing dental units. But to consistently achieve this reduction, three essential criteria must be met:

- The dental unit must have a closed water system,
- A chemical antimicrobial in conjunction with sterile distilled water must be used; and
- The closed-water system must be properly maintained to avoid contamination of the sterile distilled water and the dental unit water bottle.

There was no correlation between the amount of biofilm present and the reduction in colony forming units. **Figure 3** illustrates the inside surface of new tubing at high magnification. The tube is not smooth but has a rather an undulating surface, which might contribute to biofilm accumulation.

Additional research is recommended to evaluate individual commercial products for patient acceptance of water taste, corrosion of dental equipment, prevention and/or elimination of the biofilm, long-term effectiveness of antimicrobials, effects of these products on restorative materials (the bond strength of composite resins, color changes of tooth-colored restorations, etc.), and the effects of routine use on the longevity of dental handpieces and ultrasonic scalers.

It should be noted that the products used in these study are marketed as antimicrobial agents and not as disinfectants and should be used according to the manufacturer's intended use and directions

Conclusions

Based on the testing format and the materials used in this study, the following conclusions were drawn:

1. Sterile distilled water alone cannot reduce microbial contamination of dental treatment water from dental unit waterlines to the 200 cfu/ml ADA stated goal.

2. Dental units with a closed water system met or exceeded the American Dental Association goal of 200 cfu/ml when sterile distilled water was treated with any one of the following products: Listerine mouthrinse, 0.5% sodium fluoride, Rembrandt mouthrinse, Bio 2000 (Now BioBLUE), or Dentosept.

3. Microbial reduction of dental unit waterlines can be achieved using 100 percent of any of the five antimicrobial products tested and no distilled water, but such a protocol would be more costly than one involving a dilution with sterile distilled water.

4. Given the equivalent performance of the antimicrobial products tested in this study, strong consideration should be given to the cost of each product.

5. Additional research is recommended to assess patient acceptance of water taste, corrosion of dental equipment, prevention and/or elimination of the biofilm, long-term effectiveness of antimicrobials, effects on restorative materials, and the impact of routine use on the longevity of dental handpieces and ultrasonic scalers.

6. A biofilm was detected in the waterline samples for all the dental units. While the biofilm may have been reduced in size (volume) as a result of treatment, it was not eliminated by any of the antimicrobial rinses used in this study.

References

1. Blake GC, The incidence and control of bacterial infection of dental unit and ultrasonic scales. Br Dent J 15:413-6, 1963.
2. Williams JF, Johnston AM, et al, Microbial contamination of dental unit waterlines: prevalence, intensity and microbiological characteristics. JADA 124(10):59-65, 1993.
3. Mills SE, The dental unit waterline controversy: defusing the myths, defining the solutions. JADA 131:1427-41, 2000.
4. Shearer BG, Biofilm and the dental office. JADA 127:181-9, 1996.
5. Miller CH, Microbes in the dental unit water. *J Calif Dent Assoc* 24(1):47-52, 1996.
6. Kono G, The dental waterline controversy. Dent Today 15(8):82-5, 1996.
7. Atlas RM, Williams JF, Huntington MK, Legionella contamination of dental-unit waters. Appl Environ Microbiol 61(4):1208-13, 1995.
8. Jensen ET, Giwercman B, et al, Epidemiology of Pseudomonas aeruginosa in cystic fibrosis and the possible role of contamination by dental equipment. J Hosp Infect 36:117-22, 1997.
9. Santiago JI, Huntington MK, et al, Microbial contamination of dental unit waterlines: short- and long-term effects of flushing. Gen Dent 48:528-44, 1994.
10. Karpay RI, Puttaiah R, et al, Efficacy of Flushing Dental Units for Different time Periods. (IADR abstract 3366) *J Dent* Res 76:434, 1997.
11. Williams HN, Kelley J, et al, Assessing microbial contamination in clean dental units and compliance with disinfection protocol. JADA 125:1205-11, 1994.
12. Kettering J, Muñoz C, et al, Comparison of methods for reducing dental unit waterline bacteria and biofilm. Abstract (AADR abstract 3371). *J Dent* Res 76:435, 1997.
13. Murdock-Kinch CA, Andrews NL, et al. Comparison of dental water quality management procedures. JADA 128:1235-43, 1997.
14. Meiller TF, DePaola LG, et al, Dental unit waterlines: biofilms, disinfection and recurrence. JADA 130:65-72, 1999.
15. Kettering J, Stephens J, Muñoz CA, Use of antimicrobial rinses for reducing bacterial counts in dental unit waterlines. (AADR abstract 287). *J Dent* Res 77(A):141, 1998.
16. Kettering JD, Stephens JA, et al, Reducing bacterial counts in dental unit waterlines: tap water vs distilled water. J Contemp Dent Practice Accepted for publication, summer 2002.
17. Costerton JW, Lewandowski Z, et al, Microbial biofilms. Ann Rev Microbiol 49:711-45, 1995.
18. Christensen R, More about waterlines. Letters. *J Am Dent Assoc* 132:142-6, 2001.

To request a printed copy of this article, please contact: James D. Kettering, PhD, Loma Linda University, Loma Linda, CA 92350, or jkettering@som.llu.edu.

CDA JOURNAL, VOL 30, Nº10

UCLA School of Dentistry: Successes, Challenges and Opportunities

No-Hee Park, DMD, PhD

AUTHOR

No-Hee Park, DMD, PhD, is dean of the University of California at Los Angeles School of Dentistry.

The University of California at Lost Angeles School of Dentistry has a vision to be one of the most respected dental schools in the nation. Encompassed in this vision are the school's core ideology (core purpose and core value) and an envisioned future. The core purpose of the UCLA School of Dentistry is to improve the oral health of the people of California and the United States. We seek to accomplish this purpose with the school's core values of integrity, collegiality, care, allegiance of disciplines, and academic freedom. More specifically, the school makes an effort to carry out the core purpose through the following means:

- Educating and training individuals who will provide the highest quality dental care with established and new bases of knowledge;
- Conducting outstanding research into the cause, prevention, diagnosis, and treatment of oral and craniofacial diseases and abnormalities; and
- Offering services to the community including patient care services, educational programs, and expertise.

Our envisioned future is that the achievements of the school with respect to teaching, research, and service be recognized for, if not synonymous with, excellence.

I am extremely proud of the accomplishments of our school. It is essential to note that our successes do not always come easily. In this article, I have highlighted some of accomplishments and some of our significant internal and external challenges.

Student Admissions

On a consistent basis, the UCLA School of Dentistry admits one of the top classes academically among all 54 dental schools. The Class of 2005, admitted in September 2001, is no exception. This class had an average GPA of 3.61 and scored close to the 95th percentile on the academic portion of the Dental Admission Test. It is important to note that we do not rely on scores alone for our decision-making regarding admissions. We have recently reinstated the personal interview in the admission process because we believe that personal interviews complement the review of an applicant's academic record and assist us in identifying the applicants most likely to possess the personal skills required to successfully complete our rigorous educational program.

There are a number of factors that contribute to our success in recruiting. These factors include the reputation of the School of Dentistry, reasonable tuition, excellent faculty, and the

reputation of UCLA. Other important contributing factors include our graduates' successful acceptance rate into excellent residency/postgraduate programs and the achievements of our graduates, who excel not only in the practice of general dentistry, but also in varied specialties and in unique leadership positions.

Student Performance

Throughout the four years of the dental education program, our students meet high standards of performance. One measure of student performance is the National Board Dental Examination, the standard exam that provides the nation's dental schools with benchmarks of their educational progress and excellence. UCLA dental students consistently rank in the top five among dental schools in performance on the National Boards Part I. In addition, UCLA graduates have performed exceptionally well on the California Dental Board exam, reflecting the clinical training they received while students. A third indicator of the success of the academic program is our students' high rate of placement in residency/postdoctoral programs. For example, approximately 60 percent of the graduates from the Class of 2002 were accepted to residency/postgraduate programs; in fact, close to 90 percent of those graduates who applied for such programs were accepted. This statistic is particularly impressive given the fact that the number of open slots for residencies is far less than the number of applicants.

Although our teaching program has been successful -- as demonstrated by our students' scores, acceptances to residency/postdoctoral programs, and job placements -- we recognize that there is a critical need to incorporate new instructional methods and technologies into the curriculum. The integration of problem-based and service-based learning methodologies and clinical simulation technologies into the curriculum will provide an even better educational experience for our students. This represents a divergence from the traditional didactic instruction characteristic of most dental schools. This shift in philosophy is a challenge not only for our faculty (who must find the time to develop and implement these methodologies sometime between their other teaching, research, and clinical obligations), but also for our students who tend to be resistant to these less traditional teaching styles and learning techniques. An additional barrier is that problem-based and service-based learning require an increased number of faculty members to provide appropriate supervision, resulting in an increased number of required full-time-equivalent positions. Given our limited resources, we seek the involvement of volunteer clinical faculty. The students greatly appreciate the real-world experiences shared by these faculty members.

Financial Concerns of Students

Debt is one of the greatest challenges facing our students. The average indebtedness of our 2001 graduating class members was $78,000. Eliminating the students who were able to pay for their schooling without loans, the average indebtedness was nearly $85,000. This is an insurmountable sum, which serves to limit the options of our graduating students. This oppressive debt discourages these graduates from pursuing careers in academia, entering solo practices, and purchasing practices of retiring dentists.

To alleviate our students' debt obligations, we have increased our development campaigns for various student scholarships, with positive results. We consistently seek and communicate opportunities to our students regarding scholarships and debt forgiveness.

Faculty Recruitment and Retention

The UCLA School of Dentistry continues to undertake a number of significant recruitments and academic personnel actions. Among the areas of recruitment in the past year were advanced prosthodontics, oral biology and medicine, oral and maxillofacial surgery, orthodontics, combined orthodontics-pediatric dentistry, public health and community dentistry, restorative dentistry, and the Dental Research Institute. The school was pleased to attract a highly qualified and competitive group of applicants for these positions. It is clear, however, that advancement opportunities are critical for retention of faculty. We are pleased that we were able to promote several members of the faculty.

Although we have been successful with our efforts to recruit and retain faculty, we are continually faced with the challenge of identifying and obtaining adequate resources for faculty recruitment and support. In particular, we must provide the current ladder-rank faculty with the resources necessary to teach and conduct research. A second challenge is the fact that our faculty is aging. We must identify resources to hire new faculty to ensure an appropriate transition plan that will minimize the loss of institutional knowledge and expertise of these invaluable faculty members. Finally, we face the challenge of attracting graduates to enter academia. As mentioned above, debt serves as a primary deterrent for graduating students to pursue an academic career. One way we have sought to address these challenges is through the establishment of endowed chairs. We have recently implemented the Tarrson Family Endowed Chair in Periodontics and established the Dr. Jack A. Weichman Endowed Chair in Endodontics and the Dr. Thomas R. Bales Endowed Chair in Orthodontics. I have every intention of pursuing additional funding to increase the number of endowed chair positions.

Research and Creative Activities

The UCLA School of Dentistry has outstanding sponsored research activities. We continued to advance science in traditional areas and to create new research opportunities in

nontraditional areas of inquiry. Our research, traditionally individually focused, has expanded in recent years to multidisciplinary and interdisciplinary efforts. Research currently being conducted at the UCLA School of Dentistry can be categorized into six major areas:

- Oral cancer and carcinogenesis research – Topics falling under this area include early detection of head and neck cancer using biomarkers, mechanisms of carcinogenesis, signal transmission studies in oral cancer, oral cancer and immunology studies, bioengineering studies in oral cancer, and gene therapy for oral cancer.
- Oral microbiology research -- Topics falling under this area include molecular biology studies in dental caries, motility of bacteria, and the role of oral bacteria in the development of systemic diseases such as myocardial infarction and diabetes.
- Oral health disparities research – Topics falling under this area include minority oral health disparities with caries, orofacial trauma, and HIV infection.
- Bone biology, tissue engineering and biomaterials research –Topics falling under this area include the molecular basis for craniosynostosis and craniofacial development, the molecular basis for tissue damage and repair processes, the mechanisms of bone formation and resorption, the mechanisms of collagen formation, early detection of osteoporosis using X-rays, and allergies and dental materials.
- Health services research – Topics falling under this area include research regarding outcomes, quality assurance, and access to oral health care.
- Clinical research -- Topics falling under this area include clinical drug trials, material testing, biocompatibility research, and clinical outcome studies.

The school is pleased to have secured National Institutes of Health funding and donations from friends to build the Jane and Jerry Weintraub Center for Reconstructive Biotechnology, a 5,000 square foot state-of-the-art research facility for basic, translational, and clinical research. In addition to the Weintraub Center, the school also has two other research centers: the Dental Research Institute and the Center for Oral Microbiology Research.

Clinic Operations and Specialty Training Under Graduate Medical Education Program

The school operates a 200-chair dental center at the Westwood campus and additional clinics at the Wilson-Jennings-Bloomfield UCLA Venice Dental Center and the UCLA Children's Dental Center at the Edward R. Roybal Comprehensive Health Center in East Los Angeles. We are known as a safety-net provider, offering inexpensive comprehensive care to low-income or indigent residents of Los Angeles.

In addition to the student clinics, the school has a number of specialty clinics that train future specialists through residency programs. These specialties include advanced education in general dentistry, dental anesthesiology, endodontics, general practice residency, maxillofacial prosthetics, oral and maxillofacial surgery, orofacial pain and dysfunction, orthodontics, pediatric dentistry, periodontics, and prosthodontics. These residency programs have operated under the Graduate Medical Education Program for the past seven years, providing stipends for the residents. In addition to the specialty clinics, we also have various faculty clinics, including faculty group dental practices and faculty clinics specializing in hospital dentistry, maxillofacial prosthetics, oral and maxillofacial pathology, oral and maxillofacial radiology, oral maxillofacial surgery, oral medicine, orofacial pain, and periodontics.

We have strived to bring our clinical operations into the 21st century with the implementation of a new management information system. This system is to be utilized for clinical management with an electronic medical record feature, student instruction, research, and evaluation. The School of Dentistry partnered with Software of Excellence to develop and implement the first phase of the new management information system.

Community Relations

The UCLA School of Dentistry's involvement with the community is not limited to providing services at our dental centers. The school has taken a leadership role in a number of community-based initiatives such as community-based screening, oral hygiene instruction, and sealant programs.

We are proud of the school's community service accomplishments to date and hope that future state budgetary constraints will not hinder our ability to expand our community service activities in both the Los Angeles and San Fernando Valley communities.

New Academic Programs

We recently established a combined DDS/MBA program, which is a collaborative effort with the Anderson School at UCLA. In this five-year program, students attend classes at the Anderson School after completing three years at the School of Dentistry and then return to dentistry to complete their fourth year. In the 2001-02 academic year, the first dental student was admitted into the combined DDS/MBA Program.

We are also pleased to inform you that the school has just established a formal DDS/PhD program. Beginning in fall 2002, there will be two slots per year for students interested in pursuing a joint DDS/PhD. We hope this program will encourage the development of future faculty.

The school has also established a two-year Professional Program for International Dentists for graduates of non-U.S. dental schools in response to an appeal from the California Legislature.

This program is part of the phase-out of the California "bench" exam for foreign-trained dentists. The goal of this program is to graduate dentists who will possess the necessary scientific knowledge and clinical skills to provide competent comprehensive dental care as practiced within the United States. Graduates of the program will be eligible to take the dental licensing examinations throughout most of the United States. The first entering class of six students began June 24, 2002. For each year hereafter, we anticipate accepting 10 students.

I hope this article has provided you with some insight regarding the activities at the UCLA School of Dentistry. As is evident from the description above, there are many successes, challenges and opportunities as the UCLA School of Dentistry continues to fulfill its mission. I am both proud and honored to serve as dean of this institution during this exciting time.

CDA JOURNAL, VOL 30, Nº10

The School of Dentistry at the University of California, San Francisco: Service to Humanity

Charles N. Bertolami, DDS, DMedSc

AUTHOR

Charles N. Bertolami, DDS, DMedSc, is professor of oral and maxillofacial surgery and dean of the School of Dentistry, University of California, San Francisco.

UCSF defines its mission as the achievement of excellence in teaching, research, patient care, and public service. For many years, UCSF has been world-renowned for scientific discovery and research, teaching, and innovative delivery of health care. However, we are not satisfied to rest on our reputation. Our faculty and administration are both catalysts for and responsive to scientific, social, and economic changes, and are committed to preparing students for careers in a rapidly changing environment.

-- J. Michael Bishop, chancellor

Mission

The dental profession, like the other healing arts, is best understood as a calling to help people in need, doing so in a highly specialized way. The lofty goal of service to humanity -- whether through patient care, research, or teaching – remains the keystone of the dental programs at the University of California at San Francisco.

Recognizing the importance of the dental profession in serving the public and promoting a healthy and humane society has penetrated the school's core identity and has deeply influenced our educational philosophy and curriculum. Thus, the school's mission is to establish the highest quality academic environment for development, application, and dissemination of knowledge necessary to prevent, treat, or cure orofacial diseases and malformations.

History and Setting

The founding of the School of Dentistry at the University of California, San Francisco, occurred in 1881 when Samuel W. Dennis petitioned the regents of the University of California to permit the formation of a dental department. From its inception, the School of Dentistry was a component of the University of California.

It patterned itself after and was assisted by the existing dental schools at Harvard University, the University of Pennsylvania (of which the founding dean was an alumnus), and the University of Michigan. After the school had been announced as an integral part of the university, donations were solicited from the city's practitioners; and their generosity yielded $510 -- enough to furnish the clinic, lecture rooms, library, and a pathologic museum.

Today, 121 years later, the school is located on the UCSF campus in the Parnassus Heights region of San Francisco -- one of nine campuses making up the University of California system, and the only one dedicated exclusively to the health sciences. The campus as a whole consists of four research-intensive professional schools -- dentistry, medicine, nursing, and pharmacy -- and a graduate division. Also at the Parnassus site are two acute-care hospitals, a psychiatric hospital, and one of the largest ambulatory care facilities in California. UCSF enterprises are distributed throughout the city, including subsidiary campuses at the UCSF/Mt. Zion Medical Center; a Laurel Heights campus; a community dental clinic on Buchanan Street; and active clinical sites at our affiliated institutions, San Francisco General Hospital and the San Francisco Veteran's Administration Hospital. During 2002, a major new campus -- nearly the size of the Parnassus site -- will open in the Mission Bay section of San Francisco.

Academic Program: Dental Predoctoral, Postgraduate, and Graduate Academic

The school admits 80 students per year into its four-year DDS curriculum, 18 students per year into its two-year bachelor's degree in dental hygiene curriculum, 15 students per year into its unique Postbaccalaureate Program, and 16 students per year into its International Dentist Program. Advanced educational programs (postgraduate and specialty) are offered in general dentistry, orthodontics, pediatric dentistry, periodontology, prosthodontics, oral medicine, dental public health, endodontics, and oral/maxillofacial surgery. Soon, the school will initiate a hospital-based General Practice Residency program.

In collaboration with the campus's Graduate Division, the school offers graduate academic programs such as the master of science and the doctor of philosophy degrees in oral biology. Our community relations and continuing education unit provides cutting-edge courses for dental professionals, both on our home campus and in outreach venues as well.

Central to the school's clinical educational and service programs are its 14 dental clinics, which are responsible for more than 130,000 patient visits per year and generate roughly $12 million in clinical income.

Our predoctoral curriculum offers dental and dental hygiene students the opportunity to become outstanding clinicians and seeks to cultivate in them the self-identity of being men and women of science. The intent is to train competent dentists and dental hygienists who understand the relationship between the craniofacial complex and the rest of the body and who see themselves as contributing significantly to improving oral health by integrating basic, behavioral, and clinical sciences for individuals and communities. Our postgraduate and graduate academic programs aim to educate clinicians in the various dental specialties as well as to become educators and scientists.

Organization and Funding of Academic and Research Programs

Organizationally, the school is highly decentralized, consisting of four departments which, in turn, are composed of 15 divisions. The structure has allowed the school to be highly responsive to opportunities in an ever-changing environment. By way of example, the UCSF School of Dentistry has ranked first in overall National Institutes of Health research funding among the 55 dental schools in the United States for each of the past 10 years, with an overall research budget today of approximately $25 million. This decentralized organization is illustrated in Table 1.

Table 1. UCSF School of Dentistry Organization

Department of Stomatology
Oral biology
Oral medicine
Oral pathology
Oral radiology
Periodontology
Department of Growth and Development
Orthodontics
Pediatric dentistry
Craniofacial anomalies
Developmental biology
Department of Oral and Maxillofacial Surgery
Department of Preventive and Restorative Dental Sciences
Behavioral sciences
Biomaterials and bioengineering
Clinical general dentistry
Dental hygiene
Endodontics
Preclinical general dentistry
Oral epidemiology
Dental public health
Prosthodontics

In addition to programs based in our four departments, the internationally known Center for the Health Professions is administered by the UCSF School of Dentistry.

Space does not permit detailing the plethora of research projects in which our faculty are engaged, but it is important to emphasize that much of this research is clinically based and aimed at improving the practice of dentistry, not only here at home, but abroad as well.

In addition, UCSF School of Dentistry considers itself the research institution with a heart, so many of our research projects are aimed at doing our part to try to improve the human condition.

UCSF Dentistry's Oral AIDS Center is one of the word's leading centers for the study of the oral manifestations of HIV

infection. Research to fight this terrible health problem is not a new commitment on the part of our UCSF faculty: the Oral AIDS Center was established in 1986 by a group of investigators and clinicians who had been working together since the early days of the AIDS epidemic. Director Dr. John Greenspan pointed out "The Oral AIDS Center comprises many of the leading clinicians and investigators in the field of oral and dental aspects of AIDS; several of these people were responsible for the discovery of hairy leukoplakia, its association with Epstein-Barr virus, and its relationship to HIV infection and AIDS."

"Our group," Greenspan added, "was among the first to describe the periodontal infections associated with HIV. Also, we were the first group to initiate a systematic study of the oral features of simian AIDS."

In addition to the Oral AIDS Center, the UCSF AIDS Specimen Bank was created more than 20 years ago. Yvonne De Souza, assistant director of the Specimen Bank, explained its function as "a repository for tissue biopsies and serum specimens for investigators involved in the search for the causative agent of this disease."

There are many other examples as well, including the school's NIH-funded Comprehensive Oral Health Research Center of Discovery, directed by Dr. Caroline Damsky; its new $11 million Center to Address Disparities in Children's Oral Health, under the direction of Dr. Jane Weintraub; its Oral Cancer Research Center, headed by Dr. Randall Kramer; and several NIH-funded research training initiatives, under Dr. Grayson Marshall.

Diversity and Outreach

Our school strives to assemble a diverse student body that accurately reflects the population of California. At present, 45 percent of DDS students are women. Total minority student enrollment is 67 percent; total underrepresented minority student enrollment is 12 percent. We operate a number of outreach and recruitment programs designed to increase the numbers of economically disadvantaged students and students from underserved areas. These programs augment our involvement in local career fairs, recruiting visits to high schools and colleges, and our Dental Aptitude Test preparation course.

The centerpiece is the Postbaccalaureate Program -- the only one in dentistry in the United States. Admitting 15 students per year, the program targets disadvantaged students who have failed to gain admission to a U.S. dental school. The one-year curriculum provides both residential and academic experiences to increase academic competitiveness. In the four years of the program's existence, 100 percent of postbaccalaureate students successfully gained admission to at least one U.S. dental school.

Other programs include the Dental Mentorship Program, which is designed for students who have an interest in the health professions and who wish to participate in career exploration activities. It provides students with limited hands-on experience in a clinical setting, matching them with a faculty or dental student mentor. Up to 25 students are selected to participate each academic year.

The UCSF Health Sciences Enrichment Program is a six-week residential summer offering designed to increase the math and science proficiency of economically disadvantaged high school students. This is done in the hope that they will become more academically competitive in college and, ultimately, consider applying to dental school. Students are recruited from three UCSF partnership high schools in San Francisco and two in Oakland.

The UCSF Summer Research Training Program is an intensive 10-week summer experience for undergraduate college students designed to address the under-representation of minorities and disadvantaged students in the biomedical and behavioral sciences. Students are placed in research laboratories of faculty with well-funded, highly organized research programs.

The UCSF Undergraduate Mentorship Program allows undergraduate college students, primarily from economically disadvantaged backgrounds, to spend an intensive seven-week summer session working with dental school faculty on clinical and research projects. The goal of the program is to target potential applicants for dental school at an early phase in their undergraduate academic development, to foster an appreciation and understanding of the dental profession, to understand the process of becoming a health care provider, and to become familiar with the UCSF School of Dentistry. The program accepts 30 college students each year from targeted colleges throughout the country that have a partnership with the UCSF School of Dentistry.

Community Service

UCSF has a history of community service dating back to the 1906 earthquake and fire that destroyed much of San Francisco: Dental students and faculty helped care for the injured. Building on that tradition, today's dental students are active participants in community service activities, expressed most commonly through the school's consistent tradition of providing care for the indigent.

Inasmuch as our patients are largely people on public assistance, people on fixed incomes, and the working poor, fees in our student clinics are set at 50 percent to 75 percent of that of community practitioners. Eighteen percent of our overall clinical income is from DentiCal, with some of our clinics posting DentiCal income in the 36 percent to 59 percent range. In 2001, 53 percent of DentiCal procedures done at all California dental schools were done at UCSF.

The most popular elective course in the school is one that allows students to take part in a clinic for the city's

homeless; roughly 100 dental and dental hygiene students participate each year. Visiting citywide shelters, students have the opportunity to conduct screenings and interviews for approximately 80 to 100 patients per month. Following the screenings, selected patients are transported to campus one night a week for operative care provided by students supervised by volunteer faculty. There is no charge for the services, since the students raise money for supplies and supervising faculty are volunteers.

Students who provide this care do so voluntarily. "It is hard to motivate yourself to come to the clinic for the homeless on the one Thursday night a month when I don't have to be in the clinic for school," said fourth-year student Gladys Lim. "But then I remember how genuinely appreciative of our work these people are. So I go."

Mary Anne Baysac, a second-year student, explained that her decision to attend UCSF was based partially on our school's commitment to this Community Clinic. "I did research before I came to UCSF, and one of the big reasons I am here is because I wanted to go to a dental school where I'd have a chance to be involved in community service."

Baysac is one of the student coordinators at the clinic. As such, she has the opportunity and responsibility to be involved with the organizational and logistical aspects of this outreach project. Steven Silverstein, DDS, who has been supervising students at the Community Clinic for nearly a decade, said, "Students have a chance here to be involved not only with the clinical aspects of providing quality dental care, but the logistical ones as well. I'm impressed, not only with how they find the time to be here, but with the quality of their work."

UCSF School of Dentistry outreach efforts extend to a whole variety of sites and diverse patient populations. The school is in a unique position to offer expert dental care to HIV-positive San Franciscans. We have multiple sites convenient to all neighborhoods of the city and are fortunate to have internationally renowned faculty and students who are well-experienced in providing expert, sympathetic treatment to patients with HIV disease. The program is funded under a Title I Ryan White contract with the city of San Francisco to provide $434,000 per year of dental care to HIV-infected city residents.

Our Alumni and Our Mission

One of the important outcomes measures of any school of dentistry is the quality of its human product: its graduates. Our graduates evince a commitment to lifelong learning and service to others.

"Continuing to learn keeps us energized in our profession," said Rob Huntley, DDS, president-elect of the UCSF Dental Alumni Association "This tradition of learning is important to UCSF Dental Alumni Association members, not just as dental professionals, but as human beings."

As a public institution, the school had a time when it relied relatively little on the generosity of its alumni, patients, and friends to support its core activities. That has all changed in recent years. In fact, only about 8.8 percent of the school's overall budget comes from state funds. Alumni play an ever-increasing role in providing quality education for the young women and men who will be joining them as UCSF graduates.

With technological advances, altered disease patterns, and changing health care delivery systems, dentistry has undergone substantial change in recent decades. The UCSF School of Dentistry has embraced these changes, and it seeks to help lead them. In so doing, it hopes to continue to contribute to the health and quality of life of all Californians.

Acknowledgments

The author wishes to gratefully acknowledge the contributions of Dr. James Anderson and Dr. Troy Daniels in carefully reviewing and revising the original manuscript and for making useful additions.

CDA JOURNAL, VOL 30, Nº10

Implementing an Infant Oral Care Program

Francisco Ramos-Gomez, DDS, MS, MPH; Bonnie Jue, DDS; and C. Yolanda Bonta, DMD, MS, MS

ABSTRACT The American Academy of Pediatric Dentistry, American Dental Association, American Public Health Association, Association of State and Territorial Dental Directors, California Dental Association, and California Society of Pediatric Dentists currently recommend that children receive their first dental evaluation within the first year of life. Providing early care to children from ages 6 months to 5 years offers an opportunity to educate and inform parents about their children's oral health. Anticipatory guidance -- counseling of parents by health providers about developmental changes that will occur in their children between health visits -- for children's dental health is an important part of preventive care. It may be the most effective way to prevent problems that traditional infectious disease models have failed to address, such as early childhood caries. The model of anticipatory guidance is valuable for dental professionals because it emphasizes prevention of dental problems rather than restorative care. A comprehensive infant oral care program utilizes (1) oral health assessment at regularly scheduled dental visits, (2) risk assessments, (3) counseling sessions with parents during either regular dental visits or additional visits scheduled if a child is deemed at risk, (4) preventive treatment such as the application of fluoride varnish or sealants, and (5) outreach and incentives to reinforce attendance. Facilitating access to early and regular dental care is a crucial part of any effective intervention strategy, and intervention techniques should be tailored to the community being served.

AUTHORS

Francisco J. Ramos-Gomez, DDS, MSc, MPH, is an associate professor in the Department of Growth and Development, Division of Pediatric Dentistry, at the University of California San Francisco and the director of Pediatric Dental Services at San Francisco General Hospital.

Bonnie L. Jue, DDS, is an adjunct faculty member at UCSF School of Dentistry and the University of the Pacific School of Dentistry. She is part of the research team at UCSF for the prevention of early **childhood caries, and is a private practitioner in San Francisco.**

C. Yolanda Bonta, DMD, MS, MS, is the director of technology, global professional relations, and marketing at Colgate Palmolive Company.

CDA JOURNAL, VOL 30, Nº10

Dental caries is a transmissible, infectious, chronic, preventable disease. It is five times more common than asthma and seven times more common than hay fever in children.1 Therefore, there is an increasing trend toward providing dental care to children before the age of 3 years. The rationale for early dental intervention with infants and parents includes determining the infant's risk status based on information from parents and performing a dental examination before potential dental problems have a chance to manifest and become more complex and costly to treat.2,3 The purpose of an infant oral health programs is to improve access to care, to provide counseling and anticipatory guidance for children age 6 months to 5 years, and to prevent early childhood caries. Most importantly, such programs are meant to make the dental team more proactive in preventive dentistry rather than reactive with full-mouth rehabilitation.4 Many children seeking emergency dental treatment have ECC, also known as baby bottle tooth decay or nursing caries. Its prevalence varies from 5 percent to 72 percent, depending on diagnostic criteria, age, race, and population.5 More than 40 percent of children in the United States have tooth decay by the time they reach kindergarten.6 The symptoms of ECC include severe pain, infection, abscesses, chewing difficulty, malnutrition, gastrointestinal disorders, and low self-esteem.7 Decay of primary teeth can affect children's growth, lead to malocclusion by adversely affecting the alignment of the developing permanent dentition, and cause poor speech articulation. ECC may be associated with future decay of the permanent dentition.8 According to Nowak and Warren, infants who are of low socioeconomic status, whose mothers have a low education level, who consume sugary foods, or who have high salivary Streptococcus mutans levels are 32 times more likely to have caries at the age of 3.5 years than children in whom those risk factors are not present.9 ECC patients are difficult to manage in the dental chair and are often impossible to treat under normal clinical conditions without the aid of conscious sedation or general anesthesia. All of these factors make this disease expensive to treat, and many of the patients' parents cannot afford to follow the dentist's recommendations. A recent study concluded that ECC is a preventable condition that may begin as an infant's teeth erupt.10

Figure 1. The dentist takes a young patient's health history.

Because of the scarcity of funds, lack of insurance, and difficulty in gaining access to dental providers, the population most in need of medical and dental care for ECC does not receive it. In the United States, more than 108 million children and adults do not have dental insurance, which is more than 2.5 times the number of those who do not have medical insurance. Children in this group are 2.5 times less likely than insured children to receive dental care.7 Yet, the children lacking dental insurance are three times more likely to have dental needs than those with either public or private insurance. These statistics reflect the urgent need to address this disparity, especially for children with special health care needs, who are nearly six times more likely to have unmet dental treatment concerns than their insured peers.11 The prevention and treatment of ECC are complicated by medical, physical, social, or psychological situations; and children affected by the condition tend to have more dental disease and more missing teeth than the general population.12

To further complicate matters, many caretakers and providers may not understand the necessity of regular dental care for primary teeth or the importance and timing of a child's first dental visit. Caretakers and providers may also be unaware that they can be the cause of their child's ECC, which has been found to be a very common infectious disease.13-15 By facilitating access to dental care and improving parents' knowledge of ECC and other dental problems, dental professionals can improve oral health for these patients.

Prenatal Care Intervention Programs for Pregnant Women

The earliest and probably best opportunity to provide education about infant oral health is during pregnancy. Outreach to pregnant women through prenatal programs effectively improves infant oral health.16 Women are highly motivated to give their child the best possible care, and the likelihood of better health for the child and reduced future dental costs can motivate parents. Because poor maternal periodontal health has been associated with pre-term birth and low birth weight, dental care and prenatal counseling for mothers may result in better pregnancy outcomes.17 Prenatal counseling programs should also educate parents about healthy feeding

Figure 2a. The dentist shows a young patient a toothbrush to observe his behavior.

Figure 2b. The dentist starts to examine the child.

Figure 3. The "knee-to-knee" position allows the dentist to examine a young child with the parent's help.

Figure 4. Counseling parents is an important part of the dental visit.

habits for their children, including the avoidance of using food to comfort them or modify their behavior.

Several studies have shown that reductions in S. mutans in pregnant women may result in delayed or diminished transfer of caries-inducing bacteria to infants. Brambilla and colleagues showed that a low-cost program of dietary counseling, dental prophylaxis and instruction, and appropriate use of systemic and topical fluoride and topical chlorhexidine during pregnancy could delay or prevent S. mutans infection in children of infected mothers, which resulted in lower overall rates of dental caries in children.18 Another study found that pregnant women who had dental visits every six months beginning sometime before they gave birth reduced the incidence of caries and of S. mutans colonization in their children.19

A new University of California at San Francisco program based at San Ysidro Community Health Center will work with pregnant women beginning in the second trimester of pregnancy to proactively manage S. mutans levels. The intention is to educate the mothers-to-be about the infectious nature of ECC and to monitor their S. mutans levels. Fluoride varnish treatments will begin for a subgroup of children when teeth erupt and will continue until the children are 3 years old. The cariogenic threshold levels of S. mutans and Lactobacilli are lower in younger children and toddlers than older children, and consequently infants and toddlers are at greater risk.10 San Ysidro, Calif., is a low-socioeconomic-status area with a large migrant Hispanic community who engage in agricultural work and are affected by border health issues. Successful preventive efforts there would provide a valuable model for decreasing disparities in the availability and delivery of dental care in other disadvantaged communities.

CDA JOURNAL, VOL 30, Nº10

Intervention Programs for Children

For too long, "intervention" has occurred only after dental disease has been detected. The infection can be present before carious lesions are observed clinically. Thus, the treatment of caries through the use of fillings and other interventions does not take place until after the child's mouth has already been damaged. The focus of the intervention strategies outlined below is to prevent the initial formation of dental caries by counseling caregivers on proper dental hygiene and by treating the mouth with antibacterial and tooth-protecting substances.

Children should be screened and actively recruited for prevention programs. Every child, starting at 1 year of age, should have a dental evaluation encompassing comprehensive preventive care at least twice a year. Evaluations should include four primary components: oral health/risk assessment, counseling, preventive treatment, and outreach and incentives.

Risk Assessment Visit

Risk assessment should be part of a regular, thorough oral-health assessment visit. Risk assessment is based on the recommendations of the American Academy of Pediatric Dentistry for anticipatory guidance in pediatric dental care.20 It entails several visits to a dentist, from the first year of life to age 5 years. Risk-assessment visits should also include a diet evaluation survey, as well as a survey about parental knowledge, attitudes, and behavioral practices including oral health status of siblings and parents, and socioeconomic status (**Figure 1**). Patients from underserved communities are at higher risk for dental decay. Anticipatory guidance could include checks of S. mutans and Lactobacilli levels, particularly if a more cost-effective means of testing becomes available. Other checks may include examinations of calcium, phosphate, and fluoride levels in saliva, ECC development, and effects of drug-induced caries.

Before infants or toddlers undergo a dental examination, the dental team should establish a positive relationship with the patient and the parents. To initiate an effective connection with the child, the examiner can introduce himself to the child and parent with a toothbrush and observe the child's behavior (**Figure 2**a). The clinician may begin the examination procedure by placing the child in the dental chair or, in the case of very young children, in the "knee-to-knee" position. In this position, the examiner and parent sit face to face with their knees touching to make a comfortable support for the young infant (**Figure 2**b). Then the child, facing the parent, wraps his or her legs around the parent's waist and lies down across the laps of the examiner and parent (**Figure 3**). In this position, the examiner can look directly into the patient's mouth and evaluate the teeth. The handle of the toothbrush can then be used as a mouth prop or mouth opener to prevent sudden closure. The child's oral condition may be assessed with a dental mirror, and the findings recorded. Relevant information, as well as recommendations for follow-up, is passed along to the parent.

Counseling Visit

Based on the same recommendations as those for risk assessment, counseling of parents entails additional visits if the child is at high risk (**Figure 4**). Counseling visits should cover oral development, fluoride intake, oral hygiene/health, habits, diet and feeding practices, and injury prevention. All of these issues depend upon the age of the child, with specific recommendations for different ages. The following guidelines for counseling topics and risk assessment issues are organized by major topics with age-specific concerns highlighted in the text.

Oral Development

Oral development issues for 6- to 12-month-old children include eruption of the first primary tooth, planning for the eruption of primary molars, and the formation of permanent teeth.21 Dentists should show oral anatomic landmarks to parents during the examination of the infant and discuss oral stimulators, such as pacifiers. It is also important to review patterns of eruption and teething facts and myths. Parents need to be educated about the important role primary teeth play in biting and chewing for healthy nutrition, and speaking clearly to promote self-esteem and education. For parents of 12- to 24-month-old children, understanding completion of the primary dentition, concepts of occlusion and arch length and spacing, and formation of permanent teeth are important.22 The dentist should discuss the importance of space maintenance and the effects of bruxism, and review molar, canine, and incisal positions with parents during examination. By the age of 6 years, children will undergo the exfoliation of primary teeth and the eruption of the first permanent teeth.23 Molar occlusion and healthy gums are important issues to discuss at this time. The dentist should review patterns of eruption, discuss permanent molar occlusion with parents, point out permanent molar occlusal anatomy, and describe healthy periodontal tissues.

Fluoride

Topical fluoride use is not recommended until after the age of 6 months. However, systemic fluoride intake may be beneficial from birth, although there is controversy regarding this approach. Some researchers suggest systemic fluoride from birth may not be as beneficial as topical applications and its excess could lead to fluorosis. Children should be assessed at all visits for fluoride need based on dental status and sources of fluoride (water and food inside and outside of the home). Dentists should be aware of community water fluoridation, or the lack of it, in the region where their patients live. If fluoride use is indicated, it should be administered in an age-appropriate

Figure 5 thorough 9. Figures 5 through 9. Early appointments also consist of preventive measures.

Figure 6.

Figure 7.

Figure 8.

fashion. The dentist should be certain to educate parents about the benefits of systemic fluoride action, which primarily involves fluoridation of the family's water supply or, if necessary, fluoride supplements for the child, prescribed by the pediatrician or dentist. For the 12- to 24-month-old child, proper use of topical fluoride depending on method of administration, such as fluoride-containing dentifrices, can be introduced as long as the child is able to spit out the substance thoroughly. The issues of fluoride toxicity and safety and management of accidental ingestion should always be discussed with the parents or caretakers.24

Oral Hygiene and Health

The frequency of dental visits should be based on risk assessment, and the importance of these visits should be discussed with parents. This allows the health care provider to customize a dental prevention program for the individual patient; some patients may need exams every six months, while others may benefit more from three-month recall appointments. One of the most frequent variables in caries risk assessment models is past caries experience.25,26 Other risk indicators may include socioeconomic factors, such as income, race or ethnicity, and psychosocial factors, such as health attitudes.27,28 For children of all ages, regular dental care is important. Appropriate oral hygiene techniques vary with the age of the child.

For infants 6 to 12 months of age, microflora acquisition from maternal or caregiver sources should be explained to parents; and the dentist should review oral hygiene techniques for infants with the caregiver, using a soft brush and pea-sized amount of dentifrice or no dentifrice. Parents of children 12 to 24 months of age should be educated about the type of brush to use with the child, the role of a dentifrice in oral hygiene and health, the roles of the child and parent in

CDA JOURNAL, VOL 30, Nº10

Figure 9.

brushing, and the frequency and setting of oral hygiene. The dentist should review home oral care procedures and compliance and work with parents to solve problems. From the ages of 2 to 6 years, the child's role in maintaining his or her own oral health becomes more important; and dentists should review home oral care procedures and compliance and recommend that the child begin brushing with parental supervision and assistance. By the time the child's first permanent molar erupts, the parents should be informed of the benefits of dental sealants, as they play an important role in caries prevention.29 This is also the time to explain dental radiographs and discuss parental separation or presence at dental visits and normal child anxiety.24,30-32

Habits

Certain sucking behaviors can be deleterious to dental health.32 Early discussion of these habits with parents or guardians of 6- to 12-month-old infants should include the role of the mouth in infantile exploration, pacifier use (safety and hygiene issues), and the effects of digit-sucking and breast-feeding on the mouth. Visits for 12- to 24-month-old children should include a discussion or review of nonnutritive sucking and the safe use of a pacifier. Discussions with parents about how to stop habitual thumb-sucking behavior in 2- to 6-year-old children are warranted.

Diet and Feeding Practices

When the baby is 6 months of age, the mother should ask her pediatrician or dentist about fluoride supplements for the baby, especially if the family lives in a community where the water is not fluoridated. The importance of putting the baby to bed without a bottle should also be stressed in this early phase of the baby's life to prevent the habit from forming. ECC can develop if the baby is allowed to suck on a bottle containing sweetened liquid during the night, as sugars can cling to teeth and initiate the decay process, unless the content of the bottle is water.

Injury Prevention

Oral trauma can be a problem at any age. Dentists should give parents of 6- to 12-month-old infants information about what to do if an infant experiences oral trauma and contact numbers in case of emergency. As children become older and more mobile (12 to 24 months), electrical cord injuries and trauma to primary teeth are more likely injuries. Dentists should review normal dental and oral anatomy with parents during the examination. Parents should be provided with information on home child-proofing, electrical cord safety, use of car seats, and prevention of chemical substance ingestion, including exposure to lead. Recent studies have shown that salivary gland function is impaired by prenatal exposure to lead, which is a serious problem in many low-income inner-city families and may increase susceptibility to caries.35 Parents should also be encouraged to develop plans for oral trauma management for children in preschool and child care. Children in the 2- to 6-year-old age group may sustain oral and dental injuries from sports activities (such as bicycling or skating) or car accidents. Injuries at this age may affect not only primary but also permanent teeth. Dentists should encourage the use of protective sports equipment (helmets, pads, and mouthguards) when appropriate and review differences between primary and permanent teeth with parents during examination.36 Parents should again be encouraged to prepare a plan for home and school for oral injury and treatment options, and to keep children in car seats during travel as required by law.

Preventive Treatment

Preventive treatment (Figures 5 through 9) includes the application of fluoride varnish such as Duraphat (Colgate), Duraflor (Pharmascience), or CavityShield (OMNI). A semi-annual application of varnish has been tested most often.37,38 Other studies have shown that an intensive treatment of three applications of Duraphat in one week per year (over three to four years) may reduce caries by 46 percent to 67 percent in proximal surfaces.39,40 The regimen of Twetman and colleagues, which consists of varnish applications at three-month intervals, reduces caries by 40 percent to 51 percent among children age 4 to 5 years.41 Furthermore, fluoride varnish treatments can also inhibit carious lesions in pit and fissure surfaces by up to 50 percent to 70 percent.42,43

Additionally, brushing or swabbing the teeth with a very small amount of chlorhexidine solution can decrease S. mutans and Lactobacilli in the mouths of babies at risk. Other studies have shown that swabbing with Betadine (povidone iodine) can also reduce the levels of these pathogens.19,44 Recent clinical studies support findings that

CDA JOURNAL, VOL 30, Nº10

suggest that the replacement of sucrose with sorbitol and xylitol may significantly decrease the incidence of dental caries. Subjects using these sugar substitutes had a 30 percent to 60 percent decrease in dental decay. The xylitol or sorbitol was used as the sugar substitute in chewing gum or toothpaste, in which the xylitol demonstrated the highest rate of caries reduction.45 Another study, involving Head Start preschool students, suggests that chewing xylitol gum is well-accepted by children.46 Furthermore, it has been concluded that mothers who regularly used xylitol chewing gum prohibited the transmission of S. mutans to their children, thereby preventing dental caries from forming.47 However, this mode of delivery is not feasible for most infants and toddlers; therefore, the "Fall-Asleep Pacifier," a slow-release administration device, was studied as a prophylactic measure against oral infection with S. mutans and dental caries in 1-year-old children. The results were beneficial, possibly because of the advantages of the prolonged intraoral bioavailability of the NaF-xylitol-sorbitol preparation administered via the pacifier.48

Children should be followed prospectively for at least three years, and their oral health should be assessed routinely. Thereafter, the goal should be to keep the child as regular patient in the office to receive and maintain ongoing care as part of a regular dental home. Treating patients from an early age has an unexpected benefit on behavior modification: It desensitizes them to dental environment and the dental experience. It is wonderful to see young children jump into the dental chair and eagerly await their treatment.

Outreach and Incentives

Outreach and incentives are intended to reinforce attendance at the assessments and to reinforce habits recommended in the counseling visits. The surgeon general's oral health report cited factors affecting oral health seeking behaviors of pregnant and parenting teens. Many of the participants cited a general need for improvements in the delivery of care by health professionals, including better oral health teaching methods, better appointment and reminder systems, and shorter waiting times for appointments.

These concerns can be addressed by the dental office or clinic staff by incorporating the following guidelines into their regular protocol. By setting their next appointments even before they leave the office, the patients may feel more accountable for the next visit. The patients should be called a few days or the day before their appointment to confirm the date and time; this process may greatly reduce the number of missed appointments and unproductive clinic time. In addition, the appointment should include time for counseling the patient and parents. This should be done in a culturally and linguistically sensitive manner. This practice allows the practitioner more time to educate the parents on dental health care without falling behind schedule. Advocacy and counseling by the hygienist was helpful in the Spokane Partnership Program in Spokane, Wash.49

Incentives may include dental care products, such as toothpaste or toothbrushes, and age-appropriate toys. The incentives should be contingent on increases in the assessed knowledge of the caregiver (e.g., not putting a child to sleep with a bottle) and favorable results of risk assessment. Achievement charts can be monitored at home as a game with the child.

Conclusion

ECC is a significant dental disease that can have devastating effects on both the primary and secondary dentition. The burden of this disease is disproportionately carried by low-income and other underserved children. For too long, the model of treatment has been to address an already diseased dentition; in contrast, a program based on anticipatory care guidance would seek to shift the focus to the prevention of caries in children (**Table 1**).

From birth to 6 months of age, before the baby's first teeth erupt, it is essential for the mother to maintain her oral health. New mothers should see a dentist for regular dental exams and cleanings, usually every three to six months. These visits have the important benefit of reducing the amount of bacteria in the mother's mouth, which can adversely affect the dental health of the child. The baby's gums should be cleaned daily with a clean, damp washcloth or piece of gauze starting within the first few days of birth. Gently wiping the gums and tongue after feedings keeps the baby's mouth clean and helps the child become accustomed to regular dental maintenance at an early age.

Primary teeth may begin to erupt around the age of 6 months. Parents should be instructed in how to gently clean the teeth and gums with a soft, child-sized toothbrush or a clean, damp washcloth. Between 5 and 12 months, babies should be introduced to drinking from a training cup. At 12 to 18 months, babies should be weaned off the bottle or from nursing.

By 18 to 24 months of age, the toddler should be off the bottle or nursing and the family should be in the habit of taking the child to the dentist for regular check-ups, about twice a year. The dentist might ask about the child's eating patterns and warn about risks from constant snacking. The baby's teeth should be brushed in the morning and before bedtime, and the child can begin to learn how to hold the toothbrush at this age. However, the child will need assistance in brushing the teeth for years to come, as most children do not develop the coordination to brush effectively by themselves until they are 6 to 8 years old. One study has determined that children who brush their teeth themselves are more likely to have visible plaque after brushing than children whose teeth are cleaned by their parents.50

Table 1. Counseling Visit Time Table

Prenatal

Mothers should take care of their own oral health.

Mothers should know that periodontal disease is associated with prematurity and low birth weight.

Infancy

Babies should begin regular visits to a dentist when the first tooth appears, no later than 12 months of age.

The dentist will:

- Examine the child's mouth, check for cavities and potential problems with teeth and gums.
- Teach parents how to care for the child's teeth and gums.
- Explain how diet and feeding patterns can cause decay.
- Help parents understand the child's oral development.
- Check to be sure the child gets proper amount of fluoride
- Schedule a continuing care/recall visit based on the child's oral health needs.

Parents should:

- Prepare baby for brushing by cleaning mouth, gums, and tongue with gauze or a washcloth before teeth appear.
- Brush teeth at least twice a day: after breakfast and before bed.
- Use a child-sized toothbrush; brush with only a smear-sized amount of fluoride toothpaste.
- Know that signs of a healthy mouth include pink gums, white teeth, and no mouth sours.
- Know that good oral hygiene is especially important for babies with special needs.

Early Childhood

Twenty baby teeth will have come in by approximately 30 months of age. Young children should be in the habit of visiting the dentist at least twice a year for regular check-ups.

The dentist will:

- Conduct a thorough exam and risk-assessment, similar to infancy exams.
- Reinforce concepts discussed in infancy exams.
- Help address problems like prolonged digit-sucking and pacifier use after age 4.

Parents should:

- Begin teaching preschooler to brush by gripping the brush for the child and guiding it around the mouth.
- Continue helping child brush until at least age 6 years.
- Increase toothpaste to pea-sized amount as child learns to spit after brushing.
- Coach brushing until age 11, when most children can brush on their own.

Source: Based on recommendations by the American Academy of Pediatric Dentistry

So, even though children should be encouraged to try brushing their own teeth after the age of 2, the parents or caretakers must still continue to take an active role in the child's brushing and flossing routine.

This proactive approach -- including services and education that emphasizes risk assessment, regular dental appointments, counseling sessions, preventive treatment, and outreach and incentives -- makes it possible for dental practitioners to greatly reduce oral infections among affected populations. Providing oral health education and counseling to pregnant women in a culturally and linguistically sensitive manner may also be an effective means of reducing both the risk of adverse pregnancy outcomes and the incidence of ECC in their young children. By establishing an infant oral care program in their practices, dentists can provide a much needed service to their existing patients, while attracting new patients. In addition, adopting a preventive approach to dental care may decrease the need for costly restorative procedures, which could also deliver a corresponding savings for the public health sector. It is a "win-win" situation for all involved by making healthy babies healthier.

Acknowledgments

The authors thank all the staff and faculty of the UCSF Family Dental Center at San Francisco General Hospital and of the Chinatown Health Center Dental Clinic for their support and Dr. Jane Weintraub, Dr. Bob Isman, Helen MacDiarmid, and Stephen Ordway for editorial assistance.

References

1. US Department of Health and Human Services, *Oral Health in America*: A Report of the Surgeon General. US Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health, Rockville, MD, 2000.
2. Nowak AJ, Casamassimo PS, Using anticipatory guidance to provide early dental intervention. *J Am Dent Assoc* 126:1156-63, 1995.
3. Ramos-Gomez FJ, Shepard DS, Cost-effectiveness model for prevention of early childhood caries. *J Calif Dent Assoc* 27:539-44, 1999.
4. Brown LJ, Wall TP, Lazar V, Trends in total caries experience: permanent and primary teeth. *J Am Dent Assoc* 131:223-31, 2000.
5. Kaste LM, Marianos D, et al, The assessment of nursing caries and its relationship to high caries in the permanent dentition. J Public Health Dent 52:64-8, 1992.
6. Pierce KM, Rozier RG, Vann WF Jr, Accuracy of pediatric primary care providers' screening and referral for early childhood caries. Pediatrics 109(5):E82-2, 2002.
7. US Department of Health and Human Services, Oral health in America: a report of the surgeon general -- executive summary. U.S. Department of Health and Human Services, Rockville, MD, 2000, pp 1-13.
8. Almeida AG, Roseman MM, et al, Future caries susceptibility in children with early childhood caries following treatment under general anesthesia. *Pediatr Dent* 22(4):302-306, 2000.
9. Nowak AJ, Warren JJ, Infant oral health and oral habits. Pediatr Clin North Am 47:1043-66, 2000.
10. Ramos-Gomez FJ, Weintraub JA, et al, Bacterial, behavioral and environmental factors associated with early childhood caries. J Clin *Pediatr Dent* 26:165-73, 2002.
11. Manski RJ, Edelstein BL, Moeller JF, The impact of insurance coverage on children's dental visits and expenditures, 1996. *J Am Dent Assoc* 132:1137-45, 2001.
12. University of the Pacific School of Dentistry, Practical protocols for the prevention of dental disease in community settings for people with special needs -- 2002 consensus protocol.
13. Smith DJ, Anderson JM, et al, Oral streptococcal of infants. Oral Microbiol Immunol 8:1-4, 1993.
14. Berkowitz RJ, Jones P, Mouth to mouth transmission of the

bacterium Streptococcus mutans between mother and child. Arch Oral Biol 30:377-9, 1985.
15. Li Y, Caufield PW, The fidelity of initial acquisition of mutans streptococci by infants from their mothers. *J Dent* Res 74:681-5, 1995.
16. Casamassimo PS, Maternal oral health. Dent Clin North Am 45:469-78, 2001.
17. Dasanayake AP, Poor periodontal health of the pregnant woman as a risk factor for low birth weight. Ann Periodontol 3:206-12, 1998.
18. Brambilla E, Felloni A, et al, Caries prevention during pregnancy: results of a 30-month study. *J Am Dent Assoc* 129:871-7, 1998.
19. Slavkin HC, Streptococcus mutans, early childhood caries and new opportunities. *J Am Dent Assoc* 130:1787-90, 1999.
20. Journal of the American Academy of Pediatric Dentistry, Pediatric Dentistry. Special Issue: Reference manual 23(7), 2001-2.
21. Kohler B, Andreen I, Influence of caries-preventive measures in mothers on cariogenic bacteria and caries experience in their children. Arch Oral Biol 39:907-11, 1994.
22. Jenkins S, Addy M, Newcombe R, Evaluation of a mouthrinse containing chlorhexidine and fluoride as an adjunct to oral hygiene. J Clin Periodontol 20:20-5, 1993.
23. Aaltonen AS, Tenovuo J, Association between mother-infant salivary contacts and caries resistance in children: a cohort study. *Pediatr Dent* 16:110-6, 1994.
24. Zickert I, Emilson CG, Krasse B, Effect of caries preventive measures in children highly infected with the bacterium streptococcus mutans. Arch Oral Biol 27:861-3, 1982.
25. Abernathy JR, Graves RC, et al, Development and application of a prediction model for dental caries. Community Dent Oral Epidemiol 15:24-8, 1987.
26. Beck JD, Weintraub JA, et al, University of North Carolina Caries Risk Assessment Study: comparisons of high risk prediction, any risk prediction, and any risk etiologic models. Community Dent Oral Epidemiol 20:313-21, 1992.
27. Powell LV, Caries risk assessment: relevance to the practitioner. *J Am Dent Assoc* 129:349-53, 1998.
28. Gillcrist JA, Brumley DE, Blackford JU, Community socioeconomic status and children's dental health. *J Am Dent Assoc* 132:216-22, 2001.
29. Dennison JB, Straffon LH, Smith RC, Effectiveness of sealant treatment over five years in an uninsured population. *J Am Dent Assoc* 131:597-605, 2000.
30. Berkowitz RJ, Turner J, Green P, Primary oral infection of infants with Streptococcus mutans.
Arch Oral Biol 25:221-4, 1980.
31. Li Y, Caufield PW, The fidelity of initial acquisition of mutans streptococci by infants from their mothers. *J Dent* Res 74:681-5, 1995.
32. Rogers AH, The source of infection in the intrafamilial transfer of Streptococcus mutans. Caries Res 15:26-31, 1981.
33. Berkowitz RJ, Turner J, Hughes C, Microbial characteristics of the human dental caries associated with prolonged bottle-feeding. Arch Oral Biol 29:49-51, 1984.
34. Falco MA, The lifetime impact of sugar excess and nutrient depletion on oral health. Gen Dent 49(6):591-5, 2001.
35. Bowen WH, Response to Seow: biological mechanisms of early childhood caries. Community Dent Oral Epidemiol 26 (Suppl 1):28-31, 1998.
36. Ranalli DN, Prevention of sports-related traumatic dental injuries. Dent Clin North Am 44(1):35-51, 2000.
37. Seppa L, Studies of fluoride varnishes in Finland. Proc Finn Dent Soc 87:541-7, 1991.
38. de Bruyn H, Arends J, Fluoride varnishes -- a review. J Biol Buccale 15:71-82, 1987.
39. Petersson LG, Arthursson L, et al, Caries-inhibiting effect of different modes of Duraphat varnish reapplications: a 3-year radiographic study. Caries Res 25:70-3, 1991.
40. Skold L, Sundquist B, et al, Four-year study of caries inhibition of intensive Duraphat application in 11-15-year-old children. Community Dent Oral Epidemiol 22:8-12, 1994.
41. Twetman S, Petersson LG, Pakhomov GN, Caries incidence in relation to salivary mutans streptococci and fluoride varnish applications in preschool children from low- and optimal-fluoride areas. Caries Res 30:347-53, 1996.
42. Petersson LG, On topical application of fluorides and its inhibiting effect on caries. Odontologisk Revy S34:1-36, 1975.
43. Seppa L, Tuutti H, Luoma H, Three-year report on caries prevention of using fluoride varnishes for caries risk children in a community with fluoridated water. Scand *J Dent* Res 90:89-94, 1982.
44. Lopez L, Berkowitz, et al, Topical antimicrobial therapy in the prevention of early childhood caries. *Pediatr Dent* 21(1):9-11, 1999.
45. Hayes C, The effect of non-cariogenic sweeteners on the prevention of dental caries: a review of the evidence. *J Dent* Educ 65:1106-9, 2001.
46. Auto JT, Court FJ, Acceptance of the xylitol chewing gum regimen by preschool children and teachers in a Head Start program: a pilot study. *Pediatr Dent* 23:71-4, 2001.
47. Isokangas P, Soderling E, et al, Occurrence of dental decay in children after maternal consumption of xylitol chewing gum, a follow-up from 0-5 years of age. *J Dent* Res 79:1885-9, 2000.
48. Aaltonen AS, Suhonen JT, et al, Efficacy of a slow release device containing fluoride, xylitol, and sorbitol in preventing infant caries. Acta Odontol Scand 58:285-92, 2000.
49. Milgrom P, Hujoel P, et al, Making Medicaid child dental services work: a partnership in Washington state. *J Am Dent Assoc* 128:1440-6, 1997.
50. Habibian M, Roberts G, et al, Dietary habits and dental health over the first 18 months of life. Community Dent Oral Epidemiol 29:239-46, 2001.
To request a printed copy of this article, please contact/ Francisco J. Ramos-Gomez, DDS, MS, MPH, UCSF School of Dentistry, 707 Parnassus Ave., Room D1021, Box 0753, San Francisco, CA 94143-0753.

CDA JOURNAL, VOL 30, Nº10

A Dental School That Serves the Practicing Profession

ARTHUR A. DUGONI, DDS, MSD

AUTHOR

Arthur A. Dugoni, DDS, MSD, is dean and professor of orthodontics at the School of Dentistry, University of the Pacific.

The School of Dentistry at the University of the Pacific is a bridge between one of the great private universities in the West and one of the nation's most respected professions. The mission of Pacific is to provide a superior, student-centered learning environment integrating liberal arts and professional education, and preparing individuals for lasting achievement and responsible leadership in their careers and communities. Among its core values are academic distinctiveness, building relationships with our communities, and using outcomes data for continuous improvement. This makes it a unique home for educating competent beginning dental practitioners in a humanistic environment. Pacific may be the only dental school in the United States that is not part of a research-intensive university or a major health sciences campus with their emphases on medicine, basic science research, and cost recovery through tertiary care. Our environment is the world of the private practitioner.

It is the purpose of the School of Dentistry to serve the needs of the dental profession. Our graduates are competent to begin modern private practices and remain current throughout their careers or to enter the best graduate programs. Our professional development program emphasizes hands-on skill-building courses. The research we conduct focuses on clinical applications to the practice of dentistry. We have initiated new programs in oral and maxillofacial surgery and dental hygiene in response to needs identified by the profession. Our clinics provide safety-net services to population groups such as the medically compromised and transient and disadvantaged communities the profession cannot easily reach. And Pacific continues to provide its share of exceptional leaders for the profession.

Competency-Based Education

It is no surprise that competency-based professional education began at Pacific. Competency means the capability to begin independent professional practice and acceptance of responsibility for continuous professional development. This replaces the old model where the curriculum was driven by a desire of the faculty to tell everything they know. There are three problems with that older view. With a big enough faculty and an exploding knowledge base, the curriculum would expand beyond reasonable limits. There is always the danger that what teachers find interesting and important may not

Figure 1. Dr. Phil Oppenheimer, dean of the Thomas J. Long School of Pharmacy; Dr. Donald DeRosa, president of the University of the Pacific; and Dr. Arthur Dugoni, dean of the UOP School of Dentistry, help break ground at UOP's new $21 million Health Sciences Learning Center and Clinics on the Stockton campus. The facility will house a state-of-the-art clinic for the dental school's new hygiene program and its expanded Advanced Education in General Dentistry program in the Central Valley.

Figure 2. Sohail Saghezchi, class of 2002, presents his senior research project on gene therapy in human oral cancer cells to faculty at UOP School of Dentistry's annual Research Day.

efficiently match what practitioners need. And finally, learners should be given the opportunity and ultimately full responsibility for being able to direct their own professional growth.

Competency-based professional education begins by identifying the skills, understanding, and supporting values required to begin practice. The faculty at Pacific has identified 59 such competencies. Among these are "evaluate the range of available dental therapies for individual patients' dental, medical, and personal situations, including advantages, disadvantages, and risk-benefits rations," "perform simple and surgical tooth and root extractions," "function as a patient's primary and comprehensive oral health care provider," and "think critically, solve problems, and base dental decisions on evidence and theory." If this sound more like what practitioners do than schoolwork for students, that is as it should be. Competencies, not numerical requirements, drive the graduation decision.

The competency approach to curriculum design is now practiced in all U. S. and Canadian dental schools. It is a requirement of the accreditation process. Competency-based education is also beginning to appear in other professional programs such as nursing, dietetics, law, and business. But Pacific remains the only dental school that drives its educational program based entirely on the needs of practitioners. For example, we are the only dental school that completes the four-year predoctoral program in 36 months. That is possible because we have eliminated the activities that do not directly support initial competence. This has required careful differentiation of what is essential compared with what is nice to know and awareness of how the profession is changing. The faculty has also developed the perspective that the curriculum belongs to the whole faculty and is not a collection of disciplines that fight for clock hours.

Competency-based education views learning as a 10- to 15-year journey through the predictable stages of novice, beginner, competent, proficient, and mastery or expertise. The first three stages are accomplished in dental school. The four-academic-years-in-36-months curriculum at Pacific is accomplished by dramatically shortening the novice stage and somewhat telescoping the beginner stage. Clinical education, where competency is achieved, is actually expanded. Pacific students are among those in the top half dozen in the country in clinical experiences, consistently performing 10 percent to 15 percent more dentistry than the national average, and doing so with one fewer year of overall education. Pacific was a pioneer in the early 1970s of the comprehensive patient care model of clinical education. This is an essential foundation for competency-based education because dentists must learn to integrate a wide repertoire of skills, understanding, and values in realistic settings. Novices are very good at doing what the faculty tells them to do, and beginners are good at getting requirements (doing what they need to do). Only competent practitioners are good at doing what is in the patient's best interest.

Not all learners achieve competence on the same time schedule. Years ago, to break the traditional lock-step sequencing of the dental school curriculum, we introduced "breathing spaces" at key points where students who needed tutorial assistance could get it. It turns out that this also provided the opportunity for a rich array of selective courses throughout the three years. In some years, a few students are

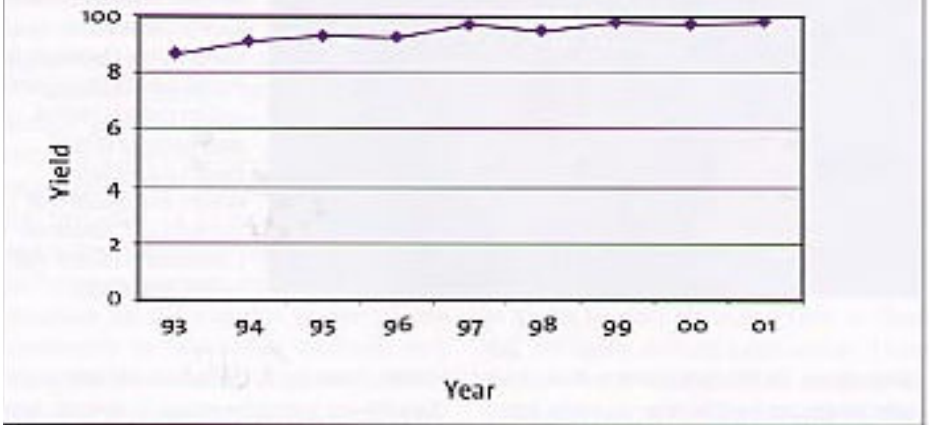
retained at the end of three years for additional clinical experiences. Last year, we added enrichment experiences in the final quarter for nine students who were deemed competent before the nominal graduation date.

The proof of the competency-based approach to dental education is in the performance of our graduates. Table 2 shows the four-year yield of our program since 1993. This is not the pass rate on state boards; it is the proportion of students who first enter the program and are qualified to practice independently four years later. The two or three percent who do not achieve competency include those who have difficulties with state or national boards, are extended for further training by the faculty or who repeat, and those who are dismissed, change their career goals, or experience severe illness or other personal problems. Our three-year yield, the proportion that is qualified to practice in 36 months, has now reached 87 percent.

By focusing on the needs of practicing professionals rather than academic disciplines, Pacific has proven that dental education can be effective and efficient.

Table 1.

Four-year Academic Yield at the University of the Pacific



Humanism and Leadership

I have frequently stated that we have the privilege of educating outstanding young men and women at Pacific, and along the way they become doctors. A large part of being a professional is who one is, not just how smart or talented one happens to be. It will not do just to train the head and hands and leave out the heart. Although we teach modalities that are state of the art; the care that our graduates provide must be state of the heart.

Humanism and leadership are not optional at Pacific. Among the competency statements developed by the faculty are "establish and maintain patient rapport" and "participate in organized dentistry." We feel the profession expects and deserves this of the young people entering the dental profession.

Humanism is a major part of the culture of the dental school. Over the years, faculty and administrators have learned how to challenge and motivate

Figure 3. CDA Speaker of the House and Pacific Alumnus Dr. Sig Abelson, '69, with his wife, Teri Abelson, receives a thumbs up from their son, Dr. Michael Abelson, '89, for receiving the School of Dentistry's prestigious Medallion of Distinction Award at the 103rd Annual Alumni Association Meeting.

Figure 4. UOP School of Dentistry Dean Dr. Arthur A. Dugoni congratulates Courtney Inada, class of 2004, as she receives her white coat and certificate during the White Coat Ceremony at the Herbst Theatre in San Francisco. The ceremony focuses on the importance of professionalism, ethics, and responsibility to the community as the second-year dental students begin their new roles as health care providers.

Figure 5. Student volunteers from UOP's Student Community Outreach for Public Education organization provide dental screenings and oral health education to adults and children at the annual Chinatown Community Health Fair in San Francisco.

students to excel, how to correct problems in patient care, and even how to take criticism from students in ways that preserve students' self-respect and individuality. There has been a self-selection for these traits. The students' view matters. In regular meetings, students meet with the administration and faculty on a regular basis to discuss how the program can be improved. All student suggestions are taken seriously, investigated, and acted upon if appropriate; and then students are told what happened. Students are active members of all committees, including the faculty appointment, promotion, and tenure committees. Participation, including funding for attendance at national meetings, is encouraged for student representatives to the American Dental Association, the American Student Dental Association, the California Dental Association, the American Dental Education Association, and several research associations. Student government is active and currently includes 12 percent of the entire student body.

Students in all dental schools have been active in community service and outreach. Screenings, foreign missions, and fund-raising activities are typical examples. At Pacific, the emphasis has been on full participation. For the past two years, 100 percent of each graduating class has participated in some form of community outreach. This program -- called SCOPE, for Student Community Outreach for Patient Education -- is run by students as a way of instilling the values of "giving something back to the community." The profession should be proud of this level of involvement.

The values of humanism and leadership learned in dental school continue through one's professional careers. They affect the way dentists think of themselves and how they interact with their patients and staff. These values also influence involvement in the profession. Two ADA presidents in recent years were Pacific faculty members (Drs. Arthur Dugoni and Burton Press). Seventeen percent of the dentists practicing in California are graduates of Pacific. A count from the Leadership Directory of the California Dental Association reveals that 41 percent of the state and component society officers in this state are Pacific graduates. The contributions of talent, time, and treasure to the profession and the school speak volumes regarding the satisfaction our alumni feel with their careers. Humanism and competency together are a powerful mix and a strong foundation for the future of the profession.

Helping Meet the Needs of Special Patient Populations

Every dentist cannot provide care for every type of patient. But the profession as a whole needs to provide this broad range of services to retain the public's trust. Each of the dental schools in California helps provide such "safety-net" coverage, and Pacific has its own special niches.

Dental schools have traditionally been clinics where patients traded time for money: They pay a little less because the care takes a little longer. We are not satisfied with that arrangement at Pacific. One of the elements in our overall mission statements is to "provide patient-centered, comprehensive, quality care in an efficient clinical model that demonstrates the highest standards of service achievable." Our clinic mission statement affirms, "The mission of the school's clinics is to provide patient-centered, quality oral health care in a humanistic educational environment." We are working to move away from the model of compensating patients for the inconvenience we impose and toward reducing that inconvenience to a minimum. The competency-based approach and humanism both require this. We have cut the time required from initial screening to first therapeutic procedure in half and decreased "redos" by 40 percent in the past five years. Recalls are up, and chart audits show a significantly improved quality of care. We truly seek to model appropriate and comprehensive patient care rather than focus on isolated technical procedures.

Because of our location in San Francisco, Pacific has been a long-time and active participant in the Ryan White program. This is a national program that reimburses health care providers for the extra expenses involved in treating HIV-positive and AIDS patients. For the past five years, the clinics at Pacific have provided more than 5,000 professional visits for these patients per year. Our Advance Education in General Dentistry program has a national reputation for its work with patients who have developmental, emotional, and other disabilities. We are currently in the second year of a program funded by the California Endowment to establish regional treatment centers and train dentists and other health care professionals to provide care to patients with special needs in their own communities.

Pacific has a tradition of establishing partnerships with the profession for bringing care to underserved communities. Our Union City Dental Care Center was built to serve a group of patients in the East Bay by gifts

from our alumni in 1976 and remodeled in 2002. We are currently building a treatment facility to bring care to underserved patients in San Joaquin County. For the past two years, Pacific has received more scholarships for establishing dental practices in areas with low dentist-to-population ratios than the other California schools combined. We also rotate students through clinics in Northern California that have been created by component dental societies and communities to reach the underserved. In this way, dental students learn first-hand about the sense of responsibility that the profession must demonstrate to serve the underserved and provide access to care.

Another example of helping the profession provide the full range of care to patients is the creation of a hygiene program. In the fall of 2002, we will accept the first class of 32 students in the nation's first three-year baccalaureate dental hygiene program. This will be a joint program on the campus of our parent university in Stockton. Students will complete 18 months of general education and prerequisites in the biomedical sciences with the university faculty and then finish with 18 months of clinical training in clinics that are currently under construction on the campus. Not only will this help address the critical shortage of hygienists for practice, it will also ease the even more critical shortfall of educators for hygiene programs. This program has had the guidance, endorsement, and financial support of the San Joaquin, Fresno-Madera, Stanislaus, and Sacramento District dental societies.

Competence to Mastery

We have served the profession incompletely if we only graduate competent beginning dentists. Two of the stages in professional development occur following graduation. With practice, and certain kinds of help, dentists become proficient and then they become experts. Pacific has begun to offer help here as well.

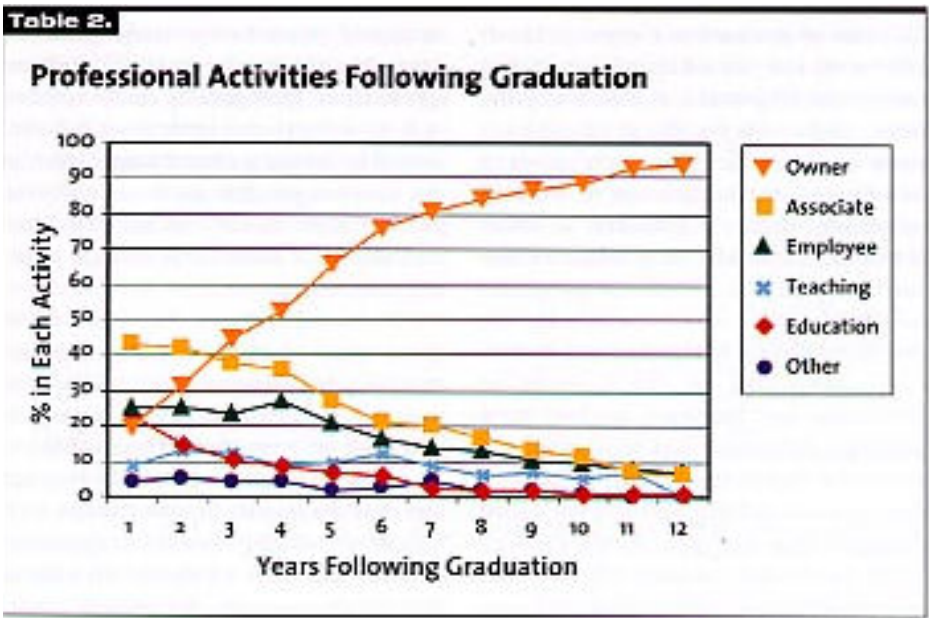
We have intensively studied our graduates during the first 12 years of practice. For example, we have discovered that they borrow almost 1 1/2 times as much to start their practices as they did for their dental education. They also pay back their loans in from seven to 10 years, at about 10 percent of their practice income, and their default rate is among the lowest of all professionals -- less than 0.2 percent.

Recent graduates feel competent in a broad range of procedures and gradually reduce the variety of techniques performed (through referral) to customize a practice in which they can become true experts. Beginning practitioners are outstanding learners. They use a blend of formal continuing education, journals, peers, observation of their own outcomes, and other sources to remain current. And they are current. There is no difference in the frequency of using newly developed techniques (such as implants, veneers, cosmetic approaches) between those who were taught these techniques in school and their older colleagues who learned the techniques themselves. (Recall that part of the definition of competency is to assume responsibility for one's continued professional development.)

One skill our recent graduates identified as being an increasing concern is the blizzard of new product claims. Never before has the profession been subjected to so many and such quickly changing messages about how to practice. In response, we have added in each curriculum year material and even whole courses designed to develop competency in critical thinking. Although we teach the traditional material on research design and statistics, our true focus is on how to read an ad, use the Internet to find out what the patient is learning, and how to think through product claims as independent professionals.

Table 2 shows that Pacific graduates tend overwhelmingly to become independent owners of their own practices. The 96 percent ownership level within a decade of graduation compares

Table 2.



favorably with the national average of just more than 80 percent in a dentist's lifetime. Although Pacific graduates are more likely to start a "scratch" practice or to associate and less apt to work as employees than are graduates of other schools, many also specialize before starting practice. Graduate programs are an excellent way to accelerate the proficiency stage of the learning curve.

In the days of the College of Physicians and Surgeons, we had most graduate programs, but amalgamation with the University of the Pacific required consolidation where we could demonstrate strength. From 1967 to 1990, we offered graduate training only in orthodontics, with a two-year program leading to the master of science in dentistry degree in addition to the certificate. Our Advanced Education in General Dentistry program -- with emphasis on special-needs patients -- has been in place for 12 years. A special feature of this program is its emphasis on distance learning. Next year, we will have three campuses in this program -- San Francisco, Union City, and Stockton -- all connected by videoconferencing for didactic instruction and live consultation. The program is part of a national network that has already been sharing course materials and engaging in seminars with simultaneous participation from residents in states such as New York and Arizona.

Our most recent graduate program is in oral and maxillofacial surgery. The Highland Hospital program in Alameda Country has become part of Pacific. This program has two residents in each of four years and a distinguished tradition of training hands-on oral and maxillofacial surgeons. The innovative, three-year baccalaureate dental hygiene program has already been described.

These four independently accredited programs represent Pacific's response to the growing needs for advanced training in dentistry. Rather than add years to the undergraduate program and require that all students spend more time getting ready to practice, we believe the profession is better served by laying a strong foundation in the shortest possible time and allowing practitioners to choose the direction and depth of additional formal training they desire.

Becoming an expert in dentistry requires years of experience and constant searching for improvement. Pacific's approach to professional development is designed to strengthen the profession this way. We recognized about 10 years ago that the lecture update courses with big-name speakers belonged to organized dentistry and that we should fill a niche that no one else was adequately covering. What practitioners told us they needed were hands-on extended clinical experiences -- something like the old study club approach. Currently, Pacific offers multiweek, laboratory and clinical, participation courses in endodontics, anesthesia, periodontics, prosthodontics, implants, surgery, and esthetic dentistry. In some of these disciplines, the participation programs are sequenced in as many as three levels of difficulty to form learning continua.

Blurring the Line

The best practitioners are always learning; the best educators are always practicing. Lines between education and practice have been drawn more distinctly than they need to be or than is helpful to the profession. Of the 319 faculty members currently at Pacific, nine are full-time administrators, nine are biomedical scientists, and 46 are full-time. Most of those who are qualified to do so practice one day a week. We have 114 one-, two- and three-day per week faculty members and 152 adjunct (volunteer) faculty members. Virtually all of these continue to practice, and many are among the best-known and most highly respected in their communities. Among recent graduates, an average of 8 percent teaches for some period during the first 12 years following graduation.

Practitioners are drawn to Pacific to share some of what they have learned with the next generation of their colleagues and to be part of the inquiring environment of a dental school. Scholarship -- disciplines, peer-reviewed generation of new and useful ideas -- is expected of every faculty member. This includes adjunct faculty members who are invited to join ongoing teams. Pacific is even developing the concept of the "scholarship of practice," systematic improvements in the practice of dentistry.

Each dental school in the United States is unique or nearly so. What makes Pacific special is its determination to serve the practicing profession.

CDA JOURNAL, VOL 30, Nº10

Clinical Evolution of the Invisalign Appliance

VICKI VLASKALIC, BDSc, MDSc, AND ROBERT L. BOYD, DDS, MEd

ABSTRACT The Invisalign System of tooth movement has been available to orthodontists since 1999 and has now become available to the entire dental profession. This paper explores the role of this system within the dental armamentarium and describes the clinical evolution of the appliance, based on a feasibility study initiated at the University of the Pacific in 1997.

AUTHORS

Vicki Vlaskalic, BDSc, MDSc, is an assistant professor in the Department of Orthodontics at the University of the Pacific School of Dentistry. **Robert L. Boyd, DDS, MEd, is professor and chairperson of the Department of Orthodontics at UOP School of Dentistry.**

Disclosures
The study described in this article was supported by a grant from Align Technology, Inc., Santa Clara, Calif.

Dr. Boyd has a financial interest in Align Technology, Inc.

Documented use of vacuformed removable appliances to move teeth has been available since the 1940s, and their use in the dental office may have occurred even earlier.1-7 Kesling first described the movement of teeth via a tooth positioner, which is often used today to refine the occlusion after fixed appliance treatment.1 In 1964, Nahoum published a thorough article describing his "vacuum formed dental contour appliance."2 Unlike his colleagues who used home vacuum cleaning systems to create an appliance over a modified study cast, Nahoum used a laboratory vacuum system to create appliances that were subsequently used to treat significant malocclusions. He applied elastics and utilized attachment systems that are still being used today in what is erroneously considered to be a revolutionarily new tooth movement system. In the 1990s, Sheridan popularized the "Essix" overlay appliance as a retainer and an active orthodontic appliance.3-5

The main feature that distinguishes the Invisalign System from those before it is 3-D computer software, which dramatically increases the ability to manipulate teeth via a series of precise, small, directional movements. As a result, the treatment of significant malocclusions requiring a greater magnitude of change is viable.8 Other notable departures from the traditional active, vacuformed appliance systems include the loss of direct control by the clinician in creating these movements, as well as the highly commercial nature of Align Technology, the company that produces the Invisalign System. Although standard orthodontic consultation and treatment planning is required to use this system to provide optimal occlusal outcome, many clinicians believe that the transformation of the clinician's treatment plan to a 3-D computer image by employees of the company means a loss of control

Figure 1a. Phase 1 case ex ample: Class I mild maxillary and mandibular spacing. Pretreatment frontal occlusion.

Figure 1b. Pretreatment right buccal occlusion.

Figure 1c. Pretreatment left buccal occlusion.

Figure 1d. Pretreatment maxillary occlusal.

Figure 1e. Pretreatment mandibular occlusal.

Figure 1f. Posttreatment frontal occlusion.

Figure 1g. Posttreatment right buccal occlusion.

Figure 1h. Posttreatment left buccal occlusion.

Figure 1i. Posttreatment maxillary occlusal.

Figure 1j. Posttreatment mandibular occlusal.

over treatment. While direct-to-consumer marketing is commonplace in the medical scene, it is relatively new to the world of orthodontics. These characteristics combine to embody this novel and controversial appliance, whose ultimate place within the dental armamentarium is at this stage unclear.

The development of the Invisalign System began in 1996, with the formation of a small team of computer engineers skilled in 3-D digital technology. By 1997, a crude technique had been established that would allow the fabrication of vacuformed "aligners," based on a stereolithographic resin model created from a computer-programmed laser. Align Technology approached the University of the Pacific to conduct a feasibility study to test and suggest improvements for its system.

Materials and Methods

The University of the Pacific contracted with Align Technology to conduct a feasibility study that would test the system in vivo and suggest any improvements that might lead to increased clinical efficiency. The protocol involved the recruitment of 40 subjects, who were added in groups according to malocclusion severity. More than 120 subjects were screened, many of them dental students. Subject selection criteria included fully erupted permanent dentition discounting third molars, dental health with no immediate need for restorations, availability for evening appointments, and a desire to comply with orthodontic treatment. The subject age range was 14 to 52 years. Some subjects had been treated previously with fixed appliances.

The first 10 subjects fell into the "mild" malocclusion category. These categories were selected via subjective determination. These were largely incisor crowding, spacing, and alignment cases. Once evidence of feasibility was established, two groups of 15 subjects with successive malocclusion severity were recruited. These subjects included those with crossbites, posterior rotations, severe crowding, and antero-posterior discrepancies. All subjects were offered $200 for their participation and the guarantee of treatment with fixed appliances if they were unhappy with the clinical results obtained with the system. Of the 40 subjects recruited, two patients in Phase III did not proceed with treatment, resulting in a final sample size of 38.

Records collected included patient history, intra- and extraoral photographs, panoramic or FMX radiographs, and lateral cephalometric radiographs. In addition, each subject completed a patient questionnaire while in treatment. Patients were reviewed on a four-week schedule. Progress records including intra- and extraoral photographs were taken at approximately six-month intervals. End-of-treatment records included study casts, intra- and extraoral photographs, and panoramic and lateral cephalometric films.

Results

The results of this feasibility study are represented by the clinical advancements that occurred during treatment of the subjects. These are summarized in **Table 1**.

The Phase I subjects were diagnosed with Class I mild crowding or spacing malocclusions. The average treatment time was 20 months. This was measured as the time from the first polyvinylsiloxane impression to the time of delivery of the retainer. This treatment time is excessive considering the mild malocclusions within this group. These subjects, however, were initiated in late 1998 and early 1999 when the manufacturing process was unrefined. It took an average of 4.8 months from the date of impression taking to the delivery of the aligners to the patient. In addition, the aligners delivered did not always fit the patient, or additional impressions were taken due to treatment plan change or case refinement. At this early stage, the optimum duration of wear of each aligner was unknown, and many patients changed aligners weekly. This rapid pace combined with programmed increments of tooth movement that were larger than the current 0.25 mm maximum in many cases led to ill-fitting aligners. This meant that in most cases, new impressions were required to continue treatment. Actual active treatment time in this sample is similar to that of fixed appliances, as physiology rather than the appliance system largely dictates the speed of tooth movement.

Figures 1a through j depict an example of one of the first cases treated in this study. The subject was diagnosed with Class 1 mild upper and lower anterior spacing. This spacing was consolidated by the treatment. The patient wore 15 maxillary and 11 mandibular aligners, with a total treatment time (including inactive treatment) of 22 months. Since this patient was treated, tooth movement increments have become automated within the software program used to create aligners.

A finding that should have been anticipated was the creation of a posterior open bite in some patients. This was pronounced in patients who had thicker aligners, who were clenchers, or who had little freeway space. Because many of the patients in the study tested aligners of different material and thickness, not all developed this open bite. The study utilized aligners of thickness ranging from 0.030 inch to 0.040 inch. Currently, aligners are 0.030 inch thick, and this dimension seems to cause a posterior open bite less frequently than was originally observed. Patients who developed open bites wore final aligners trimmed to cover the anterior teeth only, so that in a few days the posterior teeth re-erupted.

The need for overcorrection in the virtual 3-D treatment plan, or "Clincheck," also became apparent. This is likely due to the amount of elastic "give" in the aligner material, so that there is a slight difference between the position of a tooth on the 3-D setup and the clinical position of the tooth. This became most obvious when treating incisor rotations, though overcorrection is currently recommended not only for rotations but also for extrusion and root position.

The sophistication of the 3-D Clincheck

Figure 2a. Phase II case example: Class I moderate maxillary and mandibular crowding. Pretreatment extraoral smile.

Figure 2b. Pretreatment extraoral profile.

Figure 2c. Pretreatment extraoral profile smile.

Figure 2d. Pretreatment frontal occlusion.

Figure 2e. Pretreatment right buccal occlusion.

Figure 2f. Pretreatment left buccal occlusion.

Figure 2g. Pretreatment maxillary occlusal.

Figure 2h. Pretreatment mandibular occlusal.

Figure 2i. Pretreatment overbite -- overjet.

Figure 2j. Posttreatment frontal occlusion.

Figure 2k. Posttreatment right buccal occlusion.

Figure 2l. Posttreatment left buccal occlusion.

Figure 2m. Posttreatment maxillary occlusal.

Figure 2n. Posttreatment mandibular occlusal.

Figure 2o. Posttreatment overbite -- overjet.

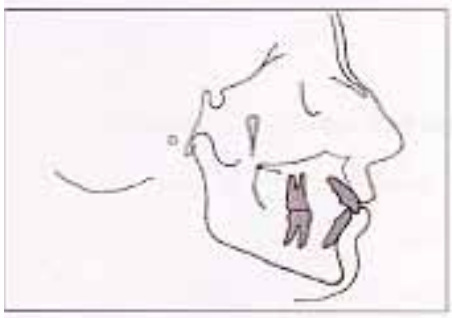


Figure 2p. Cephalometric superimposition.

software, which allows the clinician to view the setup and each increment of movement, has greatly improved during the progression of this study. Initially, the teeth were poorly defined, and the ability of the clinician to accurately assess alignment and occlusion was limited. The software has evolved not only in resolution, but also in terms of additional diagnostic features such as the use of calibrated grids and superimposition of dental changes. Future advancements under investigation by the team of the craniofacial research laboratory at the University of the Pacific include the addition of individualized root form and condyle position and accurate determination of dental change within the jaws, made possible by the latest digital radiographic scanning techniques.

The Phase II subjects were diagnosed with malocclusions comprising Class I moderate crowding, posterior crossbite, and lingually impacted mandibular premolars, as well as Class III malocclusions with mild to moderate crowding and anterior crossbite. The average treatment time was 27.2 months, with an average time of 3.6 months between initial PVS impression and aligner insertion.

For three Phase II patients, the treatment plan called for mandibular incisor extraction. This treatment required significant control of the root position from the appliance system. As the clinicians struggled to obtain this control, the demands on the properties of the aligner material increased. The material of choice was EX 30-30, a polyurethane sheet of 0.030 inch thickness. This material provides better control and comfort than others that were tested. In a continued effort to obtain root control, composite buttons, or attachments, were bonded onto the labial surface of teeth requiring movements that were less predictable to achieve. These movements included rotation of cylindrical shaped teeth, extrusion, and intrusion. They were also introduced on teeth adjacent to extraction sites. The shape and size of these attachments appeared to influence clinical efficiency, so many designs were tested.

It was also unclear whether the PVS impression should be taken before or after the clinical extraction of a tooth, as it was possible to do either. Allowing the computer programmers to virtually extract the tooth before the clinical extraction took place turned out to be the method of choice, although both options currently exist. The benefit to patients of a virtual extraction was that they would not have to wait for aligners while retaining the edentulous space for an extended period of time.

Figures 2a through p depict a Class I moderate maxillary and mandibular crowding case. The 33-year-old subject presented with a chief complaint of crooked teeth. She had no previous orthodontic treatment and was not interested in extraction treatment, despite a protrusive profile, gingival recession, and lack of adequate attached gingiva effecting the mandibular dentition. The treatment plan included resolution of crowding via dental arch expansion and interproximal reduction. Total treatment time (including inactive treatment) was 37 months, with a total of 41 maxillary and 43 mandibular aligners. Two sets of PVS impressions were needed to complete her treatment. Note the posterior open bite in the immediate post-treatment photographs. The patient's maxillary aligners were cut distal to the first bicuspids to allow re-eruption of the posterior teeth. Cephalometric superimposition showed slight proclination of the maxillary and mandibular incisors, with no accompanying increase of the mandibular plane angle. Subjective determination of vertical control appears favorable with this system, likely related to the control of tooth extrusion and posterior bite-block effect.

The Phase III patients were diagnosed with malocclusions including Class I and II severe crowding. As a result, the treatment

plan for most of these patients called for extraction therapy and, later, buccal segment correction via distalization of the maxillary buccal segments. The average treatment time of those subjects who have completed treatment was 31.5 months, with an average time of 3.3 months between PVS and aligner insertion.

The biggest clinical challenge with this group of patients was bodily extraction space closure. Initially, they experienced tooth tipping because they either had no attachments or had small suboptimal ones. Currently, UOP clinicians use at least one 5 x 1 x 1 mm long vertical attachment for root control, and they overcorrect root position on the virtual set-up. Esthetics was also a major concern for these bicuspid extraction patients. In those cases, the virtual pontic space that is created where the extracted tooth existed is now filled with a tooth-colored PVS material that sticks to the aligner. The virtual pontic system also aids controlled movement of adjacent teeth as it provides a wall of semi-rigid material for the teeth to move against, rather than a thinner span of plastic that tended to flex in the extraction space.

When surveyed, 100 percent of the subjects claimed that they would select the Invisalign system over regular fixed appliances. Even early in the study when subjects often spent more time waiting for aligners than wearing them, after multiple PVS impressions and testing many different materials, the subjects tolerated the aligners well and compliance was not an issue. Sample decay occurred (5 percent), particularly in the first phase of subjects since these were largely mild malocclusions, the system of treatment was not as refined as it is today, and many of the subjects graduated dental school and moved away. Loss and breakage were not the problem that was anticipated, perhaps due to the largely adult population of the group and relatively short duration (10 to 14 days) of wear of each aligner. When asked whether oral hygiene was easy to maintain while using the system, 100 percent of subjects replied that it was. This highlights the benefit of sustainable periodontal health to the patient.10

Discussion

This study was designed to determine the feasibility of abstracting data from a patient, transferring it to a 3-D computer format, manipulating the image according to the clinician's treatment plan, and manufacturing a series of therapeutic, custom-made appliances based on the resulting 3-D program. At the advent of the study, many of the systems in place were still under development. Phase I of this study demonstrated that the cumulative error involved in the entire process was within clinically acceptable limits. Phase II demonstrated that judicious planning was required of the clinician to ensure the system of appliances would create the desired result. Considerations such as overcorrections and bodily control of individual teeth, as well as strategies for retention and less predictable movements such as extrusion needed to be addressed before appliance manufacturing. In this study, the clinician had the luxury of taking new impressions and refining treatment to achieve an ideal result and to test novel approaches. This creates longer overall treatment duration but allows the achievement of results comparable to fixed appliance treatment.

Phase III patients in this study are those with malocclusions that fall largely outside current commercial guidelines for the system. While most of these cases have finished with good clinical results, buccal segment distalization and large edentulous space closure remain less predictable. This study will continue to investigate methods to make these movements more predicable. The use of occlusal indices, such as the PAR Index, to objectively determine subject groupings via malocclusion severity would not have enhanced the resulting data of this feasibility study. However, future studies investigating the clinical efficiency of this system utilizing larger sample size would enhance their value from the application of such measurement tools.

The likely outcome of the availability of the system to other dental disciplines will be the use of the system to perform other, more limited tooth movement needs such as augmenting bridge, implant, or veneer preparation. This system has been used in orthognathic surgical cases to replace the pre- and postsurgical fixed appliance phase of the treatment plan. It should be stressed that these cases are not routine, and their outcome in comparison to traditional techniques is largely unknown.

It is clear that that many of the questions and concerns that the specialty and the entire dental profession raise regarding this appliance system have not yet and will not be addressed in a definitive manner by this continuing feasibility study alone. Thousands of patients are currently being treated in practices across the United States, Europe, and Asia with this system; and resulting case reports are providing valuable anecdotal clinical information. Although this study has helped refine and improve the system that is now commercially available, outstanding issues such as the clinical efficacy, occlusal quality, and iatrogenic effect compared to the "gold standard" of fixed appliances will require prospective, controlled clinical trials with adequate sample size, increased record base, and the use of objective assessment methods such as occlusal indices to evaluate outcome. As the Invisalign System has undergone rapid and continual evolution and refinement, it has been impractical to undertake such a controlled study up to this time.

The paucity of such objective information on this new product has induced justified clinician frustration and suspicion. As a profession, it is prudent to treat new products in such a manner and to embrace them with caution in an effort to protect patients from inexpedient treatment. While this system has provided an alternative to the mechanically more complicated fixed appliance system, it has not replaced the need for thorough dentofacial diagnosis and treatment-planning expertise. For those clinicians

who choose to utilize this current system, sound knowledge in orthodontic treatment planning and biomechanics as well as experience in new skills such as manipulation and diagnosis via 3-D images are imperative to provide patients with quality outcomes. The orthodontists treating patients in this study experienced a steep learning curve with this system, so that it is advisable for the novice to begin with mild cases.

It is apparent that the combination of fixed appliance therapy and the Invisalign System is often a prudent treatment alternative to offer patients. To date, three of the 38 subjects in this study had some degree of fixed appliance and Invisalign combination to complete orthodontic treatment to an appropriate standard. The Invisalign System is an attractive alternative to traditional orthodontic appliances for the adult population due to its removable, esthetic nature, allowing high standards of oral hygiene during treatment. As such, it has attracted many patients who would not have otherwise sought treatment. However, it remains to be determined exactly how the dental profession will ultimately incorporate this system, with the introduction to the rest of the profession being a relatively recent occurrence. What is clear is that the role of the Invisalign System should be based on sound clinical results and not directed by consumer demand.

Conclusion

The Invisalign System of orthodontic tooth movement is a feasible alternative to traditional fixed and removable appliance therapy in select cases. The system has experienced a rapid clinical evolution and will likely continue to do so. Clinical results from this study and other sources suggest that permanent dentition patients with mild to moderate malocclusions may benefit from carefully planned orthodontic treatment using this system. The ultimate clinical potential of this product remains unclear without further investigation.

References

1. Kesling HD, The philosophy of the tooth positioning appliance. Am *J Orthod* 31:297-304, 1945.
2. Nahoum H, NY State Dent J 30; 9:385-90, 1964.
3. Sheridan, JJ, Ledoux W, McMinn R, Essix retainers: Fabrication and supervision for permanent retention. J Clin Orthod 27:37-45, 1993.
4. Rinchuse DJ, Rinchuse DJ, Active tooth movement with essix based appliances. J Clin Orthod 31:109-12, 1997.
5. Lindauer SJ, Shoff RC, Comparison of Essix and Hawley retainers. J Clin Orthod 32:95-7, 1998.
6. Ponitz RJ, Invisible retainers. Am *J Orthod* 59:266-72, 1971.
7. McNamara JA, Kramer KL, Juenker JP, Invisible retainers. J Clin Orthod 19:570-8, 1985.
8. Boyd RL, Miller RJ, Vlaskalic V, The Invisalign System in adult orthodontics: mild crowding and space closure. J Clin Orthod 34:203-13, 2000.
9. Vlaskalic V, Boyd RL, Orthodontic treatment of a mildly crowded malocclusion using the Invisalign System. Case Report Aust Orthod J 17: March 2001.
10. Boyd et al, Periodontal implications of orthodontic treatment in adults with reduced or normal periodontal tissues vs adolescents. Am *J Orthod* 96:191-8, 1989.

To request a printed copy of this article, please contact/Vicki Vlaskalic, BDSc, MDSc, UOP School of Dentistry, 2155 Webster St., Room 130, San Francisco, Calif, 94115.

CDA JOURNAL, VOL 30, Nº10

University of Southern California School of Dentistry: Dental Education for the 21st Century

HAROLD C. SLAVKIN, DDS

AUTHORS

Harold C. Slavkin, DDS, is the dean and G. Donald and Marian James Montgomery Professor of Dentistry at the University of Southern California School of Dentistry.

California is the fifth-largest economy in the world, with 34 million people who speak 224 different dialects and languages.1 By 2050, California's population will exceed 50 million people.1 We have some of the finest universities in the world. We are innovators; and we thrive on discovery in our laboratories, clinics, and hospitals. When we think of California, many of us think about adventure, higher education and outstanding universities, information technology, biotechnology, the entertainment industries of motion pictures and television, agriculture, import/export shipping industries, cultural diversity, sunshine, physical fitness, and fun. In great measure, the universities and colleges of the Golden State have and continue to provide the talent, knowledge, and innovative technology that continue to fuel the success of California.

The School of Dentistry at the University of Southern California graduated its first class in 1900. USC has been contributing to what is thought, what is taught, and what is practiced in the oral health professions since 1897.2 In 1923, USC began its dental hygiene program under the direction of Cora L. Ueland and has sustained a baccalaureate program. During the mid-20th century, USC developed a number of superb dental specialty programs in oral-maxillofacial surgery, orthodontics, pediatric dentistry, periodontics, prosthodontics, endodontics, and general practice residency, which continue to contribute to dental education and science. In 1974, USC began its graduate program in craniofacial biology administered by the Graduate School of the university, the first in the nation; and it continues to educate and train outstanding PhD graduates who serve on the faculty of many outstanding dental schools in America and abroad. In 2002, USC began its first advanced education in general dentistry program.

As USC enters this current academic year (July 1, 2002, through June 30, 2003), we are proud of our history and tradition of clinical excellence and more than 13,000 alumni in the oral health professions. For more than a century, we have taken pride in the development of professional human beings through learning and

CDA JOURNAL, VOL 30, Nº10

teaching, research, professional practice, and various forms of service to the community and our profession. We are extremely proud of our clinical-excellence legacy in operative and restorative dentistry as well as orthodontics, oral surgery, periodontics, endodontics, pediatric dentistry, dental hygiene, craniofacial molecular biology, and community outreach programs. We have evolved with California. We have grown through the remarkable advances made in the oral health professions, especially the profound changes and advances made in the dental sciences that affect what we teach, how we learn, and how we critically think in the 21st century.

USC has a distinguished faculty that have earned significant state, national, and international respect for their contributions to what is thought, taught, and practiced in the oral health professions. For example, our faculty contribute to organized oral health professions with individual members serving in the Institute of Medicine (National Academy of Sciences), fellows in the American Association for the Advancement of Science, fellows in the American College and International College of Dentists, Pierre Fauchard Academy, and numerous roles in the American Dental Association, American Dental Education Association, American Association of Dental Research, various dental specialties, the California Dental Association, and numerous local dental societies. Our faculty contribute through scholarship to innovation and discovery, and they are ranked No. 6 in federal research support for biomedical research among the 55 dental schools in America. USC is ranked No. 2 in the citation index for our faculty contributions to the oral health scientific literature (oral surgery, dentistry, and oral medicine). USC faculty are internationally recognized for their significant contributions to continuing dental education in dental anesthesia, medical emergencies, esthetic dentistry and dental materials, implantology,

USC School of Dentistry

STUDENTS

553 dental students; 95 dental hygiene students; 60 advanced standing international dentists; 97 postdoctoral students in advanced specialty programs (21 concurrently pursuing advanced degrees); and 62 MS and PhD candidates.

FACULTY

118 full-time faculty and more than 400 part-time faculty.

PROGRAMS

Doctor of dental surgery

- Doctoral dental program (four-year program)
- Advanced standing program for international dentists (two-year program)

Bachelor of science in dental hygiene

- Dental hygiene program
- Post-certificate hygiene program

Advanced specialty certificates

- Advanced education in endodontics
- Advanced education in general dentistry
- Advanced education in oral and maxillofacial surgery**
- Advanced education in orthodontics*
- Advanced education in pediatric dentistry*
- Advanced education in periodontics*
- Advanced education in prosthodontics
- General practice residency

*In conjunction with the USC Graduate School, offers combined programs with craniofacial biology leading to a specialty certificate and MS degree.

** In conjunction with the Keck School of Medicine, offers a combined program leading to a specialty certificate and MD degree.

Master of science

- Craniofacial biology program

Doctor of philosophy

Craniofacial biology program

- Combined degree programs:
- DDS-MBA program with the Marshall School of Business
- DDS-MS program with the Leonard Davis School of Gerontology
- DDS-MS program with the Rossier School of Education

imaging, and instrumentation in dental hygiene. Since 1900, when Dean Edgar Palmer presided over the first graduation of 12 USC dental students, faculty and graduates have contributed to what is thought, taught, and practiced in the oral health professions.1

This paper will highlight strategies and advances that will reacquaint the reader with the University of Southern California.

The Present Opportunities

The USC School of Dentistry is a "learning organization," dedicated to our own ongoing learning, flexibility, comfort with change, and openness to new ideas. We are committed to improving the health of all people through education and training, innovation and discovery, patient and community oral health, and leadership. We seek to provide outstanding undergraduate, graduate, and postgraduate academic programs of instruction for highly qualified students leading to academic degrees in the oral health professions; extend the knowledge of oral health by encouraging and assisting faculty in the pursuit of innovations and discovery scholarship; improve the oral health of the people of Southern California; stimulate and encourage in our students those qualities of scholarship, leadership, and character that mark the true oral health professional; serve California and the nation in providing lifelong learning to oral health professionals; and, provide oral health leadership in the solution of community, regional, national, and international complex problems.

Being located in Southern California (eight counties comprising 24 million people), our university is "an engaged university" that forms collaborations and partnerships with our communities to improve the quality of life. The School of Dentistry is aligned with our parent university, and we have a long and distinguished history of community outreach programs that affect the people in our region. In Southern California, 7 million people do not have dental insurance or access to oral health care; this disturbing oral health disparity is particularly pronounced in poor and working-poor people who live in our region. One major opportunity for USC and the other four dental schools of California is to collaborate to improve the safety net for larger percentages of the population with particular attention to infants and toddlers, their caregivers, and the poor elderly of the Golden State.

Of course, the recent explosion of informatics and biotechnology heralds a true "biological revolution" within dentistry and medicine. The completion of the human genome; the completion of numerous microbial genomes; the advances in diagnostics, treatments, and therapeutics; as well as novel biomaterials are affecting what we think, what we teach, and how we practice clinical dentistry in California. The intellectual boundaries of dentistry are expanding!3-7

At USC, we consider the full array of clinical competencies that we set in our research intensive university-based schools of dentistry – health promotion, risk assessment, disease prevention, diagnostics, treatment planning, treatments (numerous technique-sensitive procedures) and therapeutics, health services, health outcomes, multicultural competencies, patient management and human behavior, business management practices, informatics, conflict resolution, and mediation.7-9

The knowledge and technology expansion is nothing short of remarkable. There is more to know and more to teach than ever before within the same time frame of professional dental education.7-9 All of us in dental science, education, and patient care have a significant opportunity to rethink our admissions policies, the four-year curriculum, how we learn and how we teach, and the clinical competencies that we establish as our functional goals.7-9 Today, we are living in a remarkable time in oral health history. We have the opportunity to revisit previous assumptions, consider the emerging new biological and behavioral sciences, consider the individual and community quality of life issues, assess the costs and management of health care, and improve the cultural diversity of our profession while increasing access to oral health care for all people.3-6 The social, economic, and political dimensions are truly significant!

Strategic Planning, Accreditation, and University Reviews

As you read this article, I have completed just more than two years as the 11th dean of the USC School of Dentistry. Two years before I arrived, under the direction of interim dean Jerry Vale and led by Roseanne Mulligan, USC organized to engage in a comprehensive "self-study" in preparation for the American Dental Association national accreditation. This process engaged hundreds of faculty (full-time and part-time), students (dental hygiene, predoctoral, residents, graduate students), staff, and alumni. Their intensive work over two years resulted in the "self-study" documents that were submitted to the ADA. This body of information (descriptions, analyses, evaluations, and recommendations) was invaluable to me in my learning about the community culture, core values, priority setting, and ambitions for the future. The timing was excellent. The process coincided with my return to USC from Washington, D.C., where I had worked and lived with my wife from July 1995 through July 2000 as director of the National Institute of Dental and Craniofacial Research, one of the 20 institutes that make up the National Institutes of Health in Bethesda, Md. As I began my USC tenure on Aug. 14, 2000, the two-year "self-study" developed by my USC colleagues provided an opportunity to gain an appreciation for and understanding of their assessment of strengths, weaknesses, opportunities, and threats.

CDA JOURNAL, VOL 30, Nº10

Independently – under the leadership of Provost Lloyd Armstrong, Jr. – our parent university administration and all of the colleges had completed a rigorous "self-study" that produced the university-wide Strategic Plan (1994 and revisions in 1998). This plan serves as the blueprint for developing the entire university including the School of Dentistry. The plan sets forth four strategic initiatives to leverage USC's distinctive characteristics. The four strategic initiatives are:

- **Initiative 1:** Undergraduate education – Provide a distinctive undergraduate experience built on excellent liberal arts and professional programs, incorporating unique opportunities for career preparation through innovative collaborations between the liberal arts and our diverse array of professional schools.
- **Initiative 2:** Interdisciplinary research and education – Create the organizational flexibility, and capacity for teamwork, to become a world center for innovative interdisciplinary research and education in selected areas.
- **Initiative 3:** Building on the resources of Southern California and Los Angeles – Create programs of research and education that utilize and contribute to the special characteristics of Southern California and Los Angeles as a center of urban issues, multiculturalism, arts, entertainment, communications, and business.
- **Initiative 4:** Internationalization – Build upon USC's strong international base of alumni, students, established relationships, and Southern California's position as an international center to enhance future global opportunities for education, research, and career development. Because of the characteristics of Southern California and of our students and alumni, focus efforts on the countries of the Pacific Rim and of Central and South America.

In addition, the university-wide plan outlines strategies and actions to realize these initiatives and proposed four critical pathways:

- Communications – Understanding and helping to solve technical, social, cultural, legal, and political issues of communications in its many forms.
- Life sciences – Coordinating and building on considerable expertise in the life sciences ranging from basic biological sciences to clinical and engineering applications.
- The arts – Coalescing our considerable strengths in the arts to move USC to the center of the cultural stage in Los Angeles.
- The urban initiative – Exploring how complex urban environments function and how to improve them.

Importantly, the university-wide strategic plan and the work of the USC dental community meshed and indicated a clear alignment including many positive opportunities for collaborations and leveraging of resources. Five months after I began my tenure as dean, we completed and published a strategic plan for the USC School of Dentistry "Shaping the Future" (2001-2006). The plan contains our vision; mission; our "SWOT" analysis (strengths, weaknesses, opportunities, and threats); four strategic directions or initiatives; and four critical operational factors with goals and objectives. "Shaping the Future" serves as a blueprint for the future of the School of Dentistry.

USC School of Dentistry Strategic Plan

The strategic plan is organized into four strategic directions. Each strategic direction is described briefly in the body of the strategic plan followed by goals and objectives. Each of these four strategic directions detail actions to be completed within the next three to five years. The four strategic directions are:

- Education and learning – Based on critical analyses of a five-year educational demonstration project, problem-based learning, we proposed to utilize PBL to achieve our educational goals. The PBL pedagogy emphasizes student-centered, patient-focused, small group-oriented, inquiry-based strategies of learning, with learners addressing developmentally appropriate patient-based problems.9
- Innovation and discovery – The School of Dentistry plans to expand scientific research in oral infection and immunity, innovations in antimicrobial therapeutics, molecular epidemiology of complex human diseases, oral health disparities, health services and outcomes research, chronic facial pain, oral-dental-facial rehabilitation and esthetics, bioengineering, tissue engineering and biomaterials, implantology, and "virtual craniofacial-oral-dental patient reality."
- Patient care and community oral health – Oral diseases and disorders represent the most common chronic diseases of children. In Southern California, infants, preschool, and K-12 children constitute a "silent and neglected epidemic" of tooth decay, tooth pain, oral infections, and related poor school attendance. The problems are very significant in that many of these infants and children reside in close proximity to both University Park and the Health Science campuses of USC. In addition, oral health addresses pregnancy, premature babies, craniofacial birth defects, craniofacial-oral-dental trauma, severe malocclusion, head and neck cancers (e.g. oral and pharyngeal cancers), a variety of oral and periodontal infections, chronic facial pain, osteoporosis, osteoarthritis as related to temporomandibular joint diseases and disorders, xerostomia or "dry mouth." and a number of related oral health diseases and disorders. The challenges represent the entire life span, from conception through senescence, and include individual patients, families, communities and populations. Improving the oral health of all people of all ages and all cultures is fundamental to the mission of USC.

- Leadership for the oral health professions – Our goal is to educate and foster leadership through critical thinking, problem-solving, cultural competencies, and a shared desire to improve the health of all people. At USC, we are dedicated to nurture learners to consider multiple career pathways including careers in science, technology, education, and organized dentistry and beyond. We recognize the importance of equipping faculty and students with leadership skills and incentives so they may effectively stand for, and communicate, the USC model.

University Academic Performance Review

The University of Southern California was founded in 1880. At that time, the founders anticipated that USC would grow and evolve with the Southern California region and that USC would serve as "an engaged university" to collaborate with public and private sectors to improve or enhance the intellectual, technological, financial, and "quality of life" for the people of California and beyond. For the first 50 years, USC was Southern California's only major university. For more than a century, USC has contributed to what is thought, taught, and practiced in the numerous disciplines that make up the university.

Inherent in success is the zeal for self-improvement. In this context, USC embraces not only the formal accreditation processes of each of its colleges, but also seeks to define each of its colleges' academic performance by national and international objective criteria. In the late 1990s, the provost of USC initiated a series of "self-study" assessments of the academic performance of each of its colleges. The USC School of Dentistry was selected to be reviewed beginning October 2001. The yearlong process included:

- Self-assessment;
- A projected five-year written plan;
- Internal reviews by a panel of distinguished academicians drawn from throughout the university; and
- An external review and site visit by a panel of distinguished dental academicians drawn from around the country (Drs. Bruce Baume, laboratory chief, gene therapy/therapeutics, NIH; Bruce Donoff, dean, Harvard School of Dental Medicine; and Charles Bertolami, dean, UCSF School of Dentistry. Under the leadership of Chuck Shuler, associate dean for Academic Affairs, the combined final report was submitted to the provost who in turn will soon engage the faculty and administration of the School of Dentistry. Our shared goal is to define measurable goals and objectives for the School of Dentistry to attain and/or sustain pre-eminence in the oral health professions.

Prospectus

USC will complete our transition to school-wide PBL in two years. Our faculty will continue to contribute to what is thought, taught, and practiced in the oral health professions. For example, the article in this issue contributed by Drs. Paul Denny and Mahvash Navazesh indicates the numerous opportunities to improve clinical diagnosis using saliva fluid as an informative solution that reflects health and/or disease. USC faculty are significant contributors to craniofacial molecular biology, biomimetics and tissue engineering, oral cancer, biomineralization with emphasis upon enamel bioceramics, oral infection and mucosal immunity, oral microbiological diagnostics, antimicrobial therapeutics, "virtual head and neck patient" research and applications, and educational research. USC is also a major contributor to esthetic dentistry as well as implantology, and we remain dedicated to reducing oral health disparities from Bakersfield to the Mexican border using numerous venues such as community-based clinics, school sites, hospitals, and mobile units. Our new emphasis is to provide students, faculty, and staff with opportunities to address the oral health care needs of all people over the entire lifespan – ranging from prenatal care through hospice care.3 And USC continues to be dedicated to nurturing the future leadership for the oral health professions.

References

1. Baldassare M, California in the New Millennium: The Changing Social and Political Landscape. University of California Press, Berkeley, 2000.
2. Done HN, Gardner J, eds, 100th Year Centennial of the University of Southern California School of Dentistry. USC Dental Alumni Association, Redondo Beach, Calif, 1997.
3. Slavkin HC, Expanding the boundaries: Enhancing dentistry's contribution to overall health and well-being of children. *J Dent* Ed 65:1323-34, 2001.
4. Slavkin HC, The human genome, implications for oral health and diseases, and dental education. *J Dent* Ed 65: 463-79, 2001.
5. Tabak LA, A Revolution in biomedical assessment: The development of salivary diagnostics. *J Dent* Ed 65:1335-9, 2001.
6. Ratner BD Replacing and renewing: Synthetic materials, biomimetics, and tissue engineering in implant dentistry. *J Dent* Ed 65:1340-7, 2001.
7. Cohen MM, Major long-term factors influencing dental education in the twenty-first century. *J Dent* Ed 66:360-73, 2002.
8. Hendricson WD, Cohen PA, Oral health care in the 21st century: Implications for dental and medical education. Acad Med 76:1181-206, 2001.
9. Shuler CF, Application of Problem-Based Learning to Clinical Dental Education. J Cal Dent Assoc 30:435-43, 2002.

CDA JOURNAL, VOL 30, Nº10

Saliva: A Fountain of Opportunity

Mahvash Navazesh, DMD; Paul Denny, PhD; and Stephen Sobel, DDS

ABSTRACT Saliva continues to demonstrate that it is more complex than generally perceived and has more diagnostic value than is generally appreciated. This article will review some of the components and functions of saliva; discuss its promise as a diagnostic aid; review some of the problems associated with inadequate salivary function; and, it is hoped, enhance oral health care providers' appreciation of the importance of saliva in everyday clinical practice.

AUTHORS

Mahvash Navazesh, DMD, is an associate professor and chair in the Division of Diagnostic Sciences at the University of Southern California School of Dentistry.

Paul Denny, PhD, is a professor of biochemistry in the Division of Diagnostic Sciences at USC School of Dentistry.

Stephen Sobel, DDS, is an associate professor of clinical dentistry in the Division of Diagnostic Sciences at USC School of Dentistry.

Saliva, often described as being "99 percent water," mirrors an individual's health; and the complexity of saliva offers multiple windows of opportunity for monitoring general wellness, assessing oral health and disease, tracking the progression and treatments of systemic disease, assessing risk, and detecting substance abuse.1

Many and various attributes of saliva are routinely referenced in forensic dentistry; but the challenge for exploiting the full potential of saliva for diagnosis, pharmacological monitoring, and risk assessment remains.2

The oral cavity is one of the most important portals into the body. Saliva represents the first line of defense against foreign pathogens as well as commensial residents when high population densities can also be pathogenic. The flow of saliva allows for the constant cleansing of oral tissues with its beneficial properties and provides the fluid current that moves food and microbes out of the oral cavity. The coating property of saliva is complex and can alternatively lubricate tooth surfaces as well as contribute a protective layer to oral soft tissues that protects against desiccation and microbial colonization.2-5

The remineralization capability of saliva depends upon the combination of its uncompromised buffer systems and the systems it employs to maintain calcium and phosphate ions in a supersaturated state relative to the hydroxyapatite of enamel. When the pH of saliva drops to near 5.5 or lower, the equilibrium between the free ions and the mineral shifts to favor demineralization. The antimicrobial properties of saliva depend upon a variety of enzymes and proteins that individually have demonstrated antibacterial, antifungal, and/or antiviral activities. Saliva initiates the general digestive process by the secretion of a variety of digestive enzymes whose role is to degrade food and bacterial

CDA JOURNAL, VOL 30, Nº10

remains lingering in the oral cavity. Saliva is also a source of hormones and growth factors.2,6-9

Saliva as a Diagnostic Aid

Saliva is a mixture of ions, small organic molecules, enzymes, and proteins, some in multiprotein complexes and others complexed with other biochemicals.10 Add to this the oral microorganisms and their byproducts, and an ecological system is created that either maintains good oral health or, conversely, contributes to its decline.11

Science is only beginning to recognize the complexity of the ecology and knows even less about how alteration of individual components of the system can affect the whole. The understanding of these interactions may make it possible to manipulate the system in favor of promotion and maintenance of oral health. The type and quantity of oral microbes harbored in the oral cavity may contribute to elevated risk levels for a number of systemic diseases.

Within the past 20 years, more than 2,500 citations have focused on the diagnostic value of oral fluids. Saliva is a fountain of opportunities for innovation and discovery, risk assessment and disease prevention, and pharmacotherapeutic monitoring. The potential is great. Multiple uses for detection of drug abuse and treatment monitoring have been developed. However, exploitation of the full richness of the medium has only begun. Below are some examples of systemic and oral conditions, along with chemotherapeutics, where salivary qualitative and/or quantitative changes have been investigated as potential diagnostic aids.

Systemic Conditions

Saliva has been studied in relation to sundry medical conditions including congenital, autoimmune, endocrine, infectious, and neoplastic disorders. Celiac disease is a congenital disorder of the small intestine that involves malabsorption of gluten. Salivary IgA-AGA measurement has been reported to be a sensitive and specific test for the screening of this disease and monitoring the patient's adherence to the required gluten-free diet.12,13 Sjögren's syndrome is a chronic autoimmune disorder that affects many systems, including the salivary and lacrimal glands. Attempts have been made to use xerostomia (dry mouth) and salivary gland hypofunction (reduced saliva flow rate and/or altered sialochemistry) for the clinical diagnosis of this medical condition.14-16 A "yes" response to any of these questions: "Have you had a daily feeling of dry mouth for more than three months?" "Have you had recurrent swollen salivary glands as an adult?" " Do you frequently drink liquid to aid in swallowing dry food?" along with an unstimulated whole saliva flow rate of 0.1 ml/min have been included in the revised European classification criteria for the diagnosis of Sjögren's syndrome.17 Salivary steroid hormones have been used to assess ovarian function18 and the risk for preterm labor,19,20 to evaluate child health and development,21 and to study mood and cognitive emotional behavior.22

Human immunodeficiency virus infection is one of the best examples for utilizing saliva as a diagnostic aid.23 A saliva test in a self-contained kit is available for HIV screening.24 Saliva is also used for the measurement of other viral pathogens such as hepatitis C, a leading cause of liver cirrhosis;25 hepatitis B surface antigen;26 cytomegalovirus; herpes simplex viruses 6, 7, and 8;27 and epidemiological studies of Epstein Barr virus in schoolchildren.28 Saliva has also received much attention in recent years for its potential role in the diagnosis of Helicobacter pylori, the pathogen associated with peptic ulcer.29 Elevated levels of some salivary markers have been associated with ovarian and breast cancer.30-32 The potential value of saliva as a diagnostic aid for breast cancer detection is under evaluation by FDA.33

Table 1. Common Conditions Associated with Salivary Gland Hypofunction.

Systemic Disorders
Autoimmune
Cardiovascular
Connective tissue
Endocrine
Neurologic
Psychiatric
Metabolic
Neoplastic
Infectious
Pharmacotherapeutics
Radiotherapy
Chemotherapy
Medications/Polypharmacy
Analgesics
Antihistamines
Antihypertensives
Antidepressants
Cytotoxics
Sedatives
Anticonvulsives
Antiretroviral therapy

Oral Conditions

Saliva can be used to detect oral fungal and periodontal infections, to assess susceptibility to dental caries, and to screen for oral neoplasms. Salivary fungal colony forming units can be used for detection of oral candidiasis.34 The salivary levels of pathogens such as Porphyromonas gingivalis, Streptococcus mutans, and Lactobacillus acidophilus can be utilized in risk assessments for periodontal diseases10 and dental caries.35,36. Elevated levels of some salivary proteins have also been associated with oral squamous cell carcinoma.37 The possibility of oral cancer

Figure 1. Fissured and lobulated tongue secondary to salivary gland hypofunction.

Figure 2. Atrophic and erythematous tongue in a patient with dry mouth complaint.

Figure 3. Pseudomembranous candidiasis involving tongue mucosa in a patient with salivary gland hypofunction and uncontrolled diabetes.

Figure 4. Erythematous candidiasis in a patient with salivary gland hypofunction who was on multiple xerogenic medications.

Figure 5. Desiccated mucosa, absence of salivary pool, extensive restorative experience, and recurrent caries in a patient with Sjögren's syndrome and severe salivary gland hypofunction.

Figure 6. Cervical caries involving multiple maxillary anterior teeth in the patient seen in Figure 5.

is also reported to be higher in individuals who have high salivary levels of nitrate and nitrite. Salivary levels of these two factors are significantly associated with the levels of dietary intake.38 The type and quantity of oral microbes harbored in the oral cavity may contribute to elevated risk levels for a number of systemic diseases. Though the evidence rarely extends beyond epidemiological correlation, there is reason to anticipate that there are direct links between uncontrolled oral disease and systemic conditions such as cardiovascular disease, and delivery of low birth weight, premature babies.39-41

Pharmacotherapeutics

Saliva can be used for monitoring the systemic (plasma) levels of medications as well as therapeutic responses to medications. For example, saliva can be used to monitor a patient's compliance with insulin therapy, psychotherapy,42 and anticancer medications.43 It can also be used for evaluation of illicit drug use, ethanol consumption, recreational drug use, and tobacco consumption.44-47 A comprehensive list of medications easily monitored in saliva is available elsewhere and is not discussed here.2,33

When Production of Saliva Fails

The absence or loss of function of any of the beneficial actions of saliva mentioned above can predispose an individual to oral disease and the systemic cascade that may follow. The importance of saliva is never more clear as when there is too little or none. There is a dramatic impact on oral health as well as a level of discomfort and inconvenience that adversely affects personal freedom and the feeling of well-being.

The quality and quantity of saliva are affected by a broad array of local and systemic conditions as well as by large families of pharmacological agents48-51(**Table 1**). Bacterial infections, viral infections, sialoliths, and medications may act as local factors in reducing saliva secretion. On the other hand, Sjögren's syndrome, rheumatoid arthritis, lupus erythematosis, sarcoidosis, cystic fibrosis, Alzheimer's disease, uncontrolled diabetes, hypertension, strokes, AIDS and HIV infection, and depression are systemic causes for salivary gland hyposecretion.52,53 Some consequences of persistent and severe salivary gland hyposecretion are the onset and rapid progression of dental caries, fungal infection, and intraoral soft tissue changes54,55(Figures 1 through 6). Chronic reduced saliva secretion may lead to depression56 and tooth loss57 and affect an individual's quality of life.52 Salivary gland hypofunction may go unnoticed by patients and practitioners, because the subjective perception of dry mouth is not

always correlated with objective evidence of salivary hypofunction and vice versa. Therefore, it is imperative to include salivary gland assessment as part of everyday practice. Otherwise, practitioners may be faced with the consequences of dry mouth that lead to therapeutic rather than preventive approaches.

The importance of including an oral soft-tissue evaluation and cancer screening when doing a dental examination has long been established and is not questioned by the profession. In view of the effects on one's quality of life in general, and the potentially disastrous effects on restorative treatment plans in particular, the dental profession must recognize the need and the value of including an evaluation of salivary function with every new dental examination as well as ongoing observations during treatment and recall. Consider as one example the patient with salivary hypofunction who has had extensive full-coverage restorations and is soon found to have severe cervical caries around the restorations. The implications for retreatment, chair time, cost, and possible loss of patient rapport are significant. **Table 2** is a flow chart to help practitioners through the logical steps of screening patients for possible salivary gland hypofunction, and the time required is minimal.

This flow chart contains four questions relative to saliva secretion. These questions have been significantly associated with objective evidence of salivary gland hypofunction.58 These questions should be routinely asked of new and recall patients at the time of examination, even if there is no complaint of dry mouth. The clinical changes involving the intraoral and extraoral hard and soft tissues listed in the flow chart have also been successfully utilized for identification of patients with salivary gland hypofunction.55 Practitioners, when performing clinical evaluations, should also observe for objective evidence of salivary hypofunction.

The management of salivary gland hypofunction and its sequelae has been well-documented52,53,59,60 and will not be covered in detail here. The management may include hydration, regular at-home and professional oral prophylaxis and fluoride therapy; medical, nutritional, pharmacotherapeutic, and emotional counseling; and salivary stimulation and substitution as indicated.61-63

Conclusion

The wonders of saliva have recently been appreciated by the media and the health professions.64 Dentistry should support the development and promotion of saliva as a window into wellness and a means for early disease detection that leads to more-effective treatments, risk assessment for future oral and systemic diseases, and a simple, non-invasive alternative to blood and urine tests. The authors envision that a greater understanding of the dynamics of the oral environment mediated by saliva will provide opportunities for developing batteries of multiple analyte tests dedicated to different aspects of oral health, such as an individual's remineralization potential, caries and periodontal disease risk, and even the types and titers of oral microbes that contribute risk to other diseases or medical procedures.

The value of saliva to humankind will expand during the coming years as more scholars, educators, health care providers, and policy makers come to appreciate its fascinating world.

For more information about saliva, readers are encouraged to visit the following sites:

- * www.sjogrens.org
- * www.oralcancer.org
- * www.nidcr.nih.gov
- * www.salivatest.com
- * www.nlm.nih.gov/medlineplus/

References

1. Tabak LA, A revolution in biomedical assessment: The development of salivary diagnostics. *J Dent* Educ 65(12):1335-9, 2001.
2. Kaufman K, Lamster IB, The diagnostic applications of saliva -- a review. Crit Rev Oral Biol Med 13(2):197-212, 2002.
3. Zelles T, Purushotham KR, et al, Saliva and growth factors: the fountain of youth resides in us all. *J Dent* Res 74:1826-32, 1995.
4. Shugars DC, Wahl SM, The role of the oral environment in HIV-1 transmission. *J Am Dent Assoc* 129:851-8, 1998.
5. Mandel ID, The functions of saliva. *J Dent* Res 66:623-7, 1987.
6. Baum BJ, Principles of saliva secretion. Ann NY Acad Sci 694:17-23, 1993.
7. Quissell DO, Steroid hormone analysis in human saliva. Ann NY Acad Sci 694:143-5, 1993.
8. Ambudkar IS, Regulation of calcium in salivary gland secretion. Crit Rev Oral Biol Med 11:4-25, 2000.
9. Dumbrigue HB, Sandow PL, et al, Salivary epidermal growth factor levels decrease in patients receiving radiation therapy to the head and neck. Oral Surg Oral Med Oral Pathol 89:710-6, 2000.
10. Kaufman K, Lamster IB, Analysis of saliva for periodontal diagnosis. A review. J Clin Periodontol 2000 27:453-65, 2000.
11. Lenander-Lumikari M, Loimaranta V, Saliva and dental caries. Adv Dent Res 14:40-7, 2000.
12. al-Bayaty HF, Aldred MJ, et al, Salivary and serum antibodies to gliadin in the diagnosis of celiac disease. *J Oral Pathol Med* 18:578-81, 1989.
13. Hakeem V, Fifield R, et al., Salivary IgA antigliadin antibody as a marker for coeliac disease. Arch Dis Child 67:724-7, 1992.
14. Sreebny LM, Zhu WX, The use of whole saliva in the differential diagnosis of Sjogren's syndrome. Adv Dent Res 10:17-24, 1996.
15. Fox PC, Spreight PM, Current concepts of autoimmune exocrinopathy: Immunologic mechanisms in the salivary pathology of Sjögren's syndrome. Crit Rev Oral Biol Medical 7:144-158, 1996.
16. Streckfus CF, Bigler L, et al, Cytokine concentrations in stimulated whole saliva among patients with primary Sjögren's, secondary Sjögren's syndrome, and primary Sjögren's syndrome receiving varying doses of interferon for symptomatic treatment of the condition: a preliminary study. J Clin Oral Invest 5:133-5, 2001.
17. Vitali C, Bombardieri S, et al, Assessment of the European classification criteria for Sjögren's syndrome in a series of clinically defined cases: results of a prospective multicentre study. The European Study Group on diagnostic criteria for Sjögren's syndrome. Ann Rheum Dis 55:116-21, 1996.
18. Lu Y, Bentley GR, et al, Salivary estradiol and progesterone levels in conception and nonconception cycles in women: evaluation of a new assay for salivary estradiol. Fertil Steril 71:863-8, 1999.
19. Voss HF, Saliva as a fluid for measurement of estrodiol levels. Am J Obstet Gynecol 180:S226-31, 1999.
20. Heine RP, McGregor JA, Dullien VK, Accuracy of salivary estriol testing compared to traditional risk factor assessment in predicting preterm birth. Am J Obstet Gynecol 180:S214-8, 1999.
21. Granger DA, Schwartz EB, et al, Salivary testosterone determination in studies of child health and development. Horm Behav 35:18-27, 1999.
22. Van Honk J, Tuiten A, et al, Correlations among salivary testosterone, mood, and selective attention to threat in humans. Horm Behav 36:17-24, 1999.
23. Malamud D, Oral diagnostic testing for detecting human immunodeficiency virus-1 antibodies: a technology whose time has come. Am J Med 102:9-14, 1997.
24. Schramm W, Angulo GB, et al, A simple saliva-based test for detecting antibodies in human immunodeficiency virus. Clin Diagn Laboratory Immunol 6:577-80, 1999.
25. Bello PY, Pasquier C, et al, Assessment of a hepatitis C virus antibody assay in saliva for epidemiological studies. Eur J Clin Microbiol Infect Dis 17:570-2, 1998.
26. Chaita TM, Graham SM, et al, Salivary sampling for

hepatitis B surface antigen carriage: a sensitive technique suitable for epidemiological studies. Ann Trop Paediatr 15:135-9, 1995.
27. Lucht E, Brytting M, et al, Shedding of cytomegalovirus and herpes viruses 6, 7, and 8 in saliva of human immunodeficiency virus type 1-infected patients and healthy controls. Clin Infect Dis 27:137-41, 1998.
28. Crowcroft NS, Vyse A, et al, Epidemiology of Epstein-Barr virus infection in pre-adolescent children: application of a new salivary method in Edinburgh, Scotland. J Epidemiol Community Health 52:101-4, 1998.
29. Reilly TG, Poxon V, et al, Comparison of serum, salivary, and rapid whole blood diagnostic tests for Helicobacter pylori and their validation against endoscopy based tests. Gut 40:454-8, 1997.
30. Di-Xia C, Schwartz P, Fan-Qin L, Salivary and serum CA 125 assays for detecting malignant ovarian tumors. Obstet Gynecol 75:701-4, 1990.
31. Streckfus C, Bigler L, et al, A preliminary study of CA15-3 and c-erbB-2, epidermal growth factor receptor, cathepsin-D, and p53 in saliva among women with breast carcinoma. Cancer Invest 18:103-11, 2000.
32. Streckfus CF, Bigler L, et al, The presence of c-erbB-2, and CA 15-3 in saliva and serum among women with breast carcinoma: a preliminary study. Clin Cancer Res 6:2363-70, 2000.
33. Streckfus CF, Bigler LR, Saliva as a diagnostic fluid. Oral Diseases 8:69-76, 2002.
34. Hicks MJ, Carter AB, et al, Detection of fungal organisms in saliva from HIV-infected children: a preliminary cytologic analysis. *Pediatr Dent* 20:162-8, 1998.
35. Klock B, Svanberg M, Petersson LG, Dental caries, mutans streptococci, lactobacilli, and saliva secretion rate in adults. Community Dent Oral Epidemiol 18:249-52, 1990.
36. Kohler B, Bjarnason S, Mutans streptococci, lactobacilli and caries prevalence in 15 to 16-year olds in Goteborg. Part II. Swed Dent J 16:253-9, 1992.
37. Tavassoli M, Brunel N, et al, P53 antibodies in the saliva of patients with squamous cell carcinoma of the oral cavity. Int J Cancer 78:390-1, 1998.
38. Badawi AF, Hosny, et al, Salivary nitrate, nitrite and nitrate reductase activity in relation to risk of oral cancer in Egypt. Dis Markers 14:91-7, 1998.
39. Joshipura KJ, Douglass CW, Willett WC, Possible explanations for the tooth loss and cardiovascular disease relationship. Ann Periodontol 3:175-83, 1998.
40. Morrison HI, Ellison LF, Taylor GW, Periodontal disease and risk of fatal coronary heart and cerebrovascular diseases. J Cardiovasc Risk 6:7-11, 1999.
41. Offenbacher S, Jared HL, et al., Potential pathogenic mechanisms of periodontitis associated pregnancy complications. Ann Periodontol 3:233-250, 1998.
42. El-Guebaly N, Davidson WJ, et al, The monitoring of saliva drug levels: psychiatric applications. Can J Psychiatry 26:43-8, 1981.
43. Takahashi T, Fujiwara Y, et al, Salivary drug monitoring of irinotecan and its active metabolite in cancer patients. Cancer Chemother Pharmacol 40:449-52, 1997.
44. Slavkin HC, Toward molecularly based diagnostics for the oral cavity. *J Am Dent Assoc* 129:1138-43, 1998.
45. Penttila A, Karhunen PJ, Pikkarainen J, Alcohol screening with the alcoscan test strip in forensic praxis. Forensic Sci Int 44:43-8, 1990.
46. Kidwell DA, Holland JC, Athanaselis S, Testing for drugs of abuse in saliva and sweat. J Chromatogr B Biomed Sci Appl 713:111-35, 1998.
47. Di Giusto E, Eckhard I, Some properties of saliva cotinine measurements in indicating exposure to tobacco smoking. Am J Public Health 76:1245-6, 1986.
48. Navazesh M, Brightman VJ, et al, Relationship of medical status, medications, and salivary flow rates in adults of different ages. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 81:172-6, 1996.
49. Navazesh M, Mulligan R, et al, The prevalence of xerostomia and salivary gland hypofunction in a cohort of HIV-positive and at-risk women. *J Dent* Res 79:1502-7, 2000.
50. Mulligan R, Navazesh M, et al, Salivary gland disease in human immunodeficiency virus-positive women from the WIHS study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 89:702-9, 2000.
51. Navazesh M, Barron Y, et al, The relationship among HAART, HIV disease markers, and salivary gland hypofunction. *J Dent* Res 81, Abstract #1076 pg. A-153, 2002.
52. Ship JA, Pillemer SR, et al, Xerostomia and the geriatric patient. J Am Geriatr Soc 50:535-43, 2002.
53. Ship JA, Diagnosing, managing, and preventing salivary gland disorders. Oral Diseases 8:77-89, 2002.
54. Epstein JB, vander Meij EH, et al, Effects of compliance with fluoride gel application on caries and caries risk in patients after radiation therapy for head and neck cancer. Oral Surg Oral Med Orla Pathol Oral Radiol Endod 82:268-75, 1996.
55. Navazesh M, Christensen CM, Brightman VJ, Clinical criteria for the diagnosis of salivary gland hypofunction. *J Dent* Res 71:1363-9 1992.
56. Reisine S, Parke A, Xerostomia and depressive symptoms among females with primary Sjogren's syndrome (PSS), early onset rheumatoid arthritis (RA) and healthy female controls (HC). *J Dent* Res 81 Abstract #2412 pg. A-305, 2002.
57. Thompson SD, Watkins, CA, et al, Dry mouth and oral disease in 79+ elders. *J Dent* Res 81 Abstract #0986 pg. A-143, 2002.
58. Fox PC, Busch KA, Baum J, Subjective reports on xerostomia and objective measurements of salivary gland performance. *J Am Dent Assoc* 115:581-4, 1987.
59. Daniels TE, Wu AJ, Xerostomia – clinical evaluation and treatment in general practice. J Cal Dent Assoc 28:933-41, 2000.
60. Navazesh M, Salivary gland hypofunction in elderly patients. J Cal Dent Assoc 22:62-8, 1994.
61. Heifetz S, Fluorides for the elderly. J Cal Dent Assoc 22:49-54, 1994.
62. White S, MacEntee M, Cho G, Restorative treatment for geriatric root caries. J Cal Dent Assoc 22:55-60, 1994.
63. Navazesh M, Dry mouth: aging and oral health. Compendium of Dental Education 2002 (accepted for publication)
64. Mestel R, The wonders of saliva. Los Angeles Times, Jan 21, 2002, p S1.

To request a printed copy of this article, please contact/ Mahvash Navazesh, DMD, USC School of Dentistry, 925 W. 34th St., Room 4320, Los Angeles, CA 90089-0641, or navazesh@usc.edu.

CDA JOURNAL, VOL 30, Nº10

Oral Gratification Out of Control

Robert E. Horseman, DDS

Current studies, along with a startling glimpse of Anna Nicole Smith, confirm our observation that obesity is so rampant in this country that it can almost be considered the norm. Concurrent research is pointing toward overmastication as the prime etiology of most TMJ problems and intractable love handles. We are obsessed with food. It functions nicely as nutritive Xanax and at the same time is the essential ingredient in all social intercourse.

We don't eat because we're hungry, but because it's time, or because food is constantly displayed on TV with only occasional interruptions for the programming. Food can be clearly heard importuning from the fridge, "Turn on the light, let's party down!"

Actually, we rationalize, there is nothing better to do and there is so much food, we owe it to the farmers to help reduce the glut. All this in spite of the fitness craze now in its third decade and the millions of dollars spent on diet foods. The exhortations of Suzanne Somers flogging the Thigh Master and the chimera of the six-pack abs are apparently not enough. The lip service given the fat-free diet also features lips wrapped around anything that tastes, smells, looks or feels good.

All the gondolas in the supermarket are accompanied by frowny citizens intently studying the percentage of calories derived from the fat in the foods they are about to purchase. The wheels of rationalization turn audibly in their heads. To aid them and us in this determination, the government has dictated that the nutritional value of the product be listed prominently on the package. This has the same effectiveness as cancer warnings placed on cigarettes because the amount is expressed in grams. In this country, the metric system has met with the same popularity you would experience upon learning the Osbourne family has moved in next door.

As a result, except for the scientific community that can at least pretend to grasp the concept, nobody has any idea of how much or what a gram is. Telegrams we know; cablegrams, sure, but the gram without a prefix is an entity completely outside our frame of reference. Look it up and find out how many grams are in a pound if you feel guilty for not knowing, but you'll forget it moments later without hesitation or regret.

You might accept that a milligram is one-thousandth of a gram, but you can't say that easily without lisping like Sylvester the puddy-tat. You could perhaps agree that a kilogram is a thousand grams, but does that mean you could hold that much in your hand or would you need a forklift? See, you don't know! If you could

hold a thousand grams in your hands, then a gram couldn't amount to a hill of beans, could it? That's what we think, and that's what the mayonnaise and potato chip manufacturers, for example, are slyly encouraging us to believe. Mayonnaise contains only 12 grams of fat, they assure us in the sincere manner of a used car salesman sliding quickly over the fact that the car has 200,000 miles on it. They are hoping you won't notice the small print on the label casually mentioning that the 12 grams of fat occurs in each and every tablespoon of the dressing. Potato chips have only 10 grams of fat per serving, they state in the same reassuring manner you'd use with a patient about to get an injection. And how much is a serving? It's one ounce. Six chips? Eight? Who would know? Nobody at our house, where a 12 ounce bag of chips in the presence of two adults lasts no longer than five minutes -- much less in the grimy paws of children and adolescents.

Further deliberate obfuscation of an already murky subject occurs when the agency in charge of Consumer Obfuscation decides to subdivide its fat report into saturated, unsaturated and polyunsaturated categories. They know they are on pretty safe ground here, because the same people who can't get a fix on a gram are going to come up equally clueless with all this saturation information.

We think the surgeon general, who may be too busy advocating the use of birth control devices to pay enough attention to more practical matters, should require warning labels to be placed on these products stating that the contents will go directly to the hips, supersaturating those areas and bypassing normal routes.

Laboratory tests with rats, while conceding that these animals in their natural state seldom wear form-fitting outfits, indicate that continued use of the product by a human consumer will require her to shoehorn herself into Spandex pants at considerable risk to her self-esteem. Then there is the additional possibility of laying out upwards of $4,000 for services rendered by professional fat removers wielding large suction hoses.

We dentists have shamefully neglected our responsibility here. What's the question most often asked us? "How soon can I eat on this, Doc?" Like they can't wait, haven't chewed anything for an hour and loss of oral gratification is threatening to unhinge them. Regretfully, our traditional response has been, "Don't chew on that side for four to six hours." Or, "Don't chew anything hard, fibrous, tough or sticky at lunch (or dinner) today." As guardians of the oral orifice and professional people wearing serious white coats upholding our pledge to care for the health of our patients, our response should have been, "Don't chew anything for six months, or better yet, never."

We concede that this may be an unworkable suggestion much like "be sure to floss every day." Even if implemented, dedicated trenchermen would soon figure out how to get their mass quantities of food transdermally, by I.V., or incorporated into suppositories. In the meanwhile, we see no harm in returning the word "gram" back to its proper definition of the female half of one's grandparents.