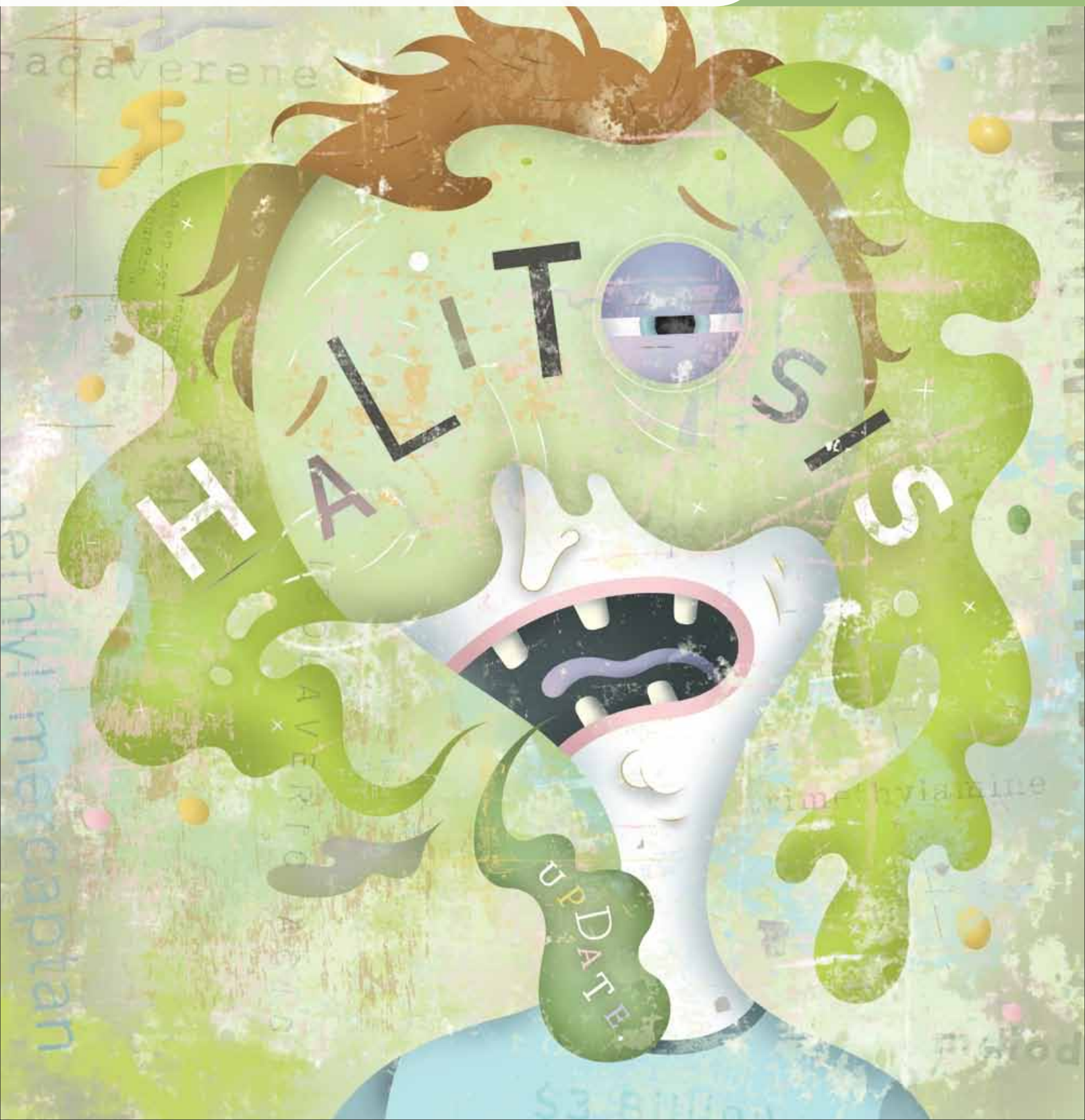
OF THE CALIFORNIA DENTAL ASSOCIATION

Journal

APRIL 2007



OF THE CALIFORNIA DENTAL ASSOCIATION
Journal
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DEPARTMENTS

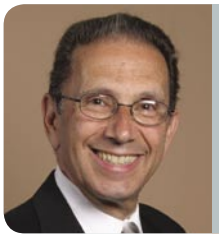
FEATURES

CDA JOURNAL, VOL 35, Nº4

A Little Help Here

ALAN L. FELSENFELD, DDS

When my youngest granddaughter was 3, she undertook a mission to build the world's largest tower of Legos. There was a long period of silence as she toiled diligently in the next room followed by a crashing sound that could only be the tower falling down on her table. Expecting a cry of dismay or tears, it was surprising to hear a wee voice calling out in a plaintive plea "I need a little help here." Terribly cute at the time, but it made me realize that all of us need help in the performance of our jobs.



It is hard to imagine efficiency of operation without good supporting staff.

The California Dental Association commissioned a study designed to evaluate the numbers of hygienists and the purported need for additional personnel and educational resources. Included in the study was a parallel assessment of dental assistants in an effort to see if there was a sufficient number to support clinical practitioners. It was surprising to learn that the hygienist-dentist ratios did not validate any specific shortages in our state. Similar evaluation of dental assistants indicated there was a more pronounced scarcity of personnel to assist in clinical care.[1]

There are reported instances where dentists practice without any assistants at all, and there are several practices where the dentist has but one assistant, but more than 95 percent of dentists have multiple dental assistants.[1] The number of assistants needed to support an individual dentist varies, but an estimate of three to four per practitioner could be considered to be a workable, conservative ratio. Given the more than 30,000 dentists in the state and the relatively rapid turnover of assistants for a multitude of factors, one can appreciate that the employment pool needs to be large. Most of us practice with multiple assistants in the business and clinical aspects of our offices. The ability to see numerous patients with an attendant increase in productivity is enhanced with a multiple-assistant office. Those procedures that are legally delegatable to assistants with tiered levels of ability and credential will be assigned allowing the supervising dentist to care for more patients and deliver better care. It is hard to imagine efficiency of operation without good supporting staff.

Most of our assistants are young people, mostly women, who are high school graduates seeking a career as opposed to pursuing a full college education. The training for these new assistants is varied. The work experience pathway, where on-the-job education is possible, is the educational track elected by many dental assistants. Other means of obtaining the skills and knowledge necessary for the career may be from community colleges, vocational educational programs in school districts, and commercial schools. Each of these institutional programs requires classes, practical and office experience, and clinical and conceptual examinations.

For the young individual who is not a "student" type, there are alternative careers. Dentistry has to compete with corporate entities such as Starbucks, Ralphs, or Costco for entry-level individuals. Unfortunately for dentistry, there is a plethora of employment opportunities that are replete with good salaries, flexible hours, and significant benefits. Perusal of the Web sites of those and similar companies reveal that employees are eligible for packages that variably include health care (medical, dental, drugs, and vision) insurance, disability and life insurance, pension plans, educational opportunities for career development, bonus plans, legal plans, stock purchase options, dependent care, and long-term care programs. For individuals who stay with these employers, promotion into management positions is possible with career potential and salaries that can approach six figures. It is an easy option for a young person to be enticed by this in choosing a career.

The problem for dentistry is to convince these individuals that being a dental assistant and part of a health care team has many rewards that are not necessarily quantifiable. The good feeling of treating disease, providing care to patients, seeing immediate outcomes for the efforts expended, and helping people are many of the reasons we became dentists. These good feelings can be afforded to, and are enjoyed by, our assistants as well. The problem is that we cannot demonstrate those intangibles until such time as the individual has gone through the training and is working in practice and can appreciate them.

The option of stocking shelves or serving as a checker at Ralphs, assisting customers at Costco who are purchasing large quantities of items they usually do

not need at great discount, or serving up yet another Double-Double animal style at In-N-Out Burger pales in comparison to the self-actualization values of dental assisting. It is difficult to compete with industry in the recruitment and retention of assistants, and this is a priority we need to consider and act on to continue to provide safe and efficient care to our patients. ■■■■

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Articaine vs. Lidocaine

An article in the December issue of the *Journal of the California Dental Association* by Stanley Malamed, DDS, "Local Anesthetics: Dentistry's Most Important Drugs, Clinical Update 2006" appears to be written to promote the use of articaine and nullify the reports of paresthesia rates up to 20x that of lidocaine. The word "articaine" appears 17 times, three times noted as "articaine is very popular," and once as "it is increasingly popular in the United States." The article uses the word "superiority" four times with the local anesthetic, "superior" once, and "advantage" once.

Dr. Malamed reports claims that articaine works faster, works better, is effective more often, gets the patient numb when other local anesthetics fail, and that endodontists have become "enamored" with the drug. Terms used for the other amide local anesthetics are "very effective in general," "darned good," and "more traditional." Although there are many studies, including Septodont's FDA study on Septocaine, that the efficacy of lidocaine for local anesthesia is unsurpassed, he only listed a clinical trial where articaine had better results than lidocaine. However, that study was for trying to achieve anesthesia of mandibular posterior teeth via a buccal infiltration. A testimony to the efficacy and safety of lidocaine compared to articaine are the data in Table 2 of the article where it can be seen that lidocaine is used nearly 50 percent of the time and nearly twice as much as articaine. Also supporting the efficacy and safety of lidocaine is its predominant use in dental schools in the United States.

Interestingly, Jeffrey Caputo, DDS, a 2005 graduate from University of Southern California and a resident in the University of Pacific, Arthur A. Dugoni School of Dentistry, Oral and Maxillofacial Surgery Program at Highland Hospital, publicly stated that articaine is not used, or is seldom used, at University of Southern California. According to Dr. Caputo, Dr. Malamed said articaine was restricted for "political reasons."

While appearing to promote the use of articaine, the author endeavors to nullify the global findings that the drug is associated with very significant increases in paresthesias with mandibular block injections. Very few of the possible references reporting the increased paresthesias with articaine are included, and the article by Hillerup and Jensen on the 52 paresthesias in Denmark is mischaracterized.[1] Dr. Malamed stated on two occasions there is no scientific evidence that articaine is associated with increased paresthesia rates. He also stated that the advisories to dentists from TDIC and the Professional Liability Program of Toronto, Canada, suggesting that it might be prudent to avoid the use of articaine in mandibular nerve blocks is unjustified. Actually, there is substantial evidence of the very significant increase in paresthesias with the use of articaine. The concluding quote from the FDA statisticians on the Septocaine study was, "Regarding the adverse events, there is evidence that the risks of paresthesia and nausea are higher with articaine than with lidocaine."[2]

AT LEAST THREE TIMES the FDA has required changes in the product insert for articaine because of reports of adverse events to the FDA.

At least three times the FDA has required changes in the product insert for articaine because of reports of adverse events to the FDA. One of the changes is listed as "Persistent paresthesias of the lips, tongue, and oral tissues have been reported with the use of articaine hydrochloride with slow, incomplete, or no recovery. These postmarketing events have been reported chiefly following nerve blocks in the mandible and have involved the trigeminal nerve and its branches."[3,4] An article demonstrating articaine has up to a 20x higher paresthesia rate than lidocaine can be seen at dentistrytoday.com.[5] Contrary to the portrayal by Dr. Malamed, Hillerup and Jensen concluded, "This indicates that during the two-year period mentioned, Articaine produced a more than 20-fold higher incidence of injection injury when applied for mandibular block analgesia."[1]

The increased paresthesia rate with articaine has been noted by a large dental clinic, government agencies, and dental insurance carriers (SAFECO in 2001, Royal College of Dental Surgeons of Ontario, Canada in 2005, The Dentists Insurance Company in 2005).[6-11] Note that the European Union's Eudravigilance does not publish adverse events data.

The depth and breadth of the problem can also be seen by a literature search on "articaine AND paresthesias" as well as via search engines (google.com, yahoo.com, ask.com, answers.com and wikipedia.com) on the subject, and discussion boards on dentaltownusa.com and other dental Web sites.

Two of the references cited by Dr. Malamed are his papers on the safety and efficacy of articaine from the Septodont's

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FDA study on Septocaine, for which he was the principal investigator.[12,13] Dr. Malamed quotes the conclusion of his research that articaine is a "safe and effective local anesthetic" for dentistry. Having more than 11 paresthesias in 882 treatments seen in the product insert could hardly be characterized as "safe."[3,4,14] I also found a number of irregularities in the Septocaine study and journal articles from the study. Listed below are what I believe to be some of the irregularities in these publications.

- The efficacy article on Septocaine (articaine) was reported nine months before the safety article on Septocaine (articaine) even though all data was available for reporting.[12,13]
- The authors stated the drug was "well-tolerated" in the efficacy article, on articaine despite 21 paresthesias documented in 882 patient treatments.[12,15]
- The references listed in the efficacy article did not include any with reported paresthesias.[12]
- Cases of paresthesia that did not begin on the day of the injection were attributed to the dental procedure and not the anesthetic even though there was no dental surgery that could have damaged the lingual or inferior alveolar nerves.[13,15]
- Although Dr. Malamed's textbook recommends patients should be seen clinically to determine the degree and extent of paresthesia and to record findings, this was not done in the study.[16]
- The lexicon for neuropathies was reported as being inconsistently used.[15]
- Data on paresthesias was reported as being inconsistently gathered.[15]
- Several cases of pain and burning were reported with the paresthesias.[15]
- Cases of paresthesias were listed as, and with, minor adverse events from local anesthesia.[13]
- The number of mandibular block injections administered in the study is not noted.[12,13]
- The authors reported that lidocaine had the same frequency of paresthesias as articaine.[15]

Even without reporting the number of mandibular block injections and apparently not reporting some paresthesias, the Septodont's FDA application indicated there were 21 paresthesias in 882 patient treatments.[15] This is reported as a 2 percent paresthesia rate. This number of paresthesias would be 1:42 treatments and does not select out the number of mandibular block injections where the paresthesias occurred.

THERE IS NO LISTING of the number of maxillary and mandibular procedures or the number and type of injections administered.

The authors also did not consider some of the paresthesias to be due to the local anesthetic. On page 259 of the FDA application it was stated, "In many cases, symptoms did not begin on the same day as the administration of study drug, indicating that these symptoms were more likely to be due to the procedure than the anesthetic."[15] This indicates it was the study drug articaine that was connected with these paresthesias. Also, their conclusion that it was the dental procedure and not the articaine that was responsible for the paresthesias is preposterous since there were no dental procedures adjacent to the lingual or inferior alveolar nerves. Also, "delayed" paresthesias are known in dentistry to be associated with the injected solutions, not the procedure. Evers and Haegerstam in "Introduction to Local Anesthesia" indicated injected solutions may cause edema that over time may induce a paresthesia some time after the treatment.[17] It has also been reported that the highest concentrations of local anesthetics are associated with endoneurial edema.[18] The issue of "delayed" paresthesias is also discussed on page 183 of the safety article on articaine.[13] In the FDA study a table listed as, "Summary of patients with numbness/tingling at the second follow-up interview" shows 38 percent of the patients with pain or burning.[15]

There were serious self-reported flaws in the author's data gathering. Page 256 of the FDA application states, "In some cases the numbness and tingling were recorded as adverse events (coded as paresthesia, hypesthesia, or circumoral paresthesia), but this was not consistent across all investigators.[15] Therefore, the overall rate of paresthesia derived from telephone follow-up is higher than the rate of paresthesia recorded as adverse events." It goes on to say, "Follow-up was continued for these reports of paresthesia; however, these additional phone contacts were not consistently recorded in the database." The safety article on articaine indicates that the providers of dental treatment did not make the calls to the patients.[13]

Concerning the sampling and demographics, the efficacy article on articaine indicates, "Many factors were equally distributed by the authors in the study."[12] Although the demographics of complexity of procedure and patient age, weight, gender, and race were distrib-

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uted and listed, there is no listing of the number of maxillary and mandibular procedures or the number and type of injections administered. The distribution of arch and injection would be critical for reporting the frequency of paresthesias with mandibular block injections. Although the study submitted to the FDA indicated a 2 percent (21/882-actually 2.38 percent) paresthesia rate for articaine, if half of the patients received mandibular block anesthesia the paresthesia rate would be 4.76 percent (21/442) or 1 paresthesia per 21 mandibular block injections.

It appears the FDA approval of articaine was based on the Septocaine study reporting that articaine had the same safety and efficacy profile as lidocaine. Lidocaine was the control local anesthetic administered in 443 patient visits and articaine was administered in 882 patient visits. On page 256 of the Septodont study to the FDA reports 2 percent (21/882) of the patients who received Septocaine (articaine) and 2 percent (10/443) of the patients who received lidocaine had paresthesias.[15] On page 259 it states, "Thus, there were no differences between treatment groups in the rate of or nature of prolonged numbness/tingling following anesthesia and a dental procedure." This would be very unusual considering the study done in Ontario, Canada, where there were only five confirmed lidocaine-linked paresthesias reported in 21 years.[19] If the 10 paresthesias for lidocaine were accurate, and if half of the injections were for mandibular block injections, the paresthesia rate would be 10 paresthesias in 222 patients, or 1 in every 22 patients receiving a mandibular block injection.

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Well-supported Workers Reflect a Well-supported Leader

Sometimes, nice guys finish first AND have a happy staff to boot.

"Great companies realize that employees are their most important resource," said Ed Rehkopf, author of *Leadership on the Line – A Guide for Front Line Supervisors, Business Owners, and Emerging Leaders*. "They foster a leadership style that motivates leaders to serve their employees as well as their customers. This approach to leadership creates relationships—the deep and abiding bonds that sustain the efforts of the company."

It is in the best interest of a leader to be as supportive of employees as possible. The ultimate concern is satisfying the customer and how employees are treated

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Biotene PBF Mouthwash →

Laclede, the makers of Biotene, introduce Biotene PBF Plaque-Biofilm dissolving mouthwash. Plaque is a biofilm created by bacteria to hide within. Biotene PBF's breakthrough chemistry dissolves excessive plaque-biofilm, freshens breath longer and brings out the natural whiteness in teeth. The all-new mouthwash also contains Biotene's proven LP3 salivary enzyme system to strengthen the natural antibacterial system found in saliva. Biotene PBF mouthwash is alcohol-free, sweetened with xylitol to fight cavities and does not include any SLS or chlorine compounds. Essential for anyone with dry mouth or oral irritations. For more information or free samples, call 800-922-5856 or visit www.biotene.com.

Major Revision of Standard Practices for Dental Materials' Biocompatibility

The American Dental Association Standards Committee on Dental Products has published a major revision of ADA Specification No. 41, "Recommended Standard Practices for Biological Evaluation of Dental Materials."

According to a press release, this specification, recently approved by the American National Standards Institute as an American National Standard, is its first revision since 1979. Updated and expanded, the revised edition provides detailed methodologies and guidelines for dental professionals, manufacturers and scientists who must evaluate the biocompatibility of dental materials as part of a materials research or evaluation program.

To determine the potential toxicity resulting from contact of the component materials with the body, biological evaluations of dental materials are performed.

ANSI/ADA Specification No. 41 and all ANSI/ADA Specifications, ADA Technical Reports and ISO Standards are available for download or hard copy purchase from the ADA E-catalog at www.adacatalog.org or by calling 800-947-4746. Questions regarding the standards section of the ADA E-catalog or the purchasing of standards should be made via e-mail to standards@ada.org.

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Results for Dental Anesthesia Reversal Agent Announced

Novalar Pharmaceuticals, Inc. announced that NV-101, a local dental anesthetic reversal agent, was well-tolerated and met its primary endpoints in two pivotal Phase 3 studies. In both trials, NV-101-treated patients reported the return of sensation in less than half the time it typically took after receiving local dental anesthesia.

"We are extremely pleased with the outcome of these studies," said Donna Janson, president and chief executive officer, in a press release. "Based on these positive results, Novalar will continue to work closely with the U.S. Food and Drug Administration toward a successful submission of our New Drug Application for NV-101 in 2007, and to build the organizational infrastructure necessary to launch NV-101 following FDA approval." Both pivotal trials were initiated in the first quarter of 2006 after a Special Protocol Assessment was completed by the FDA.

The two multicenter, randomized, blinded, controlled Phase 3 studies were conducted in 18 centers across the country, including leading dental schools, private clinics and clinical research organizations. Youths and adults were enrolled across the two studies. In the first, 244 patients received anesthesia in the mandible while 240 patients were administered anesthesia in the maxilla in the second study. Following anesthesia and completion of the dental procedure, patients were administered either sham control or NV-101.

If approved by the FDA, NV-101 will be the only local anesthetic reversal agent available for use in pediatric, adolescent and adult, including geriatric, patients, which accelerates the return to normal sensation and function following restorative and periodontal maintenance procedures.

"Good oral health should no longer be a privilege of a few but a right for all"

MICHELLE AERDEN

Oral Health Focus Renewed by World Health Organization

After a 26-year absence, the topic of oral health was finally back on the agenda at the recent World Health Organizations' executive board meeting in Geneva. The report, "Oral Health: Action Plan for Promotion and Integrated Disease Prevention," was prepared by the WHO's Global Oral Health Programme.

Addressing the WHO board, Michele Aerden, DDS, president of the FDI World Dental Federation talked about the important strategic principles contained in the report.

Supporting the merger of oral health into promoting overall general health, the FDI wants to involve the dental profession as a responsible and active partner in integrated disease prevention.

"By reducing the risks common to many chronic diseases, such as smoking or high sugar consumption, we do not only improve oral health, but also other chronic diseases such as diabetes or cardiovascular diseases," Aerden said.

The WHO report cited oral disease as an acute public health problem, linking tooth loss and periodontal disease to other chronic illnesses, and oral cancer to such lifestyle determinants as alcohol and tobacco use.

Oral diseases are a "neglected area of international health," despite their huge impact on well-being and economies, particularly in low and middle-income countries, said Margaret Chan, MD, newly elected director-general of the WHO, adding that "the tools and best practices are there and we need to ensure that they are applied and implemented."

"Good oral health should no longer be a privilege of a few but a right for all," Aerden said.

UPCOMING MEETINGS

2007	
April 15-21	United States Dental Tennis Association, Sarasota, FL, www.dentaltennis.org.
April 17-21	American Academy of Oral Medicine Annual Meeting, San Diego, www.aaom.com.
May 3-6	CDA Spring Scientific Session, Anaheim, 866-CDA-MEMBER (232-6362).
June 27-July 1	Academy of General Dentistry Annual Session, San Diego Convention Center, 888-243-3368.
Sept. 27-30	American Dental Association 148th Annual Session, San Francisco, www.ada.org.
Nov. 27-Dec. 1	American Academy of Oral and Maxillofacial Radiology 58th Annual Session, Chicago, www.aaomr.org.
2008	
May 1-4	CDA Spring Scientific Session, Anaheim, 866-CDA-MEMBER (232-6362).
Sept. 12-14	CDA Fall Scientific Session, San Francisco, 866-CDA-MEMBER (232-6362).
Oct. 16-19	American Dental Association 149th Annual Session, San Antonio, Texas, www.ada.org.

To have an event included on this list of nonprofit association meetings, please send the information to Upcoming Meetings, CDA Journal, 1201 K St., 16th Floor, Sacramento, CA 95814 or fax the information to 916-554-5962.

Tongue Tool →

The new stainless-steel, long-lasting Tongue Tool is a durable, lifetime guaranteed tongue cleaner that is easy to use, affordable and dishwasher safe with prices ranging from $9.99 to $13. The Tongue Tool tongue cleaner maintains durability and effectiveness in removing the plaque, bacteria, and sulfur compounds that collect on the tongue daily. For more information on the Tongue Tool or other Britestar Products, visit www.tongue-tool.com or call 419-341-0432.

Novel Stem Cell Treatment Used to Save Kids' Teeth

Endodontists have been able to save the teeth of four children — without the use of traditional root canal therapy.

In a recent issue of the *Journal of Endodontics*, endodontists fostered the growth of the stem cells surrounding the tooth root, allowing the youths to regenerate new root tissue and in the end, save their teeth. The children were between the ages of 9 and 10, and had suffered an injury or experienced severe endodontic disease in a permanent adult tooth.

Root canal treatment is effective in children and the tissue in young adult teeth has a rich blood supply and proximity to the stem cells outside the tooth. The endodontists were able to develop a method to use on tissue more responsive to regeneration.

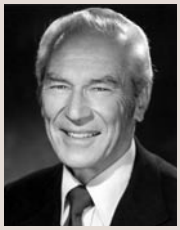
The article "Immature Teeth with Periradicular Periodontitis or Abscess Undergoing Apexogenesis: A Paradigm Shift," presented four cases involving children, where endodontists irrigated the affected area of the inner tooth with a cleaning solution instead of using endodontic files or other instruments, and effectively assisted the regeneration of the root tissue.

This treatment approach not only saved the childrens' natural teeth, but also allowed the young tooth to continue its development into a healthy adult tooth. This development is critical to long-term oral health since tooth loss at a young age can result in additional dental complications and possible facial disfigurement. The findings detailed in the article may allow endodontists to save even more of kids' adult teeth by encouraging the natural development to continue, allowing for healthy, strong teeth into adulthood.

For more information on this article, or to speak with an endodontist familiar with this area of research, contact Meg O'Connor at 312-233.1322 or meg.o'connor@edelman.com.

Honors


Craig C. Yarbobough, DDS


Rex Ingraham, DDS


Carl Lundgren, DDS

Craig S. Yarborough, DDS, of Greenbrae, Calif., a former associate dean for institutional advancement, has been named executive associate dean at the University of the Pacific Arthur A. Dugoni School of Dentistry.

Rex Ingraham, DDS, Distinguished Emeritus Professor at the University of Southern California School of Dentistry, has been awarded the Pierre Fauchard Academy Gold Medal. He was honored for a lifetime of contributions in teaching.

Carl Lundgren, DDS, of Rolling Hills Estates, has been awarded the Pierre Fauchard Academy's Distinguished Service Award for community and dental leadership. He recently served as president of the USA Section of the International College of Dentists, and as president of the PFA Foundation.

Yiming Li, DDS, MSD, PhD, director of Loma Linda University School of Dentistry Center for Dental Research, has been appointed to serve on the U.S. Food and Drug Administration Dental Products seven-member panel. Li's term is until Oct. 31, 2009.

Single Tooth Anesthesia System From Milestone Scientific →

Milestone Scientific has unveiled its FDA-cleared Single Tooth Anesthesia System, comprised of a computer-controlled drive unit and a single-use disposable handpiece/needle assembly. The STA System enables the dental professional to precisely administer an intraligementary injection to anesthetize a single tooth in only one to two minutes, rather than administering a mandibular block that anesthetizes an entire quadrant. The STA Intraligamentary injection has an immediate onset and the injection lasts as long as a radiational infiltration or mandibular block. Unlike traditional syringe injections, the STA System allows the dental professional to start working immediately after the injection is administered, resulting in definitive and uninterrupted treatment saving valuable chairtime. For more information, contact Elite Media Group at 407-585-1080.

American Academy of Periodontology Clarifies Guidelines

The American Academy of Periodontology has issued "Guidelines for the Management of Patients with Periodontal Diseases" for nationwide distribution in an effort to identify patients with periodontal diseases, who, because of the severity of the disease and/or risk profile, may present treatment challenges.

The guidelines have four sections: a narrative introduction, a three-level categorization of patient conditions, definition of terms, and frequently asked questions. Taken together, these sections provide the philosophy and context essential for the proper interpretation of the document. Excerpting any portion of the document out of context will lead to a misunderstanding of the content.

The American Academy of Periodontology issued the clarification since some questions arose regarding the guidelines.

Concern had been expressed that the guidelines mandate referral of patients with specific conditions to a periodontist. However, the language of the guidelines provides flexibility. The word "should" is used, which is defined in the document as "a highly desirable direction but does not mean mandatory." The guidelines do not include treatment or referral mandates.

The guidelines identify a category of patient conditions (Level 3), for which treatment by a periodontist is highly desirable. This identification is based on the experience and judgment of periodontists. The guidelines do not indicate that periodontists are the only individuals qualified to treat patients with Level 3 conditions. However, they do suggest, that periodontists are the individuals best qualified to do so by virtue of their education and experience.

The guidelines also suggest conditions of disease and risk for the general dentist to co-manage with the periodontist in Levels 2 and 1. The academy supports the role of the general dentist as the primary care provider. It offers these guidelines as a means for dentists to immediately identify those patients at greatest risk and, therefore, most appropriate for specialty level care.

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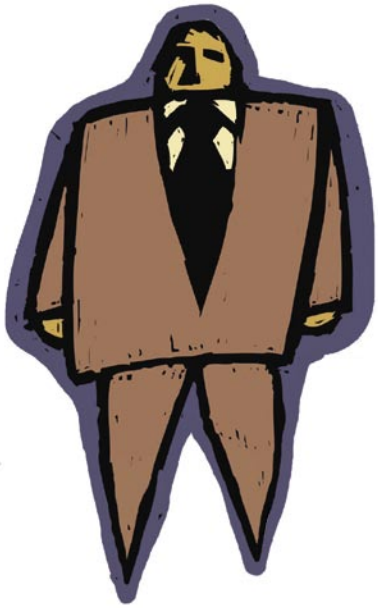

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has an immediate and direct bearing on how customers are treated. Employees who feel good about themselves, whose welfare and problems are attended to in a supportive way, who are provided with the right tools and training to do their jobs, will continually and enthusiastically communicate their satisfaction in countless small but vitally important ways.

A good leader sets up an environment where:

- Employees continually are recognized.
- There is an open flow of ideas, opinions, and information.
- Initiative and risk are highly regarded.
- Problem discovery and solution is a focus while placing blame is unimportant.
- Every employee feels energized and part of the team and is valued for his or her contribution.
- Prestige is derived from performance and contribution, not title or position.
- Customers are treated well because employees are treated well.
- The energy and initiative of all employees is focused on the common effort.

"Being the best leader is an evolutionary process. No one is perfect," Rehkopf said. "The gradual understanding of what makes people tick, of what motivates and de-motivates, of what does and doesn't work, will eventually develop into a storehouse of common sense proven to be successful.

"The accumulated wisdom should bring a leader to a state of profound humility. What gets accomplished is not so much a result of your efforts, but the efforts of your willing and committed employees. Your singular role is to articulate the vision and stand aside while coaching and cheerleading."

"Given the overall risk of sudden cardiac arrest in the general population, the potential for an event in the operatory, waiting room, or common areas surrounding dental practices is significant, especially in large public clinics."

Dental Settings and Defibrillators

The aging of America means medical professions are seeing more and more elderly patients. Among these professions, dentists and their staffs may be called upon to respond to medical emergencies in their offices, most likely: cardiac arrest.

In an issue of the *New York State Dental Journal*, Barry Boyd, DMD, MD; Joseph Fantuzzo, DDS, MD; and Timothy Votta, DDS, MD, noted that since the American Heart Association has assigned high priority to defibrillation for cardiac arrest victims, it is important that dental settings have access to automated external defibrillators, as well as staff trained to use them.

"With the increasing medical complexity and aging of dental patient populations, the likelihood of sudden cardiac arrest in the dental practice setting is of major concern," according to the article. "Given the overall risk of sudden cardiac arrest in the general population, the potential for an event in the operatory, waiting room, or common areas surrounding dental practices is significant, especially in large public clinics."

The authors also stated that dental health professionals have an obligation to "become part of the chain of survival," train in the use of automated external defibrillators, and ensure that properly working devices are available in their offices.

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Halitosis Update: A Review of Causes, Diagnoses, and Treatments

SEAN S. LEE, DDS; WU ZHANG, MD; AND YIMING LI, DDS, MSD, PHD

ABSTRACT Up to 50 percent of the U.S. population reports that their own "bad breath" has concerned them during some point in the course of their lifetime. Half of this group is indeed likely to have an ongoing sporadic or a chronic breath malodor problem. This report looks at the phenomenon of malodorous breath, which oddly persists in a society rife with scientific and medical advancements. Also reviewed are the primary causes, diagnoses, treatments, and research frontiers.

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People have been concerned about "bad breath," or halitosis, for a long time. More than 2,000 years ago, Hippocrates suggested a rinse using herbs and wine be used to sweeten the unpleasant odors of the breath.[1]

While up to half of the adult population is estimated to be affected by real or perceived halitosis at some time or another, one-quarter may have this problem chronically to the extent that others have "trouble enjoying their company."[2-4] These estimates are difficult to validate, however, as many who readily admit breath malodor have none, while those who deny experiencing any significant breath problems are actually suffering from it.[5] We've all known the latter type, and putting oneself in the place of one who unknowingly inflicts others feeds our social paranoia. Thus, it is no surprise that over the decades, the public's concerns over their own potential oral odors have not decreased, even while dental health has improved. These concerns continue to spawn ingenuity in the breath-freshening industry. For example, in 2002, *Time* magazine hailed Listerine's PocketPaks — the first breath strips that dissolved on the tongue — as one of their "Products of the Year," along with breakthroughs such as the birth control patch.[6] Meanwhile, diagnostic devices, usually used in dental offices and research studies, are available to measure odor-producing chemical compounds in the breath.

In the United States, estimates are that the American public spends $1 billion to $3 billion a year for gum, mints, and breath fresheners, and there's no sign of the popularity of these products dissipating any time soon.[7,8] The joke is on the consumer, however, when a product (e.g., Altoids, etc.) contains sugar, as this feeds bacteria, furthering odor production just as the mintiness dissipates. Also, alcohol-containing rinses can dry out the mouth, re-establishing an odor problem soon after their fragrance is gone. One report claims that even sugarless gum has been shown to slightly increase the production of methyl mercaptan (smells of feces).[9] So, when over-the-counter fresheners fail, it is not uncommon for some to consult with, or at least mention it to, a doctor of dental medicine or surgery.

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Dentists get lots of education about treating teeth, but could probably learn more about malodor. In 2001, one dental conference established some best practices regarding oral malodor evaluation.[3] A few years later, the American Dental Association Council on Scientific Affairs released its "2003 ADA Seal Acceptance Program Guidelines for Products Used in the Management of Oral Malodors," in which an example of a scale for odor assessment can be found.[10] These guidelines will protect the public by assuring that ADA Seal products that make malodor control claims have met strict criteria since mid-2005. Yet, some dentists still complain that the profession has yet to agree upon a standard assessment of halitosis.[11] Before the dust settles on assessment protocols or which products will end up bearing the ADA Seal, diagnostic and treatment products will continue to make their way into dental offices and the Home Shopping Channel. Halitosis is on the American consumer's radar so fluorimetric sensor-based instruments — among other types of clinical gizmos — may be at a dental office near you, or in your own, for volatile sulfur compound diagnostic assistance.[12]

This review article summarizes some of the current literature on halitosis to provide an overview of etiology and treatment. Suggestions for management and prevention are provided, along with research frontiers in halitosis.

Malodor Origin and Causation: Oral or Systemic?

Assessing causation is a dubious duty. Causes of bad breath can be multiple, and etiological culprits may shift over time. Ninety percent of the time, the dark, wet and warm oral cavity is the source of malodor (localized); systemic origin comprises roughly the remaining 10 percent of cases.[3,13,14]

LOCALIZED SOURCES. The oral cavity is an ideal breeding ground for microorganisms, and most sufferers have a localized cause for malodor in their mouths.[15] The properties of saliva, and the acts of chewing, drinking, throat clearing, and coughing all work in harmony to keep the mouth homeostatic, and thus healthy.

THE TONGUE — WITH its malodorous colonized bacteria, shed cells, and decayed food — is the primary odor host of all sites in the human body.

Insults such as smoking, conditions such as xerostomia, and the neglect of oral hygiene can tip the balance by contributing to the multiple factors that enable odiferous bacteria to grow with a virulence.

The benign act of eating can even be fraught with treachery. Common food impaction within crevicular spaces between teeth can produce unpleasant odors.

The surfaces of diseased gingiva, and the film-coated palate, teeth, tonsils/adenoids, throat, and sinuses, as well as ear infections, directly impart malodor to the exhaled air of otherwise unremarkable smelling expirations.

Under magnification, the tongue could be compared to the surface of the moon after a rain shower. Its craters and peaks are covered by a thin, sticky or tacky wetness colored clear to whitish yellow. The tongue — with its malodorous colonized bacteria, shed cells, and decayed food — is the primary odor host of all sites in the human body.[16] Research shows that tongue cleaning reduces odor, but must be performed daily as the bacteria "bounce back" within a day, and even in as little as 15 minutes, depending on technique used and host response.[17,18]

Tests of mouthwash efficacy show that while they reduce overall mouth volatile sulfur compound scores, they don't improve tongue-coating volatile sulfur compound scores.[19] The back of the tongue is akin to a sponge for postnasal drip, which itself isn't offensive smelling until it commingles with and feeds the tongue's resident bacteria.

When proper brushing, daily flossing, tongue cleaning, mouth rinsing, and gum chewing don't work, the dentist's office is typically the first stop for the afflicted. Dentists can run through a differential diagnosis and do a complete exam. Among the culprits, perhaps the patient's prostheses are not being soaked in disinfectant nightly. If prescriptions are divulged in the health history, the dentist may determine if dry mouth is a drug side effect, which is itself a causal factor for halitosis.

SYSTEMIC SOURCES. Systemic causation (hepatic, pulmonary, renal, metabolic, etc.) of bad breath is infrequent. Yet, toxins in the blood that are produced by subsurface systemic illness do contribute to oral malodor as they are eliminated via the lungs.[20] When this air breezes through the nose and mouth, foul odorous gases fly away like invisible kites.[20] Furthermore, nerves, glandular disorders, and GI infections may be etiological and necessitate referral to physician specialists.

For example, coughing or sore throats, frequent throat clearing, sinusitis, tonsillitis, snoring, and intranasal obstructions could require an evaluation by an otolaryngologist.[21] Many adults suffer from disorders such as gastric acid reflux. All of these conditions can affect breath. If

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suspected by a dentist, the patient should be referred to his or her physician for diagnosis and treatment. Unusual malodor-inciting occurrences have been recorded also, such as a chronically infected foreign body (for example, a metal ball bearing or plastic bead) lodged within the nose or sinuses unbeknownst to its host.

Occasionally, eating certain foods, such as raw onions, may be associated with oral malodor, but spicy foods like these are frequent odorant scapegoats. If oil of garlic or onion has adhered to the surfaces of the mouth, there may well be transient odor. But if it is in the stomach, it will not cause oral malodor outside the occasional belch in the short term because of the esophageal collapse and "trapdoor effect" that keeps its acidic soup from escaping.[22]

Thus, telling patients to restrict certain foods from their diet to cure chronic halitosis is not supported by research. Of course, metabolizing a lot of garlic can result in allyl methyl sulfide seeping out of the pores of the skin — not just the breath — but this calamity only lasts less than 24 hours.[23]

Finally, hormonal fluctuations or stress, such that can occur in some women's menstrual cycles, has been implicated with higher volatile sulfur compound concentrations in one study.[24]

Diagnostic Methods

Fifty percent of all dentists probably have half a dozen patients come through their practice each week who are self-admitted halitosis sufferers.[25] The question is, are they detecting them?

Diagnosing oral odor is an ubiquitous affair. There are different compounds that can be measured and devices to do the measuring, and none are free of pitfalls. In fact, low self-esteem may contribute to the false and debilitating paranoia that one's breath is horribly offensive; this is known as "delusional halitosis."[26] This "halitophobia" is not uncommon and is associated with mental illness and depression.[27]

At the initial consultation, a screening questionnaire can assess the psychological status of a patient complaining of halitosis, for these patients will never feel their problem is cured/controlled no matter what "evidence" to the contrary that the dentist produces.[28]

Calibration and correlation issues arise when the quality (hedonic) and strength rankings of a patient's breath can vary appreciably from examiner to examiner. A five-point (0-5) organoleptic intensity scale (**TABLE 1**) based on Rosenberg and others has a different ranking for "barely detectable" than for "slight malodor."[10,29-33] Would two dentists in the same practice both differentiate these rankings similarly? Probably not without hedonic training. Thus, using standard odorants, calibration and standardization between two or more evaluators is needed.

A nine-point hedonic scale was used in 2004 research by Li and colleagues that had a midpoint ("5") for neutral odor.[34] A four-point scale has also been suggested in the literature.

In 2001, the ADA Conference on the Diagnosis and Management of Oral Malodor by consensus adopted some of Rosenberg and colleagues' protocols as "methods of choice."[3] For example:

- From the mouth, breath should be evaluated at 10 centimeters away by the nose of a blinded judge;
- From a spoon, it should be evaluated five seconds after the spoon has scraped the dorsal tongue, and at a distance of 5 cm from the judge's nose;
- From used floss, it should be evaluated 3 cm from the judge's nose.

Besides determining a problem exists, there are various traits to record (e.g., "Is the malodor occasional or chronic?") to characterize the problem during the exam. Various types of questionnaires are available to record malodor health history taking, and to assist in diagnoses.[35]

SELF-DIAGNOSIS. The age-old method of breathing into the cupped palms to discern one's own breath may or may not detect anything. Regardless, if a foulness is detected by this antiquated method, rating its severity and improvement/degradation over time is not possible in this way. The value in self-diagnosing may be in establishing a suspicion of a problem. By licking the wrist with the length of the tongue (including as far back as possible) and waiting 15 seconds before sniff-testing, one is allegedly able to discern negligible or problematic tongue odors.[36,37] By doing the same with floss, one can detect negligible or problematic periodontal odors. By having another person evaluate mouth breath (while nose pinched closed) versus nose expirations (while holding mouth closed) can help detect odors of sinus origin.

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TABLE 1

Organoleptic Intensity Scale (Based on Rosenberg[34]).[10]

Rating	Odor Intensity
Odor cannot be detected	0
Questionable malodor, barely detectable	1
Slight malodor, exceeds the threshold of malodor recognition	2
Malodor is definitely detected	3
Strong malodor	4
Very strong malodor	5

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Products for self-diagnosing by patients include some that the consumer has rejected because of perceived high price. OK-to-Kiss (Emjoi) was a palate and treatment solution kit that is no longer offered by the company. It had a novel color change that correlated to an enzyme that related to one's malodor status.[38] Before dentists recommend products described in the literature to their patients, they should research whether they are still available and an idea of cost involved.

DIAGNOSTIC TOOLS, DEVICES OR INSTRUMENTS. To have a tool for measuring bad breath that works, it has to have something to measure. Strongly odiferous oral substances known as volatile sulfur compounds are produced by a combination of ingredients such as anaerobic bacteria that are gram-negative, and sloughed epithelial cells breaking down (rotting), among a host of other organochemical orchestrations. This degradation process involves the release of the gases dimethyl sulfide, hydrogen sulfide, dimethyl disulfide, and methyl mercaptan. Measuring volatile sulfur compound concentration in expired mouth air produces data that aids in diagnosing halitosis.[39,40] In *Scientific American,* Rosenberg's 2002 bad breath article included a "Most Unwanted List" of bacteria and associated smell (**TABLE 2**).[4]

Interestingly, the severity of periodontal disease and the concentration of volatile sulfur compounds (how bad the odor) has been linked.[41]

In the literature, there is consensus that the human nose is the primary "organoleptic device" for detecting foulness. But for quantification and research, there are two categories of electronic devices that have been marketed over the years that range from under $100 to thousands of dollars. Each measures odor—one for differentiating out the various volatile sulfur compounds via gas chromatography and then detecting the volatile sulfur compounds (for example, a portable GC known as OralChroma (ABILIT, Osaka City, Japan) does a halitosis analysis for three gases that are in volatile sulfur compounds); another involves a semiconductor gas sensor.[39,42] The latter includes the Halimeter (Interscan, Chatsworth, Calif.), a gas analysis sensor that measures the volatile sulfur compounds, and has been thought of as the "gold standard" instrument by some.[43] Although it has some disadvantages, it is resourceful in that it is used to record the volatile sulfur compound status, and degree of change, as well as source.[3] There are other detectors measuring volatile sulfur compounds and tying them into gingival health or tongue odor.[44,45] More recently, the sensor-based FF-1 Odor Discrimination Analyzer (Shimadzu, Japan) dubbed the "electronic nose" was tested with promising initial findings.[46]

Some chairside tests for proteolytic activity of bacteria, microbiology smears for bacteria type, and an assay for enzymes are also available.[3] Commercially available sulfide monitors such as the benzoyl-DL-arginine-naphthylamide test are marketed. Modestly priced devices are available such as the BreathAlert Breath Checker, Tanita, Arlington Heights, Ill.), and other portable sulfide monitors.[47] Research findings, however, caution of fluctuations in sulfur concentrations in the breath, which could complicate assessment.[48] Another study warns of the useful but occasionally inaccurate estimation of some sulfide detectors.[49]

TABLE 2

Most Unwanted List*

Cadaverine	Corpse
Hydrogen sulfide	Rotten eggs
Isovaleric acid	Sweaty feet
Methyl mercaptan	Feces
Putrecine	Decaying meat
Trimethylamine	Decomposing fish

*Adapted from, and used with permission, "The Science of Bad Breath," Rosenberg M, *Scientific American,* 286(4):72-9, April 2002.[4]

EXAMINER PERCEPTION. Dentists can perform the organoleptic sniff testing exam on a patient at two or more visits. A tube and a privacy screen dividing him or her from the patient is suggested.[50] This clinical assessment barrier reduces embarrassment for patients, who probably have never exhaled directly at a person's nose before. The dental team should learn helpful assessment questions and become well-versed in proper dialogue with patients in the data-gathering process.[51]

To remove confounding odors from the subject on test day, patients should not use perfumes or scented deodorants, lotions, shampoo/conditioner, or lip balm. Thus, it is advisable to bathe with unscented soap. Alcohol and tobacco product use should be ceased for a day or two before the exam, as well as spicy foods. No coffee for several hours before the exam, and no water or eating for a few hours before the exam. Antibiotic use should be ceased three weeks before the assessment.[16]

While some dentists who diagnose halitosis in their clinics instruct their patients not to brush, floss, or gargle the day of the exam, this is unreasonable to others, some who believe it would lead to overdiagnosing halitosis. The 2003 ADA Seal guidelines previously mentioned earlier suggests that appropriate clinical protocol is that those who have "intrinsic" oral malodor will exhibit this odor two hours after oral activity ceases (eating, drinking, or toothbrushing).[10]

Treatment and Prevention

Reducing oral malodor may involve dental and oral care, oral hygiene management, and pharmaceuticals. Surgery has reduced oral malodors, but this is a secondary outcome to that for other indi-

cations. Initial treatments for bad breath are, in fact, often the same as those for management and preventive strategies.

ORAL AND THROAT HEALTH. A dentist must provide oral care and repair so that all restorations and prostheses are intact. Care, including treatment of any soft tissue pathology, must be current. Just as homeowners with pets who clean their carpets once a year have homes that tend to have less odor than those who do so only every five to 10 years, patients who delay their six-month prophylaxes to "every few years" are inviting problems. Plaque may be gathering between teeth and below the gumline in preparation for periodontal disease. At this stage, there is no measurable sign (i.e., pocket depth, attachment loss) of the disease except pungent odor. Recent research has indicated that a concentration of sulfide gas is the first "periodontal parameter" associated with initiation and progression of early plaque-induced periodontitis.[44] Fortunately, a standard prophylaxis can wipe out the gathering pathogens, reversing breath degradation. Patients who have a six-month dental cleaning often find this simple commitment will keep breath problems (not to mention gum disease) away.

Frequent sore throats and other observations should be duly noted, as causation and impact will need to be understood. Tiny openings like tunnels on the surface of tonsils can get plugged with sloughed cells, food, and bacteria, creating recurring infections in some patients. This can be a source of odor in these individuals. Even small, calcified, bacterial debris called tonsilloliths may be expelled. Outside of the mouth, tonsilloliths smell putrid but, interestingly, those who expel them don't necessarily have bad breath.[36] Dentures need to be checked for acrylic breakdown, and the ridges checked for apthous ulcers and the mouth for fungal infection.

Some dentists take a PH reading (alkaline pH is associated with increased odor), and all should do a gingival and a periodontal exam. *Porphyromonas gingivalis* is one of many species that seem to be associated with periodontal disease and strongly correlated with putrefactive odors.[4,52]

ORAL HYGIENE MANAGEMENT STRATEGIES. Besides showing the patient proper brushing and floss techniques, tongue cleaning should be explained and demonstrated because research shows this regimen acts to ameliorate malodor.[53] But the act of "scraping" can be too damaging to the sensitive tissue. Thus, instead of a tongue scraper, one or two gentle dorsal sweeps with an extra-soft toothbrush head devoid of paste and at an angle of least resistance can work safely, as can a folded square of gauze.

Patients who undergo an oral hygiene program designed to educate them as to proper home care techniques were found in one study to have reduced volatile sulfur compound levels compared with a control group.[54]

Oral rinses should be suggested to following the tongue cleaning regimen. Chlorine-containing preparations (including a stabilized form of chorine dioxide or a peroxide rinse), have long been advocated for destroying putrefied mouth oils.[22,55] Other rinses include essential oils, for example, Listerine (Pfizer, New York, N.Y.) and Tooth & Gum Tonic (Dental Herb, Northampton, Mass.).[56] Others contain the stain-producing chlorhexidine, hydrogen peroxide, zinc acetate, sodium bicarbonate, and chloride.[57-59] The use of triclosan, zinc chloride, or oil-water-cetylpryridium choride-containing mouthrinses seem to reduce oral bacteria and thus odor as well.[3,59-64] Less frequently, but increasingly, we learn of natural remedies such as tea extract and herbal plant compounds for freshening breath via antimicrobial activity.[65,66]

Xerostomia that can result from drugs and snoring/sleep apnea requires management strategies such as chewing gum, sipping water, and trying gels and saliva substitutes.

PHARMACEUTICAL/OVER-THE-COUNTER ARMAMENTARIUM. Dentists and hygienists should be able to explain the properties of various dentist-dispensed and over-the-counter rinses and their ingredients. If oral lesions or diseases are present, prescriptions for antibiotics may be needed. For those with known sinus and allergy problems, discussions of over-the-counter medications for drying sinuses may be suggested to probe the perioral role of postnasal drainage as a cause. But even if such over-the-counter medication balances the patient's sinus issues, the resulting dryness from the medication can counterbalance the oral malodor dilemma. Thus, these patients' malodor progress should be monitored to better understand the complex balance of treatments needed.

TAGGING THE CAUSE(S) of halitosis may at times be an ongoing collaborative project between the patient and dentist.

SURGICAL SITUATIONS. Some patients report improved breath postsurgically when treated for infected adenoids or tonsils. Yet, oral malodor alone is not a sufficient indicator for surgery, and is in no way guaranteed to improve oral malodor.

Research Horizons

Future aspects of malodor investigations are largely absent in the dental literature. Speculation in the literature tends to center on novel therapies and diagnostics under investigation. One breath spray promises to reduce breath odorants, while producing an unpleasant taste in the mouth should its user try to smoke.[67] The reports have ranged from measuring volatile sulfur compound in perio pockets to predict periodontal disease progression, to the availability of an online breath assessment.[68] Someday, genetic markers may even predispose us of our halitosis potentiality. Currently, rRNA microassays are identifying the hundreds of oral species and phylotypes on the tongue.[69,70]

Discussion

Like the process of identifying food allergies via elimination, tagging the cause(s) of halitosis may at times be an ongoing collaborative project between the patient and dentist.

This area is overdue for substantive research attention, as few university-based clinical studies that are not manufacturer-funded have been done. The data on oral malodor itself need to be assessed for reliability. Therefore, we must weigh the findings of large-scale, well-designed, industry-sponsored research with the understanding that they serve to pedal a product that benefits from favorable research results being published.

Furthermore, it is hoped that dentists will pursue continuing education on assessment, diagnosis, and treatment protocols, for an aging America is sure to result in greater numbers of patients with breath malodor complaints. Besides reading halitosis articles in dental journals and taking continuing education courses at dental meetings, a nonprofit group, the International Society for Breath Odor Research,

meets biannually so that dentists can keep abreast of new findings and learn strategies from colleagues interested in this field.

Conclusion

At least half the world's population suffers from oral malodor, and most of it originates in the mouth. The nose is the primary diagnostic tool, with optional devices that measure volatile sulfur compounds as quantitative tools to augment and quantify the process.

Organized dentistry and government agencies can more strongly educate the public that proper oral care, including tongue cleaning, are the real "bad breath busters."

As of this writing, although no consumer orodental products have yet earned or been assured retention of the ADA Seal for complying with the new 2003 Acceptance Program Guidelines, it is reassuring to know they will be required to do so if they want to bear the ADA Seal and continue to make oral malodor therapeutic claims.[10]

Could organized dentistry and government go further? Perhaps a public information campaign could be developed that would ask something along the lines of: "Would you wear cologne instead of taking a shower? Then why are you using breath mints instead of seeing your dentist? Research shows nine in 10 people with bad breath can be cured by a dentist." ■■■■

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Permanent Nerve Damage From Inferior Alveolar Nerve Blocks — An Update to Include Articaine

M. ANTHONY POGREL, DDS, MD

ABSTRACT Permanent nerve involvement following inferior alveolar nerve block may occur from 1 in 20,000 to 850,000 patients with little information on local anesthetic used. Patients with permanent nerve damage from blocks were recorded. Lidocaine was associated with 35 percent, with articaine causing approximately 30 percent of the cases. Nerve blocks can cause permanent damage to the nerves, independent of the local anesthetic used. Articaine is associated with this phenomenon in proportion to its usage.

AUTHOR

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Permanent involvement of the inferior alveolar and/or lingual nerve following an inferior alveolar nerve block has been reported.[1-7] There are a relatively small number of studies, and the reported incidence varies from a high of 1 in 20,000 blocks to a low of 1 in 850,000 blocks.[1,6] Several studies do not indicate whether the involvement was temporary or permanent. Studies appear to show that when nerve damage occurs, the lingual nerve is affected approximately twice as frequently as the inferior alveolar nerve, and one suggested reason for this may be the fascicular pattern in the region where the injection is given.[6,8] It also appears that about half the patients feel an "electric-shock sensation" on injection, but approximately half do not.[6] The phenomenon has been noted with every local anesthetic used in dentistry, but it has been suggested there may be a higher incidence with prilocaine and articaine.[7,9,10] Although the reason for this is unknown, suggestions have been made that it may be because they are 4 percent solutions, whereas the other local anesthetics are at lower concentrations.[9] With the exception of isolated case reports, the major information on a possibly higher incidence with articaine in particular comes from the studies of Haas, which are from cases reported to the major dental malpractice carrier in Ontario, Canada, from the early 1980s (when articaine was approved in Canada) until the present day.[9,11-14] In order to further elucidate these findings, the following study was carried out.

Materials and Methods

The Department of Oral and Maxillofacial Surgery at the University of California, San Francisco, has become known as a tertiary referral center for injuries to the inferior alveolar and lingual nerves in general, and in particular injuries

caused by inferior alveolar nerve blocks. Most dental practitioners are aware of these problems and refer patients for evaluation. This study covers all patients referred from Jan. 1, 2003, to Dec. 31, 2005. All patients still had neurological symptoms nine months after injection and were considered permanent.

Results

A total of 57 patients were referred to the Department of Oral and Maxillofacial Surgery at the University of California, San Francisco, with a diagnosis of damage to the inferior alveolar and/or lingual nerve that could only have resulted from an inferior alveolar nerve block. None of these patients underwent surgical or other procedures that could have been responsible for the nerve involvement. The symptoms included paresthesias and dysesthesias, varying from mild to severe, but there were no cases of total anesthesia. The distribution of local anesthetics used is shown in **TABLE 1**, coupled with an appropriate percentage of U.S. national sales.[15]

Articaine, as the sole local anesthetic, is responsible for about 29.8 percent of the total. One patient received articaine as well as lidocaine, therefore it cannot be determined which agent was associated with the nerve involvement.

Discussion

In 2001, after its introduction, articaine was felt to have captured around 15 percent of the U.S. dental local anesthetic market. In 2002, it had approximately 22 percent of the market, and in 2003, it reached approximately 25 percent of the market and has stayed around that level since then. Current estimated percentage sales figures for all local anesthetics are shown in **TABLE 1**.[15]

TABLE 1

Number of Cases of Nerve Damage With Percentage U.S. National Sales Figures

Anesthetic	# of cases	Approximate % sales (total 260 million cartridges/year)
Lidocaine alone	20 (35%)	(54%)
Prilocaine alone	17 (29.8%)	(6%)
Articaine alone	17 (29.8%)	(25%)
Articaine plus lidocaine	1 (1.75%)	
Lidocaine plus prilocaine	1 (1.75%)	
Bupivacaine	1 (1.75%)	
Mepivacaine	0 (0%)	(15%)

Utilizing figures obtained from dentists in Northern California in previous studies, it is estimated there could be between 4.5 (incidence 1 in 850,000) and 190 (incidence of 1 in 20,000) cases of permanent nerve involvement per year from local anesthetic injections in Northern California with a population of around 10.5 million.[6] It is extrapolated that an incidence of 1 in 20,000 inferior alveolar nerve blocks causing permanent nerve damage may be accurate, and therefore the annual occurrences may be as high as 190 cases per year in Northern California. Over a three-year period we have seen approximately 19 patients per year with this problem, which may be around 10 percent of all the cases occurring in Northern California each year. When these figures are compared with studies such as that of Hass, differences become very apparent.[9,10] In his study, there were virtually no cases caused by lidocaine, whereas in all of our studies, lidocaine has caused the most individual cases. This is extremely difficult to explain, since we have been examining patients, questioning their dentists, and examining medical records, and are comfortable the results are accurate.

We chose not to use data from 2000, 2001, and 2002 since with the introduction of articaine in 2000, usage was variable. For 2003-2005, sales figures and usage appear more constant. We are aware of discussion in dental circles as to the use of articaine for inferior alveolar nerve blocks, and are aware of recommendations suggesting that it not be used for inferior alveolar nerve blocks.[16-18]

This was the predominant reason for submitting this paper at this time, since we did not want to find that although sales figures remained high for articaine, it was not being used for inferior alveolar nerve blocks, since this would obviously distort our numbers. The authors are confident this phenomenon has not taken place to any appreciable extent in Northern California by the end of 2005. Therefore, using our previous assumption that approximately half of all local anesthetic used is for inferior alveolar nerve blocks, then on the figures we have generated from our clinic we do not see disproportionate nerve involvement from articaine.[6] For prilocaine, it does appear to be causing approximately 29.8 percent of cases with sales of about 6 percent of all dental local anesthetics, which may indicate a higher incidence. ■■■■

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The History of Local Anesthesia

MALVIN E. RING, DDS

ABSTRACT For hundreds of years, mankind has struggled with the problem of controlling pain during surgical procedures without putting the patient to sleep. In 1884, cocaine was discovered to have local anesthetic properties and soon became widely used in many types of surgery. The many undesirable properties of cocaine led scientists to find a safer alternative. Since then, more effective local anesthetics have been and continue to be developed.

AUTHOR

Malvin E. Ring, DDS, is the author of *Dentistry: An Illustrated History.* He practiced dentistry for more than 30 years in Batavia, N.Y.

For about a thousand years, people have been using various methods to create insensibility, either in a painful area, or to allow some form of surgical intervention. Probably the earliest written mention of achieving local anesthesia is in book 2 of Homer's *Iliad*, where Patroclus is described as removing the shaft of an arrow from the thigh of Eurypylos, and then putting on the wound a bitter root "that took the pain away and ended all his anguish." Over the years numerous other techniques were tried with varying degrees of success. But it was not until modern times that true anesthesia was achieved.

The Use of Electricity

Aristotle wrote of a "numbness-producing fish," which we know today as the Torpedo ray, and its use was further described by the Roman physician, Scribonius Largus in his book *Compositiones Medicorum* written around the year 47, "For any type of gout, a live black torpedo should, when pain begins, be placed under the feet. The patient must stand on a moist shore washed by the sea, and he should stay like this until his whole foot and leg, up to the knee, is numb."[1]

This was the beginning of a long series of experiments with the use of electricity as an anesthetic. Galen, too, wrote about using the fish to free the patient from pain by "numbing the senses." Attempts to achieve anesthesia using electricity continued into modern times. A London dentist, Joseph Snape, in 1858, reported in the *London Times* that he had used electricity as a local anesthetic. "In the course of the week I have extracted upwards of 150 teeth from persons of all ranks, of both sexes, and of every age, and the testimony of each has been most satisfactory." Almost all of the patients described their feelings as "delightful" upon experiencing no pain.[2] Attempts at using electricity to achieve freedom from pain were not unique to Europe. In Philadelphia, in 1856, a dentist, J. B. Francis, attached a wire to his extraction forceps and the other end to the negative pole of a battery. A metal handle, attached to the positive pole was grasped by the patient, thus completing the circuit.[3] Whether anesthesia was achieved is questionable, although there were numerous reports in the public press of the use of this technique.

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Refrigeration Anesthesia

Refrigeration was another early attempt to achieve numbness of a part. Around the year 1050, an unknown Saxon monk in England compiled a "leechbook" which listed recipes for treatment of various conditions as well as suggestions for simple surgery. For "cutting and bleeding" in the area of the anus, probably for a cyst, it was recommended that the patient should "sit in cold water until it be deadened; then draw him up. Then cut four scarifications around the pocks and let drip as long as he will."[4]

A dramatic use of refrigeration anesthesia occurred during Napoleon's retreat from Moscow. When his surgeon general, Baron Larrey, (**FIGURE 1**) needed to amputate mangled legs of some soldiers, he found that those who were almost frozen stiff felt no pain. He then began packing those limbs to be removed in snow or ice, and successfully removed them with minimal pain. In succeeding years, several other doctors tried achieving such results with other materials. One of the more well known was a British physician, Benjamin Ward Richardson, who, in 1866, attempted to achieve anesthesia by spraying ether on the part to be operated on. As the ether evaporated, it chilled the area; he designed a special apparatus for spraying, especially for use in extracting teeth (**FIGURE 2**). General acceptance of cold as an anesthetic came about when, in 1942, a surgeon, Dr. Frederick M. Allen read a paper "Refrigeration Anesthesia for Limb Operations" before the American Society of Anesthetists in New York.[5] The procedure became popular for some time, and probably gave rise to the term "freezing" as a popular synonym for anesthetization.[6] The use of cold as an anesthetic became so ubiquitous that Gandhi, in his autobiography, related that, during World War I, an itinerant quack treated patients, including the Mahatma himself, by the application of ice all over the body, making sure to cover any area that was painful.[7]

FIGURE 1. Baron Larrey (1766-1842), Napoleon's chief surgeon, who performed amputations of soldiers' legs by first wrapping them in ice.

Pressure Anesthesia

Another method tried was the use of pressure on nerves to achieve numbness of an area. It was believed that if sufficient pressure was applied to a sensory nerve, after a given time it would cease to function, thus interrupting messages of pain to the brain. Archaeologists excavating the Egyptian necropolis of Saqqara, found wall paintings, dating from around 2500 BC, showing Egyptians apparently using compression of peripheral nerves to achieve localized anesthesia.[8] Ambroise Paré, a Renaissance-era surgeon, is said to have recommended this method.

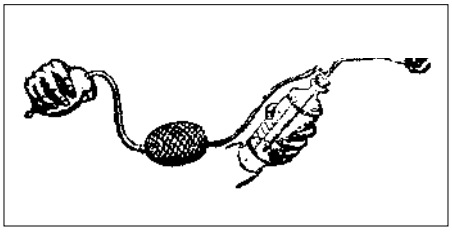


FIGURE 2. Benjamin Ward Richardson's apparatus for achieving refrigeration anesthesia by spraying ether on the area. *(From the Medical Times and Gazette, London, 1866.)*

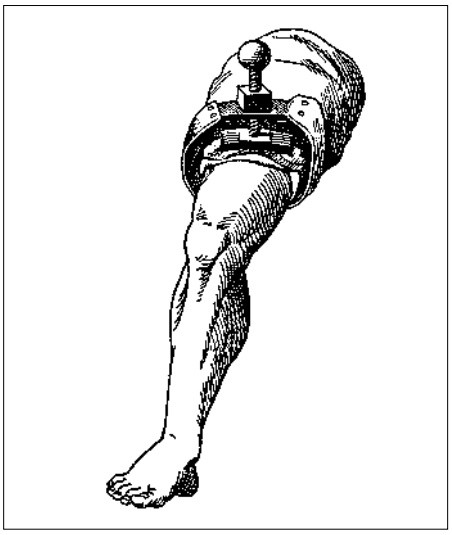


FIGURE 3. James Moore's clamp for surgical pain control by putting pressure on peripheral nerves. *(From Robinson V, Victory Over Pain, New York, Henry Schuman, Inc., 1946. Copyright Harper & Row, Publishers.)*

It came to fruition in the 18th century when London surgeon, James Moore, in 1784, described a clamp that could be screwed onto a limb to compress the main nerves. It was left on for at least a half-hour before the surgery to allow full numbness to take effect[9] (**FIGURE 3**). The renowned British surgeon, Benjamin Bell, discussed Moore's compression appliances in his book *System of Surgery* (1796) and suggested that they be used in amputations to reduce pain.[10]

But all of these methods failed to truly achieve complete relief from pain of surgical procedures. In the Middle Ages patients were drugged with mandragora or opium, but this wasn't sufficient. When an operation was scheduled to begin, a bell was rung to summon attendants to hold the patient still and prevent struggling.[11] It was necessary to find a way to deaden sensation in a portion of the body safely and reliably, and that would not come about until the 19th century. Today, no bells have to be rung.

Development of Hypodermic Syringes

Attempts were made over the years to develop a method of injecting materials into the body. In the beginning hol-

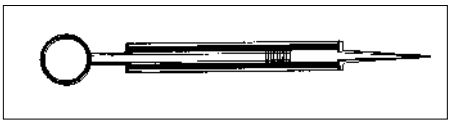


FIGURE 4. Zophar Jayne's syringe especially created for hypodermic injection in 1841.

low quills were used, with the material squeezed out from a bulb.[12] The first true hypodermic syringe was invented in 1841 by Illinois physician Zophar Jayne. It had a pointed, hollow tip, but an incision first had to be made through the skin with a lancet (**FIGURE 4**). Slightly more than a decade later, in 1853, a French veterinarian, Charles Gabriel Pravaz, invented a syringe that required turning a handle to force the injectable fluid out of the tube. This, too, required the skin first be pierced with a trochar to provide an entry for the cannula, which did not have a sharp point. This was the first true injection syringe and a significant feature was the capability to deliver a measured dose (**FIGURE 5**). An improvement came about in 1860 when an English surgeon, Alexander Wood, devised a glass-bodied syringe into which a tight plunger was fitted. The barrel's end had a screw onto which a hollow needle, of varying gauges and with a beveled point, could be attached.[13] Around the first decade of the 20th century, Guido Fischer, director of the Dental University Institute at Greifswald, Germany, introduced a syringe which became the prototype of most modern syringes[14] (**FIGURE 6**).

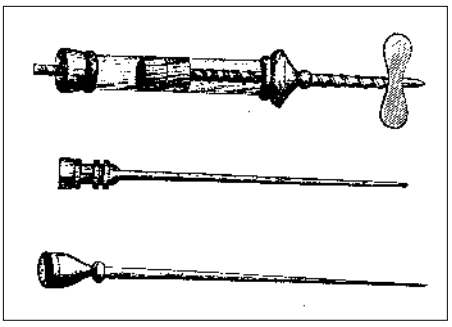


FIGURE 5. Syringe designed by Charles Gabriel Pravez. At the bottom is the trochar for piercing the skin, and above it is the cannula. This attached to the syringe, and the drug was forced out by turning the screw.

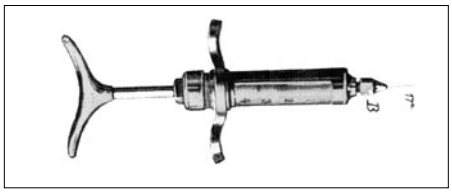


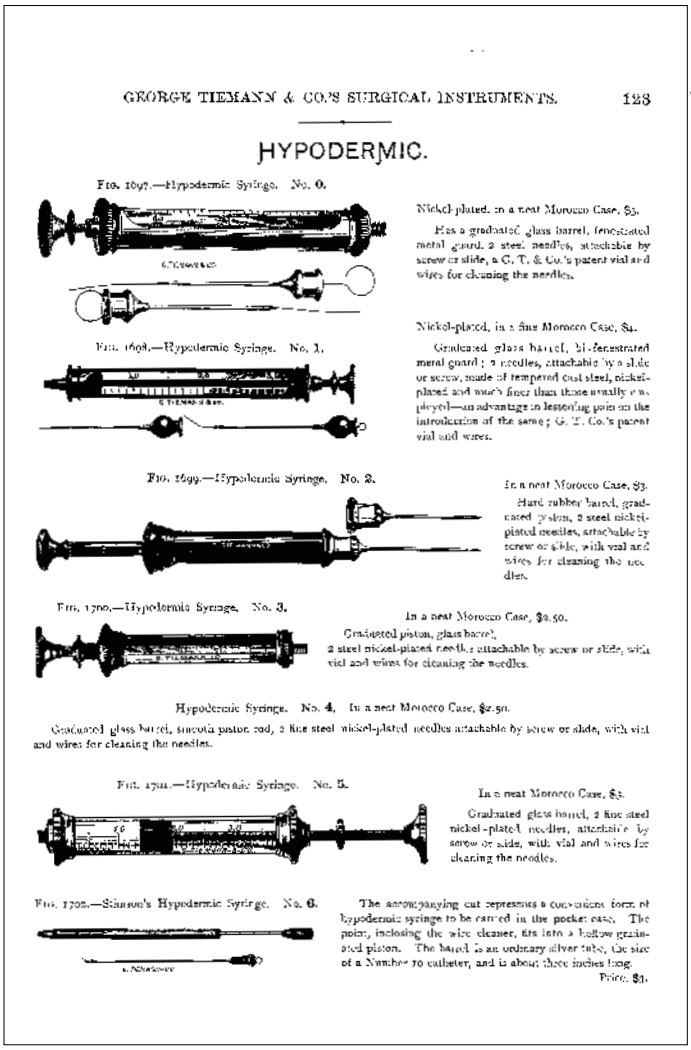
FIGURE 6. Guido Fischer, of Germany, in 1906 introduced this syringe, which became the prototype of most modern syringes.

The first syringes to be manufactured in the United States were made by George Tiemann & Company around 1870 (**FIGURE 7**). They were made of combinations of silver, glass, hard rubber, celluloid and German silver. The plunger had a tip made of either leather or rubber. In 1876, a combination glass and metal syringe was made specifically to be sold to dentists.[15]

Up to this point, syringes had to be loaded by drawing the desired liquid out of a vial. In 1917, during World War I, an American army physician, Harvey Cook, invented the anesthetic "cartridge," basing his idea on the cartridges used in a gun barrel. He cut the glass tubes himself from laboratory tubing, and made both the plunger on one end and the closing seal on the other from slices cut from rubber pencil erasers. Soon dental manufacturing companies adopted this new idea, and in 1921, Cook Laboratories began producing glass Carpules and syringes to accommodate them.

Injection of the anesthetic solution — and more important, the vasoconstrictor in the solution — into a blood vessel, frequently led to dire consequences. This danger was averted by aspirating before injecting. In 1947, the Novocol Company introduced a screw-type cartridge and syringe. This allowed the doctor to aspirate by pulling back on the plunger, easily accomplished by having a ring on the end of the syringe's plunger. Ten years later, in 1957, the Cook-Waite Company brought out a syringe which had a harpoon-type plunger, making it easier to engage the rubber stopper and pull it back for aspiration.

The only other major modification of



GEORGE TIEMANN & CO.'S SURGICAL INSTRUMENTS. 123

HYPODERMIC.

FIG. 1697.—Hypodermic Syringe. No. 0.

Nickel-plated, in a neat Morocco Case, $5.

Has a graduated glass barrel, fenestrated metal guard, 2 steel needles, attachable by screw or slide, a C. T. & Co.'s patent vial and wires for cleaning the needles.

FIG. 1698.—Hypodermic Syringe. No. 1.

Nickel-plated, in a fine Morocco Case, $4.

Graduated glass barrel, bi-fenestrated metal guard; 2 needles, attachable by a slide or screw, made of tempered cast steel, nickel-plated and much finer than those usually employed—an advantage in lessening pain on the introduction of the same; C. T. Co.'s patent vial and wires.

FIG. 1699.—Hypodermic Syringe. No. 2.

In a neat Morocco Case, $3.

Hard rubber barrel, graduated piston, 2 steel nickel-plated needles, attachable by screw or slide, with vial and wires for cleaning the needles.

FIG. 1700.—Hypodermic Syringe. No. 3.

In a neat Morocco Case, $2.50.

Graduated piston, glass barrel, 2 steel nickel-plated needles attachable by screw or slide, with vial and wires for cleaning the needles.

Hypodermic Syringe. No. 4. In a neat Morocco Case, $2.50.

Graduated glass barrel, smooth piston rod, 2 fine steel nickel-plated needles attachable by screw or slide, with vial and wires for cleaning the needles.

FIG. 1701.—Hypodermic Syringe. No. 5.

In a neat Morocco Case, $3.

Graduated glass barrel, 2 fine steel nickel-plated needles, attachable by screw or slide, with vial and wires for cleaning the needles.

FIG. 1702.—Stimson's Hypodermic Syringe. No. 6.

The accompanying cut represents a convenient form of hypodermic syringe to be carried in the pocket case. The point, inclosing the wire cleaner, fits into a hollow graduated piston. The barrel is an ordinary silver tube, the size of a Number 10 catheter, and is about three inches long.

Price, $3.

FIGURE 7. A page of syringes manufactured by George Tiemann & Co. From the company's catalog of 1889.

syringe design resulted from the belief that injection of an anesthetic under pressure would allow for deeper penetration and more profound anesthesia. This led to the invention, in 1915, of specialized pressure syringes by Wilcox Jewett. These are seldom used today (**FIGURE 8**).

The Advent of Cocaine Anesthesia

Cocaine was first extracted from the leaves of the coca plant (Erythroxylon coca) by Albert Niemann, a graduate student in pharmacology in Göttingen, Germany, in 1858. He tried chewing some and reported that "it numbs the tongue and takes away both feeling and taste." Unfortunately, he did not consider its value as an anesthetic in surgery.[16]

Some researchers became aware that Peruvian Indians could work long hours without food or rest when they chewed coca leaves. Thus it was believed that chewing the coca plant preserved human strength even when no other food was taken.

An Indian, in the employ of Dr. Scherzer, traveled the distance from La Pazto to Taena, 250 English miles, in four days, then, after resting one day, returned in five days, over a mountain 13,000 feet in height; he partook of no food except coca and some roasted maize.

To study this effect, a Dr. Montegazza chewed, in one day, a bit over 2 ounces of coca, and, after sleeping three hours, required no food for 40 consecutive hours,

without experiencing any loss of vigor.[17]

Some 20 years later, Sigmund Freud, a graduate student in Vienna, was researching the body's ability to adapt to adverse circumstances. He had read Niemann's report. Freud ordered some coca leaves from a pharmaceutical company and chewed them to gauge their effect. To his surprise his tongue became numb, and he began experimenting with cocaine. In 1884, he published a famous paper "Über Cocaine." He advocated cocaine as a means of treating patients with morphine addiction, and also thought that the drug could be valuable in treating a variety of complaints, including dyspepsia, fatigue, hysteria and headaches, as well as a number of mental problems.[18]

Freud had a young colleague, Karl Koller, who was a resident in ophthalmology, and he suggested to him that he might use an extract of the coca leaves to achieve numbness of the eye when he operated on it. Koller did so, and found it effective when a solution of cocaine was dropped onto the eyeball. Koller published his first paper on the use of cocaine as a local anesthetic in 1884. He described using a 2 percent aqueous solution instilled into the eyes of rabbits and dogs, causing insensitivity to painful stimuli in as short as 30 seconds. He then tried it on his own corneas and those of friends with similar results[19] (**FIGURE 9**).

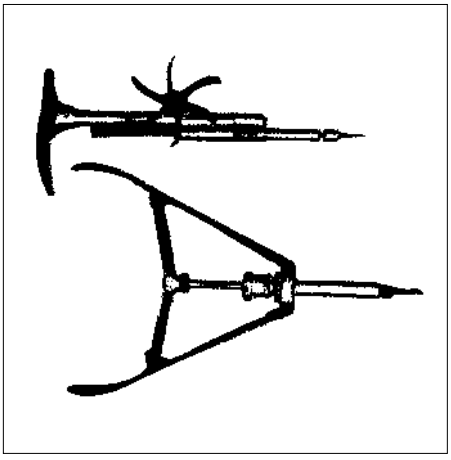


FIGURE 8. Pressure syringes invented by Wilcox Jewett in 1915 and manufactured by the Lee Smith Company.

FIGURE 9. Karl Koller, the ophthalmologist who was the first in the world to use cocaine in a surgical procedure. He is pictured at the time he was a resident in Vienna and a colleague of Sigmund Freud.

Physicians in Great Britain soon picked up on Freud's and Koller's writings. In an article in 1884, the advantages of cocaine use in many procedures were extolled, from ophthalmic use to stricture of the urethra where, in the latter condition, a paste made of cocaine was recommended.[20]

Unfortunately, the medical establishment was slow to accept the new anesthetic and its vast potential. A young assistant in the Ziegelstrasse Clinic in Berlin, Karl Schleich, read a paper on the use of infiltration anesthesia, using a dilute solution of cocaine, before the German Surgical Congress in 1892. He went overboard in his declamation of the successes he had had in numerous surgeries, so much so, that he said that those who used chloroform instead of cocaine were guilty of malpractice. This did not sit well with the surgeons present, and Schleich never received the recognition he deserved.[21] Nevertheless, most practitioners quickly adopted the use of the drug as an aid in preventing pain during a variety of operations. In a short time, the major pharmaceutical companies began producing large quantities of the drug and it was widely sold.

Cocaine in Dentistry

With the discovery of inhalation anesthesia by Horace Wells and subsequently by William T. G. Morton, part of the problem of pain elimination was controlled, but it was still hoped that a local area could be anesthetized without putting the entire patient to sleep.

The first use of a hypodermic injection arose because of the very introduction of general anesthesia. There was a general agreement that sedation of the patient by opiates was desirable before inducing anesthesia with ether, and this was generally accomplished by administering the drug by mouth. In 1868, W.W. Green, a professor at the Maine Medical school, made a subcutaneous injection of from a half to one grain of morphine while the patient was under ether. He wrote that this injection would help in "preventing shock, shortening the anesthetic influence and in preventing delirium and nausea."[22]

Within a short time, cocaine found its way into dental practice in this country as well as in Europe. A British physician in 1884 wrote that "in dental practice cocaine will probably prove itself of service, as there are many less severe tests of a patient's fortitude than the extraction of a tooth. The mode of application is either to employ a solution in alcohol of one in five or stronger, painting the gum, or to inject the submucous or subcutaneous tissue with a solution."[23] But the paper went on to say that the toxic effects of the alkaloid were as yet not known.

This latter remark was, unfortunately, all too true. Since there was not, as yet,

any consensus on what a proper dose was, there were many untoward accidents. Overdosing was common; it was used in strengths stronger than necessary or advisable. Solutions as strong as 2 percent, 5 percent, 10 percent, and even 25 percent were reported. And since epinephrine was not used to limit the distribution of the drug, the results were erratic, dangerous, and even fatal.

Even the *British Medical Journal* of Nov. 29, 1884, recommended doses ranging from half a grain to 2 grains, but as much as 22 grains had also been suggested. Sir Arthur Conan Doyle, a physician himself, had his fictional character, Sherlock Holmes, injecting himself with a 7 percent solution.

Another problem was that there was no standardization, even when pharmaceutical houses prepared cocaine solution. The Central Chemical Company of Wellsville, New York, supplied a dentist in western New York with a solution, which contained beside its 1 percent cocaine, trinitrin, hydronaphthol, eucalyptus, mentha arvensis, baptisia, gaultheria, thyme, and benzo-boracic acid.

Dentists in other countries had their own suggestions. A Russian doctor described using cocaine in nine cases of extractions. He mixed the cocaine with a 2 percent aqueous solution of carbolic acid. Injection was followed in a few seconds by local numbness, then, in four minutes, by complete anesthesia. However, following the injection of the cocaine, there were many unpleasant consequences, among them giddiness, clouding of sight, rapid pulse, talkativeness, exhilaration, and sometimes, in "nervous" persons, a hysterical fit with tears, and clouding of the sensorium. This Russian doctor proposed administering a glass of rum before injecting, to prevent these effects, and then after the extraction, placing the patient in a prone position with the head hanging down, and given two or three drops of amyl nitrite to inhale.[25]

Just six years after cocaine's introduction, dentists were warned of untoward effects of the drug. It was reported that a Philadelphia physician injected "a few drops" of a 10 percent solution to a woman, from whose face he proposed to remove a small tumor. The patient became erotically excited and behaved "in a most unseemly way, although her usual conduct was modest and becoming." A St. Paul dentist's experience was that his patient made "an indecent exposure of the person while under the influence of a small injection of cocaine." Not stated is the gender of the patient.

THE PATIENT BECAME erotically excited and behaved "in a most unseemly way, although her usual conduct was modest and becoming."

Dentists then were warned to be particularly on their guard since they used cocaine so often in treating and extracting the teeth, and were frequently alone with their patients. Dentists soon made it standard practice to have a nurse or assistant present when an anesthetic was administered.[26]

Bizarre effects of the drug were apparently widely experienced. A dentist in Shawnee, Oklahoma, in 1899, gave a woman an injection of cocaine, at which point she began to scream and cry out that she was choking. A physician was sent for, who administered a drug (possibly epinephrine), which brought her out of it. This was, perhaps, the last time this dentist used cocaine.[27]

Some dentists, leery of injecting cocaine, used it as a topical anesthetic, with varying success. Recommended was a preparation of equal parts of the drug and phenic acid, which is derived from carbolic acid and was contraindicated for injection. Anesthesia was purportedly achieved by placing a pledget of cotton, soaked with the solution, around the tooth and allowing it to remain for five minutes. It was to be reapplied if anesthesia was not achieved. There is doubt whether sufficient anesthesia could ever be achieved merely by placing the drug on the surface. But it was highly recommended for "opening abscesses, removing tumors, treating exposed pulp and kindred operations."[28] All of these experiences resulted in an unsavory reputation for cocaine as an anesthetic, and started the search for a safer alternative.

The Development of a Safer Anesthetic

The search for a safer alternative to cocaine was on, with many researchers tackling the problem. Around 1892, Dr. Carl Schleich, suggested that the toxic effects of cocaine injection could be lessened by reducing the concentration of cocaine, and using sodium chloride solution as the vehicle. He added some phenol for antisepsis and trinitrin, which, he felt, that since it was a vasodilator, it would prevent spastic contraction of the blood vessels. In this he was wrong, for vasoconstriction was needed, not vasodilation. Disagreeing with Schleich's assumptions, Heinrich Braun, aware that the product of the suprarenal glands caused vasoconstric-

FIGURE 10. Drawing, about 1810, by the English artist, Rowlandson, caricaturing the pain suffered by a female patient undergoing an extraction. Her agony, as captured in the mirror and her kicking over the table, are expressive of the great pain patients suffered before the invention of local anesthesia.

tion, mixed this with a cocaine solution, and injected it into his arm. He achieved a profound and long-lasting anesthesia.[29]

In 1904, a researcher named Thibault, made a solution of quinine, urea, and hydrochloric acid. The resulting crystals were dissolved in water and a 1 percent solution made, which was then injected with profound anesthesia resulting. It was a very unsuccessful attempt. Not only was it very irritating, but the anesthesia often lasted for up to six days.[30]

At around the same time, Merck, Lieberman, and Giesel produced a synthetic version of cocaine. Now, armed with the knowledge of cocaine's molecular structure, the way was open to synthesize new anesthetic molecules which were equally as potent as cocaine, but safer and less addicting. Alfred Einhorn, working for Alfred von Bayer, in 1904 synthesized procaine hydrochloride. In 1905, the previously mentioned Braun, was the first to use the new drug in surgery. It was soon marketed by Höchst and Company under the tradename Novocain.[31] The patent for this new drug stated that it was for the "process of production of p-amino-benzoic acid alkaline esters"; one of these chemical compounds was given the generic name procaine. Braun declared the new anesthetic "positively non-irritant … Toxic side effects were not seen in any instance, though we repeatedly injected a dose of 0.25 Gm."[32]

A problem, though, soon became apparent. It was learned that procaine, a vasodilator, caused a profound drop in blood pressure, allowing the anesthetic to travel widely from the area of injection. A number of deaths occurred after infiltration anesthesia. This was overcome by combining the procaine with epinephrine. In the early days it was at the ratio of 1 to 20,000, but in time, the standard became 1 to 200,000.

In the beginning, tablets of procaine hydrochloride were sold to the dental profession. The dentist would crush the tablet in a spoonful of distilled water and heat it over an alcohol flame to help it dissolve. In 1914, sterile ampules of Novocain in solution were introduced, followed by a major advance in 1920 when Dr. Cook got the idea for an anesthetic cartridge, which became commercially available in 1921. However, it was necessary to create an isotonic solution, and this was achieved by Dr. R. B. Waite, who created a solution containing several mineral salts, and this was successfully marketed by the Antidolor Manufacturing Company.

Soon after Novocain was offered to the profession, numerous other local anesthetics were introduced, among them Tropocaine, Stovaine, which was used primarily for spinal anesthesia, Eucaine, as well as others for specific purposes such as Borocaine for surface anesthesia and Butyn for nasal and ophthalmic surgery. This profusion of drugs did not completely satisfy the need for an ideal anesthetic. At the Dental Centenary Celebration held in Baltimore in 1940, Dr. Tainter, a renowned professor of pharmacology at the University of the Pacific, succinctly summarized what was needed in the way of an ideal anesthetic: "It would be highly desirable to have a local anesthetic solution, which is safer than the present procaine-epinephrine mixture. This would require synthesis of a local anesthetic which has a wider margin between the dose needed for blocking the sensory nerves and the dose which will produce systemic toxicity after it is absorbed."[33]

Now, more than 60 years later, although many improvements have been made in local anesthetics, the search is still on for the perfect one.

After the introduction of Novocain, other anesthetics were being marketed at a rapid pace. Drs. Goldberg and Whitmore invented Monocaine in 1937, but the search was on for higher potency solutions. Cook-Waite Laboratories introduced the combination Novocain-Pontocaine-Cobefrin in 1940. This allowed for higher anesthetic potency and longer duration of anesthesia. A real breakthrough came in 1949 when the Swedish pharmaceutical company, Astra, introduced lidocaine under its trade name Xylocaine. This new non-ester-type anesthetic molecule, having a xylide nucleus, showed fewer undesirable effects than Novocain and provided deeper anesthesia. Many new anesthetics were introduced in the succeeding years and the research into still-newer drugs continues.

Conduction Anesthesia

One of the most significant advances in local anesthetics occurred when conduction anesthesia was introduced. This is especially important in dentistry because of the inability to obtain satisfactory anesthesia of the mandibular teeth and jaws through infiltration alone. The story began when a young resident at Roosevelt Hospital in New York City, R. J. Hall, working together with fellow resident William Stewart Halstead, in 1885 began using cocaine as a local anesthetic in the outpatient department. Before that he tried the drug on himself by injecting a 4 percent solution of cocaine in the middle of his forearm and found that "it caused complete loss of sensation over an area extending downward as far as the lower end of the ulna."[34]

Halstead (1852-1922), who was to go on to become a world-renowned professor of surgery at Johns Hopkins University, was the true discoverer of conduction anesthesia. He decided to try out the technique in the mouth, and injected cocaine near the mandibular nerve of a medical student. Within four minutes there was complete anesthesia, not only of the tongue, but also all structures from the median line to the ramus of the mandible.[35]

Unfortunately, Halstead began experimenting on his body, giving himself repeated injections of cocaine and becoming hopelessly addicted to the drug. He was constantly hospitalized for his addiction, yet, in spite of it, was appointed as surgeon-in-chief of the hospital at Johns Hopkins on the recommendation of the renowned surgeon William Welch, and his standing as a great surgeon, innovator, and teacher has not been diminished by time.[36]

The time is past when patients suffered severe pain at the hands of even the most experienced dentist (**FIGURE 10**). It is through the efforts and brilliance of our forebears that the dental profession has eliminated the association of pain with our services, adding immeasurably to the human good. ■■■■

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Use of Primary Tooth as a Surgical Guide in Implant Insertion: A Case Report

LEN TOLSTUNOV, DDS

ABSTRACT A variety of surgical templates are being used routinely in implant dentistry to guide a surgeon in proper implant insertion. One additional technique is being suggested in this article. It relates to the placement of a dental implant immediately after extraction of the retained primary molar, using the crown of the deciduous tooth as a surgical guide for implant insertion. The clinical case and related technique are presented in this article.

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Collaboration between surgical and restorative colleagues in implant rehabilitation of the stomatognathic system has become a mainstream approach in implant dentistry. In the majority of cases, common diagnostic work up prior to the surgical phase includes study models, diagnostic wax-up, fabrication of surgical template, and construction of transitional prosthesis.

One of the key points in this synergy between different dental practitioners of the implant team is the construction of a precise surgical template by the restorative doctor in order to guide a surgeon to a proper 3-D insertion of a dental implant.

Different materials and techniques have been employed for the fabrication of a surgical implant guide, including resin (ortho resin, acrylic resin, composite resin), vacuum-forming material ("suck-down" stents), a combination of resin teeth and vacuum-forming techniques, Essex appliance, use of a transitional appliance as a template, and the use of computed tomography, etc.[1-4] A precise surgical template can also facilitate use of a flapless approach in implant placement.[5] Transitional implants have also been used for the same purpose.[6]

This article introduces another technique for using a primary tooth as a surgical guide for implant insertion in cases where both extraction of the retained deciduous molar and immediate implant placement are indicated.

A Case Report

A 25-year-old female with retained primary molar #T was examined for an extraction and possible immediate implant placement. A preoperative evaluation and radiograph revealed disto-occlusal caries of the crown and short and divergent roots of the primary lower right second molar (#T) (**FIGURE 1**).

A decision was made to use the retained deciduous tooth before its extraction as a guide to implant insertion. Preoperatively, marker lines of

the channel through the center of the crown into furcation, as well as a planned implant position below it, were drawn on the panoramic radiograph (**FIGURE 2**).

Intraoperatively, a 1 mm high-speed round bur was used to make a vertical pilot hole from the middle of the occlusal surface through the crown of the primary molar to the root furcation, extending about 3 mm into the bone underneath it (**FIGURE 3**). Next, a 2.3 mm twist drill (Implant Innovations, Inc., Palm Beach Gardens, Fla.,) was used to broaden and deepen the pilot hole, extending about 4-5 mm below the furcation into the underlying supporting bone. A direction indicator was placed into the hole to confirm the planned path of implant insertion. Deciduous tooth #T was then atraumatically removed with the help of a periotomes (**FIGURES 4 AND 5**). (Divergent roots and presence of solid bone just below the furcation, that commonly seen in the primary lower or upper molars, make for easier use of this technique.)

Extraction of the deciduous molar in this case did not require sectioning of the crown. In some cases, when a retained primary molar has thin and divergent roots, sectioning of the crown may assist in its atraumatic removal. This eliminates the possibility of leaving small and fragile root tips behind or the need to reduce bone in order to elevate them.

After the extraction of the tooth, the pre-drilled pilot hole was located in the middle of the socket (**FIGURE 6**), and the direction indicator was placed again into the osteotomy to reconfirm its alignment and emergence (**FIGURE 7**). A standard sequence of twist drills was then used to lengthen and widen the osteotomy. Next, a 4 mm 3i Osseotite "Certain" (internal connection) implant (Implant Innovations, Inc.) was inserted into the prepared osteotomy site (**FIGURE 8**). The implant had good primary

FIGURE 1. Preoperative view of the deciduous tooth (#T) (primary mandibular right second molar). Occlusal and distal caries can be visualized.

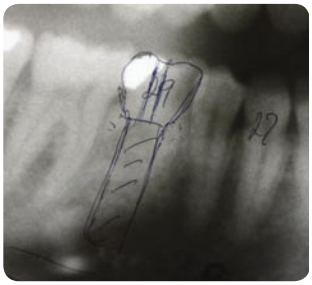

FIGURE 2. Preoperative radiograph of the deciduous tooth #T. Two small and divergent partially resorbed roots of the primary tooth can be seen. Permanent second premolar is missing. The drawing represents a preoperative assessment of the proposed channel through the center of the crown into the furcation, as well as a projected implant position

FIGURE 3. Intraoperative view of a channel made with a 1 mm round bur in the middle of the crown from the occlusal surface into the furcation.

FIGURE 4. Postoperative view of the removed primary tooth with a channel that served as a surgical guide for insertion of the implant.

FIGURE 5. Postoperative view of the removed primary tooth. Divergent roots are shown.

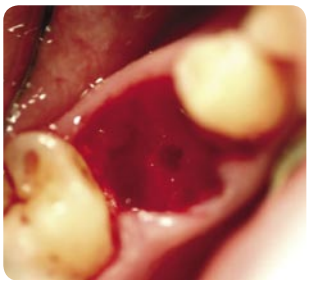

FIGURE 6. Intraoperative view of the socket after removal of the primary molar. Pilot hole in the middle of the socket is shown and it is an extension of the pre-drilled channel through the crown of the primary molar. It extends about 5 mm deep into the bone.

FIGURE 7. Intraoperative view of the direction indicator placed into the pre-drilled pilot hole after removal of the primary tooth.

FIGURE 8. Postoperative view of the inserted implant.

FIGURE 9. Postoperative radiograph of the inserted implant (area #29).

FIGURE 10. Restorative stage, ideal implant emergence, prior to fixture-level impression.

FIGURE 11. Abutment-level impression, restorative stage.

FIGURE 12. Final cement-on PFM implant-supported crown in ideal restorative position.

FIGURE 13. Final smiling photograph.

stability. A temporary healing abutment (stage 2) was placed within the same surgery. The postoperative clinical evaluation and radiograph showed ideal implant placement (**FIGURE 9**). A final screw-retained PFM implant-supported crown was delivered two months after the implant surgery in the office of the restorative dentist. It had an ideal prosthetic position and emergence profile (**FIGURES 10-13**).

Discussion and Conclusion

It is commonly accepted that implant dentistry is an integrative dental discipline that requires close collaboration of restorative and surgical colleagues. The three most important components for ensuring long-lasting success in dental implantology are: planning, precision, and teamwork. A surgical template as a part of the diagnostic work-up is a connecting link between restorative and surgical implant specialists that helps to achieve the necessary precision.

Sometimes, due to cost or other reasons, a surgical guiding template may not be available. The described method can be used in cases when both an extraction of the retained lower or upper first or second primary molar and immediate root-form dental implant insertion are planned. In these cases, the presented approach may either eliminate the necessity of a traditional surgical stent or may add a second technique to an already existing surgical guide in order to assure proper restorative-driven implant placement. ■■■■

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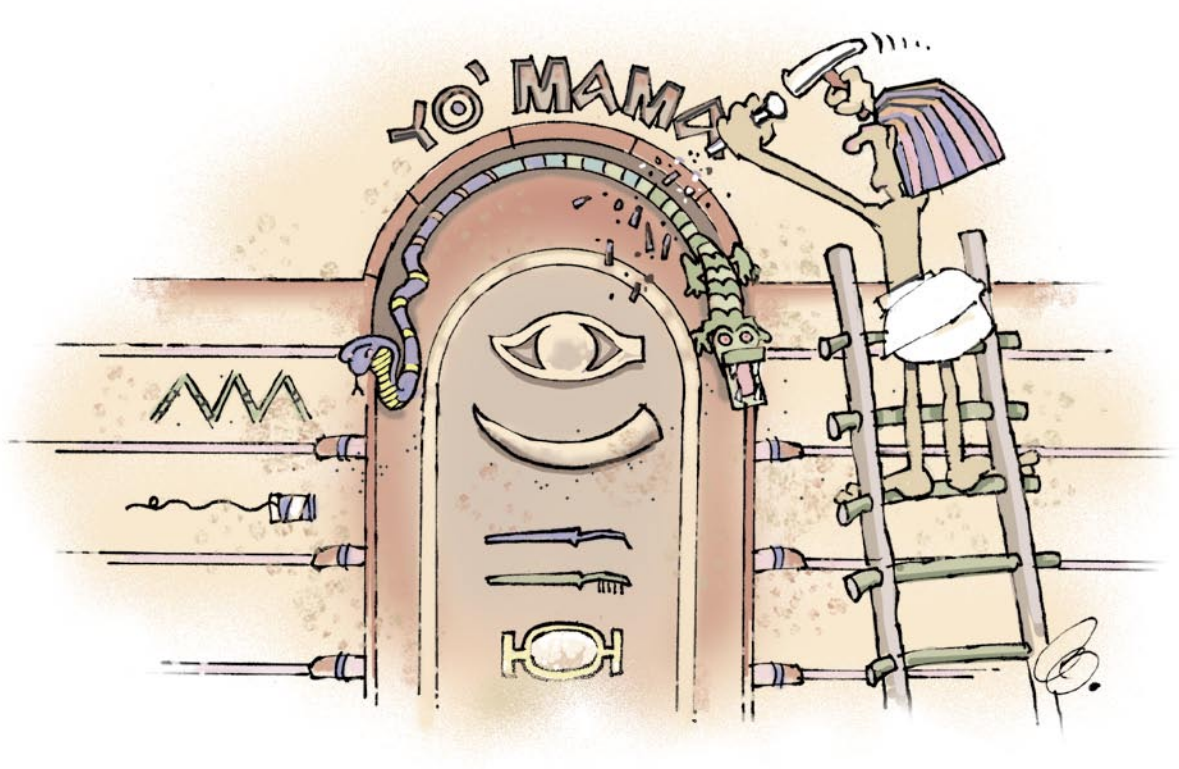
Raiders of the Lost Arch



They were not digging for anything in particular, believing that sand is sand and one might as well start here as there.

Robert E. Horseman, DDS

ILLUSTRATION BY CHARLIE O. HAYWARD

Saqqara, Egypt — An extraordinary archeological find in Saqqara, about 12 miles south of Cairo, is credited to tomb raiders who were arrested before they actually found anything.

According to the *Al-Ahram Weekly*, Dr. Zahi Hawass , chief of Egypt's Supreme Council of Antiquities, is quoted as saying, "We have to thank the thieves." The robbers, whose raiding skills have been compared with the Three Stooges, were properly thanked, then it is said were given 56,000 hours of public service that included building a 1,500-foot pyramid with only a pancake spatula and two ice tongs.

The irony is that they were not digging for anything in particular, believing that sand is sand and one might as well start here as there.

Their defense attorney, Shyster Windlesprat, petitioned that they were merely engaged in a local sand castle competition. "Denied!" declared presiding Judge Metisaphah Schwartz who later recused himself after describing the defendants as "prime examples of unmitigated cretinism."

As it turned out, the bumblers were unknowingly on top of a very special tomb that dated back 4,000 years to the Fifth Dynasty. This was the time Lara Croft was voted No. 1 Tomb Raider in the Greater Memphite Necropolis area by members of the Undocumented Cemetery Pilferers Society.

The very special tomb, according to authorized archeologists who continued to dig in the same raiders' site, was the first necropolis ever found dedicated to dentists. It is probably the last if our research is correct. John Greenwood, G.V. Black, and all

CONTINUES ON 301

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DR. BOB, CONTINUED FROM 302

the presidential dentists following — they never got a tomb. Ancient pharaohs, kings, and future big-shot mummies attained an almost lyrical pitch in their respect for their dentists and could hardly wait until they were ceremoniously entombed, sometimes before their actual deaths.

Unfortunately, this respect was not shared by the working-class schlubs schlepping 50-ton blocks of limestone up the ramps during the pyramid building craze (April 4003 B.C.). No dental plan, no Tooth Fairy, no Nile Smile Clinics — it was Edentulous City for the common folks.

Archeologists instantly recognized they had a dental phenomenon in this particular unraided tomb. It was built to honor and respect Drs. Iy Mry, Kem Msw and Sekham Ka, personal dentists to the royal family. For the three dentists buried here, it was the whole Forest Lawn catered deluxe package and more. Depicted on the walls doing their regular family things, the men are shown playing games, slaughtering animals, and offering the standard 1,000 loaves of bread and 1,000 vases of beer to the dead.

Featured prominently over the usual hieroglyphics was the dental logo of the time — an eye over a tusk. In retrospect, this is a much better dental logo than the present caduceus within a triangle and a superimposed "D." The entwined snakes have never inspired confidence in a dental patient, not that the current grisly simulacrum of a smirking two-rooted molar is much of an improvement.

Impressive as all this is, no mention is made of what the royal dentists actually did during their office hours at the king's palace. The foreign press never takes into account what the nations' dentists would really like to know, i.e., without digital X-rays, high-speed handpieces, 8 mm curing lights and intra-oral cameras, where did all the respect come from? We know when

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respect dissipated and probably why when dentists slipped from second or third place on the national respect scale to about 27th. Maybe canceling the loaves and beer offerings had something to do with it.

To make certain the dentists' tombs would remain inviolate throughout the millennium, a curse inscription was engraved on a false door featuring a snake and a crocodile. If you want a curse to really grab the cursee's attention, a snake and croc is the place to start. Personally, I'm glad I had nothing to do with this recent tomb entrance. The idea of another dentist siccing a snake and a crocodile on me is very unprofessional, to say the least.

If you're still interested in the respect angle, you might check the want ads of the *Cairo Pyramidal Tribune* to see if there are any openings for royal dentists with tomb benefits. ■■■■