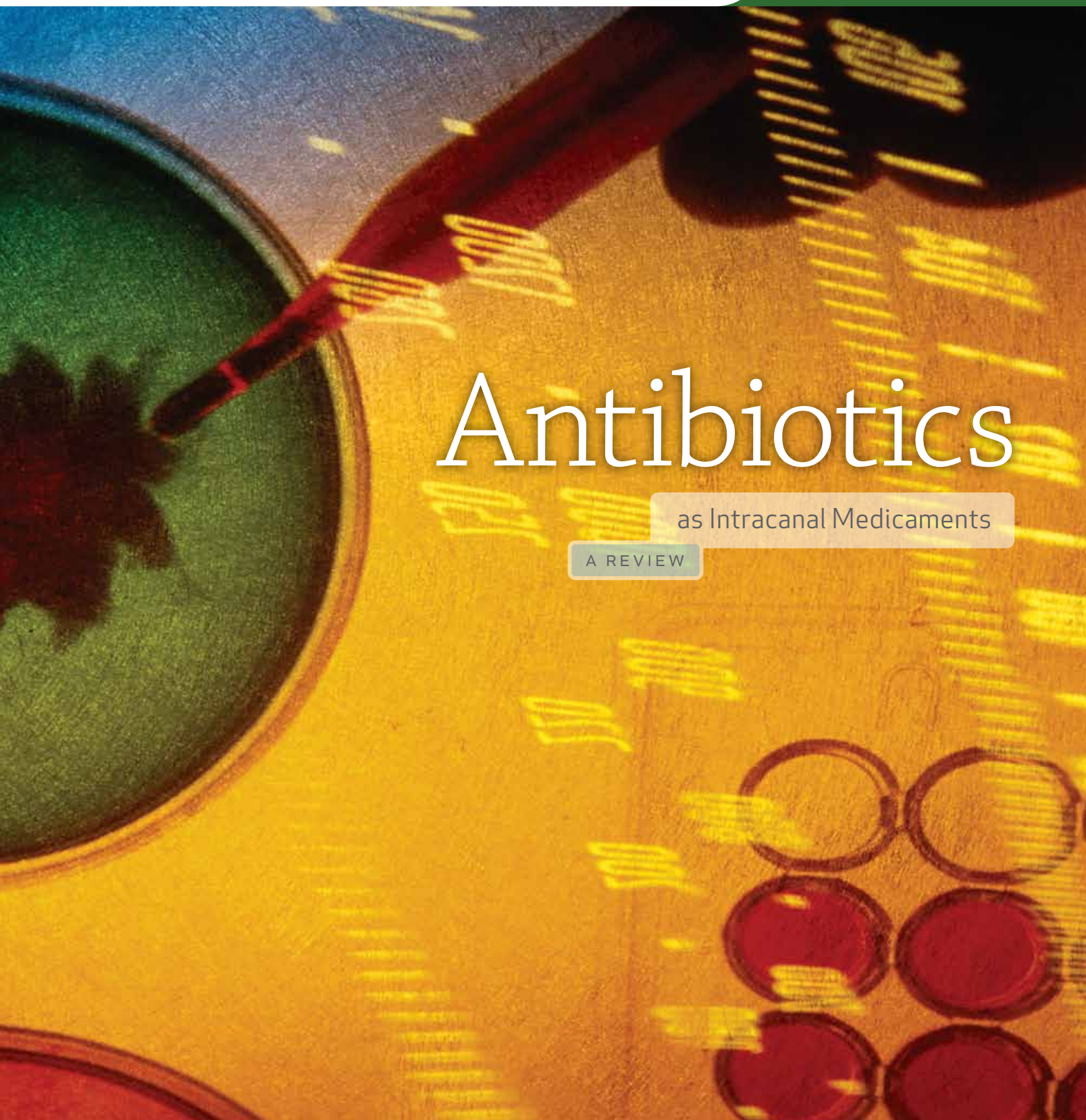
OF THE CALIFORNIA DENTAL ASSOCIATION

Journal

FEBRUARY 2009



Antibiotics

as Intracanal Medicaments

A REVIEW

OF THE CALIFORNIA DENTAL ASSOCIATION
Journal
CDA Journal
Volume 37, Number 2
FEBRUARY 2009

DEPARTMENTS

FEATURES

CDA JOURNAL, VOL 37, Nº2

Thinking Critically

KERRY K. CARNEY, DDS

We don't know what we don't know.

Some decisions are difficult to make even when we know all the facts. Some decisions are difficult to make because we cannot know all the elements of the problem. Some decisions are a matter of conjecture based on assumption, but most decisions are better when based on good evidence. That is, of course, the rationale behind an evidence-based practice of dentistry.

This is not about evidence-based dentistry per se; this is about gathering good evidence and making good decisions about dentistry and oral health care in the future. It is easy to think we already know everything we need to know to make a good decision. In many ways, the less we know, the easier the decision. Dr. David Nash, of the University of Kentucky, College of Dentistry, recently told the Board of Trustees, "We don't know what we don't know." We need more information to make good decisions about dentistry and the future of oral health care.

The first step in critical thinking is to understand the scope of a problem. The second is to gather the pertinent information. The third is to remain skeptical and critically evaluate information before incorporating it into a well-justified conclusion. Finally, one needs to be able to tolerate a considerable level of chaos. By this, I mean that answers are frequently untidy. Life is messy and conclusions are equally so.

I had a classmate in a geography course in college who was always frustrated because she wanted each topic wrapped up with a proper answer and no loose ends. Instead, each system we studied began with some beautifully simplified representation that, upon research and reflection, proved to be far more complex and unpredictable.

Oral health disparities and access to care are not simple problems.

There are those who maintain that money is all we need to eliminate oral health disparities and access to care problems. In a very simple sense that is true. Unlimited funds applied in unrealistic manners could possibly solve the problem. But oral health disparities and access to care are not simple problems. It is really misleading to use the word "problem," because that implies, like a puzzle, there exists a "solution." It is more like a "dilemma" because there is no simple answer. We must choose among alternatives, each of which may have associated unattractive ramifications. It is a multifaceted issue with no single silver bullet solution.

The Surgeon General's 2000 Report documented advances in the oral health status of the U.S. population over the past five decades. We know how to deliver excellent oral health care. Dentistry is health care that works, but it is not working for everyone.

Oral health disparities in the United States are not simply a supply side problem. Improved reimbursement would clearly improve provider participation, but there are so many other aspects that need to be addressed.

There are patient-related access barriers. These include, but are not limited to, geographic, linguistic, mobility, cultural, and transportation barriers, family income, lack of insurance, education level, child-care services, health care literacy, patient age, case complexity, fears and phobias, health fragility, and economic exigencies. The coordination of services may present a health care system too complex to successfully navigate.

Each practice owner is familiar with the provider-related barriers. We not only provide oral health care; we must operate our practices in a sustainable manner. Dental practices exhibit demand-based market distribution. Inadequate economic support means the traditional economic model cannot be sustained. This makes it impractical for new dentists, trying to repay student loans, to locate their practices in high-need/low-income communities. Low reimbursement rates, administrative burdens, patient compliance issues, and the dentist's fear of loss of control over his/her exposure to low reimbursement all work against attracting more providers to participate in current programs.

The constellation of barriers may vary from place to place and over time. An effective program in one area may not be effective in another. What works in urban California may not work in remote, rural areas. What works in a culturally homogeneous community may be useless in a multicultural context. What works in a target group of individuals of high oral health literacy

may be ineffective in groups with low oral health literacy. Where prevention is not valued and practiced, surgical intervention will be the default recourse.

Recent resolutions to the ADA House of Delegates included a description of the Community Dental Health Coordinator (CDHC) pilot program. It is envisioned that the CDHC would work in community health centers and nontraditional dental settings, e.g., schools, churches, senior centers. They would still be under a dentist's supervision, in some cases using remote communications. Recruited from the community they serve, they would be oral health educators and case managers. They would be trained to provide preventive services, temporary fillings, and simple cleanings. In California, many of these functions are already performed by assistants with extended functions or other individuals as part of community-based, outreach, and case management programs.

The reference committee at the House of Delegates heard extensive testimony from many parties concerning the appropriateness of the ADA's CDHC pilot program. Criticisms were wide-ranging and sincere but at the end of the day, the delegates voted to support the project. There is no expectation that this program alone will end the access to care problem. It will not address every variable for every community. It will not, by itself, end oral health disparities in the United States. It will not give us a proper answer with no loose ends. It will let us test some ideas. It will tell us more about what we don't know. It will give us more evidence with which to make better decisions about dentistry and oral health care in the future. ■■■■

REFERENCES

Dr. David Nash's address to the California Dental Association Board of Trustees, Oct. 11, 2008.

Oral Health in America: A Report of the Surgeon General, May 25, 2000.

Albert H. Guay, DDS: Report of the Future of Health/Universal Coverage Task Force Report to the ADA House of Delegates Referral Paper, October 2008.

Address comments, letters, and questions to the editor at kerry.carney@cda.org.

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Retraction: Panaite D, Klokkevold P, and Charles A, The Peri-Implant Papilla: Realities on Papilla Preservation and Reformation. *J Calif Dent Assoc* 36(11): 851-67, 2008.

The *Journal of the California Dental Association* is formally retracting an article that appeared in the November 2008 issue.

The article titled "The Peri-implant Papilla: Realities on Papilla Preservation and Reformation" by Doina Panaite, DDS, MS; Perry Klokkevold, DDS, MS; and Allan Charles, DDS, contained substantial text copied without attribution from an article that had been published previously in the *Journal of Periodontology* (Pradeep AR, Karthikeyan BV, Peri-Implant Papilla Reconstruction: Realities and Limitations. *J Perio* 77[3]: 534-44, 2006).

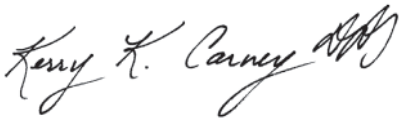
The *Journal* editor and staff had no knowledge of this situation in advance of publication. Although the article did undergo peer review by three periodontists, they were not aware that the content had been previously published. The matter was brought to our attention after publication. At that time, we took immediate steps to investigate the issue and have advised the authors of our decision to retract the article. We have removed the article from the online edition of our *Journal* and contacted the authors for an explanation.

We pride ourselves on publishing a *Journal* of integrity and very much regret that this occurred. We are reviewing our publication procedures in light of this situation and are considering modifications in an effort to avoid future incidents.

Please accept our sincerest apologies.

Sincerely,

Alan L. Felsenfeld, DDS
Editor, December 2004 through November 2008



Kerry K. Carney, DDS
Editor, current

Dan Hubig

Recent U.S. Arrivals Respond Better to Campaign of Oral Hygiene

Newer immigrants appear to be the most receptive to messages about oral health, concluded a recent study in the *Journal of Consumer Research*.

Disadvantaged communities were evaluated on the effectiveness of an oral health outreach program. The most effective strategy for improving the participants' oral health habits was to spotlight the social benefits of having a pretty grin, said article authors Shuili Du of Simmons College; Sankar Sen of City University of New York; and C.B. Bhattacharya of Boston University, in a press release in *ScienceDaily*.

"Our findings suggest that, among children from less acculturated families, participation in this oral health program leads to not only more favorable beliefs about

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3D Diagnostix Web Ordering for CT-Based Digital Dentistry

3D Diagnostix has released 3DDX Connect, a free to use Web site that lets clinicians transfer their 3-D cases and treatment plans over a secure connection that follows HIPAA regulations. A user can simply log in to the site once they've registered and check boxes to order the services of their choice. Services include quadrant or arch 3-D reconstructions, radiology reports, treatment plans, and online software training. Files can be sent easily, and 3DDX Connect allows the user to track the progress of services and billing of their case. 3DDX Connect accepts all major credit cards for easy online shopping. For more information go to www.3ddx.com.

Can Sugarless Lollipops Reduce Tooth Decay?

An article in the November 2008 issue of the *Journal of the Michigan Dental Association* reported there is research currently under way at a number of institutions to determine if ingredients in a special sugar-free lollipop actively target and kill bacteria that causes cavities.

Scientists at the University of Michigan, the University of California, Los Angeles, and the Beaumont Hospital division of Geriatric Medicine (Detroit), in a study funded by Delta Dental, are looking at lollipops manufactured by Dr. John's Candies of Grand Rapids, Mich., that contain extract of licorice root *(glycyrrhiza uralensis)*, thought to kill the bacterial agent primarily responsible for tooth decay.

The study, said Jed Jacobson, Delta Dental's chief science officer, is intended to help find effective regimens that will encourage prevention and control of dental disease in nursing home residents and children.

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Continued Care Required in Many Cases of Cleft Lip and Palate

According to a new study, adult patients with cleft palate and lip continue to face health and mental problems that often require the assistance of more than one specialist.

Authors Cher Bing Chuo, Yvonne Searle, Alison Jeremy, Bruce M. Richard, Ian Sharp, and Rona Slato said in their article, "The Continuing Multidisciplinary Needs of Adult Patients with Cleft Lip and/or Palate," that appeared in an edition of *The Cleft Palate — Craniofacial Journal*, which is published by the American Cleft Palate–Craniofacial Association, patients include those continuing their care from childhood and others seeking intervention or new advice.

"Some adult patients of all ages and all cleft types continue to have problems related to their cleft lip and/or palate and want intervention for those problems," the authors said. The most common problem is persistent nasal deformity. Other issues include problems related to speech, teeth, social life, and hearing, as well as social skills and social withdrawal.

The study examined patients who have been treated at adult multidisciplinary cleft clinics in the West Midlands, U.K., since June 2000. The researchers reviewed the number and nature of the patients' problems as well as the types of treatment they required in 2004.

Of the 145 patients seen in the adult cleft clinic, 55 attended as part of their continuing care. Ninety recently were referred as adults to the cleft service. Patients ranged in age from 15 to 70 years and had, on average, three clinical problems each.

"Intervention for the patients reviewed in this study included varied types of surgery, dental rehabilitation, psychological assessment and support, and speech assessment and therapy," according to the authors. "The problems of adults with cleft lip and/or palate may be changing. Our study supports the need for a specialist multidisciplinary cleft clinic to provide continuing care for patients who have a history of cleft lip and/or palate."

Study: Mouthwashes Can Take on and Beat Bad Breath

Halitosis may have met its match in certain mouthwashes.

Zbys Fedorowicz of the Bahrain Ministry of Health, led a study of nearly 300 people, who were at least 18 years old and did not have any serious mouth or chronic gum diseases, or other health issues such as diabetes. The studies were two, four, or six weeks long. Participants from the United States, the Netherlands, Spain, Israel, and Thailand were randomly given mouthwashes or a placebo. The results? It does matter which mouthwash you use. The difference can either mask or eliminate halitosis altogether.

"We found that antibacterial mouth rinses, as well as those containing chemicals that neutralize odors, are actually very good at controlling bad breath," Fedorowicz said in a news release. Researchers also found that mouthwashes that contain chlorhexidine can temporarily stain the teeth and tongue and reduce taste in one trial.

Chlorhexidine- and cetylpyridinium-containing mouthwashes got rid of bad breath likely from decreasing the amount of bacteria in the mouth. Chlorine dioxide and zinc versions neutralized the malodor, a stinky concoction of food bits and bacteria.

Researchers said halitosis is worldwide. Almost half of the U.S. population say they have it; about 50 to 60 percent of those living in France make the same complaints, and 24 percent of those residing in Japan "say it's a problem," according to a press release.

Preventive Dental Services Program Launched

A preventive dental program known as "Into the Mouth of Babes" in North Carolina has trained physicians in more than 400 pediatric primary care offices to screen for tooth decay.

With young children from low-income families experiencing high levels of tooth decay and facing numerous barriers to getting dental treatment and preventive services, and the fact that these children typically visit their pediatrician or other primary care provider far more frequently than a dentist, the primary care medical setting is gaining popularity as a place to provide preventive dental services.

Researchers at the University of North Carolina at Chapel Hill and Duke University examined factors that lead to dental referrals by physicians and whether these referrals result in dental office visits for children who received Into the Mouth of Babes, IMB, services. The study was funded by a grant from the National Institute of Dental and Craniofacial Research.

Using information from Medicaid reimbursement claims for IMB services provided during 2001 and 2002 and patient records completed by physicians for 24,403 children, patient records provided data on the child's tooth decay experience, results of a dental risk assessment, and whether the child was referred to a dentist, according to a press release from *Science Daily*. Of those 24,403 children, 2.8 percent were referred to a dentist; 3.5 percent made a dental visit before 42 months of age; and 5 percent had tooth decay.

Among those children with tooth decay, 32 percent were referred, and a higher percentage of children with a referral visited a dentist (35.6 percent) than those not referred (12.0 percent).

RECENT ARRIVALS, CONTINUED FROM 73

the health-related (preventing cavities and gum diseases) and psychosocial (beautiful smile and self-confidence) benefits of oral care behavior, but also an increase in oral care behavior such as brushing, flossing, and dental checkups," the authors said.

In 2002, the U.S. Department of Health and Human Services said there exists a "silent epidemic" of oral and dental disease that is pervasive in communities where the residents are disadvantaged, especially children of minority ethnic and racial groups.

Families who had been in the United States longer than their recent arrival counterparts were less responsive to the messages of the oral hygiene campaign.

Participants in urban areas with large Hispanic populations comprised the focus groups. These participants had children in the national oral health outreach program, which was launched nine years ago, and involved a corporate sponsor, the Boys and Girls Club of America, as well various dental schools, and the American Dental Association.

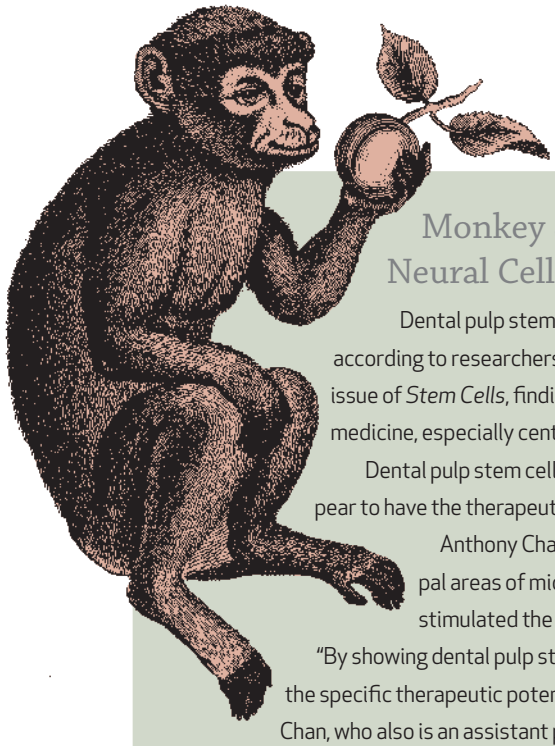
Parents of the participants reported to researchers that they intended to purchase the sponsor's products. "Their intention to reciprocate toward the company is proportionate to their perceptions of how much the program helped their children and family, the authors wrote.

REFERENCE:

Du et al, Exploring the Social and Business Returns of a Corporate Oral Health Initiative Aimed at Disadvantaged Hispanic Families. *Journal of Consumer Research*, 2008; 0 (0): 080415174210332 DOI: 10.1086/588571
Adapted from materials provided by University of Chicago Press Journals, via *ScienceDaily*, Aug. 22, 2008. A Reason To Smile: New Immigrants Respond Best To Oral Hygiene Campaign. *ScienceDaily*, http://www.sciencedaily.com/releases/2008/08/080822131332.htm.

Dr. Fresh's FireFly Boppin' Barnyard Musical Timer Toothbrush

It takes 60 seconds to fully brush top teeth, and another 60 seconds to brush the bottom. Why not brush to music? Dr. Fresh uses music to keep kids brushing. The Boppin' Barnyard toothbrush plays the kid-favorite "Old Mac Donald" when the button on its handle is pressed. Once the music stops, the child will know it is time to press the button again and start brushing their bottom teeth. Since young children enjoy music, the Boppin' Barnyard toothbrush is a great way to increase their interest in oral hygiene. The bright orange and blue toothbrush, featuring the new FireFly character, Country Boy Roy, will no longer play music when it is time to replace it (approx three mos.). The gentle bristles are end-rounded, nylon strands that bend immediately back into shape after use. Recommended for age 3-12, and retails for $2.49. For more information go to www.dr.fresh.com.



Monkey Stem Cells Stimulate Growth of New Neural Cells

Dental pulp stem cells are able to generate and stimulate the growth of a number of neural cells, according to researchers at the Yerkes National Primate Research Center, Emory University. In a fall issue of *Stem Cells*, findings suggest dental pulp stem cells can be used in cell therapy and regenerative medicine, especially central nervous system therapies.

Dental pulp stem cells have been used for the regeneration of craniofacial and dental cells, and appear to have the therapeutic potential for Parkinson's and Huntington diseases.

Anthony Chan, DVM, PhD, a researcher from Yerkes, and his team placed into the hippocampal areas of mice, the dental pulp stem cells from the tooth of a rhesus macaque. The cells stimulated the growth of new neural cells, many of which formed neurons.

"By showing dental pulp stem cells are capable of stimulating growth of neurons, our study demonstrates the specific therapeutic potential of dental pulp stem cells and the broader potential for adult stem cells," said Chan, who also is an assistant professor of human genetics in Emory School of Medicine.

Dental pulp stem cells can be isolated from people, regardless of age, while at a dental visit. Chan said he is interested in the possibility of dental pulp stem cell banking. "Being able to use your own stem cells for therapy would greatly decrease the risk of cell rejection that we now experience in transplant medicine," he said.

Chan and his team now plan to see if dental pulp stem cells enhance the brain cell development in monkeys with Huntington's disease in comparison to the way dental pulp stem cells develop from healthy monkeys.

Adapted from materials provided by Emory University, via *ScienceDaily*, Nov. 12, 2008, http://www.sciencedaily.com /releases/2008/11/081111142606.htm.

Topical Oral Syrup Prevents Early Childhood Caries, Study Shows

Toddlers given a topical oral syrup had a significant reduction in decayed teeth, said University of Washington researchers.

Children between the ages of 6 and 15 months during a clinical trial in the Marshall Islands were administered xylitol daily to see if it prevented early childhood tooth decay.

Almost 76 percent of the children receiving xylitol were caries-free by the end of the trial, compared to 48 percent of their counterparts who did not receive the fruit-flavored syrup, a five-carbon sugar alcohol used as a sugar substitute.

The study selected the Marshall Islands based on the serious public health problem of childhood caries. According to the report, the average child entering Head Start at the tender age of 5 has almost 7 cavities — about two to three times the rate in a typical mainland population.

The researchers were from the Northwest/Alaska Center to Reduce Oral Health Disparities and the Department of Dental Public Health Sciences at the University of Washington, Seattle.

HRSA Maternal and Child Health Bureau and the National Institute of Dental and Craniofacial Research provided funding.

Adapted from materials, International & American Association for Dental Research, via EurekAlert!, a service of AAAS, via *ScienceDaily*, July 7, 2008. Topical Oral Syrup Prevents Early Childhood Caries, Study Shows. *ScienceDaily*, http://www.sciencedaily.com/releases/2008/07/080705140014.htm.

Easing the Headache of Paying Bills

Paying bills online can ease what can otherwise be a monthly burden of fumbling through paper, writing checks and filing. The Nov. 20, 2008, issue of the *Wall Street Journal* featured an article by reporter Mary Pilon, in which she examined three online bill-paying services: Quicken Bill Pay (quickenbillpay.com); PayTrust (paytrust.com); and MyCheckFree (mycheckfree.com).

Noting that there is a growing market for such services, with people now paying an average of 11.5 bills a month online, and that 74 percent of households pay at least one bill online monthly, Pilon and two assistants reviewed the three bill-paying sites to see how they can help people undertake this regular, if unpleasant, task.

Quicken Bill Pay, at $9.95 a month, was convenient in that it allowed users to integrate the online component with Quicken desktop software, but it was somewhat difficult to set up, Pilon said.

PayTrust, with a number of costs, depending on the options one chose, is convenient, but sends out duplicate reminder emails. "We liked that you could also set up payments to nonconventional bills, like a babysitter or a friend you owe money to," wrote Pilon.

Finally, MyCheckFree, which, as its name implies, is free, offers a lot of variety, but doesn't allow users to pay some fairly common bills on line, including Sallie Mae student loan bills.

Dr. Fresh FireFly MouthSwoosh →

Good brushing habits are important for a child's oral health, but it may be time to add a little something to their daily hygiene routine. Dr. Fresh's FireFly MouthSwoosh is a great tasting, sugar- and alcohol-free mouth rinse that fights against cavities and strengthens tooth enamel. FireFly MouthSwoosh is bright pink in color and tastes like bubble gum. It features an LCD light in the cap so that the child

will know exactly how long to keep swishing for effective protection. FireFly MouthSwoosh is recommended for children age 6 and older, and should be used under adult supervision once daily. FireFly MouthSwoosh retails at $4.99. For more information go to www.drfresh.com.

UPCOMING MEETINGS

2009	
April 20-22	National Oral Health Conference, Portland, Ore., nationaloralhealthconference.com.
May 14-17	*CDA Presents The Art and Science of Dentistry*, Anaheim, 800-CDA-SMILE (232-7645), cda.org.
Sept. 11-13	*CDA Presents The Art and Science of Dentistry*, San Francisco, 800-CDA-SMILE (232-7645), cda.org.
Sept. 30-Oct.-4	American Dental Association 150th Annual Session, Honolulu, Hawaii, ada.org.
Nov. 8-14	United States Dental Tennis Association fall meeting, Scottsdale, Ariz., dentaltennis.org.
2010	
April 26-28	National Oral Health Conference, St. Louis, Mo., nationaloralhealthconference.com.
May 13-16	*CDA Presents the Art and Science of Dentistry*, Anaheim, 800-CDA-SMILE (232-7645), cda.org.
Sept. 24-26	*CDA Presents the Art and Science of Dentistry*, San Francisco, 800-CDA-SMILE (232-7645), cda.org.

To have an event included on this list of nonprofit association continuing education 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.

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Refer Now or Regret Later: Is the Treatment Within Your Level of Training and Experience?

TAIBA SOLAIMAN

Once a quarter, the *Journal* features a TDIC risk management case study, which provides analysis and practical advice on a variety of issues related to liability risks.

Authored by TDIC risk management analysts, each article presents a case overview and real-life outcome, and reviews learning points and tips everyone can apply to their practice.

A general dentist's decision not to refer a patient results in an untoward outcome.

A 35-year-old patient of record presents to his general dentist, Dr. Scott, for an evaluation of a toothache in his lower left molar area. After conducting a pulp vitality test and reviewing the radiograph, Dr. Scott recommends root canal treatment on tooth No. 19. He chooses not to refer the patient to an endodontist in order to boost his office's production, which has been suffering lately because of the sluggish economy. He informs the patient of the risks, benefits, and alternatives, as well as the risks involved in not having the treatment. However, he does not document the details of the conversation with the patient in the chart. The financial coordinator then discusses the cost of the root canal treatment with the patient. Due to a last-minute cancellation in the afternoon schedule, the patient is scheduled for an emergency palliative treatment by Dr. Scott that day. The patient is then reappointed to come back in one week for the root canal therapy to be performed by Dr. Scott's business partner, Dr. Asad.

When the patient arrives a week later for treatment, he is surprised to learn that Dr. Asad is not a specialist. The patient asks Dr. Asad why a specialist is not performing the treatment. Dr. Asad assures the patient that he has performed "many" root canal procedures and "there is nothing to worry about."

Dr. Asad assumes that because the patient is already a patient of record and has undergone previous root canal therapy, an informed consent discussion is not necessary. He reviews the initial radiograph and notices that the canals are slightly curved, making the procedure somewhat complicated. However, Dr. Asad views the procedure as a challenge and as an opportunity to increase his expertise with molar endodontic treatment.

He anesthetizes the patient and proceeds with cleaning the canals. Due to his lack of experience with performing molar root canals, the procedure takes longer than anticipated. Feeling the need for haste, Dr. Asad then proceeds with filling the canals and placing a cotton

pellet and the temporary filling material to seal the access. After reviewing the working and postop radiographs, Dr. Asad notices that the gutta percha and sealer extend 2 mm past the mesial root. The radiographs also reveal that the gutta percha extended 1-2 mm beyond the apex in the distal root. Dr. Asad instructs the patient to call if the pain returns, but does not mention the overfill. The treatment coordinator schedules the patient for a postoperative appointment in two weeks.

Three days later, the patient returns complaining of pain and a numb lip. After performing an evaluation and taking several radiographs at different angles, Dr. Scott notices the overfill. He prescribes a different pain medication and advises the patient to keep his appointment with Dr. Asad the following week for the postoperative evaluation. Meanwhile, Dr. Scott contacts a colleague who is an endodontist. The endodontist believes the problem is caused by excess sealer and gutta percha impinging upon the inferior alveolar nerve.

Dr. Scott documents the conversation in the chart but does not relay his findings to Dr. Asad. The following day, the patient calls to report that his condition is not getting better. At this point, the patient is extremely agitated and angry. He is advised to come in for another evaluation. Dr. Asad informs the patient about the overfill and decides to refer him to an oral and maxillofacial surgeon.

The following day, Dr. Asad contacts the patient to follow up on his visit with the oral surgeon. The patient informs Dr. Asad of the surgeon's recommendation to extract the tooth and states he was not convinced by the surgeon's treatment recommendation. Dr. Asad arranges for the patient to be evaluated by two endodontists who, after examining the patient, also agree with the surgeon's recommendation. The patient returns to the oral surgeon and following the extraction, his pain and numbness in the area of tooth No. 19 is resolved.

When a general dentist performs procedures normally performed by a specialist, he or she will be held to the standard of care of a specialist.

Approximately six months later, Dr. Asad receives a letter from an attorney stating that the patient is suing him for the failed endodontic treatment, the loss of tooth No. 19, and the costs associated with the extraction and replacement of the tooth with an implant. The patient alleges he was unable to work for several months because of the extent of his pain and additional treatment, and therefore is also requesting compensation for lost wages. Dr. Asad contacts TDIC when he receives notice of the lawsuit. TDIC performs a thorough investigation and recommends settling the case.

During the Discovery

After reviewing the information provided by Dr. Asad, TDIC discovered that Dr. Asad failed to obtain an informed consent form for the procedure from the patient. TDIC also discovered that Dr. Scott's and Dr. Asad's failures to refer the patient to an endodontist initially, as well as their failures to immediately disclose the overfill and refer the patient to a specialist, resulted in the patient's decision to pursue legal action.

Lessons Learned

What lessons can we learn from reviewing this case?

Referrals

Many patients expect their general dentist to perform all aspects of their treatment, including specialty procedures. Very often, the general dentist performs root canal therapy with positive results. However, untoward results do occur. The decision whether to refer a patient to an endodontist or any other specialist requires careful evaluation of the specifics of the case. In this case, it was determined that the patient should have been referred to an endodontist initially. The decision to refer should have been based on the location of the tooth, accessibility, anatomy of the root structure, calcification of the pulp, whether the tooth has been previously treated, the patient's general health and attitude toward treatment, and most importantly, the doctor's level of experience.

With today's economic crisis, more and more general dentists may be tempted to base their decision to refer on the level of their practice's production rather than their ability to perform the specialty procedure. However, this option could potentially result in an increased cost to the practice when the treatment outcome is not successful. When a general dentist performs procedures normally performed by a specialist, he or she will be held to the standard of care of a specialist. Therefore, not only it is important to be able to determine the potential for complications, but to promptly recognize the occurrence of an adverse situation in order to properly treat or quickly refer the patient to a specialist.

Referrals are required for many reasons, especially when a patient's treatment needs are beyond the level of training and experience of the dentist. A referral can take place anytime, including after an initial exam or evaluation, at the time a patient's advanced condition is noted or during the course of ongoing treatment. When you refer a patient to a specialist, thoroughly docu-

ment the referral in the patient's chart. Include a description of the problem, the name and specialty of the referral dentist, the reason for the referral and whether the patient has agreed to the referral. Work with the specialist to ensure a successful treatment outcome for the patient. If an issue or problem arises, respond quickly, and attempt to resolve the issue in a timely manner. The ideal is to have already formulated a plan to resolve the situation at the time the patient is advised of the problem.

Informed Consent

Informed consent is a dialogue between dentist and patient. An informed consent discussion should include risks, benefits, and alternatives to the recommended treatment, including not having treatment. Patients should not be expected to consent to treatment without having been given the information necessary to make an informed decision.

In this case, even though the patient had been a patient of record for many years and had undergone previous root canals, Dr. Asad should not have assumed that obtaining an informed consent was unnecessary. Informed consent discussions and forms are tools to aid in promoting patient understanding and consent. They serve as documentation that the discussion took place and that the patient consented to treatment.

When Patients Refuse to See the Specialist

Even though in this case the patient was not given the option to have the root canal treatment performed by an endodontist, some patients will choose not to follow through with referral recommendations. In these situations, it is important not to let patients fall through the cracks. Explain in detail to the patient all risks involved in not seeking treatment with the specialist. Remind the patient why you are making the referral and encourage him or her to see the specialist. Document your conversation and the patient's response in the chart.

The ideal is to have already formulated a plan to resolve the situation at the time the patient is advised of the problem.

Additionally, write a follow-up letter to the patient explaining his or her current dental condition, the reason for the referral, and the potential risks associated with not following through with the referral. Place a copy of the letter in the patient's chart. If the patient does not comply with your treatment plan or recommendations, consider whether dismissing the patient may be the best course of action. If you decide to allow the patient to stay in the practice and act in a noncompliant manner, you may be at risk for future allegations of medical negligence it the patient's condition worsens and causes injury.

Documentation Is Your Best Defense

Complete and thorough documentation is essential for defending allegations of professional negligence. Dentists should be especially cognizant of documenting all patient complaints and the steps taken to resolve them. Document your observation using objective terms. Also, document the informed consent discussion and have the patient sign a consent form at the time of your discussion. By signing a written informed consent document, the patient attests to the fact that the nature of the treatment, the risks, benefits, alternatives, and consequences of each have been explained to his or her satisfaction and that he or she has had the opportunity to ask questions and have them answered.

Dr. Scott informed the patient about the risks, benefits, and alternatives, as well as risks associated with not having the treatment; however, he failed to document his conversation in the patient's chart. It was also up to Dr. Asad to confirm with the patient that the informed consent discussion occurred regardless of the patient's previous root canals. Each procedure can be different and requires a separate discussion as well as documentation.

Communication Between Colleagues

When several practitioners are treating a patient, they should talk to one another to mutually resolve any issues that may arise. The patient's record should reflect communication with the other practitioners and include notes on their progress with the patient. Practitioners should agree to support one another, stick to the treatment plan, and inform the others if and when the plan changes or any complications arise. It is the referring dentist's responsibility to follow up with patients and referral practitioners about the status and progress of each referral.

Following up with patients not only demonstrates your concern, but also provides the opportunity to monitor the patient's situation and react appropriately, should complications arise. Call the patient at home the same day in which he or she underwent treatment. Document the discussion in the patient's chart, including any report of the absence of problems. Be sure to get the patient back into the office for follow-up and completion of any unfinished treatment. ■■■■

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Antibiotics as Intracanal Medicaments: A Review

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ABSTRACT Antibiotics are an extremely valuable addition to the armamentarium available to health practitioners for management of bacterial infections. Due to the potential risk of adverse systemic effects of systemic applications and ineffectiveness of systemic antibiotics in the necrotic pulpless tooth and the periradicular tissues, local application of antibiotics may be a more effective mode for delivering antibiotics to infected root canals. This paper reviews the history, rationale, and applications of antibiotics and antibiotics-containing medicaments in endodontics.

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The essential role of microorganisms in development and perpetuation of pulpal and periapical diseases have clearly been demonstrated in animal models and human studies.[1-3] Elimination of microorganisms from infected root canals is a complicated task. Numerous measures have been described to reduce the numbers of root canal microorganisms, including the use of various instrumentation techniques, irrigation regimens, and intracanal medicaments.

There is no solid evidence in the literature that mechanical instrumentation alone results in a bacteria-free root canal system. Considering the complex anatomy of root canal pulp space, this is not surprising.[4] On the contrary, there is in vitro and clinical evidence that mechanical instrumentation leaves significant portions of the root canal walls untouched.[5] Hence, complete elimination of bacteria from the RCS by instrumentation alone is unlikely to be achieved.[6] Therefore, some sort of irrigation/disinfection is necessary to kill microorganisms. Simply, chemical treatment of the root canal can be arbitrarily divided into irrigants, rinses, and intervisit medicaments. Several studies have been conducted on antibiotics as root canal irrigants and medicaments.

History

Antibiotics were first discovered in 1928 but were not routinely used clinically until the early 1940s during the World War II. Prior to this, most wartime deaths were due to bacterial infections of wounds rather than wounds themselves. The use of antibiotics was popularized as a result of the rapid recovery of wounded military personnel and this popularity

continued after the end of the war.[7]

Antibiotics have been an extremely valuable addition to the armamentarium available to health practitioners for management of bacterial infections. There is no doubt they have often been used to save lives that would otherwise have been lost if antibiotics had not been available. For several decades antibiotics have been prescribed in different disciplines of medicine and dentistry.[7] In endodontics and dental traumatology, antibiotics may be applied systemically (orally and parenterally) and locally.

The first reported local use of an antibiotic in endodontic treatment was in 1951 when Grossman used a polyantibiotic paste known as PBSC (penicillin, bacitracin, streptomycin, and caprylate sodium).[8] PBSC contained penicillin to target gram-positive organisms, bacitracin for penicillin-resistant strains, streptomycin for gram-negative organisms, and caprylate sodium to target yeasts. These compounds were all suspended in a silicone vehicle. Later, nystatin replaced caprylate sodium as an antifungal agent in a similar medicament, PBSN.[9]

Rationale for Local Applications of Antibiotics

While systemic antibiotics appear to be clinically effective as an adjunct in certain surgical and nonsurgical endodontic cases, their administration is not without the potential risk of adverse systemic effects, particularly possibilities of allergic reactions, toxicity, side effects, and development of resistant strains of microbes. Also, systemic administration of antibiotics relies on the circulation to bring an active drug to an infected site that may no longer possess a normal vasculature, including the necrotic pulpless tooth and the periradicular tissues. Therefore, local application of antibiotics may be a more effective mode for delivering antibiotics.[10]

Ledermix

Ledermix is a glucocorticosteroid-antibiotic compound. Ledermix paste was developed by Schroeder and Triadan in 1960 and was released for sale in Europe by Lederle Pharmaceuticals in 1962.[11] The primary interest of Schroeder and Triadan in the development of Ledermix paste was based on the use of corticosteroid to control pain and inflammation.[11] The sole reason for adding the antibiotic component to Ledermix was to compensate for what was perceived to be a possible corticoid-induced reduction in the host immune response.

LOCAL APPLICATION of antibiotics may be a more effective mode for delivering antibiotics.

Schroeder and Triadan initially incorporated chloramphenicol in their first trials but when Lederle Pharmaceuticals became the manufacturer, the antibiotic was changed to demeclocycline HCl. Today, Ledermix paste remains a combination of the same tetracycline antibiotic, demeclocycline HCl (at a concentration of 3.2 percent), and a corticosteroid, triamcinolone acetonide (concentration 1 percent), in a polyethylene glycol base.[11]

The two therapeutic components of the Ledermix (i.e., triamcinolone and demeclocycline) are capable of diffusing through dentinal tubules and cementum to reach the periodontal and periapical tissues.[12] Abbott et al. showed dentinal tubules were the major supply route of the active components to the periradicular tissues, while the apical foramen was not as significant as a supply route.[13] Various factors can affect the supply of the active components to the periradicular tissues. These include the presence or absence of the smear layer, the presence or absence of cementum, and the presence of other materials within the canal, for example, calcium hydroxide.

The concentration of demeclocycline within the Ledermix paste itself (i.e., as it would be when placed within the root canal) is high enough to be effective against susceptible species of bacteria. However, within the peripheral parts of the dentine and in the periradicular tissues, the concentration achieved through diffusion is insufficient to inactivate bacteria, especially over time.[14] Immediately adjacent to the root canal, inhibitory levels of demeclocycline are achieved for all reported bacteria within the first day of application but this level drops to about one-tenth of the initial level after one week in both the midroot and the apical third levels. Further, away from the root canal toward the cementum, the concentration of demeclocycline after one day is not high enough to inhibit growth of 12 of the 13 strains of commonly reported endodontic bacteria.[14]

Heling and Pecht evaluated the efficacy of the Ledermix paste in the disinfection of dentinal tubules.[15] Their findings showed that Ledermix and 3 percent tetracycline in a hydrous base were effective in reducing the amount of *Staphylococcus aureus* in dentinal tubules after seven days of incubation and also after recontamination. They were not effective after 24 hours.

Abbott showed that the intradental use of the Ledermix paste and Ledermix cement is unlikely to result in any systemic side effects.[16] Pierce et al. demonstrated histologically that the Ledermix eliminated experimentally induced external inflammatory root resorption in vivo.[17] They also found that the Ledermix paste had no

damaging effects upon the periodontal membrane and that this paste was an effective medication for the treatment of progressive root resorption in traumatically injured teeth. Taylor et al. evaluated effects of Ledermix paste and Pulpdent paste on mouse fibroblasts and on bacteria in vitro.[18]

Dilutions of Ledermix paste, Pulpdent paste and a mixture of equal parts by weight of Ledermix paste and Pulpdent paste were added to in vitro cultures of mouse fibroblasts or bacteria for 24 hours, and various cell functions were then examined: mitosis in and survival of fibroblasts, and survival of *Lactobacillus casei* or *Streptococcus mutans*. Ledermix was found to reversibly inhibit mitosis while present in the concentrations range 10(-3) to 10(-6) mg/ml. Mixing with Pulpdent did not modify this antimitotic effect. Ledermix killed mouse fibroblasts at 10(-3) mg/ml and above, while Pulpdent killed at 1 mg/ml and above.

The toxic effect of Ledermix was slightly inhibited by mixing it with Pulpdent. Ledermix killed *S. mutans* at about the same concentration at which it killed the mammalian cells, but required a one thousand-fold greater concentration to kill *L. casei*. Pulpdent killed both *L. casei* and *S. mutans* at approximately one-fifth of the concentration at which it killed the mammalian cells. Thong et al. compared the effect of calcium hydroxide (Pulpdent) and Ledermix paste on periodontal healing and root resorption following replantation histomorphometrically.[19] They found that periodontal ligament inflammation and inflammatory root resorption were markedly inhibited by both calcium hydroxide and corticosteroid-antibiotic relative to untreated controls.

Replacement resorption was lowest in the corticosteroid-antibiotic group, and significantly more normal periodontal ligament was present in this group than in calcium hydroxide and control groups. Wong and Sae-Lim evaluated the effect of immediate intracanal Ledermix on root resorption of delayed-replanted monkey teeth.[20] For the experimental group, intracanal Ledermix was placed

prior to extraction and replantation after one-hour bench dry. The positive control group was root filled and replanted after one hour while the negative control group was root filled and replanted immediately.

The negative control group produced highly significant favorable healing and unfavorable healing as compared to the Ledermix group. The Ledermix group only showed significantly higher occurrence of complete healing (35.46 percent) compared to the positive control group (16.58 percent), but there were no significant differences in the inflammatory root resorption and replacement resorption. Nevertheless, when the latter two unfavorable healing patterns were combined, there was a significantly lower overall unfavorable healing in the Ledermix group (64.54 percent) when compared to the positive control group (83.43 percent). This unfavorable healing outcome in the Ledermix group, however, was not significantly different from the favorable healing outcome with the same treatment modality. Bryson et al. evaluated the effect of immediate intracanal placement of Ledermix paste(R) on healing of replanted dog teeth after extended dry times (one hour).[21] Their finding showed that the Ledermix paste-treated roots had statistically significantly more healing and less resorption than the roots treated with $Ca(OH)_2$.

Root filling with the Ledermix paste also resulted in significantly less loss in root mass due to resorption compared to those roots filled with $Ca(OH)_2$. Chen et al. evaluated the individual influence of triamcinolone and demeclocycline on external root resorption after extended extraoral dry time (one hour).[22] Their findings showed that the groups treated with Ledermix, triamcinolone, and demeclocycline had statistically significantly more favorable healing than the group filled with gutta percha replanted after one-hour dry time (positive control). There was no statistically significant difference between the Ledermix group and the triamcinolone group, while the tetracycline group showed less favorable healing than the negative control, the Ledermix group, and the triamcinolone group. They concluded that corticosteroid and tetracycline, as anti-inflammatory and antiresorptive agents, shut down or minimized the inflammatory reaction including clastic-cells mediated resorption, thus promoted more favorable healing than the positive control group, which had no intracanal medicaments.

Furthermore, they forecasted that in severe traumatic injuries, where a large surface area of periodontal inflammation is expected, removing the pulp and placing corticosteroids into the canal at the emergency visit will become a standard protocol.[22]

ROOT FILLING WITH the Ledermix paste also resulted in significantly less loss in root mass due to resorption compared to those roots filled with Ca(OH).

Trope evaluated the relationship of intracanal medicaments to endodontic flare-ups.[23] Formocresol, Ledermix, and calcium hydroxide were placed in strict sequence irrespective of the presence or absence of symptoms or radiographic signs of apical periodontitis. He found no significant difference in the flare-up rate among the three intracanal medicaments. Ehrmann et al. investigated the relationship of postoperative pain to three different medicaments placed in the root canal after a complete biomechanical debridement of the root canal system in patients presenting for emergency relief of pain.[24] They found that painful teeth with acute apical periodontitis that had been dressed with Ledermix paste gave rise to less pain than that experienced by patients who had a dressing of calcium hydroxide, or no dressing at all.

Kim et al. investigated the effects of the Ledermix paste as an intracanal medicament on discoloration of mature teeth, whether the discoloring effects were related to the method of application, as well as the effects of sunlight upon discoloration of mature teeth.[25] Results demonstrated that after 12 weeks, sunlight exposure had caused dark grey-brown staining of the teeth in the Ledermix groups, but this did not occur when the teeth were kept in the dark. More severe staining was noted when Ledermix paste filled the pulp chamber than when the paste was restricted to below the CEJ.

They suggested that if placement of the Ledermix was restricted to below the gingival margin, such effects could be minimized. In another study, they investigated the effects of the Ledermix paste as an intracanal medicament on discoloration of mature teeth, whether the discoloring effects were related to the method of application, as well as the effects of sunlight upon discoloration of immature teeth. After 12 weeks, sunlight exposure had caused dark grey-brown staining in the Ledermix groups but this did not occur when the teeth were kept in the dark. More severe staining was noted when Ledermix paste filled the pulp chamber than when the paste was restricted to below the CEJ and when teeth were exposed to sunlight.[26]

When compared to the results of a similar study using mature teeth, the results were similar but the immature teeth were more severely stained than the mature teeth. The $Ca(OH)_2$ paste caused an increase in lightness and yellowness in immature teeth.[26]

Combination of Ledermix and Calcium Hydroxide

The combination of Ledermix paste with calcium hydroxide was advocated by Schroeder initially for the treatment of necrotic teeth with incomplete root formation.[11] A 50-50 mixture of Ledermix paste and calcium hydroxide has also been advocated as an intracanal dressing in cases of infected root canals, pulp necrosis and infection with incomplete root formation (as an initial dressing prior to using calcium hydroxide alone for apexification), perforations, inflammatory root resorption, inflammatory periapical bone resorption, and for treatment of large periapical radiolucent lesions.[12] It has been shown that the 50-50 mixture results in slower release and diffusion of the active components of Ledermix paste, which makes the medicament last longer in the canal.[27] This in turn helps to maintain the sterility of the canal for longer and also maintains a higher concentration of all components within the canal.[27]

The 50-50 mixture of Ledermix paste and calcium hydroxide paste does not alter the pH to any noticeable extent and therefore it is expected that the mixture will act in a similar manner to when calcium hydroxide is used alone. Taylor et al. also showed that for two indicator micro-organisms, *L. casei* and *S. mutans* (which are cariogens), the 50-50 mixture was marginally more effective than either paste used alone.[18] However, Seow showed that for *S. sanguis* and *S. aureus*, the addition of only 25 percent by volume of Calyxl (a calcium hydroxide in saline paste) (Otto and Co., Frankfurt, Germany) to Ledermix converted the zone of complete inhibition originally seen in Ledermix to one of only partial inhibition.[28] This latter study suggested that some medicaments should not be used in combination, and that when two medicaments with strong antimicrobial activity are combined there may be no additive or synergistic effects.[28]

Chu et al. compared the efficacy of disinfection of root canals with periapical radiolucencies when treated with either antibiotics/steroid medicaments (Ledermix or Septomixine) or a calcium hydroxide paste (Calasept, Speiko, Darmstadt, Germany).[29] Their finding showed that in the Ledermix group, 38 strains of bacteria were recovered. The Septomixine group had 25 strains, and the Calasept group had 25 strains. Gram-positive facultative anaerobic cocci (including *staphylococci* and *streptococci*) were more prevalent than the gram-negative obligate anaerobic rods after treatment in all three groups.

THE CLINDAMYCIN paste was successful in eliminating bacterial growth in 21 of 25 teeth tested by the 14th day.

Septomixine Forte

Septomixine Forte (Septodont, Saint-Maur, France) contains two antibiotics: — neomycin and polymixin B sulphate. Neither of these can be considered as suitable for use against the commonly reported endodontic bacteria because of their inappropriate spectra of activity.[14] Neomycin is bactericidal against gram-negative bacilli but it is ineffective against bacteroides and related species, as well as against fungi. Polymyxin B sulphate is ineffective against gram-positive bacteria, as shown by Tang et al., who demonstrated that a routine one-week application of Septomixine Forte was not effective in inhibiting residual intracanal bacterial growth between appointments.[30] In addition, although the anti-inflammatory (corticosteroid) agent, dexamethasone (at a concentration of 0.05 percent), is clinically effective, triamcinolone is considered to have less systemic side effects.

Clindamycin

Clindamycin is effective against many of the representative endodontic pathogens, including *actinomyces, eubacterium, fusobacterium, propionobacterium, microaerophilic streptococci, peptococcus, peptostreptococcus, veillonella, prevotella,* and *porphyromonas*. It is particularly effective in vitro against black-pigmented prevotella and porphyromonas species.[10]

Molander et al. investigated the effect of clindamycin on root canal infection when placed as an intracanal dressing.[31] A 150 mg clindamycin capsule was mixed with sterile water and placed into infected root canals. Following initial bacteriological sampling and routine instrumentation, clindamycin powder mixed to a paste with saline was applied for 14 days. The presence or absence of bacteria was determined in samples taken immediately after removal of the dressing, and after a period of seven days during which the canals were filled with sampling fluid. The results indicated that clindamycin offered no advantage over conventional root canal dressings, such as calcium hydroxide. However, the concentration of the active drug and its ability to penetrate deeply into the root canal system was not clear. Also, no negative controls were used.

Nonetheless, the clindamycin paste was successful in eliminating bacterial growth in 21 of 25 teeth tested by the 14th day. In the four remaining teeth, *enterococci* constituted the dominant flora despite antibiotic treatment. Gilad et al. evaluated the efficacy of clindamycin in an ethylene vinyl acetate, EVA, vehicle in reducing bacterial growth in vitro.[10] Clindamycin fibers were manufactured as follows: 0.075 g of calcium phosphate monobasic was combined with 10 ml of distilled water, and was added to a solution consisting of 0.050 g of clindamy-

cin phosphate and 10 ml of distilled water. The combined solution was then lyophilized for 24 hours, and the resultant powder was filtered to achieve a uniform particle size of 45 microns. The powder (125 mg) was combined with 375 mg of EVA particles and was processed through an extrusion plastometer at diameters of 2 mm, 1 mm, and 0.5 mm.

The final extrusion produced a 250 mm-long fiber, with a calculated approximate dose of 0.2 mg of clindamycin/mm fiber. Results of the bacterial sensitivity test demonstrated that at the concentration of 10 microgram/ml, all bacteria tested showed varying degrees of inhibition, especially *P. intermedia*, followed by *F. nucleatum, P. micros,* and *S. intermedius*. They also found that clindamycin/EVA fibers significantly reduced the number of bacteria present in extracted human teeth. Furthermore, clindamycin/EVA fibers demonstrated the ability to release active drug for at least two weeks.

Lin et al. compared the antibacterial effect of clindamycin and tetracycline in bovine dentinal tubule model, as well as using the agar diffusion test.[32] Their findings showed that clindamycin significantly reduced the amount of viable bacteria in each dentin layer compared with the tetracycline. The agar diffusion test, wherein dilutions in increments of 1/3 and 1/9 were used, revealed that both medicaments had antibacterial activity, but clindamycin was significantly better. In the 1/27 dilution, clindamycin had a minor effect and tetracycline had no effect at all.

Triple Antibiotic Paste

The infection of the root canal system is considered to be a polymicrobial infection, consisting of both aerobic and anaerobic bacterial. Because of the complexity of the root canal infection, it is unlikely that any single antibiotic could result in effective sterilization of the canal. More likely a combination would be needed to address the diverse flora encountered. A combination of antibiotics would also decrease the likelihood of the development of resistant bacterial strains.

The combination that appears to be most promising consists of metronidazole, ciprofloxacin, and minocycline.[33,34] Sato et al. evaluated the potential of a mixture of ciprofloxacin, metronidazole and minocycline to kill bacteria in the deep layers of root canal dentine in situ.[35] Results showed that no bacteria were recovered from the infected dentine of the root canal wall 24 hours after application of the drug combination, except in one case in which a few bacteria were recovered.

THE COMBINATION that appears to be most promising consists of metronidazole, ciprofloxacin, and minocycline.

Hoshino et al. investigated the antibacterial effect of a mixture of ciprofloxacin, metronidazole, and minocycline, with and without the addition of rifampicin, on bacteria taken from infected dentine of root canal walls.[36] The efficacy was also determined against bacteria of carious dentine and infected pulps, which may the precursory bacteria of infected root dentine. They found that alone, none of the drugs resulted in complete elimination of bacteria. However, in combination, these drugs were able to consistently sterilize all samples. Iwaya et al. reported a necrotic immature mandibular second premolar with periapical involvement and sinus tract.[37]

Instead of the standard root canal treatment protocol and apexification, antimicrobial agents (metronidazole and ciprofloxacin) were used in the canal, after which the canal was left empty. Radiographic examination showed the start of apical closure five months after the completion of the antimicrobial protocol. Thickening of the canal wall and complete apical closure was confirmed 30 months after the treatment, indicating the revascularization potential of a young permanent tooth pulp into a bacteria-free root canal space. Takushige et al. evaluated the efficacy of poly-antibiotic paste consisted of ciprofloxacin, metronidazole, and minocycline, on the clinical outcome of so-called "Lesion Sterilization and Tissue Repair," LSTR, therapy in primary teeth with periradicular lesions.[38] Results showed that in all cases, clinical symptoms such as gingival swelling, sinus tracts, induced dull pain, spontaneous dull pain, and pain on biting disappeared after treatment, although in four cases clinical signs and symptoms were finally resolved only after retreatment using the same procedures. Thus, gingival abscesses and fistulae, if present, disappeared after a few days.

Successor permanent teeth erupted without any disorders or were found radiographically to be normal and in the process of eruption. All the cases were evaluated as successful. The mean function time of the primary teeth was 680 days (range: 68 – 2,390 days), except for one case in which the successor permanent tooth was congenitally missing. Windley et al. assessed the efficacy of a triple antibiotic paste in the disinfection of immature dog teeth with apical periodontitis.[33] The canals were sampled before (S1) and after (S2) irrigation with 1.25 percent NaOCL and after dressing with a triple antibiotic paste (S3), consisting of metronidazole, ciprofloxacin, and minocycline. At S1, 100 percent of the samples cultured positive for bacteria with a mean CFU count of 1.7 x 10. At S2, 10 percent of the samples cultured bacteria-free with a mean CFU count of 1.4 x

10. At S3, 70 percent of the samples cultured bacteria-free with a mean CFU count of only 26. Reductions in mean CFU counts between S1 and S2, as well as between S2 and S3, were statistically significant.

Metronidazole

Metronidazole is a nitroimidazole compound that exhibits a broad spectrum of activity against protozoa and anaerobic bacteria. Known for its strong antibacterial activity anaerobic cocci, as well as gram-negative and gram-positive bacilli, it has been used both and topically in the treatment of periodontal disease. Metronidazole readily permeates bacterial cell membranes. It then binds to DNA, disrupting its helical structure, and leads to very rapid cell death (65). Roche and Yoshimori investigated the activity of metronidazole against clinical isolates from odontogenic abscesses in vitro.[39] Their findings showed that metronidazole had excellent activity against anaerobes isolated from odontogenic abscesses but had no activity against aerobes.

Siqueira and de Uzeda evaluated the antibacterial activity of 0.12 percent chlorhexidine gel; 10 percent metronidazole gel; calcium hydroxide plus distilled water, calcium hydroxide plus camphorated paramonochlorophenol (CPMC); and calcium hydroxide plus glycerin using agar diffusion test.[40] The results revealed that calcium hydroxide/CPMC paste was effective against all bacterial strains tested. Chlorhexidine was also inhibitory to all strains. It was about as effective as calcium hydroxide/CPMC paste against most of the strains.

Metronidazole also caused inhibition of growth of all obligate anaerobes tested and was more effective than calcium hydroxide/CPMC against two strains. In another study, Lima et al. evaluated the effectiveness of chlorhexidine- or antibiotics-based medications in eliminating *E. faecalis* biofilms.[41] They found there were significant differences between the formulations tested. The association of clindamycin with metronidazole significantly reduced the number of cells in one-day biofilms. However, of all medications tested, only 2 percent

chlorhexidine-containing medications were able to thoroughly eliminate most of both one-day and three-day *E. faecalis* biofilms.

Wang et al. evaluated the effect of metronidazole-chlorhexidine solution on treatment of chronic apical periodontitis.[42] They found that the effective rate of metronidazole-chlorhexidine solution treatment was 97.6 percent. Yu et al. evaluated the effect of a paste made of erythromycin ethylsuccinate, metronidazole and CP to sterilize the root canal.[43] The clinical observation of 180 patients with entirely developed root apex of acute and chronic apical periodontitis showed that there was no significant difference comparing erythromycin-ethylsuccinate-metronidazole-CP with formocresol in root canal sterilization. Therefore, the irritability and poisonousness of the paste could be reduced by using erythromycin-ethylsuccinate- metronidazole-CP instead of FC.

They concluded that the root canal sterilization with erythromycin-ethylsuccinate-metronidazole-CP was a safe and effective method to promote the restoration of root apex diseases.[43] Gao et al. investigated a sustained release delivery gutta percha point containing metronidazole, SRDGM, for root canal disinfection, and determined the drug concentration in vitro and the time that the device maintained the effective drug concentration.[44] Their findings showed that the SRDGM contained metronidazole 2013 micrograms; it could release 68.24 percent of the total drug in 24 hours in vitro. The effective metronidazole concentration released lasted more than 10 days. On the 10th day, there was also 33.13 microg/ml metronidazole released, which was more than a minitory inhibitory concentration of metronidazole.

Hoelscher et al. evaluated the antimicrobial effects of five antibiotics (amoxicillin, penicillin, clindamycin, metronidazole, and doxycycline) when added to Kerr Pulp Canal Sealer EWT against *E. faecalis*.[45] They found that all mentioned antibiotics, except for metronidazole, could enhance the antimicrobial efficacy of the sealer. Krithikadatta et al. evaluated the disinfection of dentinal tubules using 2 percent chlorhexidine gel, 2 percent metronidazole gel, bioactive glass (S53P4) in comparison with calcium hydroxide.[46] Their finding demonstrated that the overall percentage inhibition of bacterial growth (at 200 microm and 400 microm depth) was 100 percent with 2 percent chlorhexidine gel. The inhibition of growth was moderate with 2 percent metronidazole gel (86.5 percent), followed by bioactive glass (62.8 percent) and calcium hydroxide (58.5 percent).

GASTROINTESTINAL side effects are common among many medications, but in particular macrolide antibiotics.

Potential Side Effects

As clinicians make decisions on whether or not to prescribe antibiotics in conjunction with endodontic treatment, it is important to be cognizant of the risks and side effects of antibiotics. The use of antibiotics is not different from any other medications in that the benefits of using them must outweigh the risks involved, from the perspectives of both the direct treatment of patients and global public health issues. Among the well-documented side effects to antibiotics commonly prescribed for endodontic infections are hypersensitivity reactions and drug fevers to penicillin and other β-lactam antibiotics, pseudomembranous colitis, which occasionally occurs with clindamycin or other antibiotics, nausea, vomiting, and gastrointestinal distress common with macrolides, photosensitivity that may accompany tetracycline and renal toxicity that may be associated with the use of aminogycosides.[47]

Hypersensitivity side effects are more common among β-lactam antibiotics, and, while drug rash, serum sickness, and anaphylactic reactions are well-recognized by clinicians, drug fevers are the most common antibiotic-mediated hypersensitivity side effect.[47] Drug fevers account for 10-15 percent of unexplained fevers in hospitalized patients in the United States, and may occur with any medication, but are common with β-lactams and sulfonamides.[47] Gastrointestinal side effects are common among many medications, but in particular macrolide antibiotics. Clarithromycin (such as Biaxin XL) and azithromycin are associated with less GI irritation than erythromycin.[48]

Diarrhea is a frequent symptom of GI distress in patients on macrolides, β-lactams or clindamycin, and may be a direct irritation of the intestinal mucosa or an imbalance in intestinal flora. As was noted before, one type of complication of antibiotics due to the microbial imbalance is the overgrowth of clostridium difficile, causing pseudomembranous colitis, a rare but serious condition. This condition can develop up to six weeks after cessation of therapy and is usually caused by clindamycin, ampicillin or cephalosporins, especially in hospitalized patients.[48-50]

One of the most serious side effects of the frequent, indiscriminate use of antibiotics, not only for the individual patient but also from a global public health perspective, is the development of resistant bacterial strains.[51-54] As noted before, the percentage of β-lactamase-positive bacteria tends to increase in endodontic infections in patients with prior use of β-lactam antibiotics.[55]

Another group of microorganisms that is becoming among the most serious drug-resistant bacteria is *enterococci*.

Enterococci, particularly *E. faecalis* and *E. faecium*, were shown to be the most prevalent among the microflora of root canals in failing endodontic cases.[55]

Conclusions

1. The local application of antibiotics within the root canal system may be a more effective mode for delivering such drugs than systemic routes of administration.

2. Ledermix, a glucocorticosteroid-antibiotic compound, has anti-inflammatory, antibacterial and antiresorptive properties, all of which help to reduce the periapical inflammatory reaction including clastic-cell mediated resorption. This material has been shown to significantly lower the incidence of inflammatory and replacement resorption, and thus prompts more favorable healing in replanted teeth.

3. A 50:50 mixture of Ledermix paste and calcium hydroxide has been advocated as an intracanal dressing in cases of pulpless infected root canals, pulp necrosis and infection with incomplete root formation (apexification), perforations, inflammatory root resorption, inflammatory periapical bone resorption, and for the treatment of large periapical radiolucent lesions.

4. Clindamycin alone or in an ethylene vinyl acetate vehicle can reduce the bacterial load inside the root canal system (including dentinal tubules) significantly.

5. A triple antibiotic paste consisting of metronidazole, ciprofloxacin, and minocycline, has been reported to be very effective in the disinfection of the root canal system.

6. Among the well-documented side effects to antibiotics commonly prescribed for endodontic infections (penicillins) are hypersensitivity reactions and drug fevers. ■■■■

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Trigeminal Neuralgia and Radiofrequency

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ABSTRACT Trigeminal neuralgia is a painful neurological disorder often mistaken for pain of dental origin by the patient and dentist. Dentists should be acquainted with TN to differentiate it from orofacial pain and prevent unnecessary tooth extraction. TN pain-alleviating modalities are numerous, yet not uniformly effective. Radiofrequency, known for 25 years, is a minimally invasive outpatient procedure used for TN when drugs are ineffective. The authors evaluate RF in TN patients referred from the dental office.

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Trigeminal neuralgia, TN, is an excruciatingly painful neurological disorder often confused with dental pain. Dentists are often the first clinicians confronted by patients with TN. Differentiating this type of pain from dental pain may be difficult for dentists. Examples of patients whose teeth have been needlessly extracted by dentists in hope of a cure are not uncommon. Management of trigeminal neuralgia consists of a variety of different treatment modalities, each having its own success rate in alleviation of the signs and symptoms depending both on the type of TN and characteristics of the patient (i.e., age, coexisting problems, etc.). Modalities of treatment are numerous, yet not without complications and not uniformly successful in alleviating the painful symptoms of this disease. The management of TN has been challenging for clinicians who are often confronted primarily with these patients. Furthermore, due to the high number of complications following surgical and nonsurgical ablative approaches for TN, the authors aimed to assess the success and complication rate of radiofrequency, RF, in the management of TN patients referred by dentists in a six-year study. This article seeks to acquaint the practitioner with TN and present diagnosis and treatment modalities.

Materials and Methods

From 2000 to 2006, a six-year retrospective study was conducted based on data from 65 patients treated for clinically documented TN (according to Winn's criteria: the presence of 1) unilateral paroxysmal stabbing pain limited to the branches of the trigeminal nerve; 2) tender trigger zones; 3) frequent pain-

free intervals between pain sessions; 4) response to anticonvulsants; and 5) the absence of neurological defect) at the department of neurosurgery.[1]

Patients with a history of surgery or pathological conditions (i.e., tumors, etc.) were excluded. All patients had previously undergone pharmacologic treatment protocols (carbamazepine, antiepileptic drugs such as gabapentin, as well as cannabinoids etc., for several months to a year), which were or had become ineffective.

Informed consents from the patients were included in the documents of all 65 patients. File data including patient demographics, gender, age, presence of trigger zone, side of involvement, nerve branch involved, total/partial success, frequency of RF, and post-treatment complications were assessed. All diagnoses and treatment procedures were done by one neurosurgeon. All patients were treated as outpatients.

RF was repeated in cases with persisting pain despite the use of 600 mg of carbamazepine daily during the first month following RF therapy (due to the ineffectiveness of the first RF treatment). Settings of the RF unit were as follows: temperature 70-to 90- degrees Celsius, time length 80-90s, current intensity of 40-130mA, and voltage of 15-60V.

Straight electrodes were preferred for neuralgia of the third branch and curved electrodes for neuralgia of the first and second branches of the trigeminal nerve.

In the authors' study, total success was defined as complete pain relief with no need for further pharmacologic intervention. Partial success was defined as significant pain relief that could be further managed by medication (a maximum of 600 mg carbamazepine daily), and failure as the presence of the same level of pain immediately following RF or recurrence of the same level of pain within a month after RF not managed by medication.

The data was recorded, classified using SPSS software, and statistically analyzed using the Pearson chi-square, odds-ratio and Fisher's exact tests. Values were considered significant if p≤ 0.05.

Results

Sixty-five patients 36 (55.4 percent) females and 29 (44.6 percent) males with a mean age of 52.4±14.4 (ranging from 21-75) years were studied. A total of 51 (78.5 percent) patients were successfully treated; 14 (21.5 percent) were unsuccessful (**TABLE 1**). TN was more common in patients 50 years or over in 41 (63.1 percent) cases (p≤05). TN was unilateral 63 (96.9 percent) and bilateral in 2 (3.1 percent) cases, respectively (p≤.05). In addition, it was of the typical type in 52 (80 percent) patients and atypical in 13 (20 percent) cases (p≤.05). Separate involvement of V1, V2, and V3 branches was observed in 4.6 percent (n=3); 32.3 percent (n=21); and 40 percent (n=26) of the cases, respectively.

Combined involvement of V1 + V2, V1 + V3, and V2 + V3 was seen in 3.1 percent (n=2), none, and 13.8 percent (n=9) of the cases, respectively. Involvement of all three branches was seen in 6.2 percent (n=4) of the cases. The success rate was significantly higher for patients with defined trigger zones (74.5 percent), compared to those without trigger zones (25.5 percent). There was no need to repeat RF for the majority (72.3 percent) of the patients (p≤.05).

Discussion

Diagnostic Comparison and Differentiation of Dental Pain and Trigeminal Neuralgia

Dental pain. Severe dental pain can result from pulpitis or periapical infection. In the case of pulpitis, the patient often has nocturnal pain exacerbated by heat as well as radiographic findings such as caries or deep restorations. Pain from a periapical infection not yet apparent on X-ray can result in a patient with the previously mentioned radiographic findings or a patient with endodontic treatment. In this condition, the tooth is felt to be extruded, painful upon percussion, and painful to palpation in the vestibule over the apex of the tooth root; however, pain does not involve the face or skin. In dental pain, the facial skin is not involved and the cause is often apparent and the pain usually responds to analgesics. Radiographic findings are usually diagnostic and the origin of pain can be traced to the oral cavity, tooth or gum via clinical and paraclinical examination.

TN pain. TN is an excruciatingly painful, neuropathic, facial disorder typically presenting as paroxysmal or abrupt pain lasting from several seconds to one or more minutes and rarely up to several hours.

The pain from TN is said to feel like stabbing, electric shocks occurring spontaneously or following stimulation of a trigger zone.[1] Idiopathic trigeminal neuralgia occurs in 1/100,000 people and is found more frequently in patients over 50 years of age.[2] It may be typical (i.e., with paroxysmal pain only) or atypical (i.e., with association of a permanent background of pain). The skin of the face is painful upon TN attacks in the area innervated by V1, V2 or V3 of the trigeminal nerve; radiographic findings are lacking and pain is not necessarily nocturnal. An etiology often cannot be found. The pain is severe and may ensue even by talking or swallowing. Analgesics are usually ineffective. Radiographic findings are not diagnostic and the origin of pain cannot be traced to the oral cavity via clinical and paraclinical examination. However, there may be a trigger point in the oral cavity that sparks the attack.

TABLE 1

Demographics and Characteristics of TN Patients and the Results of RF Therapy

P-values ⩽ 0.05 are significant. An odds ratio greater than 1 indicates that the condition or event is more likely in the first group. As can be seen from the data, TN was typical in 80 percent, involved V3 in 50 percent, and had trigger zone in 74.5 percent (p<0.05). RF was successful in 78.5 percent, and done once in 72.3 percent of the patients (p<0.05).

Characteristics N=65		The Results of RF Therapy		Test Results P-Value	Odds Ratio
		Successful (n=51) 78.5%	Unsuccessful (n=14) 21.5%		
Gender	Male 29	49% (25/51)	28.6% (4/14)	0.230	
	Female 36	51% (26/51)	71.4% (10/14)		
Age Mean 52.4 (21-75 yrs.)	Under 50 years	29.5% (15/51)	64.3% (9/14)	0.017	4
	50 years and older	70.5% (36/51)	35.7% (5/14)		
Side	Unilateral	96% (49/51)	100% (14/14)	1.00	
	Bilateral	4% (2/51)	0% (0/14)		
Type	Typical 80%	92.2% (47/51)	35.7% (5/14)	0.00	21
	Atypical 20%	7.8% (4/51)	64.3% (9/14)		
Involved nerve branch	V1 and V2	2% (1/51)	7.1% (1/14)	0.077	
	V1, V2 and V3 3.1%	2% (1/51)	21.4% (3/14)		
	V2 and V3 13.8%	13.7% (7/51)	14.3% (2/14)		
	V1 4.6%	3.9% (2/51)	7.1% (1/14)		
	V2 32.3%	31.4% (16/51)	35.8% (5/14)		
	V3 40%	47% (24/51)	14.3% (2/14)		
Side	Right	70.6% (36/51)	28.6% (4/14)	0.06	
	Left	29.4% (15/51)	71.4% (10/14)		
Defined trigger zone	Present 74.5%	74.5% (38/51)	14.3% (2/14)	0.00	17
	Not present 25.5%	25.5% (13/51)	87.5% (12/14)		
Radio frequency	Twice	25.5% (13/51)	35.7% (5/14)	0.507	
	Once 72.3%	74.5% (38/51)	64.3% (9/14)		

Temporomandibular Joint Pain. TMJ pain is found over the joint in the area of the tragus; it is often seen with signs and symptoms such as clicking, locking, difficulty in mastication, limited mouth opening, bruxism, and pain in the muscles of mastication. The pain is not a stabbing or shocking pain and can be elicited by palpating the joint. The patient often complains of pain in the ears and often seeks treatment from an otolaryngologist. Clinical and MRI examination often reveals the joint disorder.

Treatment

Treatment of TN Is Possible via Both Surgery and Medication

Medical approach. The medical approach is usually employed first in an attempt to treat TN noninvasively. This is usually accomplished using anticonvulsants. Carbamazepine is the classic medication of choice for this purpose. Long-term studies, however, have shown a gradual decrease in its efficiency over time. Initial response to this medication approximates 80 percent. After 10 years however, its effectiveness decreases to 50 percent.[3] Other antiepileptic drugs such as gabapentin, as well as cannabinoids, have also been used.

Other methods. Another method by

which to manage TN is neurectomy. It has been reported to be successful in 88.2 percent of the patients but also has been reported to cause facial anesthesia in 2.7 percent of the patients.[2] Balloon compression is another method used to treat TN patients in which initial pain relief prevalence has been reported in 93 percent, but, unilateral facial sensory loss has been reported in 61 percent of the patients.[4] Use of microvascular decompression, MVD, for TN caused by venous pressure is another effective method of treatment in which the pain recurrence ranges from 31.0 percent to 75 percent, within one to three years after the initial operation due to development of new veins around the nerve root in 87.5 percent of the cases.[5] This is a major neurosurgical operation that may have serious complications, as well as prolonged convalescence.

Radiofrequency. RF is a well-known treatment modality to manage TN. It is a form of electromagnetic energy waves that move together at the speed of light.[6] Based on the studies of Kanpolat (1,600 patients treated during 25 years), Scrivani (250 patients treated during five years), Choudhury (40 patients treated during two years), and Ernest (258 patients treated during four years), RF proved successful in 97.6 percent, 92 percent, 77.7 percent, and 87 percent of TN cases, respectively.[7-10]

RF, although a modality of management known for 25 years, is still used by many. It is a short outpatient procedure with minimal side effects. Various reports regarding the success rate of this type of treatment have been published.

This study evaluated treatment results following RF in patients suffering from TN referred by dentists. In the authors' study, TN involved both genders almost equally which is approximately consistent with the findings of Kanpolat, Scrivani, and Taha who reported the female predilection to be 62.1 percent, 69 percent, 65 percent respectively.[7,8,10] In the authors' series, patients 50 years or older were more frequently involved (63.1 percent). This proved consistent with the findings of Katusic.[2] The mean age was 52 years, which is similar to the findings of Kanpolat (56 years) and younger than Taha (63 years).[7,10]

RF proved also to be more successful in patients of 50 years or older (70.5 percent) compared to younger cases ($p \leq .05$). Unfortunately, the authors have not found an assessment on the success rate of RF according to age groups. Therefore, it was not possible to compare the accuracy of the authors' results. TN was unilateral in 96.9 percent of the cases in the authors' series ($p \leq .05$), which is supported by Kanpolat's study (96 percent).[7]

IT IS A SHORT outpatient procedure with minimal side effects.

In the authors' study, the typical type of the disease was four times more frequent (80 percent) than the atypical type. Fromm and Sweet had also claimed the typical form to be more common.[13,14] The authors found that RF therapy in the typical form of the disease results in significantly more successful outcomes (92.2 percent). V3 was the most frequently involved branch (40 pe rcent). Scrivani measured this value to be 38 percent, which is consistent with the authors' findings.[8] On the other hand, Taha and Tew found V2 and V3 to be the most frequently involved branches (40 percent).[10,12]

In the authors' series, TN involved both sides of the face almost equally (61.5 percent on right), which was similar to the findings of Kanpolat (65 percent on right) and Tew (60 percent on right).[7,11] This value was found to be 67.5 percent by Taha.[9]

The success rate in patients with defined trigger zones (74.5 percent) was significantly higher compared to those without trigger zones (25.5 percent). RF was not repeated in 72.3 percent of the cases. This is in line with the findings of Kanpolat (76 percent) and Gusmao (75 percent).[7,15] Scrivani however, measured this value to be 89 percent.[8]

In the authors' study, RF was successful in 78.5 percent of the cases, which is close to the findings of Choudhury (77.7 percent).[9] This value was reported to be 87 percent by Scrivani.[8]

Other modalities have also been employed for TN. Sheehan reported that the use of gamma knife surgery for TN effected pain relief in 44 percent of 151 patients.[16] Erdine's study demonstrated that unlike RF, pulsed RF when used was not an effective method of pain treatment for idiopathic TN.[17] RF is not free of complications, however. The development of dysesthesia is one of the complications following RF therapy. In its most severe state, it appears as anesthesia dolorosa (burning sensation of the face, eyes, or mouth and its management is very difficult); Kanpolat had 0.8 percent, and Scrivani 0.9 percent.[7,8] Fortunately, the authors did not have any cases of anesthesia dolorosa.

In the authors' series, they encountered arterial puncture in 7.7 percent of the cases, while it has been reported to be 0.8 percent and 0 percent by Kanpolat and Scrivani, respectively.[7,8] This may be due to the fact that although the authors used fluoroscopy, in some cases, guiding the needle was difficult. In this complication, the authors aborted the procedure on that day. There was corneal analgesia in 3.1 percent of the patients. This was

reported to be 2.3 percent, and 4.4 percent by Scrivani, and Gusmao, respectively.[8,15]

The absence of corneal reflex is also possible, occasionally resulting in neuroparalytic keratitis, which has the potential to cause blindness.[7] Absence of corneal reflex was not recorded in the authors' series. Kanpolat, Sweet, and Taha, however, reported this to be 1 percent, 5.7 percent, and 6 percent, respectively.[7,14,18,19] The authors did not encounter any cases of neuroparalytic keratitis, and neither did Scrivani and Gusmao.[8,15] Kanpolat, however, reported a 0.13 percent rate.[7] Hypertensive crisis occurred in 3.1 percent of the authors' patients, controversially in 19 percent of the cases in the study of Kanpolat, and none in the studies of Scrivani.[7,8] There were no mortalities. Masseter weakness was not encountered in the authors' study either.

Conclusion

TN was typical in 80 percent, involved V3 in 50 percent, and had trigger zone in 74.5 percent ($p<0.05$). RF was successful in 78.5 percent, and done once in 72.3 percent of the patients ($p<0.05$).

Based on this study, RF is an inexpensive, relatively safe, minimally invasive, and effective method for the treatment for typical TN, especially in patients over the age of 50, which is performed on an outpatient basis and can be repeated if necessary to improve results. Percutaneous radiofrequency thermocoagulation of the trigeminal ganglion, PRTTG, may be regarded as the first interventional treatment choice for most patients with TN because of its relative safety and feasibility.[20] All patients are treated as outpatients. Moreover, in the authors' center, it is less invasive in comparison to other modalities of treatment, does not require hospitalization, is not time consuming to perform (30-60 minutes), and has a low complication rate. ■■■■

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A Resin-Bonded Overcasting With Highly Filled Composite Resin to Salvage a Broken Metal-Ceramic Fixed Partial Denture: A Case Report

HIROSHI SHIMIZU, DDS, PHD, AND YUTAKA TAKAHASHI, DDS, PHD

ABSTRACT A resin-bonded overcasting made of a silver-palladium-copper-gold alloy with highly filled composite resin was fabricated to salvage a broken metal-ceramic fixed partial denture using a metal conditioner, a silane coupling agent, and an adhesive resin luting cement. This resin-bonded overcasting has been functioning satisfactorily for more than nine years without any problems. The longevity of the fixed partial denture was enhanced through the use of this treatment.

AUTHORS

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When a fixed partial denture or a continuous multiple restoration fails due to porcelain fracture, ideally the entire prosthesis should ideally be removed and a new one fabricated. Although replacement is preferred, it may not be possible for some patients due to the cost and the treatment time involved.

The overcasting technique is a useful and practical option that does not require the removal of the existing prosthesis.[1–5] The procedure to fabricate a repair device to be used without removing adjacent existing cast restorations was reported.[6] This article describes the application and a nine-year clinical follow-up of a resin-bonded overcasting restoration to salvage a fixed partial denture with a broken metal-ceramic pontic. This procedure was accomplished using a metal conditioner, a silane coupling agent, and an adhesive resin luting cement.

A Case Report

A 64-year-old woman presented with the chief complaint of poor esthetics

FIGURE 1. Fractured porcelain pontic on the fixed partial denture.

FIGURE 2. Preparation of pontic for an overcasting restoration.

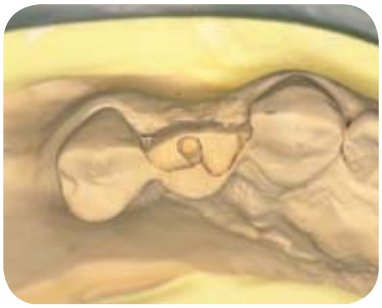

FIGURE 3. Definitive cast.

resulting from a fractured porcelain on a maxillary right fixed partial denture. The broken maxillary right first premolar served as the pontic of the three-unit metal-ceramic fixed partial denture (**FIGURE 1**). Removal of the entire prosthesis and the fabrication of a new one was proposed as the most reliable solution, but she did not accept such a large-scale treatment and preferred a less lengthy procedure. Therefore, restoration of the pontic using an overcasting restoration instead of completely replacing the denture was suggested and she agreed.

The buccal and occlusal surfaces of the pontic were prepared by removing the residual porcelain so that no undercut remained and then placing the overcasting. A diamond rotary instrument with a central pinhole in the occlusal plane was used for mechanical retention (**FIGURE 2**). An impression was made with a silicone elastomeric material (Exafine injection/putty type, GC Corp., Tokyo, Japan), and a definitive cast was prepared (**FIGURE 3**). A wax pattern was fabricated, sprued, and invested using cristobalite mold material. A silver-palladium-copper-gold alloy (Castwell MC 12, GC Corp.) was cast in the mold by means of a centrifugal casting machine. A laboratory processed composite resin material (Cesead II opaque, dentin and enamel, Kuraray Medical Inc., Tokyo, Japan) was applied to the casting in a light-polymerizing unit (UniXS II, Heraeus Kulzer GmbH, Wehrheim, Germany) in accordance with the manufacturer's instructions[7] (**FIGURE 4**).

The overcasting restoration was tried-in, adjusted, and polished. The intaglio surface to be bonded was airborne-particle abraded with 50 µm aluminum oxide particles (Aluminous Powder WA 360, Pana Heraeus Dental Inc., Osaka, Japan) using an airborne-particle abrasion unit (Micro Blaster MB102, Comco Inc., Burbank, Calif.). Immediately before insertion, a metal conditioner (Alloy Primer, Kuraray Medical Inc.) was applied to the intaglio surfaces of the metal part of the overcasting restoration. A silane coupling agent (Porcelain Liner M, Sun Medical Co., Ltd., Moriyama, Japan) was carefully applied to the narrow intaglio surfaces of the indirect composite resin material.

The prepared metal surfaces of the pontic were cleaned with pumice, rinsed, airborne-particle abraded with 50 µm aluminum oxide particles using an intraoral portable airborne-particle abrasion unit (Micro-etcher ERC, Danville Engineering, San Ramon, Calif.). The alloy primer was applied and the overcasting cemented using an adhesive luting agent (Super-Bond C&B Ivory, Sun Medical Co., Ltd.) (**FIGURE 5**). The patient was placed on a maintenance program. The resin-bonded overcasting restoration has been functioning satisfactorily for more than nine years, although the surface of the composite resin has lost its luster, and plaque accumulation has caused gingival inflammation under the pontic (**FIGURE 6**).

Discussion

The overcasting technique was originally designed specifically to avoid the removal of restorations, such as fractured metal-ceramic fixed partial dentures.[1-5] In the present situation, the metal used to fabricate the fixed partial denture was unknown since the denture had not been fabricated in the authors' hospital, whereas the overcasting restoration was made of a silver-palladium-copper-gold alloy with a highly filled indirect composite resin material. There were three kinds of surfaces to be bonded: the metal surface of the prepared pontic, the intaglio surfaces of the metal, and the indirect composite resin material of the overcasting restoration. The alloy primer contained both the thione monomer (VBATDT) to be used for precious alloys and the hydrophobic phosphate monomer (MDP) designed for base metal alloys in methyl methacrylate.[8-12]

Therefore, the use of this metal conditioner was a reasonable choice for this situation because it is applicable to any type of dental alloy. Porcelain Liner M, whose major component is 3-trimethoxysilylpropyl methacrylate in methyl methacrylate, was originally used to repair fractured porcelain facings without removing the prostheses.[13] This silane coupling agent was applied in the present situation to enhance the bond strength between the filler of the indirect composite material and the adhesive luting agent. It may be possible now to use a highly filled all-composite restoration instead of a metal

FIGURE 4. Intaglio surface of the overcasting restoration.

FIGURE 5. Cemented overcasting restoration.

FIGURE 6. Lateral view of fixed partial denture after nine years.

framework with composite resin veneer.

The combination of a small bonding surface area and insufficient retentive features often leads to debonding of resin-bonded fixed prostheses. Therefore, a retentive pin was strategically placed to improve retention in the overcasting restoration.[1,14-16] Consequently, this structure helped prolong the service period of the overcasting.

Conclusion

The overcasting made of a silver-palladium-copper-gold alloy with composite resin veneer using a metal conditioner, a silane coupling agent and an adhesive resin luting cement is one of the treatment options that can be used to repair fractured porcelain on a metal-ceramic fixed partial denture. ■■■■

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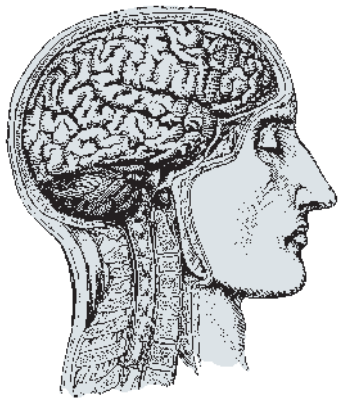

Cranio-Orbital-Temporal Neurofibromatosis With Cerebral Hemiatrophy Presenting as an Intraoral Mass: A Case Report

NIHAL AVCU, DDS, PHD; OZDEN KANSU, DDS, PHD; SERDAR UYSAL, DDS, PHD; AND HILMI KANSU, DDS, PHD

ABSTRACT Neurofibromatosis, NF, is a group of genetic disorders that primarily affect the cell growth of neural tissues. Cranio-orbital-temporal neurofibromatosis is an uncommon subtype of neurofibromatosis characterized by neurofibromas, cranial defects, and specific bone lesions. This case report presents the signs of cranial defects in a 24-year-old Caucasian woman with type 1 NF. Mandibular malformations due to NF and dental defects caused by intraoral masses and radiographic images are presented.

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The term "neurofibromatosis," NF, is used to define a group of genetic disorders that primarily affect the cell growth of neural tissues. There are two forms of NF: neurofibromatosis type 1 (NF1) and neurofibromatosis type 2 (NF2).[1,2] These two forms have few common features and are caused by mutations of different genes.[2] Cranio-orbital-temporal neurofibromatosis (NF-1), also known as von Recklinghausen's disease, is an autosomal dominant inherited disorder that presents with abnormalities of the skin, nervous system, bones and soft tissues.[3,4] It is one of the most frequent human genetic diseases, with a prevalence of one case in 3,000 births, and with no prevalence for gender or race.[5] The neurofibromas are neither circumscribed nor encapsulated, and diffusely infiltrate tissues.[6] The incidence of head and neck involvement ranges from 1 percent to 22 percent.[7]

This case report presents the signs of type 1 NF in a Caucasian woman.

Case Report

A 24-year-old Caucasian woman was referred to the oral diagnosis and radiology clinic with the chief complaint of dental caries and difficulty chewing. She had been diagnosed with cranio-orbital-temporal neurofibromatosis since 1987 and was a regular patient of the ophthalmology and neurology departments. Right ophthalmic enucleation was performed due to orbital neurofi-

broma-related pulsatile exophthalmos in 1994. Reportedly, several reconstructive operations had been performed thereafter to repair the cranial defects. Her family history was positive for neurofibromatosis in both her cousin and grandfather.

Clinical examination revealed facial asymmetry and deviation of the mandible rightward during opening. There were café au lait spots on the chest, and right palatal and retromolar intraoral masses (**FIGURES 1 AND 2**). The lesions were rubber-hard to palpation and painless. Previous biopsies of the ophthalmic enucleation reported NF. The patient did not approve additional biopsies of the intraoral masses.

Panoramic radiographic examination presented a poorly developed right posterior body and condyle of the mandible, enlarged right mandibular foramen, and a hypoplastic right zygomatic arch. The mandibular right second and third molars and maxillary molars were unerupted. The maxillary right second premolar was rotated (**FIGURE 3**). Because of the unerupted teeth, the patient had difficulty in chewing, which confirmed her chief complaint.

In order to evaluate the craniofacial abnormalities, a 3-D craniofacial CT was obtained. The 3-D CT presented hypoplasia in body and condyle of the right mandible and zygomatic arch, and aplasia of the right sphenoid wing (**FIGURES 4 A-B**). A previous MRI of the patient demonstrated right hemiatrophy, enlargement of the right third ventricle. Additionally, there was enhancing and extension of the right temporal lobe into the right infratemporal fossa, maxillary, and enucleated ocular area. Although surgery of the affected sites, including removal of impacted teeth, was offered as a treatment plan, the patient refused to undergo treatment except for caries control that required conservative treatment. Therefore, the patient was scheduled for regular recall examinations.

FIGURE 1. Intraoral mass in the right palatal region.

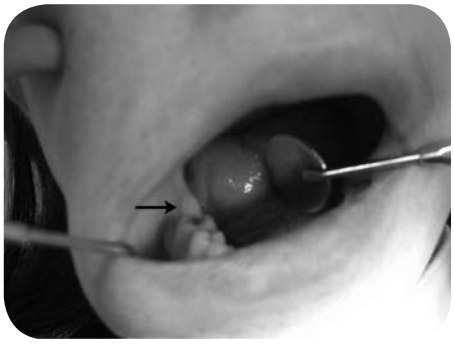

FIGURE 2. Intraoral mass in the right retromolar region.

FIGURE 3. Panoramic radiograph revealing several impacted teeth, enlarged right mandibular foramen, hypoplasic right zygomatic process, and hypoplasic condyle of the right mandible.

Discussion

NF-1, is an autosomal dominant inherited disorder that presents abnormalities of various systems and tissues.[3,4] Despite the advances in molecular diagnostic techniques, the diagnosis of NF is still based on clinical criteria. The National Institute of Health Consensus Development Conference originally established the diagnostic criteria for NF1 and NF2 in 1987.[8] Two or more neurofibromas constitute an important feature of NF1. Additionally, café au lait spots, axillary and inguinal freckling, optic glioma, Lisch nodules, and specific bone lesions are also common clinical features of NF1.[2] At least two of these clinical criteria are required to diagnose NF1.[9] In the present case, both café au lait spots and bone lesions were detected in the patient.

Cranio-orbital-temporal NF is an uncommon subtype of NF-1 characterized by orbital neurofibromas, pulsatile exophthalmos, sphenoid wing dysplasia, expansion of the temporal fossa, and herniation of the temporal lobe into the orbit.[10] Right pulsatile exophthalmos, right sphenoid wing aplasia, expansion of the right temporal fossa and herniation of the temporal lobe into the orbit were also observed. In a majority of NF-1 patients with sphenoid dysplasia (as with the authors' patient), the lateral wall of the orbit is deficient and leads to the decompression of neurofibromatous tissue or retrobulbar fat into the temporal fossa.[11] An increase in overall cerebral volume has been stated to be the reason for changes in the structure of the sphenoid. Abnormal vascularity may be the reason for bone resorption adjacent to orbital fissure.[12]

Skeletal defects such as aplasia, dysplasia, or local bone atrophies may occur as a result of expansive growth of neurofibromas within the medullar cavity.[13] The main features in the craniofacial region include bony craniofacial anomalies such as ethmoid and maxillary hypoplasia, sphenoid bone dysplasia, hypertrophy and atrophy of facial bones, radiolucent bone defects, and widened mandibular canal and mental foramen.[14] In addition, certain malformations of the mandible attributable to NF include deviation of the man-


FIGURES 4A AND B. Three-dimensional craniofacial CT demonstrating multiple cranial deformities.

dible, minimal swelling of the intraoral soft tissue, coronoid notch deformity, pseudoelongation of the coronoid process, deformity of the ramus, flattened or missing gonial angle, deformity or hypoplasia of the body of the mandible, impacted teeth, and hypoplasia of the mandible and zygoma were also determined.[15]

The authors' case is a typical presentation of NF associated with certain malformations of the mandible, including a poorly developed right posterior body and condyle of the mandible, enlarged right mandibular foramen, and a hypoplasic right zygomatic arch was detected. The presence of displaced, impacted, or missing teeth, particularly in the mandible, was recognized as oral manifestations of NF-1.[15]

In the present case, the mandibular right second and third molars and maxillary molars were impacted. In NF1, gingival neurofibroma is uncommon.[1] However, in the authors' case, the gingival masses in the right palatal and retromolar regions were considered as gingival neurofibromatosis, although the patient did not permit confirmation of this finding by biopsy. Presumably, the mandibular right second and third molars and right maxillary molars were unerupted as a result of these lesions. All the soft and hard tissue lesions were on the right side of the patient.

Due to the patient's preference, neither the biopsies nor the surgical resection of the neurofibromas and removal of impacted teeth could be performed. However, since the diagnosis of NF is based on mostly clinical criteria, the clinical findings of the patient were deemed valid for the definitive diagnosis.[9]

Cranio-orbital-temporal NF, together with cerebral atrophy, has not been described previously and these pathologies were not limited to cranium. Progressive prolapse of cranio-orbital-temporal NF may cause facial deformities. Therefore, malformations of the facial skeleton in NF have to be carefully investigated for the existence of tumors adjacent to the bone in order to determine or exclude their dependence on neoplastic soft tissue. The tumor mass may probably not be directly associated with the severity of facial skeletal malformations, jaw malformations, or tooth aberrations.[13] Thus, even a slight facial asymmetry or intraoral mass caused by a NF could be associated with several mandibular malformations and dental aberrations. These concepts may have significant implications for the necessity for treatment.

Because the diagnosis of NF is based on clinical criteria, such as intraoral mass or missing teeth, and radiographic signs should be interpreted with caution, it is important that clinicians consider this disease when oral lesions characteristic of NF1 are present. These patients must be followed in the long term because of eventual complications, including malignant transformation.[9] ■■■■

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Smile! You're on YouTube

The intraoral camera was an essential tool in every dentist's office even though many patients, if given the option, would rather see reruns of *I Love Lucy*.

Robert E. Horseman, DDS

ILLUSTRATION BY CHARLIE O. HAYWARD

"Eight thousand, nothing down, five years to pay," purred the salesman, his being suffused in the faux bonhomie requisite in such enterprises.

"Great! Where do I sign?" I exulted, my cheeks stimulated to a healthy glow. I couldn't believe it, at last, I was the owner — me and Usuers Fidelity — of an intraoral camera. Never was a dental toy mated with a penultimate pigeon so incontestably. From the moment I had witnessed a tooth 30 times life-size on the screen several years earlier and had imbibed heavily of the catnip dispensed by the demonstrator, I knew I had to have one.

Four years later, my intraoral camera had lost little of its luster, despite the fact that it was now patently obsolete and I still owed $5,315 at 21 percent interest on it. Never mind, I was still smitten with the concept, determined that every patient be swept up in my belief that bigger is always better.

As I enthusiastically displayed Mrs. Grobnick's current dental tragedy on the screen for her education, she wavered uncertainly between apathy and aversion.

"What in tarnation we looking at?" she asked with ill-concealed excitement verging on hysteria.

"That's your broken tooth. Isn't that terrific? Look at the fractured edges and the bleeding gum tissue," I pointed out with a gloved finger.

"Gaaack! You mind turning it off?" she shuddered as if she had just spied a roach in her parfait.

A few years later, the intraoral camera was an essential tool in every dentist's office even though many patients, if given the option, would rather see reruns of *I Love Lucy*. Apparently the Nielsen rating for tooth video is lower than initially thought.

Not to worry, coming up rapidly on the inside track was a new toy with a greater potential for patient acceptance. It was the dental Web site, offering an opportunity to extol the virtues of your practice with pictures and as much purple prose as you can legally generate. It was the Yellow Pages with color. Showcase your entire staff

CONTINUES ON 137

DR. BOB, CONTINUED FROM 138

displaying their veneers in a buoyantly friendly manner above profiles delineating their education and experience. The office is shown in its best light with any threatening equipment in deep shadow.

There is a complete description of the practice location, MasterCard, Visa, and American Express logos tastefully displayed alongside other soothing statements to attract the most timid procrastinator. "We Care!" is the standard recommended slogan, one that immediately places you comfortably above all those callous dentists who won't commit to that extent.

Only one problem. At last count there were 619,474,716 Web sites on the Internet. Your site, no matter how cleverly and sincerely executed, would stand out like a midget at a major rock concert. Other than your family and maybe a couple of friends who can be cozened into visiting your Web site at least once out of obligation or curiosity, you are faced with handing out printed fliers and accosting total strangers to avail themselves of your expertise.

Again, don't worry. Most everybody whoever considered doing the Internet thing has already done it and is no longer waiting for massive hits. You can move on freely to the latest marketing ploy.

Founded in August 2003, a phenomenon known as MySpace burst on the Net, immediately attracted millions of twittering adolescents who shared pictures and vied with each other for new depths of human vacuity. The main activity seemed to be a race to claim as many "friends" as possible. A friend was defined as anybody living on the planet whether known to you or not. Interesting as it was, a dentist trying to promote his practice via this fevered activity would be playing to an empty house.

Dentistry's chance to make new friends didn't occur until early 2003 about the time of the MySpace debut when three guys named Chad Hurley, Steve Chen, and Jawed Karims floated the domain name YouTube.com to a waiting world. It was an open invitation to everyone who owned a video camera to upload their inane, boring, out-of-focus videos to share. Millions did and some of them were actually pretty good, but you had to click on a lot of frogs to find a prince.

Eventually dental marketing mavens claimed YouTube to be the newest and most riveting thing to attract patients since the discovery of local anesthesia. An enthusiastic promoter of the new medium is Dr. Jerry Gordon, a dentist in Bensalem, Penn. Gordon is the director and star of the video "Root Canal Demonstration," a title guaranteed to attract thousands of avid viewers to this popular genre. The production runs 10 minutes, cost a couple thousand to produce, and attracted more than 11,000 root canal fans during its first two months.

They are rewarded by a soothing voiceover by Dr. Gordon endeavoring to reverse the public's commonly held belief that root canal therapy was an integral feature of the Spanish Inquisition. He describes each step minutely and the viewer is reassured by the remarkably calm patient. There will always be the odd Doubting Thomas who will insist this is actually a postmortem of some sort, but that's showbiz.

Predictably, the success of video root canal therapy for public viewing will be followed by gum surgery in high-definition color, impacted lower third molar extractions, and the heartwarming treatment of intractable children under the age of 4.

Aside from the obvious marketing value to the innovative dentist, a patient wishing to see himself star in his own operation may click on YouTube and enjoy what he missed while sedated. Can 3-D color with those little paper glasses be far behind? ■■■■