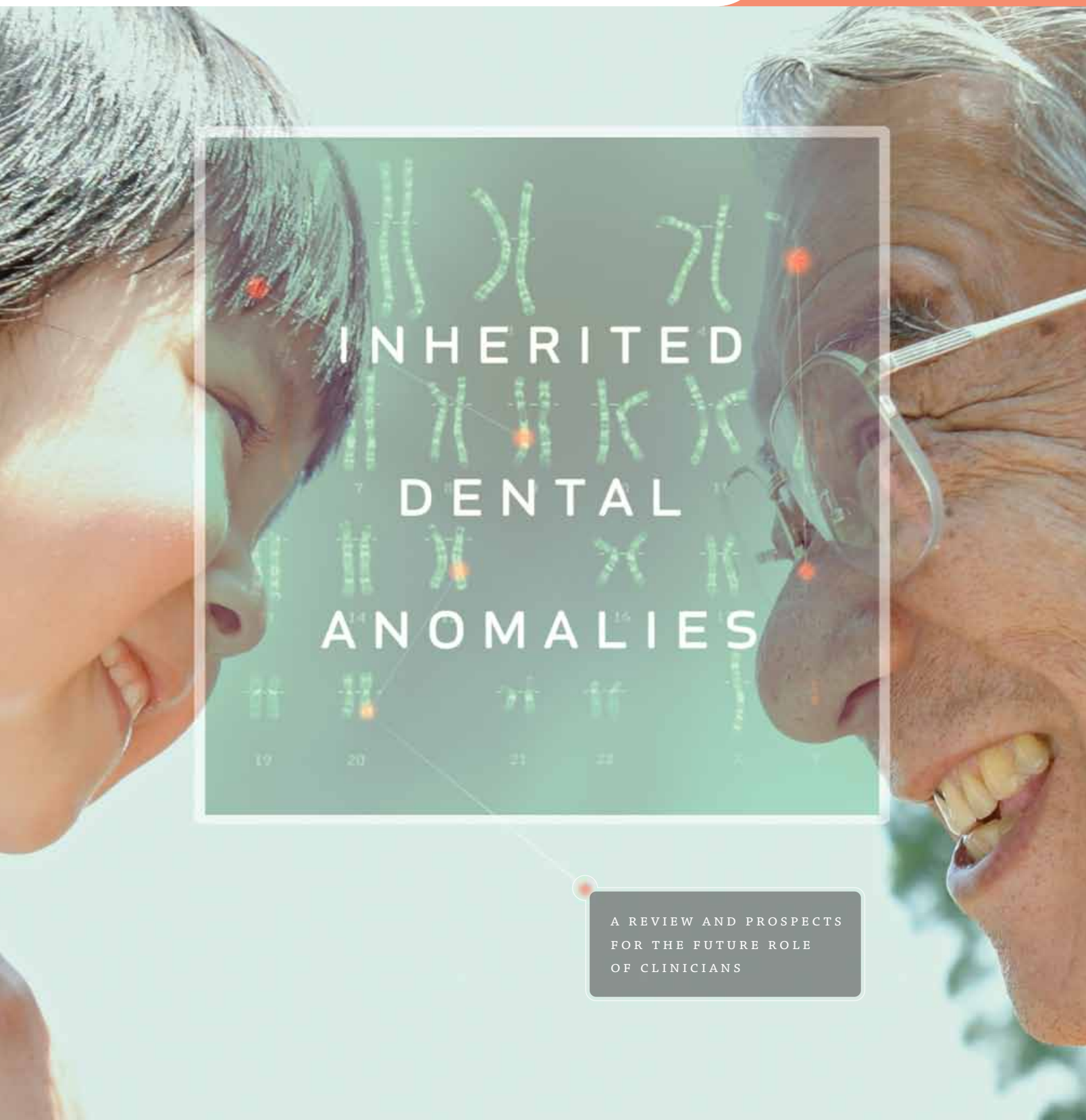
OF THE CALIFORNIA DENTAL ASSOCIATION

Journal

MAY 2007



INHERITED DENTAL ANOMALIES

A REVIEW AND PROSPECTS FOR THE FUTURE ROLE OF CLINICIANS

OF THE CALIFORNIA DENTAL ASSOCIATION
Journal
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DEPARTMENTS

FEATURES

CDA JOURNAL, VOL 35, Nº5

Virtuosity in Dentistry: Flourishing or Vanishing?

STEVEN A. GOLD, DDS

One can look up the definition of virtuoso in the dictionary. Yet, a personal experience provides a deeper and richer meaning. Probably most of us have seen a virtuoso perform and I, too, was fortunate to experience a virtuoso recently. I heard a cellist at a holiday program last year. A colleague who knew her and arranged for her performance said that her talent was comparable to that of Yo-Yo Ma. And to these classically untrained ears (undoubtedly slightly damaged by a few too many heavy metal and punk rock concerts) it was. Accompanying her on piano was the featured guest of the day — a music professor at a prominent university and an accomplished performer in his own right. As they moved through their program, it became apparent they were different. While he complained about the height of his bench, the tuning of the piano and a few other details, she quietly adjusted her instrument height and settled into one of those hotel chairs that is barely comfortable for sitting, let alone serving as the foundation of a master's performance. He played with intensity, she played effortlessly. He commanded the performance, she was the star. She was a virtuoso, he was not.

Later on, she said her dentist practiced dentistry like she played the cello. At that moment I realized that dentistry, like music, is a performance and the profession of dentistry has its own virtuosos.

At that moment I realized that dentistry, like music, is a performance and the profession of dentistry has its own virtuosos.

Some are well-known, cherished, and adored by our ranks while others practice their art every day with little recognition from others. What exactly is it that makes up this intriguing character in dentistry, the true virtuoso?

In no particular importance of order, the virtuoso first is someone who makes sacrifices for their art. The primary sacrifice is time. Being a virtuoso takes considerable time practicing, evaluating, reflecting on, and honing one's skill. Necessarily, other activities, even in the most well-balanced lives, must be foregone. Next, a virtuoso is never satisfied with his or her current level of performance. As a result, they place considerable value on constantly improving their skills. They continually educate themselves and practice their craft. Third, they recognize they have a certain level of natural, God-given talent; and they nurture this talent so that it does not go to waste. A virtuoso utilizes this talent toward achieving the best performance each and every time. They possess confidence, yet, not arrogance. Consequently, they inspire us rather than threaten us. This confidence allows them to perform at the high level they do and remain relaxed and composed even when conditions in their surroundings are not perfect. If you watch a virtuoso perform, they will appear to be doing so, like the cellist, effortlessly and even with noticeable enjoyment. In fact, the overriding force that motivates the virtuoso in practice or performance is that they love what they do with a passion.

So where do we find these individuals in dentistry? Some obviously record their clinical performances, package them onto PowerPoint presentations and go on tour. We see them when we attend continuing education lectures. Occasionally, virtuosos make their home in the academic environment and are thus likely to share their performances with students as well. This is particularly encouraging because a student is likely to be positively influenced by the virtuoso and may likely want to emulate him or her. Virtuosos can also be found in private practice choosing not to lecture but rather to devote the full expression of their performance to their patients. Their reputation is known by fewer individuals, but the work they do is

CDA JOURNAL, VOL 35, Nº5

no less spectacular. Most of us can think of some who practice in our communities. Virtuosos are good for dentistry. They raise the standard of care, and they inspire the rest of us to constantly elevate our own performances.

But sadly, virtuosos are not flourishing in dentistry. In fact, their relative numbers are declining. Why is this so? The biggest reason may be that being a virtuoso does not necessarily pay better. In fact, one's income can always be increased by cutting corners in practice, corners the virtuoso can never afford to cut. Others, who have the potential to rise to the level of a virtuoso, may feel it is too difficult or even impossible for them to do so. They simply do not believe they have the drive or the aforementioned God-given talent. But these individuals merely lack confidence in themselves. The reality is that most of us do have the potential for greatness. We would not be able to withstand the rigors of dental education and clinical practice if we did not. Furthermore, clinical skills involve nothing more than a repeated set of actions that require as much tenacity as brainpower. About achieving a great performance, Johann Sebastian Bach said it best: "There is nothing to it. You only have to hit the right notes at the right time and the instrument plays itself."

So before the true dental virtuoso becomes an extinct species, all dentists should take time to nurture both their own skills and those of other practitioners and students. We should take solemn pride in the feeling that comes only from giving our best and achieving the highest level of clinical performance possible. We should begin now. The audience is waiting. ■■■■

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

CDA JOURNAL, VOL 35, Nº5

Dan Hubig

Engineering Methods May Work in Dentistry and Medicine

The same approach to building engines may soon be applied by a dentist or physician to assess whether that stress fracture or cracked tooth requires attention.

"People have tiny cracks in their tooth enamel and bone structure all the time; it's pretty routine," said Jamie Kruzic, assistant professor of mechanical engineering at Oregon State University. "And in engineering, we've been using specialized methods for decades to help us understand things like metal fatigue, the cracks or failures that can develop after repeated, high stress movement of certain components. We believe those findings can be used in medicine, because the stresses and material behavior are fairly similar."

CONTINUES ON 318

Cosmedent Complete →

Cosmedent introduces Complete, an advanced bonding adhesive. As an advanced system, Complete can be used for all light-cure, dual-cure and self-cure restorations. Cosmedent's Complete does not employ self-etching primers, which have proven to be less effective than the acid-etch technique.

Complete maximizes bond strength, is easy to use, has minimal film thickness and virtually zero sensitivity. The components of the Complete Kit are a light-cure primer/unfilled resin, a dual-cure catalyst, and a light-cure unfilled resin. For more information regarding Complete, call 800-621-6729 or visit www.cosmedent.com.

Lights … Camera … New Tool for Caries Early Detection

The University of Texas Health Science Center at San Antonio, the University of Iowa, and Indiana University are studying a new tool for the early detection of tooth decay. Supported by a grant from the National Institute of Dental and Craniofacial Research, the Quantitative Light-induced Fluorescence is a small, portable camera that utilizes a blue light to illuminate the teeth and captures images with a yellow filter. QLF may be the ultimate detector of early caries; the fluorescent lighting is directly related to enamel's mineral content, and lesions can be identified before they progress enough to require invasive dental treatment.

The fluorescence of the light shows decay as dark spots, and a dental mirror on the camera provides uniform light to the area to be recorded. The camera is connected to a computer with software allowing storage and display of the images. While detection of early caries visually or radiographically is extremely difficult, researchers believe dentists will be able to use QLF to detect carious lesions early enough to intervene with noninvasive procedures such as sealants or fluoride. Research continues on this novel, new diagnostic tool.

CDA JOURNAL, VOL 35, Nº5

Smoking Can Harm the Integrity of Dental Implants

Smokers with dental implants have a higher rate of failure than their nonsmoking counterparts, researchers said in a recent issue of the *Journal of Periodontology*.

Researchers from the University of Murcia in Spain found that smoking is a risk factor with regard to tooth loss and dental implant failure.

"People who smoke are at a greater risk of infection following surgery, and may heal more slowly," said Dr. Arturo Sanchez Perez, Department of Periodontology at the University of Murcia. "When an implant is placed in a smoker, it is more likely to fail. This means a patient's smile may be negatively affected, and the potential for more bone loss in the areas surrounding the gums and teeth."

Smoking negatively impacts the blood flow to the bone and tissues surrounding the gums and teeth, impairing bone healing. Implant failure occurs because of the inability to integrate with the surrounding bone tissues. Over five years, the study followed 66 patients who received 165 implants. Researchers found that 15.8 percent of implants failed in smokers, compared to 1.4 percent of implants in nonsmokers.

"Tobacco use has been shown to be a risk factor for periodontal diseases, which is the main cause of tooth loss in adults," said Preston D. Miller, DDS, president of the American Academy of Periodontology. "This research shows that if you want your dental implant to last, you should not smoke. Also, the treating dentist should make sure their patients are aware of this before placing an implant, and emphasize the importance of quitting smoking."

"Each issue will deliver information and resources that are difficult to find in general media."

DONNA LIGDA

Newsletter for Patients with Bleeding Disorders

Factor Health Management, a leading provider of personalized health care for bleeding disorders, has developed *The Prophy Dose*, which offers industry news and developments, both on a regional and national scale, for those with the condition.

"Each issue will deliver information and resources that are difficult to find in general media," said Donna Ligda, Factor Health Management president, of the quarterly newsletter. "We are making it available online, but also in a print edition for those people who may not have Internet access. In general, the newsletter is a vehicle for people to stay better informed and better prepared for the future."

The content covers new patient services, legislative issues, the latest developments in research and trials, manufacturer news and milestones, and resources for medical advisories, for example. It also includes a special section for children's news and events, and local area chapter news.

Factor Health Management provides health care and resources for comprehensive services in individualized care plans, specialty pharmacy, benefits coordination, education and philanthropic support. Subscription to *The Prophy Dose* is free and available by contacting Christy Argo at cargo@factorspecialists.com or 443-334-1300, ext. 305.

UPCOMING MEETINGS

2007	
May 3-6	CDA Spring Scientific Session, Anaheim, 800-CDA-SMILE (232-7645), cda.org.
May 15-19	American Academy of Cosmetic Dentistry 23rd Annual Scientific Session, Atlanta, 800-543-9220.
June 27-July 1	Academy of General Dentistry Annual Session, San Diego Convention Center, 888-243-3368.
Aug. 22-24	International Society for Breath Odor Research Seventh International Conference, Chicago, Bill Bike, billbike@uic.edu or 312-996-8495.
Sept. 27-30	American Dental Association 148th Annual Session, San Francisco, ada.org.
Nov. 27-Dec. 1	American Academy of Oral and Maxillofacial Radiology 58th Annual Session, Chicago, aaomr.org.
2008	
May 1-4	CDA Spring Scientific Session, Anaheim, 800-CDA-SMILE (232-7645), cda.org.
Sept. 12-14	CDA Fall Scientific Session, San Francisco, 800-CDA-SMILE (232-7645), cda.org.
Oct. 16-19	American Dental Association 149th Annual Session, San Antonio, Texas, ada.org.

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

Neks Technologies DetecTar Mini

Neks Technologies Inc., a company specializing in developing and manufacturing innovative dental products, announced the launch of DetecTar mini, the first intelligent diagnostic aid to assist clinicians in the accurate detection of subgingival calculus. The DetecTar mini helps dentists, hygienists, and periodontists to locate and diagnose calculus in a minimally invasive manner.

Based on state-of-the-art light emitting diode and fiber optic technologies, the DetecTar mini detects up to three times more calculus than traditional periodontal probes and has been shown to reduce overdetection by 64 percent. For more information, call 800-873-7683.

Could Lack of ZZZZZZZZZZZs Be Detrimental to Teens' Health?

A professor and a sleep researcher at Harvard Medical School have found that students need plenty of shut-eye because a growth hormone is secreted during sleep. If the youngsters don't sleep enough, their bodies may use calories less efficiently and they may be prone to shorter attention spans.

"When you don't get the hours of sleep your body needs, the hormone ghrelin increases, and studies show it causes you to want to eat more food, especially high-carb foods," said Cherie Calbom, MS, a nutritionist and author of the new book, *Sleep Away the Pounds*.

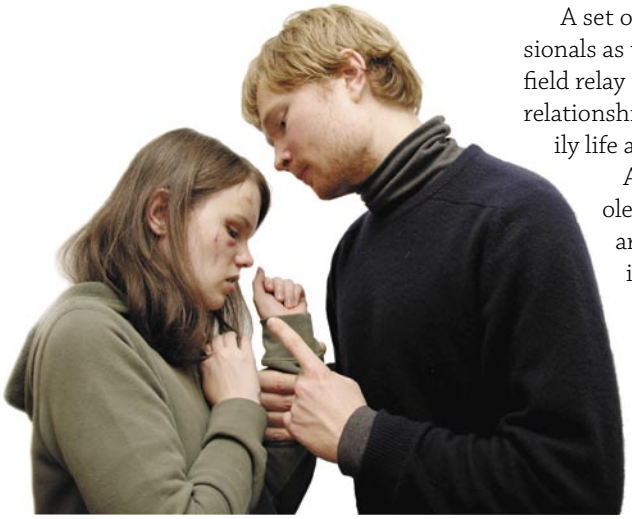
"In addition, the hormone leptin that controls the appetite goes down. This can cause intense hunger sensations," she said. "One study found that participants with the biggest fluctuation of hormones craved the most fattening foods such as ice cream, cakes, candy, and salty snacks like potato chips." So all this time the inability to conquer cravings or binge eat that has been attributed to one's lack of willpower may really be a hormonal imbalance.

Calbom, and her husband, John Calbom, MA, a behavioral medicine therapist, showed how lack of sleep can cause weight gain and affects the efficient use of calories in their book *Sleep Away the Pounds*.

An estimated one-third of the nation's population snoozes 6.5 or fewer hours nightly, far less than the eight hours many sleep specialists recommended for adults. According to one physician, the number of overtired patients he has seen has soared in the past 25 years since he has been in practice due to families trying "to squeeze 28 hours of living into 24."

All this time the inability to conquer cravings or binge eat that has been attributed to one's lack of willpower may really be a hormonal imbalance.

Safety Cards Show Patients How Unhealthy Relationships Affect Health, Kids



A set of cards may help dental professionals as well as those in the health care field relay to their patients that violent relationships can take a toll on their family life and health.

Available free from the Family Violence Prevention Fund, the cards are discreet and can be placed in exam rooms, waiting rooms, and bathrooms. Information includes safety, safety planning, and specific health problems that can result from the chronic stress that comes with an abusive relationship. The cards also offer women who are in abusive relationships guidance on how to talk with their children, and tips for protecting themselves.

"Health care providers can do so much to help victims of violence when they seek routine or emergency care of all kinds," said Debbie Lee, Family Violence Prevention Fund managing director for health. "We are making it easy to help by giving providers safety cards to place in waiting areas, exam rooms or restrooms — or give directly to patients. Perhaps most importantly, health care providers who distribute these patient safety cards are sending a powerful message that women facing violence are not alone, and that help is available."

In 2004, there were more than 625,000 intimate partner victimizations and, on average, more than three women a day were murdered by their husbands or boyfriends, according to the Bureau of Justice Statistics. Health care costs of intimate partner rape, physical assault and stalking totals $5.8 billion each year, nearly $4.1 billion of which is for direct medical and mental health care services, reported the Centers for Disease Control and Prevention.

Free materials and resources, including assessment guidelines, are available to providers; call 888-RX-ABUSE or go to the Web site www.endabuse.org/health.

To be nobody-but-yourself —
in a world which is doing
its best, night and day,
to make you everybody else —
means to fight the hardest
battle which any human being
can fight; and never stop fighting.

E.E. CUMMINGS

Gobbling Up Technology

What it may lack in flavor, it appears to make up in innovation. The SmartPill, a tiny diagnostic capsule, has been developed, according to an article in the January-March issue of the *Journal of the Philadelphia County Dental Society*.

The small capsule contains minute diagnostic hardware to monitor pH, pressure, and the hardware's progression through the digestive tract. It currently is used exclusively to diagnose gastroparesis, a condition in which the stomach empties slowly. The $500 device, which is disposable, won FDA approval in 2006.

The SmartPill travels through the body, sending signals to a wireless receiver worn around the patient's neck. After a couple of days, when the capsule is passed from the body, the patient brings the receiver back to the doctor's office, where the data is downloaded and analyzed. There is no need to retrieve the capsule.

The current and most common method for diagnosing gastroparesis is a nuclear medicine test, which requires a patient to eat a meal laced with a small amount of radioactive material and stay at a hospital while the food's progress is monitored.

Honors and Awards

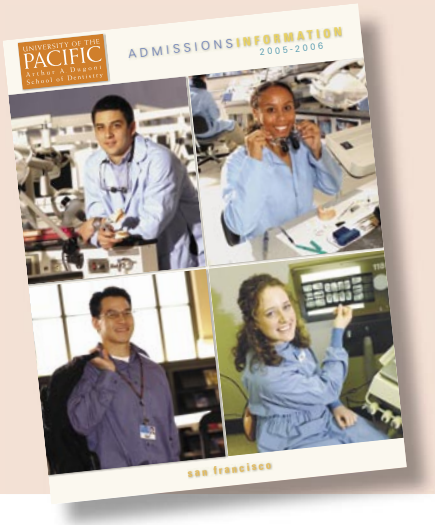
The Council for Advancement and Support of Education District VII honored the **University of the Pacific, Arthur A. Dugoni School of Dentistry** with its 2006 Silver Medal Award for Photography Series during the organization's annual conference at the Millennium Biltmore Hotel in Los Angeles on Dec. 8.

CASE District VII's Awards of Excellence honor educational institutions in the Western United States — Arizona, California, Hawaii, Nevada and Utah — for innovative and effective programs in alumni relations, advancement services, communications, marketing and fundraising. Judges in the Photography Series category selected the dental school's admissions brochure to receive a silver medal for its quality and creativity, and for successfully meeting the institution's goals.

Carol Gomez Summerhays, DDS

Joan Yokom, director of the division of design and photo services, credits Pacific photographer **Jon Draper** for his unique perspective in creating the photos for the brochure. Draper has a master of fine arts degree from the prestigious Cranbrook Academy of Art and has worked at the dental school for 15 years.

Carol Gomez Summerhays, DDS, was recently honored with the Academy of General Dentistry's Lifelong Learning and Service Recognition Award. Summerhays completed 1,600 hours of continuing education in the 16 disciplines of dentistry, including 550 hours solely to hands-on techniques and skills, as well as donating more than 100 hours of service to the community to receive this recognition. She currently is vice president of the California Dental Association.



Cosmedent KWIK Tray Adhesive →

For dentists who are tired of waiting for their tray adhesive to dry, Cosmedent introduces KWIK, a fast-drying tray adhesive that dries in less than a minute. When it dries, the material is nonsticky, yet has formed a tenacious bond to the impression material to ensure an accurate impression. KWIK Tray Adhesive is for use with addition silicon materials only. For more information regarding KWIK, call 800-621-6729 or visit www.cosmedent.com.

Kellogg, ADA Management Program Accepting Registration

The American Dental Association and Northwestern University's Kellogg School of Management have announced the opening of registration for the ADA/Kellogg Executive Management Program for Dentists.

The executive program is specially designed for dentists seeking to broaden their management knowledge from one of the nation's premier business schools.

With content based on the core curriculum of matriculating Kellogg MBA students, study areas include business strategy, organizational leadership, marketing, finance, accounting, economics, quantitative methods, and information systems. The deadline to register is May 31.

Offered jointly for the third consecutive year, the program consists of three sessions conducted at Northwestern's Chicago campus. The sessions, separated by seven-week intervals, are set for July 20-25, September 15-20, and November 1-5. Upon completion, participants receive a Northwestern University Kellogg School of Management certificate and continuing education hours.

Class size is limited. Application materials and the program details are available at http://www.ada.org/goto/kellogg or by contacting Connie Paslaski at paslaskic@ada.org or 312-440-3541.

LEADER, CONTINUED FROM 313

Bioengineers at OSU say there is promise that "Kitagawa-Takahashi diagrams," a long-time method used for helping to explain whether or not a tiny crack is going to eventually cause catastrophic failure, may have applications in medicine.

In the *Journal of Biomedical Materials Research*, Kruzic and colleagues at the University of California, Berkeley, outlined how engineering concepts may be relevant to the human anatomy.

"When we can tell a dentist exactly what type of tooth crack is most apt to get worse and needs preventive treatment, and which doesn't, that could improve patient care and save money," Kruzic said. "We have 3-D imaging of teeth that is being improved every year. We could utilize these tools better in dentistry and orthopedics if we understood what the images were telling us."

Researchers looked at initial crack sizes in bones and teeth, and are trying to develop predictive tools about which ones will grow and which will be innocuous. Engineers already do this with some accuracy when it comes to building or maintaining the engine of a jet airplane, but when it comes to human health, the science is still in its infancy.

"This work still has a ways to go before we can make definitive predictions for medicine," Kruzic said. "But in theory it should work, and it will be an exciting advance."

Study of Innovative Coating May Help Stem Plaque Growth

The coating is made from a calcium phosphate base that releases zinc — a frequent ingredient in toothpaste and mouthwash — onto braces and surrounding teeth.

Early tests on a new coating for orthodontic brackets and wires suggest it could inhibit plaque growth and decalcification common in patients wearing fixed appliances without decreasing the bond strength between brackets and teeth.

Researchers at New York University College of Dentistry have observed minimal plaque and calculus formation on teeth surrounding the coated braces and no significant difference in bond strength between coated and uncoated braces during their two-year in vitro study. The coating is made from a calcium phosphate base that releases zinc — a frequent ingredient in toothpaste and mouthwash — onto braces and surrounding teeth. Zinc inhibits the growth of acid-producing bacteria that demineralize teeth and minimizes dental calculus formation.

The coating, which would not require approval by the Federal Drug Administration, would not be expensive to produce and could be available to market pending patent approval and further testing in patients.

It is believed this is the first time that such a calcium phosphate coating has been studied. Efforts to stem plaque and calculus formation in orthodontic patients with other methods, such as applying fluoride-releasing tooth varnishes or performing laser therapy around brackets, have had limited success and have diminished bond strength in some cases.

CDA JOURNAL, VOL 35, Nº5

Treating Asthmatic Patients: The Facts

Once a quarter, the *Journal* will feature 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 which everyone can apply to their practice.

Previously, these types of case studies were featured in *Liability Lifeline*, a quarterly newsletter from TDIC's Risk Management department. For your convenience, these articles have been incorporated into the *Journal* format.

According to the American Lung Association, "an estimated 29.8 million Americans have been diagnosed with asthma by a health professional." With so many people suffering from asthma, it stands to reason that oral and maxillofacial surgeons see a number of asthmatic patients in their practices.

Different stimuli may trigger asthma attacks including:

- Respiratory infections, colds;
- Cigarette smoke;
- Allergic reactions (either seasonal or other substances or materials);
- Vigorous exercise;
- Exposure to cold air or sudden temperature change; and
- Excitement/stress/anxiety.

Many patients are anxious about visiting their dentist. While anxiety does not cause asthma, the body's response to the stress can trigger an attack in an asthmatic patient. Reducing stress during the dental appointment can help decrease the chance of an attack. The use of nitrous oxide or conscious sedation may also prove helpful for the asthmatic patient. However, the use of barbiturates and narcotics may predispose a patient to an attack; therefore, it is advisable to avoid premedicating with these types of drugs. Aspirin and penicillin have also been known to precipitate an attack. If there are specific allergens known to cause an attack, attempt to eliminate or minimize these elements when treating asthmatic patients. Allergens such as dentifrices, fissure sealants, tooth enamel dust, methyl methacrylate, fluoride trays, and cotton rolls have been known to trigger attacks.

Asthmatic patients have a tendency to be mouth breathers which, when combined with asthma medications, cause dry mouth. The decrease in saliva causes asthmatic patients to have a higher risk for caries as well as bad breath. In the November/December 2002 issue of *General Dentistry*, John M. Coke, DDS, explained, "that asthma inhalers may irritate the back roof of the mouth, causing a reddish lesion, which creates an opportunistic infection that, if ignored, can spread and affect the throat and the rest of the mouth." Be sure to talk to patients about the importance of vigilant brushing and flossing to prevent gum disease, and consider placing them on a more frequent recall, as well as ensuring the patient is using fluoride.

Because more people are suffering from asthma now than in the past, it is important for dentists to be prepared in the event a patient has an asthma attack in the office.

Case Study

THERE IS NO SUCH THING AS TOO MANY QUESTIONS

An orthodontist referred his asthmatic 16-year-old male patient to an oral and maxillofacial surgeon for the extraction of deciduous teeth. The patient's mother filled out the health history form and

indicated her son had asthma and was currently taking albuterol. While reviewing the health history with the patient and his mother, the surgeon asked the patient how often he used his inhaler and whether he had ever been treated for asthma in the hospital. They both responded that he used his inhaler as needed and had never been hospitalized.

After taking radiographs, he showed them to the patient and his mother. He explained since there was very little root structure remaining, the teeth would come out very easily. The mother told him that her son was very nervous about the extractions and asked what could be done to minimize his stress. Although the extractions would likely take only five minutes, the surgeon recommended general anesthesia. The patient was relieved he would be able to sleep through the extractions. After deciding to use general anesthesia, the surgeon gave the mother the anesthesia preoperative instructions.

The patient arrived for his appointment with his parents. The surgeon asked the parents if they had any questions, which they did not. He explained the procedure would be completed quickly and they could see their son as soon as he started to wake up.

The extractions were completed without incident. While in recovery, he answered questions and followed verbal commands. Within five minutes, he began coughing. The assistant instructed him to continue coughing. He began to show signs of difficulty catching his breath. The assistant immediately placed an oxygen mask on the patient and called for the surgeon. He administered two puffs of albuterol, but his oxygen level continued to drop. He became unconscious and stopped breathing. The surgeon administered Narcan and succinylcholine and placed a size 8 ET tube. He was able to get oxygen into his lungs.

Even though the mother signed an informed consent form for the use of general anesthesia, there was no indication the surgeon discussed the alternatives to general anesthesia.

He instructed the front office person to call 911 while he monitored the patient.

The emergency room doctor noted a slight pulse when he arrived at the hospital, but he remained in a coma for 10 days. The hospital released him three weeks later. The parents initiated a lawsuit against the surgeon for the negligent treatment of their son.

What can be learned from this case?

During the discovery phase of the lawsuit, both the defense and plaintiff attorneys noted that even though the mother signed an informed consent form for the use of general anesthesia, there was no indication the surgeon discussed the alternatives to general anesthesia. The surgeon stated he recommended general anesthesia because of the patient's anxiety about the procedure. He did not discuss alternatives believing the orthodontist had already done so. He assumed the orthodontist referred them to his practice because he offers general anesthesia. When asked if he would have chosen general anesthesia knowing the patient suffered severe asthma, the surgeon answered he likely would have chosen local anesthetic.

The patient's radiographs indicated that two of the teeth extracted had no root structure and the third had very little. The plaintiff's attorney pressed the surgeon for the reason for using general anesthesia since the extractions were fairly simple. The surgeon repeated the mother's concern for her son's anxiety.

TIP

Informed consent is a discussion with the patient about the recommended treatment, risks of treatment, benefits of the treatment, and the alternatives to treatment. Give all information necessary for the patient to make an "informed decision." The surgeon in this case explained the risks of general anesthesia but did not discuss the alternatives. During questioning, the patient's mother indicated she would have agreed to local anesthetic if she had been given that option.

The plaintiff's attorney also questioned the completed health history form. The mother indicated her son had asthma and was taking albuterol. When the surgeon asked the mother how often her son used his inhaler, she said "as needed." The surgeon even made note of this on the form. The plaintiff's attorney asked how he defined "as needed." The surgeon assumed it was infrequent. In fact, the mother told her attorney her son was using the inhaler every four hours for the two weeks prior to his hospitalization. The mother also told the attorney her son used a peak flow meter to monitor his breathing at home. The surgeon acknowledged having this information prior to treatment would have been important.

Both the patient and his mother also said he had not been hospitalized. The plaintiff's attorney asked the surgeon if he was aware that he had gone to the emergency room regularly over the past three months for his asthma. The surgeon was unaware of this because he only asked about hospitalizations not visits to the emergency room. When the plaintiff's attorney asked why he did not inquire about emergency room visits, the surgeon said he believed the mother should have offered that information when he was asking about hospitalizations.

CDA JOURNAL, VOL 35, Nº5

TIP

The health history form assists dentists in determining whether a patient has a medical condition or is taking medications that might impact dental treatment. It is important for dentists to review not only the updated health history but also to ask the patient about any areas of concern or unanswered questions. Until they are questioned specifically, many patients may not understand how their overall health or medications they are taking may affect dental treatment.

Having accurate and up-to-date health history information is the first step in determining the degree to which patients suffer from asthma and the possible severity of their condition. Collecting data during the health history discussion can assist in preventing asthma attacks from occurring in the office. Failing to review thoroughly the health history may have serious consequences should an attack occur in the office. When patients indicate they suffer from asthma, follow up with questions such as:

- How frequent are your attacks?
- What precipitates your attacks?
- What is the severity of your attacks?
- How are your attacks best managed?
- What medications are you currently taking?
- When was your last attack?
- Have you ever been to the emergency room or admitted into the hospital for an attack?
- Do you carry your inhaler with you?
- Do you use a peak flow meter?

When patients indicate they suffer frequent attacks or you believe their asthma is severe, contact their physician and discuss possible precautionary measures to prevent an attack during dental treatment. Discuss the best way to treat them should they experience an attack while in your office. Be sure to document the discussion and the physician's recommendations in the patient's chart.

While the surgeon reviewed the form with the mother and the patient, he failed to investigate further some of their vague responses. Had he questioned them more, he would have learned that the patient was not in control of his asthma, warranting a call to his treating physician.

The Outcome

Both parties agreed to mediation. There was strong evidence that the mother did not offer enough information to the surgeon. Had all the information been given to him, he likely would have made an alternate treatment recommendation. His failure to question the mother further about her son's asthma would play a larger part in the eyes of the jury. The mediator told the surgeon that at trial, the plaintiff's attorney would likely enlarge the radiographs for the jury to get a clear picture of how simple the extractions were and then ask him why he chose general anesthesia over local. He would then question why he did not inform the mother of all the anesthesia options for her son. During mediation, the parties eventually reached a settlement. ■■■■

— ROBYN THOMASON
TDIC RISK MANAGEMENT ANALYST

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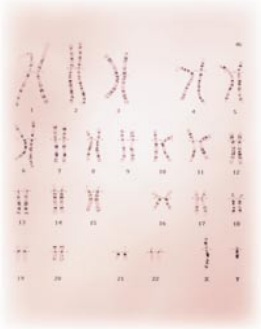

Inherited Dental Anomalies: A Review and Prospects for the Future Role of Clinicians

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ABSTRACT Inherited dental anomalies such as hypodontia, supernumerary teeth, enamel defects, and diastema are evident in large segments of most populations. Although treatment options for many of these conditions are ever improving, much remains to be understood about their etiology and pathophysiology. In this review, the authors hope to enthuse dental professionals into aiding the human geneticist by collaborating in studies seeking the underlying genetic cause of dental anomalies and referring patients presenting these conditions to the human geneticist.

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As the oral health of the population improves, considerations are now turning toward cosmetic dentistry, and the prospect of a complete and well-maintained set of dentition is within the reach of many more individuals. The correction of malpositioned and crowded teeth, as well as tooth discoloration and shape, are becoming ever more common. However, the knowledge of treatment techniques for these conditions is far more extensive than the understanding of their genetic basis. Numerous diseases of the dentition have been identified that lead to unfavorable changes in the affected person's dentition. These include hypodontia, supernumerary teeth, and alterations due to enamel defects.[1-4] While genetic factors underlying some of these conditions have been identified, the vast majority remain only partially understood.[5-13]

Dental anomalies are ideal conditions for the human geneticist to study as they are well-suited to the identification of the hereditary factors involved in their pathogenesis. While most dental anomalies can severely impact the quality of life in patients, they are not fatal. This provides a multigenerational family structure for genetic studies into their underlying causes. The problem for human geneticists is in the recruitment of families within which these diseases track. Most dental professionals, unlike medical professionals, are situated away from the human geneticist, hindering collaboration.

The authors review here the current understanding of the genetic basis of dental anomalies for which a gene or locus has been identified as the cause of the disorder, and highlight the fact

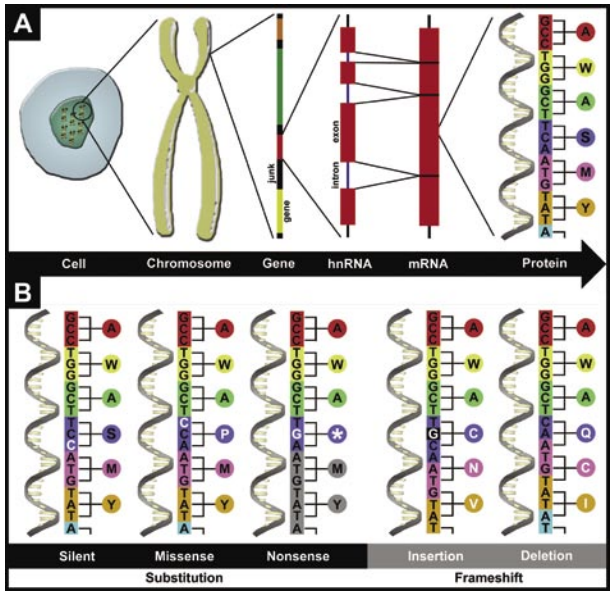

FIGURE 1. From gene to protein. (**A**) Chromosomes are found in the nucleus of the cell. Comprised of DNA, these chromosomes contain thousands of genes (colored blocks), which are separated by noncoding, or "junk," DNA (black blocks). Each gene is comprised of both exons (coding DNA; red) and introns (noncoding DNA; blue), which are copied or transcribed (expressed), for the purposes of constructing the protein it codes for, or encodes. There is an intermediary stage between the gene and the protein where a temporary copy of the gene blueprint is produced as a heterogeneous ribonucleic acid molecule, or hnRNA. The hnRNA consists of both the exons, which are pieced together to form the messenger RNA, or mRNA, and the introns, which are discarded. The mRNA is used as the template for the synthesis of the protein from amino acid building blocks. For this, the DNA is read in three-letter blocks, called codons, each of which signifies a single amino acid (colored circles). (**B**) The five major types of mutation. Silent mutations cause no change in the encoded amino acid sequence due to redundancy in the codons. Missense mutations lead to a single change in the encoded amino acid sequence. Nonsense mutations result in the formation of one of the three translation stop codons (TAA, TAG, and TGA) that result in truncation of the encoded amino acid sequence. Frame-shift mutations (insertions or deletions) result in a change in the encoded amino acid sequences from the point of the mutation as they shift the nucleotide positions in each triplet codon such that they form different codons. The mutated nucleotide and the affected amino acids are shown in white. "*" indicates the position of a stop codon.

that there remain many opportunities for further discovery. The authors hope this will stimulate the dental professional to collaborate with the human geneticist and facilitate the recruitment of families afflicted with dental anomalies into genetic mapping studies.

Primer in Human Genetics

The complete DNA content of a human cell, its genome, is currently thought to encode 20,000-25,000 genes, the discrete units of information stored in the genome, spread over 22 pairs of autosomal chromosomes and a pair of sex chromosomes (the X and the Y chromosomes) within the nucleus of all 10 cells that make up the human body.[13,14] Each gene acts as the blueprint for the synthesis of a protein that once produced, performs tasks within the cell. This multistage synthesis process is summarized in **FIGURE 1A**. Subtle changes in the DNA of these genes, mutations, between one individual and another define each of us as different. The most common type of mutation in DNA is a single nucleotide polymorphism (**FIGURE 1B**), of which a vast majority are silent and cause no visible or phenotypic consequences. However, should a nucleotide substitution cause a change at a location that results in an altered protein product that does not function appropriately or in the gene's control elements that can result in it not even being synthesized, the cells containing that genetic change may no longer perform their normal function, leading to a disease state.

Molecular genetics is essentially the study of these defective genes as they pass from one generation to next by the process called inheritance, thereby determining hereditary traits, such as the color of one's hair or eyes. Mutations can either be inherited from a parent, in which case they will be present in all cells of the body, or they can be acquired during an individual's lifetime, where they could be restricted to a particular part of the body depending upon when during the development of the individual the mutation was acquired. The former can be passed through families in a variety of Mendelian (single causative gene; autosomal/X-linked dominant or recessive) or complex (multiple causative genes) inheritance patterns (**FIGURE 2**).

The human geneticist identifies the disease gene(s) and its associated mutation(s) using a process called linkage analysis. This process, summarized in **FIGURE 3**, uses genetic markers that are known to have more than one form in the genomes of the population to identify regions of the genome that are associated with the disease in the affected family. This is achieved by sifting through many of these markers spread throughout the genome looking for those that are only found in one particular form in affected but not unaffected family members. The region(s) identified can then be analyzed to find the gene and mutation responsible for the disease, most commonly by sequencing the protein-coding parts of the gene(s) in the region(s).

As the knowledge is expanded of the genetic basis of diseases affecting the human population, it is becoming increasingly evident that many follow a complex rather than Mendelian pattern of inheritance. As these complex diseases require larger populations of affected individuals for the successful identification of their underlying genetic causes, they present a problem to the human geneticist. The identification of individuals afflicted with the condition and their referral into these genetic studies is reliant upon the clinician. As human geneticists largely reside away from the clinician, they can sometimes be unaware of the human geneticists' studies and thus not refer their patients. For dental anomalies, this is even more acute as dental professionals practice within urban areas away from

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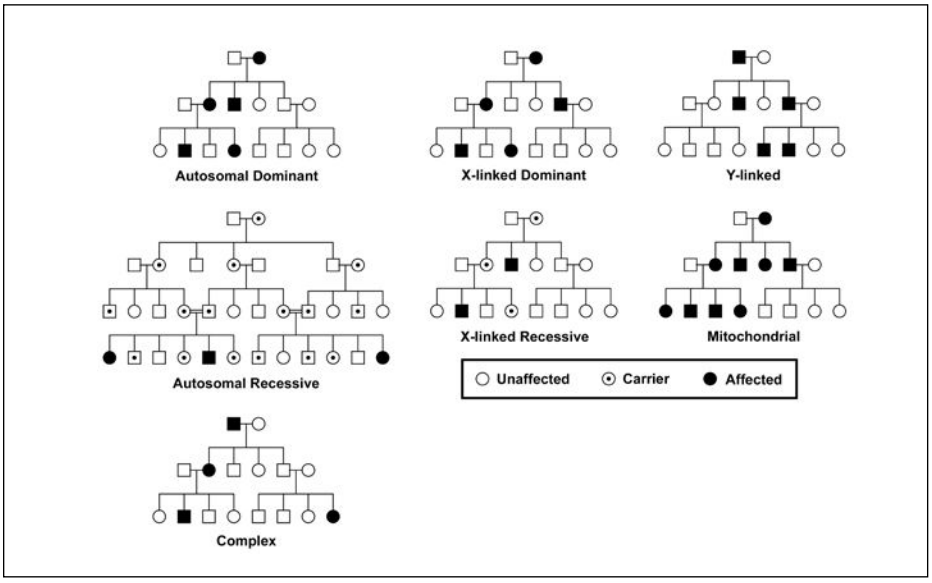

FIGURE 2. Idealized patterns of inheritance in pedigree diagrams. Autosomal dominant inheritance shows both males and females affected through successive generations with one-half of all offspring affected, and can be distinguished by male-to-male transmission. Autosomal recessive inheritance also shows both males and females affected, but affecteds are normally just present in a single generation where one-fourth of all offspring are affected and the parents of these offspring are often blood relatives. X-linked dominant inheritance also affects both males and females in successive generations with one-half of all offspring at risk (i.e., a parent is a carrier) affected, but can be distinguished by the lack of male-to-male transmission. X-linked recessive inheritance has affected males but generally only carrier females (i.e., females who have one copy of the disease gene but do not present the condition), unless an affected male marries a carrier female from which females with two copies of the disease gene can occur. Nonsuccessive generations will be affected with one-half of males being affected and one-half of females being carriers. Y-linked inheritance will be passed from male to male through successive generations and can be distinguished by no affected females and no female-to-offspring transmission. Mitochondrial inheritance shows only affected females transmitting the disease to all offspring, no male-to-male transmission occurs. Finally, complex inheritance shows both affected males and females, but with no discernible pattern or frequency.

the major genetics institutes, hindering collaboration between both parties.

Hypodontia

Hypodontia has been classified into two classes: syndromic, where tooth agenesis is found within individuals who have an underlying recognizable clinical syndrome, or nonsyndromic, where tooth agenesis is the primary condition afflicting the individual. Some syndromic conditions that present hypodontia have had genes identified as their cause, but only the genes identified as a cause of Rieger syndrome and Wolf-Hirschhorn syndrome appear to have functions that could putatively result in hypodontia when altered.[15,16]

Rieger syndrome (OMIM 180500), which is characterized by hypodontia, malformation of the anterior chamber of the eye and a protuberant umbilicus, was initially linked to the short arm of chromosome 4 (4q25-q27) in 1992.[17-19] Further mapping refined the region within which the gene mapped. Sequencing of candidate genes resulted in the identification of six mutations in the homeobox transcription factor gene *PITX2* (OMIM 601542), with others subsequently identified.[20-22] As murine *Pitx2* expression is restricted to the dental epithelium during tooth development, it represents the most likely candidate for the cause of the hypodontia presented in Reiger syndrome patients.[20,22] Another locus on the short arm of chromosome 13 (13q14) has also been associated with Rieger syndrome in families that do not show association with 4q25, indicating that this condition may be caused by multiple factors, although no gene has yet been identified at 13q14.[23]

Wolf-Hirschhorn syndrome (WHS; OMIM 194190), which is characterized by profound mental retardation, heart defects, and facial clefting, was associated with the deletion on the long arm of chromosome 4 in 1965.[24,25] In 1989, it was shown that deletion of the 4p16.1 locus was sufficient to cause WHS and that deletion of the homeobox gene *MSX1* (OMIM 142983), which is located at 4p16.1, also led to WHS.[26,27] Oligodontia was found associated with WHS in seven Finnish patients, of which five were subsequently shown to have a deletion of one *MSX1* gene, leading to the conclusion that haploinsufficiency for MSX1 serves as a mechanism that causes selective tooth agenesis and WHS.[28]

Genetic association studies into nonsyndromic hypodontia have so far identified three genes underlying this condition in numerous families: *MSX1* (OMIM 142983), *PAX9* (OMIM 167416) and *AXIN2* (OMIM 604025). Genetic linkage analysis of a family with autosomal dominant agenesis of second premolars and third molars identified a locus on the long arm of chromosome 4 (4p16.1) where sequence analyses demonstrated a mutation in the homeodomain (DNA-binding domain) of *MSX1* gene in all affected family members.[6] It was believed this mutation perturbed the ability of MSX1 to interact with its DNA or protein binding partners leading to haploinsufficiency of MSX1 in affected individuals. Subsequent research into other families afflicted with hypodontia has identified five other mutations in *MSX1*.[9,29-31] It appears likely that disruption of MSX1 functioning serves as a mechanism that causes selective tooth agenesis.

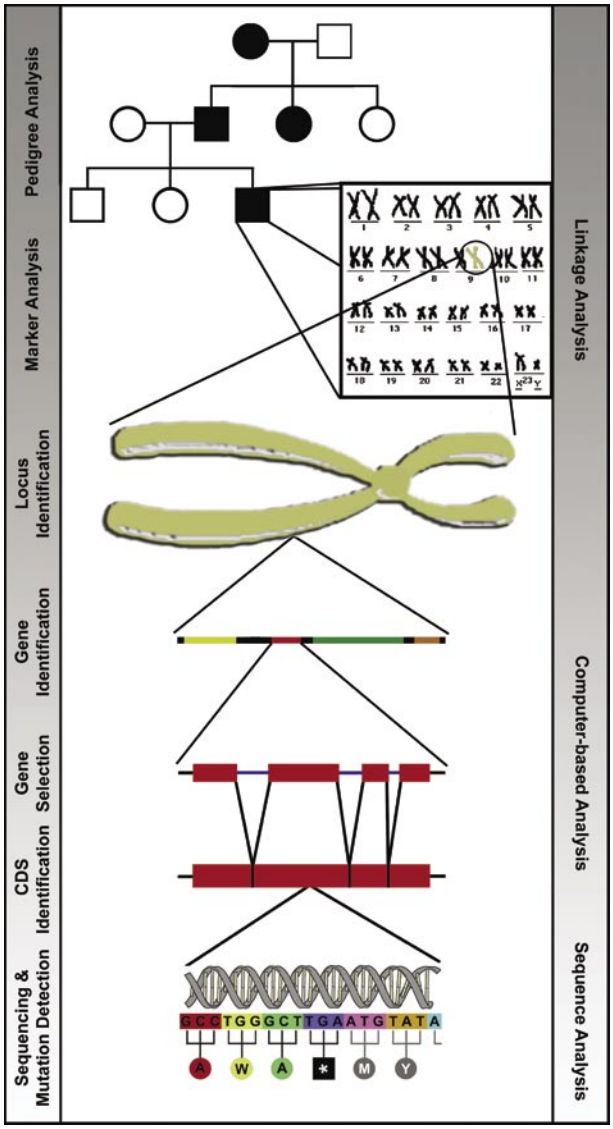

FIGURE 3. Methodology of disease gene and mutation identification. A pedigree (family tree) of the afflicted family is first drawn to identify the mode of inheritance of the disease trait (autosomal dominant or recessive, X-linked dominant or recessive, Y-linked, mitochondrial or complex). Linkage analysis is then performed using genetic markers (microsatellites or SNPs) to identify the region(s) of the chromosome(s) associated with the disease. Genes in the associated region(s) are then identified using sequence repositories available through the Internet and then candidate genes are selected based upon their known or predicted functions. Sequence analysis of these candidate genes will hopefully reveal a mutation in their coding sequence (CDS) that is present in all affected but not unaffected individuals and thus is probably the cause of the disease.

PAX9 was first associated with hypodontia in 2000 after the association of a locus on the short arm of chromosome 14 (14q12) during genetic linkage analysis of a family lacking most of their permanent molars.[8] The gene *PAX9* was found to be localized in this region of chromosome 14, and it was selected as a candidate gene based upon the observation that mice engineered to completely lack *Pax9* lacked teeth.[32] A single nucleotide insertion that resulted in a frame-shift mutation was then identified within its sequence.[8] Subsequent research has identified other mutations within its sequence that link it to hypodontia that range from single nucleotide substitutions or insertions to the deletion of the entire gene.[33-40] It appears it is the disruption of the DNA-binding ability of PAX9 that causes hypodontia.

AXIN2 was associated with oligodontia in 2004 after genetic linkage analysis of a Finnish four-generation family suffering from severe autosomal dominant oligodontia with sporadic colorectal neoplasia.[41] A region containing 80 genes on the short arm of chromosome 17 (17q24) was identified as associated with the oligodontia in this family. *AXIN2* was selected based upon previous research into colorectal cancer and sequence analysis identified two separate mutations in affected individuals. Both were single nucleotide substitution mutations that resulted in truncation of the protein product.[41] It therefore appears that loss of AXIN2 function results in oligodontia and in some patients, also colorectal cancer.

Hyperdontia

Hyperdontia (also referred to as supernumerary teeth; OMIM 187100), like hypodontia, can be classified into two classes: syndromic and nonsyndromic. Relatively recently there was success in determining a genetic cause for cleidocranial dysplasia (CCD; OMIM 119600), an autosomal-dominant condition characterized by hypoplasia/aplasia of clavicles, patent fontanelles, supernumerary teeth, short stature, and other changes in skeletal patterning and growth, in multiple families afflicted with CCD.[42] After association was found with a region on the short-arm of chromosome 6, *CBFA1* (also called *RUNX2*; OMIM 600211), a member of the runt family of transcription factors and a critical transcriptional regulator of osteoblast differentiation, was found to contain mutations ranging from deletions resulting in heterozygous loss of the gene to insertion, deletion, and missense mutations leading to translational stop codons in the DNA binding domain or in the C-terminal transactivating region of the protein, both of which are important for the functioning of the protein.[42-47] Mutagenesis of the mouse *Cbfa1* gene have produced phenotypes that show a high degree of homology to CCD and showed that Cbfa1 is a mesenchymal-factor required for correct epithelial-mesenchymal interactions regulating tooth development.[48,49] Interestingly, the teeth

in mice lacking *Cbfa1* failed to advance beyond the bud stage, and the mandibular molar organs were more severely affected than maxillary molar organs.[50] It appears likely that *CBFA1* mutations cause CCD and that haploinsufficiency is sufficient to produce this disorder, but how decreasing levels of CBFA1 can lead to either supernumerary teeth or failed tooth development still remains unknown.

However, despite this success, there have been no other reported cases where the cause of nonsyndromic hyperdontia has been identified. The small-eye mutant phenotype in mice, which includes the possession of supernumerary teeth, has been shown to have arisen from defects within the *Pax6* gene, a member of the paired-domain transcription factor family of proteins that includes *Pax9*, which the authors discussed as a known cause of hypodontia.[51] But there have been no human association studies reported.

Amelogenesis Imperfecta

Amelogenesis imperfecta represents a clinically and genetically heterogeneous group of disorders affecting tooth enamel formation. Enamel is formed by mineralization of an extra cellular matrix that contains proteins secreted primarily by ameloblasts.[52] Approximately 90 percent of the organic matrix protein is amelogenin, which is expressed differentially from two genes, *AMELX* (OMIM 300391) and *AMELY* (OMIM 410000).[53,54] It had been hypothesized that altered amelogenin function may be associated with AI.[55] The first mutation supporting this hypothesis was reported in 1991 with the partial deletion of the *AMELX* gene found in a Swedish family whose condition was associated with the region on the X-chromosome where the *AMELX* gene is located.[5] Since then, 13 other reported mutations in the *AMELX* gene have been identified, which is surprising considering less than 5 percent of AI cases are X-linked, but, interestingly, no mutations have yet been reported in the *AMELY* gene.[56-68]

Enamelin (ENAM; OMIM 606585) represents between 1 percent and 5 percent of total matrix protein content with proteolytic processing giving rise to multiple ENAM isoforms.[69-72] In 1997, a locus for autosomal dominant AI was mapped to chromosome 4 (4q11-q21) using six Swedish families.[52] The human chromosomal localization of *ENAM* was subsequently identified as 4q13.1-q21.23, and, in 2001, a mutation in the *ENAM* gene was finally identified in a family presenting autosomal-dominant AI.[12,73] Since the initial discovery, four more *ENAM* mutations have been identified, three for autosomal dominant and a single for autosomal recessive AI.[13,68,74,75]

AMELOGENESIS imperfecta represents a clinically and genetically heterogeneous group of disorders affecting tooth enamel formation.

DLX3 (OMIM 600525), mapped to human chromosome 17 (17q21.3-q22), is a member of the distal-less family of homeodomain transcription factors, and it has been implicated in the control of tissue differentiation.[76-79] It has previously been found to be a cause of Trichodentoosseous Syndrome (presented later), but in 2005 the cause of autosomal dominant hypoplastic-hypomaturation AI with taurodontism presented by a family was associated with the region containing *DLX3*.[80] *DLX3* was subsequently sequenced and a two-nucleotide deletion was identified within its homeodomain (DNA-binding domain) that led to a frameshift that altered the protein product.[80]

Finally, an enamel-specific protease has recently been identified as a cause of rare autosomal recessive hypomaturation AI. Kallikrein-4 (KLK4; chromosome 19q13.3-q13.4; OMIM 603767) is expressed during the maturation stage as the enamel hardens.[81] A nonsense mutation was identified in the affected members of a family afflicted with this form of AI during the sequencing of candidate genes in the region identified by linkage analysis.[82]

Trichodentoosseous Syndrome

Trichodentoosseous syndrome (TDO; OMIM 190320) exhibits autosomal dominant inheritance of enamel hypoplasia and hypocalcification, and taurodontism with associated strikingly curly hair.[83] Further analysis has since shown that two of the clinical features, taurodontism and enamel hypoplasia, were fully penetrant in all affected individuals, while bone and hair features were variably expressed, indicating that their cause may be complex rather than Mendelian.[84] The genetic cause of TDO was first associated with a region on the short arm of chromosome 17 (17q21) in 1997 after genetic linkage analysis of four families with a total of 39 affecteds.[85,86] Two candidate genes of the distal-less homeobox gene family, *DLX3* and *DLX7*, were selected based upon murine studies that highlighted their important role in the development of hair, teeth, and bone. The following year, Price et al. published the identification of a mutation in the *DLX3* gene (OMIM

600595) as the cause of TDO in these families with it likely causing haploinsufficiency of functional DLX3 protein.[87] It has also subsequently been shown that while amelogenesis imperfecta and TDO share similar characteristics, they are genetically distinct conditions.[88]

Dentinogenesis Imperfecta

Dentinogenesis imperfecta (DGI; OMIM 125490) is an autosomal dominant inherited dental disease that affects dentin production and mineralization. It was first linked to a locus on the short arm of human chromosome 4 in 1982.[89] Several groups pursued finer-mapping and narrowed the interval to 4q21 by 1999.[90-92] This region curiously has a high proportion of genes encoding dentin and bone ECM proteins: secreted phosphoprotein 1 or osteopontin (*SPP1*), dentin matrix protein 1 (*DMP1*), matrix extracellular phosphoglycoprotein, bone sialoprotein II (*IBSP*) and *DSPP*, a gene encoding dentin sialophosphoprotein that is processed into two proteins: dentin sialoprotein (DSP) and dentin phosphoprotein (DPP).[93] Three of these genes (*DSPP1*, *IBSP* and *DMP1*) were excluded by linkage or mutation analysis as causes of DGI. *DSPP* was subsequently evaluated for mutations and since the initial identifications in 2001, many more mutations have been identified strongly linking loss of DSP and DPP function to the development of DGI. *DSPP* has also been associated with another dentine dysplasia, which could indicate it may be a predominant cause of these conditions.[94-100] Interestingly, a knock-out mouse that was lacking the gene encoding sphingomyelin phosphodiesterase 3 (Smpd3) presented a severe form of DGI, along with osteogenesis imperfecta, indicating that other genes may also underlie this condition.[101]

Conclusions

The authors have discussed in this paper anomalies that are predominantly characterized by a Mendelian mode of inheritance caused by the disruption of a single gene. However, a majority of diseases and anomalies arise from a complex mode of inheritance where the disruption of multiple genetic factors plays a part in causing the condition. These complex diseases are now being tackled with ever-increasing frequency but with varying degrees of success, largely due to the limited affected populations available to the human geneticist.

AN ENAMEL-SPECIFIC protease has recently been identified as a cause of rare autosomal recessive hypomaturation AI.

In every subspecialty of dentistry, genetic considerations are under scrutiny in the hope of improving therapy. It is known that tooth movement only progresses at the rate at which the density of bone and rate of bone resorption will allow. Limitations to such genetic correlation lie in the complexity of the multiple genetic processes that dictate bone quality. Implants, orthodontics, and oral surgery rely heavily on how well the clinician can predict the outcome of bone health after delivery of treatment options. Periodontitis, for example, is caused by pathogenic bacteria common in plaque acting as a trigger point for its major underlying cause: a heightened and sustained inflammatory response. The complexity of the human inflammatory response and its obvious role in periodontitis has led both periodontists and scientists to consider the genetics underlying a person's predisposition to various forms of periodontal disease.[102-107] There has been some success in associating polymorphisms in certain interleukins with certain types of periodontal disease, which in some cases are isolated to certain subpopulations.[104,106]

It appears that in most cases discussed in this paper, it is the haploinsufficiency, or lack, of functional protein that leads these mutations to cause their associated phenotype. However, in many cases knowledge is still such that we do not know how the mutations cause this loss of function. As the reader will appreciate, compared to the number of known dental anomalies, the number for which we have some knowledge of their underlying genetic cause is extremely small. To identify the genetic basis of the remaining multitude of anomalies, the human geneticist requires families within which these anomalies are found to segregate. The dental professional is best placed to aid the human geneticist as in most cases they will treat complete families and can therefore identify whether a particular anomaly is found throughout the different generations. Should the dental professional find such a family, it is imperative to gain a complete family history and to create a family tree highlighting affected and unaffected members. Then through collaboration with the human geneticist, the underlying genetic cause can be identified. ■■■■

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Clinical Applications of rhBMP-2 in Maxillofacial Surgery

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ABSTRACT **Materials and methods:** Examples of defects including mandibular continuity defects, preprosthetic atrophic alveolar ridge deficiencies, traumatic defects, and maxillary clefts were included. **Results:** All patients demonstrated osseous regeneration stimulated by rhBMP-2. **Conclusion:** rhBMP-2 is successful in regenerating bone in a variety of maxillofacial defects. In the future, rhBMP-2 will play a significant role in the treatment of bone deficiencies.

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The development of bone morphogenic proteins has offered an alternative to traditional bone grafting, which has been the gold standard for oral and maxillofacial reconstruction. rhBMP-2 has been used successfully in subhuman primates to restore hemisected mandibles and large critical-sized defects.[1,2] BMP-2 has also been used successfully in simulated alveolar clefts.[3] A human multicenter clinical study revealed that rhBMP-2 was successful in inducing bone formation in the maxillary sinus prior to implant placement.[4]

Clinical application of BMPs has evolved to include defects of the facial skeleton.[5] This includes not only alveolar clefts but also segmental defects involving the mandible and maxilla. The authors will discuss the promising results, limitations, and future applications of this cytokine growth factor. Specifically, the authors will discuss use of BMP-2 for mandibular continuity defects, preprosthetic maxillomandibular augmentation, maxillofacial trauma, and alveolar cleft reconstruction. Representative cases from a series of 35 operated patients will be presented.

Mandibular Continuity Defects

Mandibular continuity defects secondary to tumor resection result in significant morbidity if not surgically reconstructed. Autogenous grafting both in the form of particulate corticocancellous grafts and free-tissue transfer provide options for reconstruction. Toriumi et al. used a canine model to study BMP-2 stimulated growth in a mandibular continuity defects.[6] They found that 68 percent of the defect was replaced by mineralized bone at six months in the BMP-2 group. Boyne found that BMP-2 was an effective inductor of osseous regeneration in subhuman primates in critical size defects.[1] In 2004, Warnke et al. used BMP-7 and bone mineral blocks (xenografts) to cre-

FIGURE 1A. *(left)* Radiograph of a mandibular tumor.

FIGURE 1B. *(right)* Superior and inferior plates paced to bridge defect. Note the rhBMP-2/ACS in place.

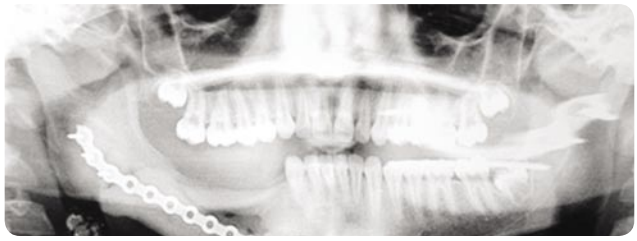

FIGURE 1C. Six-month postoperative radiograph.

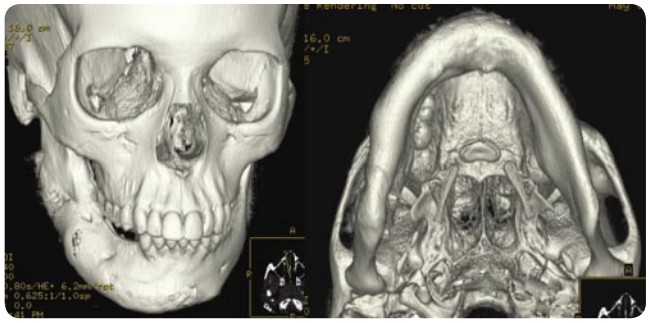

FIGURE 1D. Postoperative 3-D CT scan showing mandibular reconstruction.

ate a custom vascularized bone graft in a human.[5] They found bone remodeling and mineralization inside the titanium transplant. The development of effective reconstruction procedures using osteoinductive factors without the need for bone grafting would have tremendous impact on head and neck reconstruction surgery.

CASE

A 12-year-old black female presented for evaluation of a mandibular tumor. The tumor was biopsied and found to be an aggressive juvenile ossifying fibroma. The patient underwent surgical resection of the tumor with primary reconstruction of the defect (**FIGURES 1A-D**). A 2.0 mm locking plate (Synthes, Paoli, Penn.) was placed inferiorly and superiorly to bridge the defect. An absorbable collagen sponge (Infuse Bonegraft, Medtronic, Memphis, Tenn.) was saturated with 8 ml of a 1 mg/ml solution of rhBMP-2. The superior plate was placed to provide "tenting" of the periosteum and to maintain the space for the rhBMP-2/ACS sponge. The patient's postoperative course was significant for exposure of the superior plate seven weeks after her surgery. The superior plate was removed, and the patient was noted to have excellent bone regeneration of the entire defect. She will undergo removal of the inferior plate and implant placement in the future.

Preprosthetic Maxillomandibular Augmentation

Preprosthetic maxillomandibular augmentation procedures using bone grafts and bone substitutes are commonplace. More commonly used procedures include ridge augmentation and sinus lifting procedures. Jovanovic et al. performed a histologic study of a canine ridge augmentation model.[7] They found no significant difference between implants with rhBMP-2 induced bone compared with resident bone. They stated that rhBMP-2 induced bone allows installation, osseointegration, and long-term functional loading of dental implants in dogs. Boyne et al. recently reported the results of a multicenter study looking at rhBMP/ACS in the maxillary sinus.[4] They found that rhBMP-2/ACS predictably and safely induced adequate bone for the placement and functional loading of endosseous dental implants in patients requiring staged maxillary sinus floor augmentation.

CASE

A 45-year-old female truck driver with a long history of smoking presented for evaluation for bone grafting and implants. Her exam revealed knife-edged ridges and inadequate maxillary and mandibular bone for dental implant placement. She underwent reconstruction with a combination of autogenous iliac crest bone graft and rhBMP-2 (**FIGURES 2A-G**). The reconstruction included a LeFort I downgraft, bilateral sinus lifts, and maxillomandibular ridge augmentation.

Titanium mesh was used to provide stability and confinement of the rhBMP-2/ACS. The posterior mandible was reconstructed with rhBMP-2 alone. A total of 8 ml of rhBMP-2 was used (1 mg/ml). Bony regeneration was apparent radiographically. The patient underwent removal of hardware at eight months and is awaiting implant placement.

Maxillofacial Trauma

Studies have been reported evaluating the use of rhBMP-2 in trauma cases. BMP has been effective in treating nonunions and partial or complete segmental defects of long bones.[8,9] In severe injuries with loss of hard and soft tissues, primary

FIGURE 2A. Deficient maxillomandibular height.

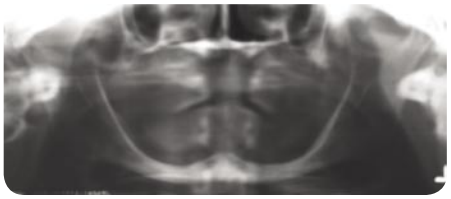

FIGURE 2B. Preoperative radiograph showing the inadequate bone for implant placement.

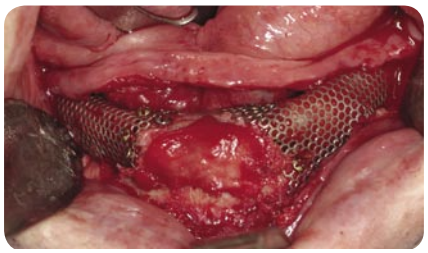

FIGURE 2C. Mesh secured in place to maintain space for the rhBMP-2/ACS.

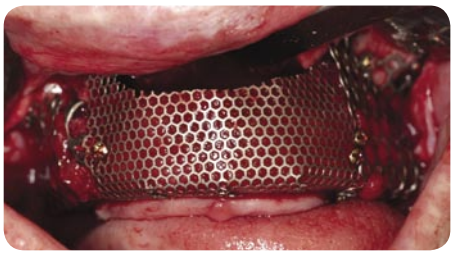

FIGURE 2D. Mesh secured to maxilla.

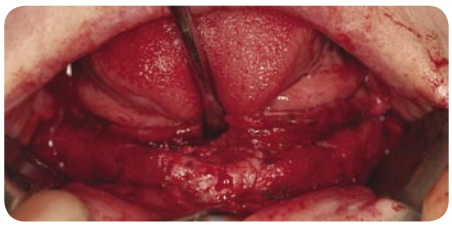

FIGURE 2E. Regenerated mandibular ridge.

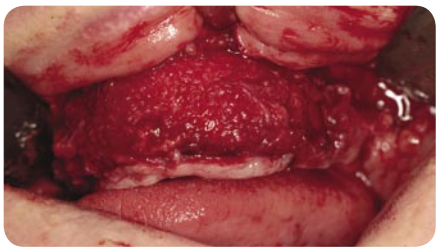

FIGURE 2F. Regenerated maxillary ridge.

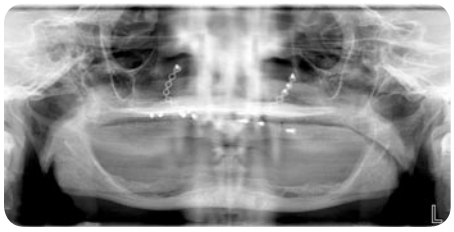

FIGURE 2G. Six-month postoperative radiograph.

treatment presents challenges including obtaining soft tissue closure and preventing contamination and loss of the rhBMP-2. With gunshot wounds there may be a significant zone of necrotic injury. These cases may require further debridement and secondary reconstruction.

CASE

An 18-year-old male who was working at a gas station sustained a close range shotgun blast to the face during a robbery. He underwent treatment including a staged secondary reconstruction utilizing a 2.4 mm locking reconstruction plate (**FIGURES 3A-F**). An iliac crest bone graft was combined with BMP-2 in a layered "sandwiched" technique. Eight ml of rhBMP-2 (1 mg/cc) was placed on two collagen sponges. The first collagen sponge was placed directly beneath the mucoperiosteum. This was followed by placement of a corticocancellous particulate graft. The second collagen sponge was placed over the graft and the incision was closed. The healing was uneventful and the patient is awaiting final reconstruction with root-form implants.

Alveolar Cleft Reconstruction

The standard procedure for repair of alveolar clefts has remained the one first reported by Boyne and Sands utilizing

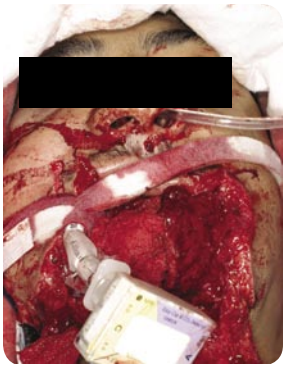

FIGURE 3A. Gunshot wound to the face.

FIGURE 3B. Radiograph showing significant loss of tissue.

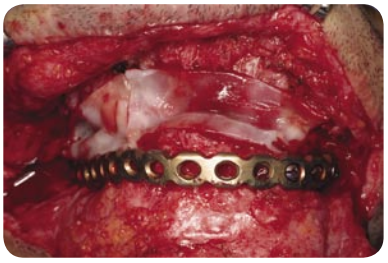

FIGURE 3C. Placement of rhBMP-2/ACS adjacent to mucoperiosteum.

FIGURE 3D. Placement of rhBMP-2/ACS over particulate bone graft (beneath periosteum).

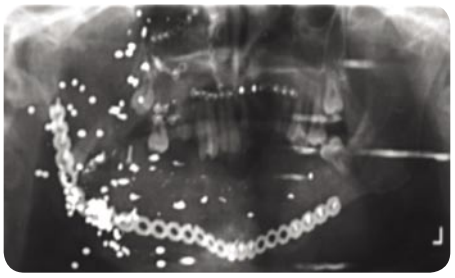

FIGURE 3E. Postoperative radiograph.

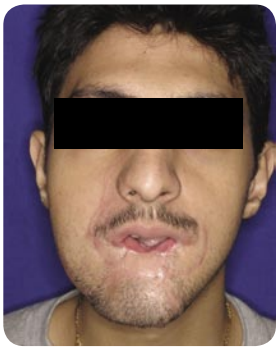

FIGURE 3F. Postoperative result.

autogenous particulate iliac crest bone graft.[10] Iliac crest remains the ideal donor site for cleft repair. Boyne et al. compared rhBMP-2 and iliac crest bone grafts to reconstructed simulated alveolar cleft defects in subhuman primates.[3] They found no statistical difference between the autogenous grafts and those defects reconstructed with rhBMP-2 alone. More recently many of our patients have benefited from use of rhBMP-2 to induce bone formation for cleft palate repair thus eliminating the need for a donor site surgery to harvest the available autogenous bone.

CASE

A 6-year-old presented with a unilateral left-sided cleft. He underwent reconstructive surgery of the osseous cleftal defect utilizing rhBMP-2 (**FIGURES 4A-F**). A standard technique was used with careful closure of the nasal floor. Next an absorbable collagen sponge with 4 ml of rhBMP-2 (1 mg/cc) was placed into the cleft defect. The palatal and labial mucosal flaps were then closed. The patient healed uneventfully with excellent bony bridging of the cleftal defect. He is in the process of undergoing orthodontic treatment.

Discussion

Particulate autogenous bone grafts have long been the gold standard for maxillofacial reconstruction. Advantages such as high success rates, availability of large quantities and graft biocompatibility make autogenous bone an excellent treatment choice in osseous reconstruction. Although associated with many advantages, autogenous grafts may be associated with disadvantages including cost of the procedure, need for a donor site, need for hospitalization, and site-specific postoperative morbidity including limitations of activity, gait disturbances, infection, and paresthe-

FIGURE 4A. Clinical view of a right alveolar depth.

FIGURE 4B. CT showing the cleft.

FIGURE 4C. Intraoperative view showing closure of the nasal floor and placement of the rhBMP-2 /ACS.

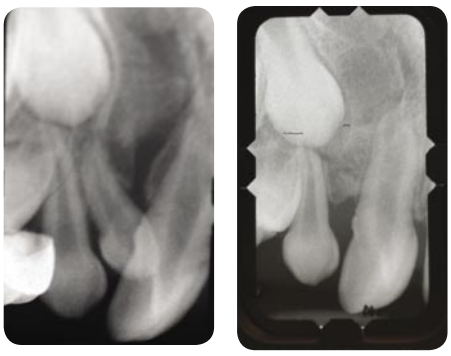

FIGURE 4D. Pre- and postoperative radiograph showing the bone formation.

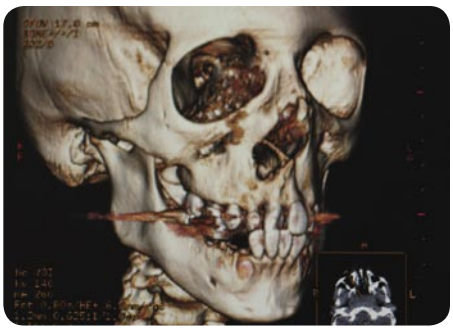

FIGURE 4E. Postoperative 3-D CT showing bridging of the defect.

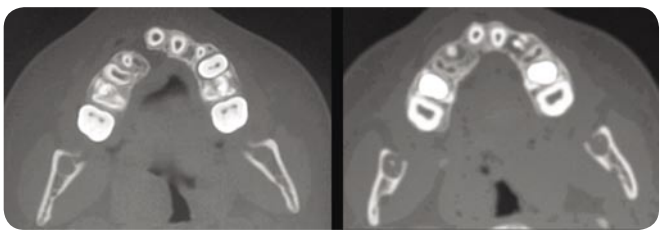

FIGURE 4F. Axial view of pre- and postoperative result.

CDA JOURNAL, VOL 35, Nº5

sia, following donor harvesting. Thus the great appeal for "bone in a bottle" for reconstructing many defects.

The application of specific growth factors for osteoinduction without the need for bone grafting would have tremendous impact on maxillofacial reconstruction. Polypeptidecytokines (growth factors) would influence healing by controlling growth, differentiation, and metabolism of stem cells. Requirements for wound healing include cell migration and proliferation, angiogenesis, and extracellular matrix deposition. Cytokines (e.g., BMP) act on this pathway (**FIGURE 5**). The cytokines can be exogenously introduced into the bone defect at the time of surgery thus influencing osteoprogenitor cells to develop osteoblastic cell lines and enhance osteogenesis. More than 20 BMPs have been isolated with varying abilities to enhance osteogenesis (**FIGURE 6**). Types 2, 4, and 7 (OP1) appear to have the greatest ability to stimulate bone formation.

BMP-2 likely effects the final differentiation of progenitor cells. Katagiri et al. reported that BMP-2 may alter the differentiation pathways of committed progenitor cells of myoblasts lines and cause a differentiation of committed myoblasts to condroblast-like cells.[11] They reported that BMP-2 is a potent regulator in determining osteoblasts differentiation effecting not only pleuri-potential immature mesenchymal cells (stem cells), but also committed myoblasts. The significance of their work might be that BMP appears to have not only the capacity to effect already committed cells from a given pathway, but also the ability to induce cells to differentiate or "dedifferentiate" into an osteoblastic lineage.

The optimal carrier for rhBMP-2 would slowly release the cytokine, be

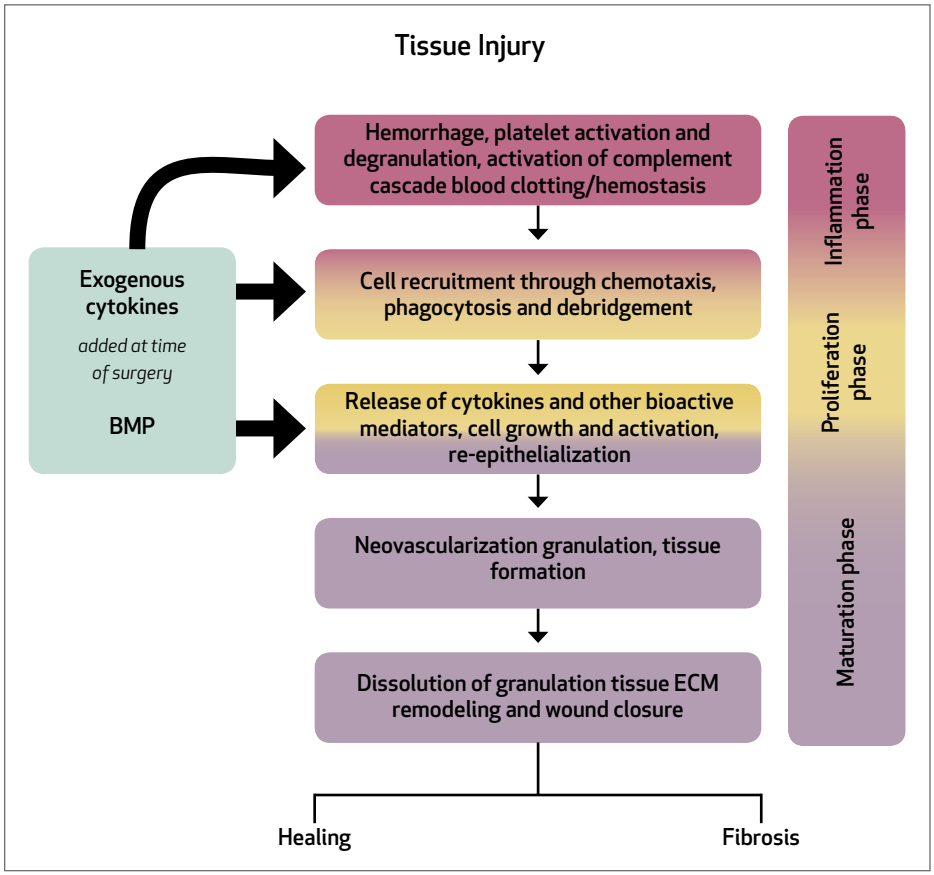

FIGURE 5.

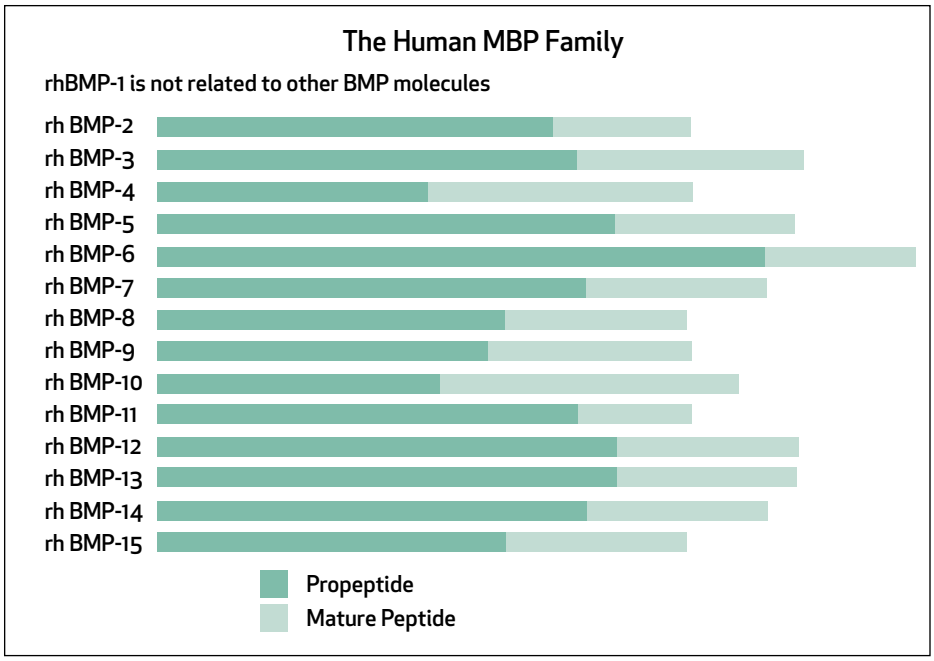

FIGURE 6.

completely resorbed, and be biocompatible. Current work continues to develop a matrix that would fulfill these criteria.[12-15] Absorbable collagen sponge is derived from highly purified bovine tendon type I collagen. The authors chose ACS because of previous work showing excellent biocompatibility. Also because ACS is not osteoinductive, any bone formation could be attributed to the rhBMP-2. A disadvantage of the ACS is that it does not maintain the space or "pack" into a defect the way a bone graft does. Future carriers will better maintain the space during healing. BMP-2 may be used alone or in combination with bone grafts whether autogenous or other. Studies are under way to compare and evaluate whether there is a synergistic effect.

The concentration for the patients was 1 mg of BMP per ml. Studies have looked at the optimal dose to stimulate bone formation. A study comparing 0.75 mg/cc and 1.50 mg/cc found that the larger dose was more effective at inducing bone for maxillary sinus floor augmentation procedures.[4] Larger doses of rhBMP-2 produce more soft tissue edema postoperatively. It is important that the patient be aware of this. A small percentage of patients may not respond to BMP-2 (nonresponders). Also, patients can develop antibodies to the collagen, which does not appear to have a clinical effect.

The highly osteoinductive rhBMP-2 has led to use of this protein for bone regeneration in the preclinical and now clinical areas. Animal studies have demonstrated successful ability to reconstruct a variety of defects and successful human studies involving the maxillofacial region have been undertaken. The great potential for bone growth factors is exciting and will offer alternatives to traditional grafting techniques.

Conclusion

In the future, BMP-2 will play a significant role in the treatment of atrophic deficiencies in aging population groups, in the restoration of neoplastic defects, and in the reconstruction of traumatic injuries and congenital anomalies. ■■■■

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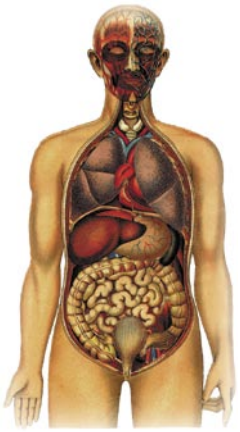
CDA JOURNAL, VOL 35, Nº5



Medical Consultations for Medically Complex Dental Patients

RONALD S. BROWN, DDS, MS; ANDRE A. FARQUHARSON, DDS, MS; AND THOMAS M. PALLASCH, DDS, MS

ABSTRACT In order to discuss the issue of the medical consultation letter for medically complex dental patients, information is provided with regard to the specifics of the process. Medical, dental, and legal implications are discussed. Specific scripting and format are provided.

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The quality of interdisciplinary cooperation and information-sharing is one of the most important issues for advancing the health of our dental patients.[1-3] Many medical conditions may require the attention of dental clinicians such as antibiotic prophylactic considerations, potential bleeding problems, HIV health issues, anemia, hypertension, cardiac disease, diabetic control, asthma, drug history, gastroesophageal reflux, psychiatric considerations, pregnancy, adrenal suppression, bulimia and overall health (ASA category). In the past, various health practitioners have criticized poor interdisciplinary communication and advocated for a standardized procedure with regard to consultation letters written by dentists.[2,4-6]

Furthermore, a basic understanding of medicine and medical and dental health implications is a necessity regarding the construct of successful interdisciplinary consultation letters.[3,5,7-9] The American Society of Anesthesiologists physical status classification is used around the world by medical anesthesiologists and other clinicians as an assessment of the preoperative physical status of patients. The ASA was established approximately 160 years ago and this group established a measurement of physical status in order to standardize the physical health evaluations of anesthesia patients. An ASA status of 1 describes a patient without systemic disease; an ASA status of 2 describes a patient with mild systemic disease; an ASA status of 3 describes a patient with severe systemic disease that limits activity but is not incapacitating; and an ASA status of 4 describes a patient with incapacitating systemic disease that is a constant threat to life.[10]

There are many questions regarding medical consultations for dental patients that demand straightforward answers. When and why is a consultation letter necessary? What information is required within the consultation letter? What information should be requested from the patient's physician? What is the proper layout for the letter? What are the various protocols involved in dental treatment?

There are several very good reasons (when and why) for referring dental patients for medical consultations: 1) The patient requires a medical evaluation and/

CDA JOURNAL, VOL 35, Nº5

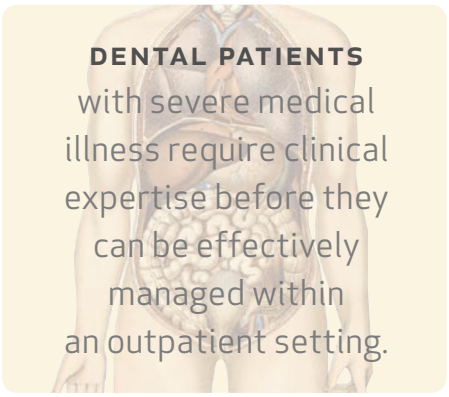
or therapy; 2) The dentist requires specific medical information (i.e., the results of laboratory tests and/or blood studies) that may influence the patient's dental therapy; and 3) The dentist requests a change in the patient's medical therapy in order to benefit the patient's oral condition.

1. THE PATIENT REQUIRES A MEDICAL EVALUATION AND/OR THERAPY.

When the dentist evaluates a patient and makes a determination that the patient may have a health condition beyond the dentist's capabilities to treat, it is imperative the patient be referred to the proper clinician and facility. Such conditions as general health, hypertension, cardiovascular diseases, diabetes, kidney disease, pregnancy, active infectious diseases (i.e., tuberculosis), gastroesophageal reflux disease, HIV/AIDS, and many other medical conditions are potential health concerns, which may necessitate a medical referral.[10-12] Furthermore, dental patients with severe medical illness require clinical expertise before they can be effectively managed within an outpatient setting. This category is essentially a referral to another clinician with greater expertise within the necessary medical discipline. A consultation letter helps as an aid for the clinician to whom the patient has been referred and encourages communication between the patient's physician and dentist.

2. THE DENTIST REQUIRES SPECIFIC MEDICAL INFORMATION THAT MAY INFLUENCE THE PATIENT'S DENTAL THERAPY.

Many patients report a medical history of heart murmur or mitral valve prolapse. Such information is important but may require further detail in order to best treat the patient under the specifications of the American Heart Association. For instance, the results of an echocardiagram determine whether there is regurgitation or the murmur is merely functional or innocent. With regurgitation, antibiotic prophylaxis is necessary for several dental procedures, according to the 1997 AHA recommendations. However, if the diagnosis of a functional heart murmur is determined, antibiotic prophylaxis is not required for dental procedures. Other specific medical information a dentist may require includes specific medical diagnoses such as unstable asthma, unstable angina, or a determination of esophageal ulcers, and a specific diagnosis of gastroesophageal reflux disease. For instance, the dentist may observe tooth enamel loss consistent with gastroesophageal reflux disease or bulimia, and need help in establishing the diagnosis in order to move the patient onto a successful therapeutic pathway. The patient may have an existing history of diabetes and symptoms such as dry mouth or slow healing oral infection. Such a clinical presentations should alert the patient's dentist to have the patient evaluated by a physician. The dentist may determine the patient is anemic through both the medical history and clinical evaluation. Therefore, dentists contemplating dental surgical procedures may request relevant blood studies to evaluate the patient for anemia.



Patients may demonstrate anemia due to a red beefy tongue, oral burning, the lack of filiform papillae of the dorsal tongue, blanched appearance of the nail beds and gingiva, change in coloration, and a history of decreased energy.[10-12] Furthermore, dentists may require a culture and sensitivity assay to determine the best antibiotics for use against a particularly recalcitrant oral infection. Some patients may report questions regarding their previous medical history such as whether or not a childhood disease was consistent with rheumatic heart disease.[10-12] Therefore, there are any number of clinical presentations and patient histories in which evaluation and clarification from the patient's physician may aid in the patient's further dental treatment.

3. THE DENTIST REQUESTS A CHANGE IN THE PATIENT'S MEDICAL THERAPY IN ORDER TO BENEFIT THE PATIENT'S ORAL CONDITION.

Patients with transplanted kidneys are sometimes placed on both cyclosporine and a calcium channel blocking agent. When these patients manifest the drug side effect of drug-induced gingival overgrowth, it is very difficult to render successful periodontal therapy. It is often necessary to ask the patient's physician to consider changing the patient's anti-hypertensive calcium channel blocking agent to another anti-hypertensive medication of another anti-hypertensive class of drugs in order to decrease the side effect.[13,14] A dentist should not change the patient's anti-hypertensive medication. Furthermore, even if the dentist could change the drug regimen, it would be improper to do so without a consultation. It is important for the patient's primary care physician to have complete knowledge regarding the patient's cardiac care. Another example of asking for a change in anti-hypertensive medication is when a drug side effect of oral burning or oral lichenoid lesion secondary to an ACE-inhibitor is suspected.

Withdrawing the ACE-inhibitor anti-

hypertensive medication and replacing it with another drug of another class of anti-hypertensive drugs is sometimes necessary to determine whether the ACE-inhibitor drug is involved as a cause of the patient's oral burning or oral lesion.[15]

What information do you place within the consultation letter?

Typical information that aids the process of the consultation should be included within the consultation letter. This information includes the patient's name, age, ethnicity, gender, chief complaint, address and other contact information, your name (the referring clinician's), address, and other contact information.[11]

What is the proper layout for the letter?

The consultation letter should contain the referring doctor's name, address, and contact information. It should contain the patient's name, address, and contact information. It should note the patient's chief complaint, age, gender, and ethnicity. It should describe the reason for which the patient is being referred and the specific questions related to the patient's health that require answers.[10,11] It should describe exactly where the physician is to respond. An example of the format is provided in **TABLE 1**.

TABLE 1

111 Anywhere Road
WhateverTown, WhereeverState
555-555-5555, fax 555-555-1111

Dr. Whoever
222 Anywhere Road
WhateverTown, WhereeverState

Re: Mr. John Smith, 34 yowm

Dear Dr. Whoever:

Please evaluate Mr. Smith's medical condition regarding the proposed dental therapies, (extractions). Mr. Smith reported a heart murmur at his last physical. Please report the results of his echocardiagram and we will follow the current AHA guidelines.

Sincerely,

Dr. Whatsmyname

Please respond below or on the back or on a separate page. Thank you.

Physician's Reply:

What information do you require from the patient's physician?

Foremost within the consultation letter is the specific reason (or reasons) you are seeking a consultation. Therefore, the requested information is specific with regard to the aforementioned reason or reasons.

What are some of the clinical protocols?

Protocols provide clinical guidelines for practitioners. Current thinking is that some medical legal protection of the clinician is provided for those clinicians who follow published protocols.

The most well-known protocol is the AHA antibiotic prophylaxis protocol for endocarditis that was last published in 1997.[10,11] However, it is anticipated a new protocol will be published in the future.

Another well-known protocol is the antibiotic prophylaxis total joint replacement protocol. The latest total joint replacement protocol was published in 1997.[10-12] This protocol states that patients with joint replacement may be prescribed antibiotic prophylaxis under some specific conditions, but does not mandate the necessity of antibiotic prophylaxis in any situation.

A recent protocol was expounded upon that provided blood pressure guidelines for dental patients. In 2004, Merin formulated dental hypertension guidelines based on a review article by Herman et al.[16,17] Patients with extremely high blood pressure values should be referred immediately while other patients with less severe hypertension may merely require a medical consultation. Some hypertensive patients may continue with routine dental therapy and some only emergent care until the blood pressure values are controlled.

Relatively recent guidelines have utilized the International Normalization Ratio to provide guidelines regarding medications, which increase bleeding potential, and when and when not to have such patients stop taking these medication previous to dental procedures that involve hemorrhage. Taking a patient off such medications may lead to drug rebound, which may result in a serious blood clot. This protocol has evaluated the relative dangers associated with withdrawing such medications and risking embolism and death, and continuing such medications and risking hemorrhage from extraction or other dental surgical procedures.[18-22]

In the treatment of HIV-infected patients, it may be necessary to attain such information as viral load, CD4 count, white count, platelet count, CBC and differential, ASA, and drug history. Having the specific information and applying this information to published guidelines allows for competent practice of dentistry upon immune-compromised patients.[23]

Other guidelines for medically complex patients are provided for within such texts as Burkett's *Oral Medicine Diagnosis and Treatment, Dental Management of the Medically Compromised Patient, Principles and Practice of Oral Medicine, Internal*

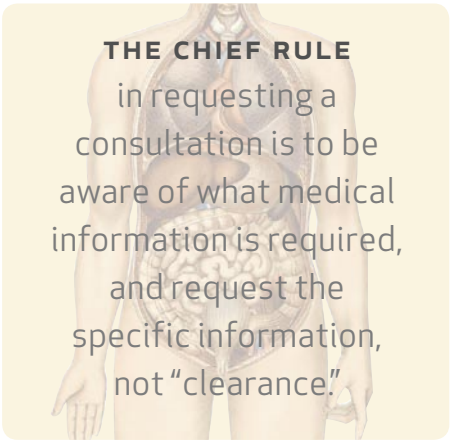
Medicine for Dentistry, Textbook of Oral Medicine, Medical Problems in Dentistry, and the *Clinician's Guide to the Treatment of the Medically Complex Dental Patient*, among others.[10-12,24-27] It is important for dentists to realize the information within texts is time-dependent and medical and dental guidelines are often updated. Furthermore, routine dental treatment for many medical conditions including HIV-infection is often unimpeded by these guidelines.[23] However, some patients with many of these and other medical conditions may require medical evaluation and intervention.

Discussion

Clinicians who merely ask physicians for advice and then follow such advice even when the advice contradicts accepted current protocols have lost the medical legal protection of the established protocols.[28] Unfortunately, many physicians may provide misinformation including protocols they were taught during their medical school education and not the current versions.[29] This may place the dentist who requested the medical consultation in a legal no man's land. If the dentist follows the incorrect physician recommendations and the patient has a problem, the dentist has violated the protocol. If the dentist follows the protocol, he has violated the physician's recommendations the dentist requested. Whatever the dentist does after the problematic medical consultation is legally questionable.

Furthermore, clinicians who ask physicians for advice when established current protocols cover the particular topic do not endear themselves to knowledgeable physicians. The major problems involved within the medical consultation process can be eliminated by asking specific questions and asking for facts rather than opinions.

It is incumbent upon practicing dentists to be knowledgeable concerning medical conditions that impact upon the practice of dentistry. Dentists need to be able to ask educated questions regarding the medical conditions of their dental patients to their patients' physicians. When a request sent to a physician asks vague questions such as "Is it all right to treat this patient?" the physician may not understand the information required or the context, and may send a vague or noncommittal reply. These vague replies are often stored in patients' charts as alleged legal protection, but they rarely assist the dentist in treating the patient effectively. The chief rule in requesting a consultation is to be aware of what medical information is required, and request the specific information, not "clearance."[10] In order, to facilitate many dental medical consultation letters, recommended scripting is provided in **TABLE 2**.



Specific concerns regarding plausible medical consultation for dental patients include information necessary for the elucidation of AHA guidelines. This information might include the results of the patient's echocardiagram, bleeding issues such as an INR, a determination of unstable or stable angina, or asthma, the results of a biopsy report, a definitive drug history, the results of previous blood studies, and the patient's ASA status.

With regard to medical and dental therapy, there are sins of commission as well as sins of omission. It would be an error to treat a dental patient with a cardiac valve disorder without antibiotic prophylaxis when the AHA protocol recommended such. But it would be an error to cover a dental patient with antibiotics when the protocol did not recommend antibiotic prophylaxis. Furthermore, antibiotics unnecessarily prescribed have the potential to increase bacterial resistance.[28,30,31] Unnecessary coverage increases the possibility of adverse drug reactions such as side effects and allergic reactions.[28,31] In the authors' opinion, many clinicians mistakenly believe that when in doubt, the correct policy is to always prescribe antibiotic coverage for medical-legal protection. However, there are any number of negative consequences, that may result due to misprescribing unnecessary antibiotics.

There are instances when physicians or patients have advocated therapy such as antibiotic prophylaxis when such is inappropriate. This situation is often a dilemma for the dentist. It is suggested that under such situations, the dentist explain the particular protocol to the physician and/or patient. Hopefully, the dialogue can be carried out in nonjudgmental fashion and result in the proper maintenance of the protocol. However, it may be necessary for the dentist to refuse to cooperate in the violation of the protocol but allow the patient's physician to carry out the problematic prescription.[28,32] An example is a plastic surgeon's admonition to the dentist to use antibiotic prophylaxis prior to dental therapy for a patient with a breast implant. As there is no data or protocol to support antibiotic prophylaxis and, therefore, no medi-

TABLE 2

Scripted Suggestions for Questions Regarding Medical Health Consultation

This patient's blood pressure is currently _____. Please evaluate this patient's blood pressure and, if necessary, treat the patient's hypertension.
The patient demonstrates a dental condition consistent with enamel erosion secondary to gastric reflex. Please evaluate this patient for gastroesophageal reflux disease and potential treatment.
This patient reports a history of _____ (kidney disease, HIV positivity, cardiac disease, breast cancer, etc.) please report this patient's ASA status.
This patient reports a complicated drug history. Please provide a summary of the patient's present drug regimens.
The patient reports a history of positive HIV status. Please report the patient's WBC, viral load, CBC and differential, and T-cell count.
The patient reports a history of anemia. Please report the patient's most recent CBC and differential.
The patient reports a history of psychological issues. Please report back concerning this patient's ability to undergo dental therapy of anticipated _____ (low, moderate, high) stress.
The patient reports an allergy to local anesthesia, please evaluate this patient with regard to local anesthesia allergy and report back your conclusions.
The patient reports a history of allergy for a number of antibiotics including _____. Please evaluate this patient's antibiotic allergy concerns.
The patient reports a history thrombocytopenia, please report the patient's present platelet level and treat if necessary.
This patient reports a history of _____ (asthma, angina), please report whether or not this patient's condition is stable or unstable.
The patient reports a history of congenital cardiac malformation. Please confirm the patient's present condition.
The patient reports a history of cardiac disease. Please re port the patient's present condition and recent cardiac disease history.
The patient reports a history of heart murmur/mitral valve prolapse. Does this patient currently have a heart murmur? If the patient does have a murmur, please report the results of the patient's echocardiagram and if regurgitation is present, the patient will be premedicated for dental treatment according to the current AHA regimen.
The patient currently reports taking medication to decrease blot clotting potential. Please evaluate the patient's bleeding potential with an INR. If the patient's INR is greater than 3.5, please consider discontinuing the patient's current anti-coagulation medication for a period of time previous to the patient's scheduled surgical dental procedure. This dental surgical procedure is designated as having a _____(low, moderate, high) probability for bleeding problems. Patients with moderate and high probability procedures for bleeding problems may require medication adjustments at lower INR values.
The patient reports a medical history significant for past steroid use. Please report on the patient's adrenal function and previous history of steroid medications. Patients with adrenal insufficiency require evaluation for corticosteroid prophylaxis with regard to stressful dental procedures.
The patient reports she is pregnant. Please advise regarding the specific time of the due date. Please advise if the pregnancy is at risk and therefore requires special considerations.
The patient reports a previous history radiation for oral cancer therapy. Please confirm the cancer diagnosis, the dosage of radiation to the head and neck region and the dates of therapy.
This patient has been diagnosed with drug-induced gingival overgrowth (hyperplasia). As this patient is presently taking more than one drug known to provoke this condition, it is hoped that you may eliminate one of the inducing drugs and replace the discontinued drug with a drug from another pharmacotherapeutic category. Please advise.
This patient has oral mucosal lesions consistent with oral lichen planus or another similar autoimmune condition. There is the potential that one of his/her present drug prescriptions _____ may be the etiological trigger for this manifestation. Please consider changing the present drug regimen to another drug from a different drug category in order to further investigate this possible connection.

cal rationale for such a prescription, the indication for such is questionable. The dentist may advise the physician to confer with the patient separately and keep any antibiotic prophylaxis information only between the patient and the physician.

Pregnancy is a normal healthy condition. Women undergoing a normal pregnancy should not require a medical consultation. Routine dental treatment including necessary imaging is acceptable. The protocol for pregnancy is to avoid elective procedures during the first trimester (the second trimester is preferred for dental treatment), and to avoid aspirin, NSAIDs, nitrous oxide, tetracycline, and doxycycline. Of course, teratogenic drugs should be avoided as well.[10-12,33-35]

There are always exceptions to the rule. There are instances in clinical patient care in which the clinician, through individual knowledge of the particular patient, may legitimately decide to disregard a particular protocol. It may help to gain information from the physician concerning the individual health issues of that particular patient. Nonetheless, the clinician may determine that in his or her best clinical judgment, a particular clinical course of action is appropriate.

Any procedure contemplated by clinicians should begin with a risk-benefit analysis. Do the benefits outweigh the risks? Are the risks sufficient to refer the case to a specialist or to a hospital facility? Procedures such as antibiotic AHA prophylaxis benefit very few as only one in a very large number are anticipated to suffer from SBE after dental therapy. However, the few are anticipated to have fairly severe health consequences with an approximate 10 percent risk of death. At a certain point, the risks of an adverse drug reaction to the antibiotic prophylaxis may outweigh the risk-benefit odds ratio and health consequences compared to SBE infection secondary to dental causation. Therefore, it is important for dentists to have an appreciation for a comparison of risks and benefits. In patients with greater health risks, the clinician must evaluate referring the patient to a hospital facility for dental care. Patients with an ASA classification of four should be considered for dental care within a hospital environment.

Furthermore, some patients may have variable laboratory reports. For example, the INR may vary widely from time to time in some patients. Therefore, it may be important for these patients, and other patients, to be considered for dental therapy within a hospital setting. Also, the nature of the surgery should be factored into the decision regarding blood thinning medications. More strenuous surgical procedures such as multiple extractions and bony surgery may place patients at greater risk with respect to hemorrhage.

In conclusion, the medical consultation letter is a valuable part of many patients' dental care. It is important for dental clinicians to have an appreciation for dental patients' medical conditions and how these conditions may impact dental therapy. It is necessary for dentists to gather pertinent medical information in order to aid the clinical decision process in determining which clinical procedures are appropriate and whether the patient should be considered for medical, dental specialty, or hospital referral. It is important to understand that physicians for the most part have only a limited understanding of dentistry just as dentists for the most part have only a limited understanding of medicine. As it is impossible to be comprehensive within an article, readers are directed to texts for further information. Furthermore, it is important for dentists to be able to establish working communication between physicians and dentists in order to best serve the health needs of the patients. ■■■■

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CDA JOURNAL, VOL 35, Nº5

A Simplified Method for Fabrication of New Complete Dentures

LOLA GIUSTI, DDS, AND GABRIELA PITIGOI-ARON, DDS

ABSTRACT This article discusses a simple technique for fabricating a new set of complete dentures when there is a reasonable existing upper and lower denture pair. This method reduces the number of appointments needed, and may be very helpful in treating patients with transportation difficulties, especially when the dentist is able to perform some simple laboratory procedures such as mounting the case on the articulator. The technique is well-suited for a "worn-out" set of complete dentures.

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Many dental school courses in removable prosthodontics teach that five or six appointments are necessary in fabrication of complete dentures.[1] The typical appointment sequence progresses from preliminary impressions (in order to make custom trays), final impressions (for master cast and record base construction), records appointment, trial denture appointment, and insertion and delivery, if all the steps can be verified.[2] When an existing set of complete dentures exhibits extreme wear of the occlusal surfaces, loss of occlusal vertical dimension is often present.[3] In this circumstance, the anterior teeth often begin to fracture or become dislodged from the denture base due to increased vertical overbite, laterotrusive, as well as protrusive forces.

When the patient is basically satisfied with the current prostheses, a new set with proper occlusal function can be of enormous benefit in restoring masticatory ability. The operator may elect to use a different occlusal scheme in order to perfect the patient's evident wear patterns by selection of a different arrangement such as a lingualized set-up. Using the lingualized arrangement (10-degree maxillary posteriors with lingual cusps centered in the fossae of monoplane mandibular posteriors), for example, may be a more appropriate occlusal scheme for a patient than the existing monoplane or cusped set-up. (More information about the lingualized arrangement may be found in the Trubyte technique manual for denture teeth [Dentsply International, York, Pa.], and in some denture texts). The new dentures may also be retrofitted as implant overdentures at a later date.

These changes may be easily accomplished with the proposed method of denture construction herein.

Technique

1. At the first appointment, occlusal vertical dimension is measured, and verified with the existing dentures

FIGURE 1. Existing set of full dentures exhibiting heavy wear on occlusal surfaces.

(**FIGURE 1**). Occlusal vertical dimension may be increased/restored or decreased by up to 3 mm on the articulator.[4]

2. A centric relation record is taken with a bite registration material, and a facebow record is made against the upper denture (**FIGURES 2-3**).

3. A wash of the impression material of choice is placed onto the intaglio surface of the old dentures. Border molding techniques may be used to extend or otherwise improve the fit of the new prostheses (**FIGURES 4-5**).

4. The impressions/dentures are then boxed and poured (stone such as Microstone, Whip Mix, Louisville, Ky., may be used).

5. The master casts are trimmed, indexed, and mounted on the articulator using the facebow transfer and C/R record from Step 2 (quickset plaster such as Mounting Stone by Whip Mix, Lousville, Ky.). Note that the master casts and dentures are not yet separated from the impression media.

6. An index is obtained by closing the mounted maxillary denture into quickset plaster on the remount jig (**FIGURES 6-8**).

7. The dentures may be separated from the master casts, cleaned, and returned to the patient. A record may be made of mold and shade, or new selections may be made.

8. Tooth arrangement is facilitated by the use of the plaster index insofar as incisal edge placement, arch form, and occlusal plane are considered. The case may be delegated to a technician at this point, and arrangement is completed for trial. The operator may decide to skip the trial denture appointment at his or her discretion, if there is confidence in the technique, esthetic parameters, phonetics, etc. A base shade must be selected as well, and the quality of

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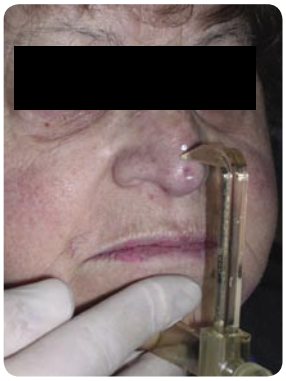

FIGURE 2. Checking occlusal vertical dimension with instrument of choice *(Dr. Hass verticorder shown).*

FIGURE 3. Facebow registration taken from existing full upper denture with Hanau facebow *(Waterpik Inc., Fort Collins, Colo.).*

FIGURE 4. Existing full upper and lower dentures with impressions taken in centric relation, individually or together, as per operator preference, closed mouth technique. The patient is instructed to use only light biting pressure.

FIGURE 5. Existing articulated dentures with impressions within, and C/R record done with Regisil.

FIGURE 6. Remount jig used on lower member of Hanau articulator *(remount record jig 85-0, Waterpik, Inc, Fort Collins, Colo.).*

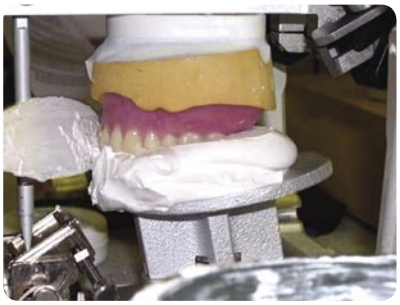

FIGURE 7. Quick-set plaster is used to obtain an index of the existing upper denture. This will guide the dentist or the technician in tooth arrangement.

FIGURE 8. Plaster index used to capture incisal edge position, arch form, and occlusal plane (Step 6), using Mounting Stone.

CDA JOURNAL, VOL 35, Nº5

TECHNIQUE, CONTINUED FROM 352

postdam transmitted to the technician or carved into the master cast by the clinician.

9. The dentures are processed, inserted and delivered as usual.

The limitations of this technique are acknowledged. Without a trial denture appointment, there is no possibility of patient approval of the arrangement. It is suggested that whenever possible a posterior/anterior try-in be made, with vigorous patient participation in the matters of color, shape, and size of teeth, as well as overall approval of the arrangement. Moreover, if the existing dentures are underextended and not corrected (as with bordermolding techniques) in the final impressions, errors may compound and the finished dentures exhibit a collection of compromises. The operator is encouraged to evaluate, in particular, the retromylohyoid spaces and the posterior zygomatic fossae as these important areas are frequently neglected with open-mouth impression techniques.

Conclusion

The authors developed the simplified method for fabrication of complete dentures in response to the many patient complaints they received regarding transportation difficulties and multiple appointments. With this method, the existing dentures are used as custom trays as well as vehicles to carry the master casts to the articulator for mounting. The use of a plaster index expedites tooth arrangement. Following this technique, a new set of complete dentures may be fabricated in two or three appointments instead of the typical five sessions. An interested, trained chairside assistant may support the dentist by participating in tooth selection, separating casts, trimming, indexing, and mounting the dentures with the facebow, cleaning the dentures, and talking with the patient about esthetic expectations, further streamlining the procedure. ■■■■

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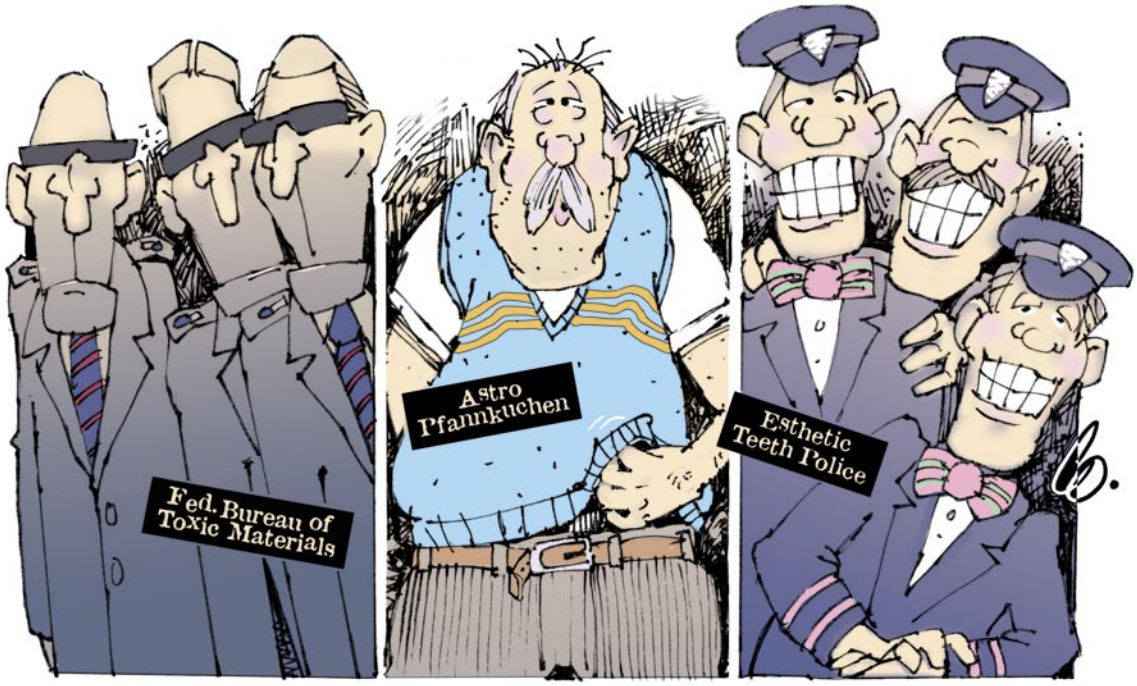
CDA JOURNAL, VOL 35, Nº5

Tooling Down Memory Lane



For reasons that defy analysis, I wanted to do one last amalgam for old time's sake.

Robert E. Horseman, DDS

ILLUSTRATION BY CHARLIE O. HAYWARD

I placed an amalgam the other day. I realize this impetuous, foolhardy act put me in grave risk of being interrogated by Federal Bureau of Toxic Materials enforcers or, at the very least, the Esthetic Teeth Police, White Stuff Division. I would ask their indulgence. For those too young to remember, amalgams were once used extensively as a restorative material. For more than 150 years they were popularly known as "silver" fillings because in the alloy of silver, copper, zinc and mercury, silver sounded classier. It's like when "restoration" replaced "filling"— same thing.

In the mid-1980s, discovery by certain forward-looking entrepreneurs that white looked better in a tooth than black, heralded the advent of the Cosmetic Age in dentistry. More like a rebirth, actually, because up until the mid-20th century a material called "silicate cement" was used to placate the esthetic-minded patient. It was very popular with dentists, having a useful life only marginally longer than a fruit fly.

The discovery, quite by accident, of a couple of ancient amalgam capsules in my lab triggered a wave of nostalgia that became well nigh insupportable. For reasons that defy analysis, I wanted to do one last amalgam for old time's sake. Like riding a bicycle, I was sure the technique would come back to me in spite of the fact that my enamel hatchets, cleoids, discoids, and amalgam pluggers had gone missing, probably encrusted with the verdigris of old age.

My wattles flushing a dusty pink, in less than a week, I had uncovered the hiding place of the amalgamator, an unexpected bonus since the traditional mortar

CONTINUES ON 373

CDA JOURNAL, VOL 35, Nº5

DR. BOB, CONTINUED FROM 374

was absent its pestle — or the other way around, I forget which. The elements were all in place now except for a willing patient.

For a patient, I chose an old friend, Astro Pfannkuchen, whose concession to the Cosmetic Age was a weekly encounter with his Gillette and the occasional brisk scrub with a Mickey Mouse toothbrush I had given him in 1997. It was my duty to explain to him the downside of amalgam, mentioning as casually as I could with an elastic conscience that I had put in enough silver fillings containing the toxic substance mercury to have contaminated every fish in the Pacific this side of the Marianas Trench.

Pfannkuchen, who always appears to be hovering on the verge of syncope, surveyed me vacuously. "Will it hurt?" he quivered, his tiny pig eyes bright with apprehension.

"Nah," I lied buoyantly. "Not half as much as a shot. Open wide."

The one thing I remembered about amalgam was, in the absence of prime-etch-rinse-dry-bond-blow gently-cure-incremental fill-cure, one needed to have the inside of the prep bigger than the outside.

Clearly a job for an inverted cone bur if I had one. No carbides, but I did find a diamond with several of the chips still attached. This would do and I fell to with a will on the occlusal of No. 2, regretting only that I could have enhanced the whole experience greatly had I not thrown away my Doriot handpiece for lack of a belt in 1955.

In less time than it took to build a single mile of the Great Wall of China, I had the amalgam mixed, packed, carved, and ball-burnished, much to the interest of my assistant who clucked dutifully at each procedure. "What will they think of next?" she fluted with more enthusiasm than I had seen for ages. She usually regards my chairside work as among the major soporifics of all times, her ennui cunningly concealed beneath her mask.

In less time than it took to build a single mile of the Great Wall of China, I had the amalgam mixed, packed, carved, and ball-burnished, much to the interest of my assistant who clucked dutifully at each procedure.

Pfannkuchen rejoined the living long enough to inquire how long before he could eat.

"Four hours."

"How long will this silver filling last?"

"Four hours."

"That long!" he exclaimed in wonder.

"Oh, sorry," I replied, still steeped in nostalgia. "I was thinking of silicates. How about 50 years, give or take a month?"

You could speculate on the foregoing until the cows come home, but nostalgia is a two-edged sword and must be indulged judiciously. First thing you know, dark visions of pre-insurance, pre-OSHA, pre-HIPAA and pre-AIDS appear like ghosts of Christmas past until visible waves of despair radiate off you like heat from a diaper drier.

I once made a vulcanite denture in 1940. I wonder if ... ■■■■