

OF THE CALIFORNIA DENTAL ASSOCIATION

# Journal

FEBRUARY 2012

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Medical Consequences

Dentistry-Based Approaches

Oral Appliance Therapies

sleep-disordered  
breathing

MICHAEL S. SIMMONS, DMD



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Michael S. Simmons, DMD; Roy Artal, MD; Miguel A. Burch, MD; Richard P. Cain, MD; Ruwanthi Campano, MD, MS; Harry G. Cohen, MD; Christopher A. Mann, PhD; Todd Morgan, DMD; Judith A. Owens, MD, MPH; Andrew Pullinger, DDS, MSc; Robert R. Rogers, DDS; John M. Roesler, MD; John Sotos, MD; John A. Yagiela, DDS, PhD; Ronald B. Ziman, MD; and Jerald H. Simmons, MD

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## Dental School Debt: Swimming to the Surface or Drowning

RUCHI K. SAHOTA, DDS

It is the 25th day of the month. His rent, \$2,500, is due in five days. Add another \$1,000 for his car and professional insurance policies. The bill for his malpractice and disability insurance for \$300, due at the end of the month, is on his desk.

And then there are his student loans. He had to borrow more than \$200,000 to pay for school. Every 30th of the month, his monthly loan payment is \$2,200. He has to pay this every month for the next 15 years.

He needs to earn \$6,000 every month just to pay these bills. He has a good associateship but the economy is still bad. His days have been cut. One day, he wants to start or buy a practice. They say he will need at least another \$500,000 — all up front. That's just to open the doors. That's another \$5,000 a month — on top of the \$6,000 he already has to pay every month. And that doesn't include the office rent and staff salaries.

How will he ever get there?

Every month, this is a very familiar fear for many new graduates struggling to make a living and to pay their bills.

In California schools, there are some students with nearly \$600,000 in loans. In 2010, the American Dental Education Association reported that more than 90 percent of all graduating seniors reported some sort of loan to finish their education and that more than 44 percent of dental students in private schools accrued more than \$200,000 of debt.<sup>1</sup> Public dental schools are no different. In 2009, ADEA reported that 20 percent of dental students in public dental schools have more than \$250,000 of debt.<sup>2</sup>

As with all graduate studies, the cost of a dental education continues to rise. Facility costs, technology improvements,



**Despite the sticker price,  
the number of dental school applicants  
continues to rise each year.**

staffing costs and competitive salaries for high-quality educators are needed to train high-quality clinicians.

Despite the sticker price, the number of dental school applicants continues to rise each year. It is more competitive to gain admission. It takes hard work, lots of heart, and complete dedication. Once in school, we regularly visit the financial-aid office. A simple ballpoint pen and our signature provide a fresh, crisp check. Those checks silently add up. And then graduation finally comes. We are eager to get on with life. But it is then one job interview after another. The bad economy becomes personal. Our hearts drop. What did we get ourselves into? The grace period for the loan repayment is ending. The 30th of the month is now inescapable.

Through the ADA-sponsored Smart-Start SUCCESS program seminars at California's dental schools, I speak to students about debt load. We teach them the financial principles of student loans. We warn about the ramifications of compounded interest, "It is like a snowball down a snowy hill, getting bigger and bigger as it goes ... Compounding the interest on ... your debts will increase the total amount that you owe, impacting your financial picture." A physician in Ohio reported watching her debt more than double from \$250,000 to \$555,000 dollars. Unable to pay her loan back, her credit rating sank, leaving her un-

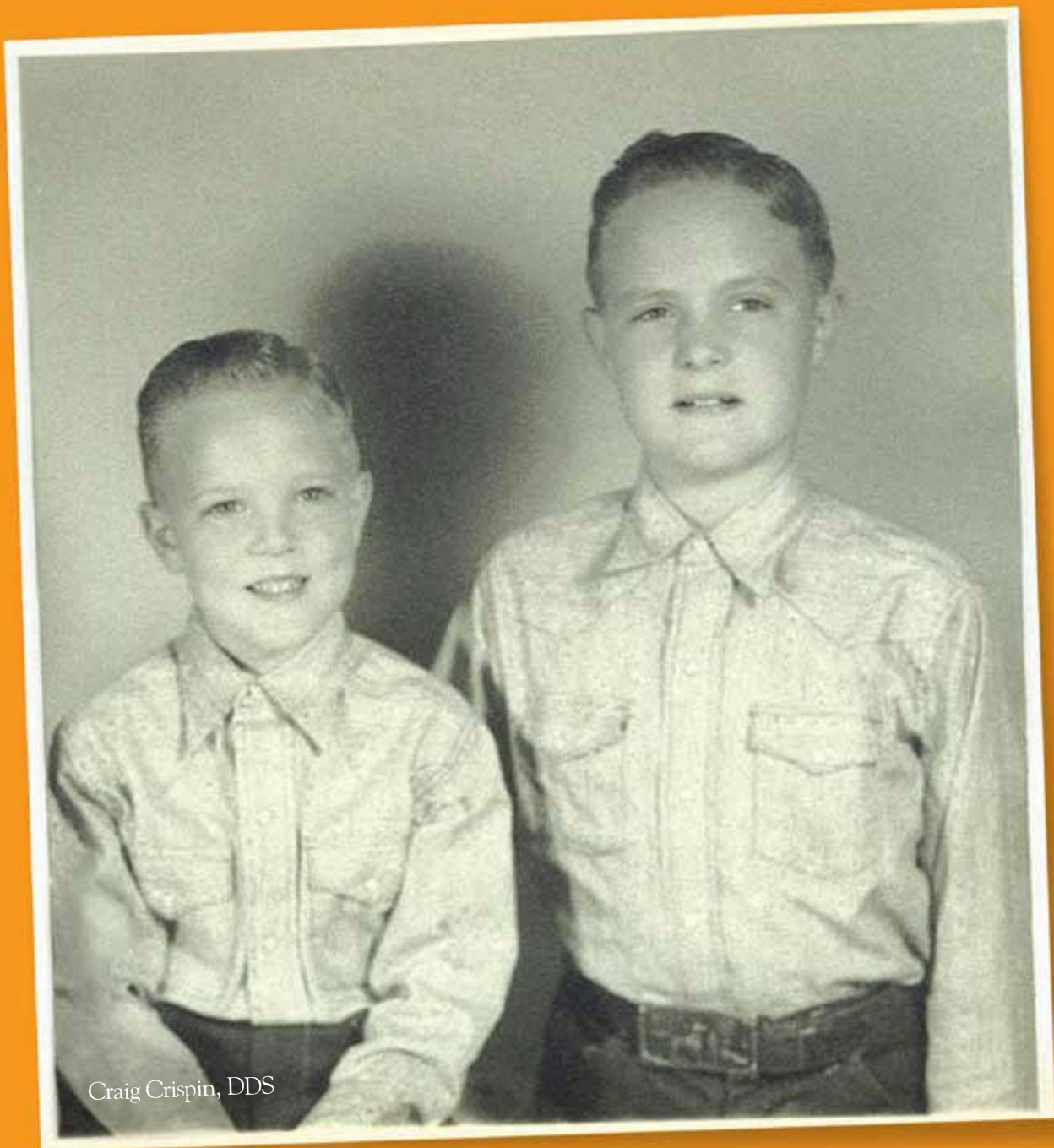
able to buy a car or home. She was left with a sense of utter hopelessness.<sup>3</sup>

We also teach them to calculate the realistic necessary amount they need to borrow. "Home life ceases to be free and beautiful as soon as it is founded on borrowing and debt," remarked Henrik Ibsen. We teach that it is prudent to borrow only what is needed. We urge students to look into student loan consolidation, graduated repayment programs, and service-connected repayment programs.

Interest rates are at the heart of the issue — inciting the actual, final, and significant repayment dollar value, said Dr. Michael Meru, former American Student Dental Association president. Meru pointed out the sizable disparity between potential student loan interest rates (roughly 6.5 to 9 percent) and a 30-year fixed home loan interest rates (currently in the 4 percent range). "We need to lobby for better interest rates because the real cost of attendance and thus cost of education is not incurred during school. The staggering blow often comes once we realize the final repayment amount, after the interest rate has piled up."

Facing the magnitude of this debt is daunting. Dentists, dental school administrators, and current dental students on studentdoctor.net share options on how to manage this debt. Facing a \$420,000 debt

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Craig Crispin, DDS

### **He nearly lost a tooth, but gained a profession.**

When Craig Crispin was 6, his older brother tied his hands behind his back and took him prisoner. What happened next changed the rest of his life. As he walked up some steps, he tripped and landed on his front teeth. He didn't knock them out, but it wasn't good. His parents took him to a dentist, who advised that since the root hadn't formed, they should wait and see. Maybe the tooth would heal. Almost a year later, his tooth turned white again. It was magic. And Crispin was hooked.

**Stories. Everybody  
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Some people have a career. The lucky ones have a calling, a passion for dentistry that likely began in an illuminating moment. For some, it was the first time they set foot in a dental office, or the magic of seeing a tooth that came back to life.

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## EDITOR, CONTINUED FROM 101

and scarce job prospects in California — one student forum entry on this website considers “moving to a higher income state.”

In the past, we may have been able to set up a practice where we wanted to live. In light of this down economy, scarce job prospects and the pressures of high debt, practicality forces other options.

One option many consider is moving to a practice location where starting a practice is less constrained by competition and the economy. As a temporary measure in one's life, some may save money and ride out the economy for three to five years. This will provide less debt pressures and greater freedom to then move anywhere without that pressure.

The magnitude of this debt may have other far-reaching implications. The best and the brightest may not consider the cost for this education worth the money. After finishing school, the pressure to pay this debt and make a living may limit those who may consider a career serving the underserved or teaching.

Ten years ago, the California Dental Association Foundation started a program to provide grants to new dentists to repay dental school loans in exchange for serving in an underserved area. Currently, each grant provides \$35,000 over three years if the educational loans amount to \$105,000 or more. This program allows new dentists whose passion is public health to pursue their goal by reducing the pressure of debt.

Each recipient has provided an average of about \$1.5 million dollars in services over their grant term. Once all of the current 11 recipients complete their grant terms, the program will have helped provide approximately \$16.5 million in oral health services.

All of the CDA Foundation's grant recipients have chosen to continue to serve those underserved populations. But

our Foundation program can help only one dentist a year. State governments, private foundations, and even communities without a dentist can consider this solution for their community.

In 2002, an article in the *Journal of the California Dental Association* concluded that larger debt correlated with delayed practice ownership. Over a 10-year period, as educational debt increased, the duration from graduation to the onset of starting or acquiring a practice also increased.<sup>4</sup>

Almost 10 years later, the economy has dipped and the ratio of dentists to available positions seems to have also increased. It seems more difficult to have a five-day-a-week “job” within the first five years of graduation. An online *Wall Street Journal* article, “The Student Loan Effect,” in late 2010 reported that many medical and law school graduates are straining to find jobs because of the high saturation in desirable locations. The article further reports that these new professionals are delaying marriage and children after graduations.<sup>3</sup>

Debt pressure can influence practice decisions. When there is an overarching monthly bill to pay, will there be decisions driven by money? There may be some very real ethical decisions and challenges facing this generation. As it is aggregated, can this debt cause our profession to encroach boundaries we would rather not enter?

The national debt is nearly \$15 trillion. National student loan debt has exceeded national credit card debt. As the payment for our school debt comes every 30th of the month, the national debt numbers become personal. Our nation and our generation are drowning in debt.<sup>5</sup>

There have been studies looking at the root cause of debt in dental education. There are articles and commentaries that describe the struggle. But this is not enough. Let us call upon the CDA House

of Delegates as well as the ADA House of Delegates to help us find sustainable solutions. The marketplace has changed. New dentists struggle to make a living.

It is in the self-interest of those ahead of us in the profession to look at the big picture of how debt affects the profession. “The bow may steer the canoe, but if the rudder is impaired, the course becomes unpredictable.” We must paddle together in this journey to reach our destination. ■■■■

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## ADDITIONAL RESOURCE

[nces.ed.gov/pubns2008/2008179rev](http://nces.ed.gov/pubns2008/2008179rev).

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Matt Mullin

## Muda Ethics

BY DAVID W. CHAMBERS, PHD

“Muda” is a Japanese word for an activity that is wasteful or unproductive. The West became familiar with it through the quality movement. Here is how the concept of “muda” relates to ethics in oral health care:

Reduced waste promotes quality, which leads to reduced cost. Because health care is a limited resource, reducing cost means that more people can have better oral health. It is unethical to raise costs unnecessarily or to avoid taking reasonable steps to reduce cost. At least that is what most of us think about cable TV monopolies, insurance companies, and government services.

Waste is any activity that does not add value. Would patients pay to sit in the waiting room? Would they pay for a full-mouth X-ray series having just had one before moving to a new town? Would they pay

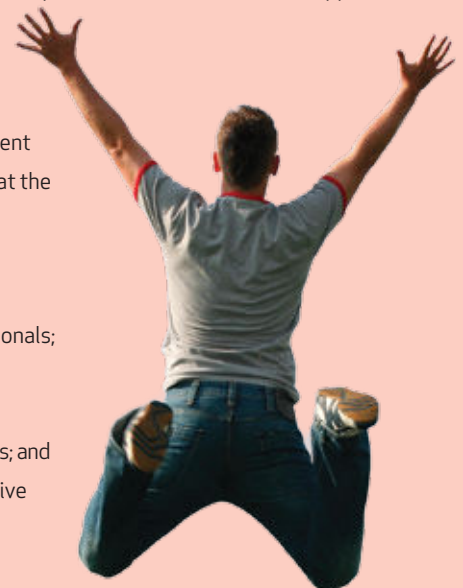
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## On Being Happy

Although recent studies have shown that people are born with a genetically determined “happiness set point,” Michael Prazich, DDS, a certified life coach who works with health care professionals, has said that happiness can be learned, even by the perennially unhappy.

Over the years, Prazich has noticed certain traits that happy dentists exhibit and that, with a little effort, self-identifying unhappy dentists can use to achieve happiness. In a recent issue of *Northwest Dentistry*, Prazich listed the following traits that the happiest people tend to have:

- They are comfortable expressing gratitude;
- They make physical exercise a weekly or even a daily habit;
- They are often first to offer aid to friends or fellow professionals;
- They devote a great amount of time to family and friends;
- They have interests and passions outside their profession;
- They maintain poise and strength when coping with challenges; and
- They are more sociable, energetic, charitable, and cooperative than unhappy people.





### Gum and Hard Candy Can Help Prevent Caries

A multidisciplinary expert panel has actually recommended gum and hard candy in preventing caries in high-risk patients. That is, provided of course, the gum is sugar-free and the lozenges contain xylitol or polyol combinations, and are combined with varnishes.

The panel, convened by the American Dental Association's Council on Scientific Affairs, said in its report that these non-fluoride options could provide an extra benefit to prevent cavities in patients at high risk for developing cavities when used in addition to products such as toothpaste, dental sealants, varnishes that contain fluoride, as well as community water fluoridation, and good eating habits.

The ADA recommended that clinicians determine a patient's risk for developing cavities by conducting a caries risk assessment, which includes completing a caries risk assessment form that can be used as a communications tool with their patients.

In addition to a comprehensive cavity-prevention program that includes the use of fluoride, the scientific panel recommended that clinicians consider applying a mixture of chlorhexidine-thymol varnish to the teeth of high-risk adults and the elderly every three months to reduce cavities developing in the root of the tooth. The panel encouraged clinicians to consider advising parents and caregivers of healthy children older than age 5 who are at higher risk for cavities to chew sugar-free polyol gum after meals for 10 to 20 minutes to prevent cavities.

The panel's recommendations are based on a review of evidence from 71 published articles that described 50 randomized controlled trials and 15 nonrandomized studies to assess the effectiveness of various nonfluoride agents in preventing cavities.

To see the full report, which is available on the ADA's Center for Evidence-Based Dentistry website, go to [ebd.ada.org/contentdocs/clinical\\_recommendations\\_non-fluoride\\_caries\\_preventive\\_agents\\_full\\_report.pdf](http://ebd.ada.org/contentdocs/clinical_recommendations_non-fluoride_caries_preventive_agents_full_report.pdf).

### Healthy Plate Menu Updated

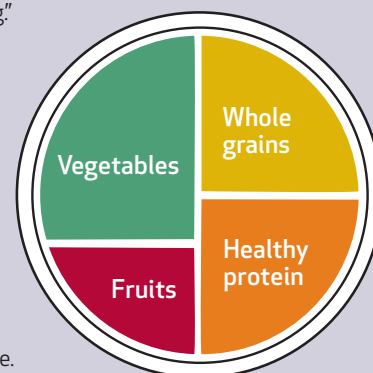
Healthy Eating Plate, which provides guidance via visuals for healthy repasts, has been launched by Harvard Health Publications, in partnership with Harvard School of Public Health nutrition experts.

Similar to the U.S. government's version of MyPlate, Healthy Eating Plate is straightforward and "addresses important deficiencies in the MyPlate icon," according to a news release.

"Unfortunately, like the earlier U.S. Department of Agriculture Pyramids, MyPlate mixes science with the influence of powerful agricultural interests, which is not the recipe for healthy eating," said Walter C. Willett, MD, DrPH, professor of Epidemiology and Nutrition and chair of the Department of Nutrition at HSPH. "The Healthy Eating Plate is based on the best available scientific evidence and provides consumers with the information they need to make choices that can profoundly affect our health and well being."

The Healthy Eating Plate is based on the latest scientific evidence showing that a plant-based diet rich in vegetables, whole grains, healthy fats, and healthy proteins lowers the risk of weight gain and chronic disease. In the United States, two in three adults and one in three children are overweight or obese. Healthy Eating Plate emphasizes an active lifestyle, a critical factor in controlling one's weight.

"We want people to use this as a model for their own healthy plate or that of their children every time they sit down to a meal — either at home or at a restaurant," said Eric Rimm, associate professor of Epidemiology and Nutrition at HSPH and a member of the 2010 U.S. Dietary Guidelines Advisory Committee.



## Dental X-rays Can Predict Risk for Bone Fractures

By using dental X-rays to investigate the bone structure in the lower jaw, it's now possible to see who's at risk of future fractures, according to researchers at Sahlgrenska Academy.

"We've seen that sparse bone structure in the lower jaw in midlife is directly linked to the risk of fractures in other parts of the body, later in life," said Lauren Lissner, PhD, a researcher at the Institute of Medicine at the Sahlgrenska Academy.

The study, which recently was published in the journal, *Bone*, draws on data from 1968 with the Prospective Population Study of Women in Gothenburg, included 731 women, who have been examined on several occasions since 1968, when they were 38-60 years old. X-ray images of their jawbone were analyzed in 1968 and 1980, and the results related to the incidence of subsequent fractures.

For the first 12 years, according to a news release, fractures were self-reported during follow-up examinations. It is only since the 1980s that it has been possible to use medical registers to identify fractures. A total of 222 fractures were identified during the whole observation period.

The study shows that the bone structure of the jaw was sparse in around 20 percent of the women aged 38-54 when the first examination was carried out, and that these women were at significantly greater risk of fractures.



## MUDA ETHICS, CONTINUED FROM 107

for fixing joint pain from a crown that was too high? Would dentists pay themselves what they pay a hygienist or assistant when doing work that can be delegated?

The muda concept begins by envisioning an office that runs smoothly, giving every patient exactly what is required the first time in the most efficient manner possible. Everything that falls short of that ideal is waste; it adds to cost without contributing value. Some offices work continuously to reduce waste; others are content to accept some level of waste. A few team members even celebrate their skill at fixing problems and would dread the prospect of losing that opportunity. This is muda by design. And anybody who sees an opportunity to increase their personal influence or profit from inefficiency will be a closet critic of quality.

The experts tell us there are eight categories of waste. Defects are an obvious example. Somebody has to pay for redos or for work that is not as serviceable as what could have been done instead. Overproduction is a second type. In the dental office, this includes overtreatment and performing work before it is needed. Moving

things around unnecessarily and waiting are also examples of waste. Patient scheduling inefficiencies is the obvious example, but staff members can also be affected. Reducing unproductive motion is one area where dentistry has driven down muda. But overprocessing, doing work to standards above what is required, is a type of waste that professionals tend to embrace. It is understandable that experts will want to use all of their talent, but it is uncertain that treating one patient to the acme of care is better than treating two to a professionally acceptable level. The squandering of talent is a final kind of waste.

The Nub:

1. Ethics is a pattern, not an event. We are judged by the overall impact of our lives, not specific acts that we select for evaluation.
2. Oral health care resources are limited: it is unethical to waste them.
3. It is better to design systems that minimize waste than to become famous for fixing symptoms.

David W. Chambers, PhD, is a professor of dental education, Arthur A. Dugoni School of Dentistry, San Francisco, and editor of the *Journal of the American College of Dentists*.



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### Emerging Evidence Base in Third-Molar Management

For several generations now, dental treatment of third molars has been based on clinical impressions rather than on published scientific data, said Matthew Dennis, DDS, in an issue of the *Journal of the Michigan Dental Association*. But, as he noted, “questions about third-molar management are beginning to be answered.”

Impacted third molars, because of the lateness of their emergence, should always be evaluated for removal or observation. Most impactions involve arch length that is less than total tooth mass, resulting in inadequate space for eruption to occur.

The average age for eruption of third molars is 20, but some eruptions can occur as late as 25. Predicting eruption is, Dennis said, an inexact science, requiring radiographic as well as clinical evaluation.

“Even when symptom-free, two-thirds of young adult subjects were found (by the clinical trials) to have periodontal pathology in their third-molar regions,”

wrote Dennis regarding indications for third-molar removal, including findings in the American Association of Oral and Maxillofacial Surgeons’ Third Molar Clinical Trials that show an association of third molars and periodontal disease.

Dennis said that the trials suggest that the inaccessible third-molar anatomy can harbor periodontal pathogens in up to four-fifth of patients with third-molar symptoms. “A large review of population and clinical studies with more than 8,000 subjects showed that patients with third molars had a worsened periodontal status on other teeth in the quadrant over those patients without third molars.” Other conditions that may have greater incidences associated with third-molar impactions are pericoronitis and caries.

Dennis explained how dentists can deal with impacted teeth that may be coming in under prostheses, including fixed-dental restoratives. “Partially erupted teeth almost always cause problems with an overlying prosthesis and must be removed prior to denture fabrication.”

### Parents of Autistic Children Have New Oral Health Resource

The National Museum of Dentistry has created “Healthy Smiles for Autism,” an oral health resource for parents of autistic children.

The guide helps parents teach children with autism spectrum disorder how to brush and floss with the assistance of step-by-step instruction, social stories, and visual sequencing cards that can be used wherever brushing happens. This guide is free and downloadable at [healthysmilesforautism.org](http://healthysmilesforautism.org). The guide also provides information to help parents prepare their children for a first dental visit.

“We want to be able to give parents readily usable tools to help their children to develop a good oral hygiene regimen,” said Jonathan Landers, National Museum of Dentistry executive director. “We’ve combined best practices for autism education, such as visual sequencing cards and rewards systems, with proven personal oral hygiene techniques to help make the process a little bit easier.”

Dental care is the leading unmet health care need among children with special needs, and across all income levels, children with special needs are almost twice as likely to have an unmet oral health care need than their peers without special needs, according to the National Maternal and Child Oral Health Resource Center



## Leukocyte- and Platelet-Rich Fibrin an Excellent Option for Heart Patients

For those cardiac patients on anticoagulant medications and who need a tooth extraction, it is important for the treating clinician to have a protocol that will help prevent major bleeding following dental extractions without suspending anticoagulant therapy.

In an issue of the *Journal of Oral Implantology*, a study evaluated the use of leukocyte- and platelet-rich fibrin biomaterial, which is commonly used in dentistry to improve tissue regeneration and healing. It was tested as a safe filling and hemostatic material after dental extractions in 50 heart patients undergoing oral anticoagulant therapy, according to a news release.

The heart patients in the study had mechanical valve substitutions and were placed on anticoagulant oral therapy with warfarin. It is not recommended to suspend the anticoagulant and replace with heparin prior to minor surgery, although this substitution may control the risk of postoperative bleeding.



Using a platelet-rich plasma placed in postextraction tooth sockets is way of controlling bleeding without suspending the anticoagulant. While this method has shown some success, barriers to daily use exist: The platelet concentrates take a long time to prepare and it is expensive.

An alternative biomaterial that is simple and inexpensive to prepare, platelet-rich fibrin has proven useful in daily dental practice as filling material for regeneration in order to place implants.

## New Contract Restricts Tobacco Use in Professional Baseball

A new Major League Baseball contract limits tobacco use in ballparks; and the coalition initiated by the American Dental Association, nine major health organizations, as well as more than 200 local, state and national supporters couldn't be happier.

Managers, coaches, and players no longer may carry tobacco containers or packages in their uniforms at games or any time fans are in the ballpark, according to the contract agreement announced following the 2011 baseball season. Additionally, they are prohibited from using smokeless tobacco during interviews that are televised, at autograph signings, and any other occasions where they are in contact with fans or at team-sponsored appearances. The restrictions take effect in 2012.

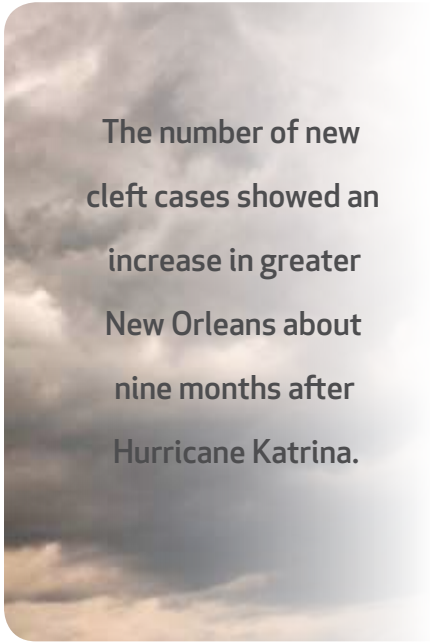
The agreement, according to a news release, enhances tobacco education programs for players and creates a new Major League Baseball Players Association center on cessation to help these athletes

quit. "This is significant progress," said the coalition. "We continue to support a complete prohibition on tobacco use at games and on camera."

"In light of the serious health risks from smokeless tobacco — it causes oral cancer and has been linked to heart disease and pancreatic cancer — players should be encouraged to quit and be given support to help them do so," according to the letter signed by officials of the Campaign for Tobacco-Free Kids, American Academy of Pediatrics, American Cancer Society, American Dental Association, American Heart Association, American Lung Association, American Medical Association, Legacy, Oral Health America, and the Robert Wood Johnson Foundation.

The 10 initial member organizations offered to collaborate with the players association "toward a smokeless tobacco prohibition that would be in the best interests of baseball, the players and the millions of young people who watch their idols," according to a news release.





The number of new cleft cases showed an increase in greater New Orleans about nine months after Hurricane Katrina.

### More Plans Needed for Treating Cleft-Lip Palate Patients During Chaotic Times

An issue of *Cleft Palate-Craniofacial Journal* recently called for the need to establish standards for continuing care for children with craniofacial anomalies during times of natural or man-made upheaval.

In general, medical care for cleft lip or palate is offered in carefully planned phases with comprehensive care provided by a team of professionals. However, when a crisis occurs, such as a natural disaster or political unrest, this standard of care is disrupted. For example, when Hurricane Katrina struck New Orleans in 2005, Children's Hospital housed one of the two craniofacial teams in the city. Lessons learned during the hurricane's aftermath have led to new policies for the hospital, according to a news release. When evacuating its facility became necessary, the hospital set up a temporary location at a Baton Rouge clinic 80 miles away and a satellite clinic in Lafayette, about two hours away. The hospital has continued to work with these locations as satellite sites in case future evacuations are required.

One of the articles in the issue addressed craniofacial care in locations where disaster and unrest have cre-

ated difficult conditions. Another paper discussed an emerging trend of a higher incidence of craniofacial anomalies after a disaster. A third article suggested that guidance is needed for domestic and global crisis-relief programs.

The review also discovered that communications with patients were found to be lacking following Hurricane Katrina. Hospital staff was unable to contact many patients' families to inform them when and where they could expect medical care for craniofacial anomalies. Before this disruption, the mail had served as the primary means of communication. Mobile phone numbers and e-mail addresses now are collected as part of routine patient information.

In another article, the number of new cleft cases showed an increase in greater New Orleans about nine months after Hurricane Katrina. Researchers found that the increase, particularly among African-Americans, could be attributed to higher levels of teratogenic agents or elevated stress levels following the hurricane, according to a news release.

Hurricane Katrina and other catastrophic events in recent years have shown a need for guidance in crisis-relief programs. No such standards currently exist for cleft and craniofacial care. As presented in another article in this issue, principles set forth by the American Cleft Palate-Craniofacial Association may provide such guidance. The authors recommended using this document as a template for international clinical care programs. This would provide standards for examining the conduct of relief programs and ensuring that medical teams are effective, ethical, and culturally sensitive.

The article, "Flood, Disaster, and Turmoil: Social Issues in Cleft and Craniofacial Care and Crisis Relief," was published in the *Cleft Palate-Craniofacial Journal* (volume 48, no. 6, November 2011).

#### UPCOMING MEETINGS

##### 2012

|                  |                                                                                                                                                                   |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| March 29-April 1 | CSPD/WSPD Annual Meeting, Portland, Ore., <a href="mailto:drstewart@aol.com">drstewart@aol.com</a>                                                                |
| April 22-28      | United States Dental Tennis Association's 45th Annual Spring Meeting, Kiawah Island, S.C., <a href="http://dentaltennis.org">dentaltennis.org</a> or 800-445-2524 |
| April 26-28      | World Federation for Laser Dentistry, 13th Annual World Congress, Barcelona, Spain, <a href="http://wfldbcn2012.com">wfldbcn2012.com</a>                          |
| May 3-5          | CDA Presents the Art and Science of Dentistry, Anaheim, 800-CDA-SMILE (232-7645), <a href="http://cdapresents.com">cdapresents.com</a>                            |
| Oct. 18-23       | ADA 153rd Annual Session, San Francisco, <a href="http://ada.org">ada.org</a>                                                                                     |

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



The Art  
and Science  
of Dentistry

Save the  
date!

Anaheim,  
California

Thursday-  
Saturday  
May 3-5,  
2012

[cdapresents.com](http://cdapresents.com)





**Lee Ann Brady, DMD**

## **Restorative Dentistry/Occlusion**

Anterior Esthetic Techniques and Materials  
*Thursday morning lecture*

Occlusion in Everyday Dentistry  
*Thursday afternoon lecture*

Fabricating Exquisite Anterior Provisionals  
*Friday workshop*



**Dennis G. Brave, DDS  
Kenneth A. Koch, DMD**

## **Endodontics**

Changing Paradigms in Endodontic Therapy  
*Thursday lecture*

Changing Paradigms in Endodontic Therapy Workshop  
*Friday workshop*



**Gerard J. Chiche, DDS**

## **Cosmetic**

Smile Design, Occlusal and Esthetic Techniques  
*Saturday lecture*



**Karen Davis, RDH, BSDH**

## **Dental Hygiene**

America's Sweet Tooth Obsession and Its Impact on Oral and Systemic Health  
*Saturday morning lecture*

Creating the Ultimate Doctor-Patient Hygiene Exam  
*Saturday afternoon lecture*



**Terence E. Donovan, DDS**

## **Dental Materials**

Restoration of the Worn Dentition  
*Friday lecture*

Update in Contemporary Restorative Dental Materials  
*Saturday lecture*



**Robert C. Fazio, DMD**

## **Periodontics**

Antibiotics and Dentistry  
*Friday morning lecture*

Medicine, Dentistry and Drugs  
*Friday afternoon lecture*

Periodontitis and Peri-Implantitis: The Good, the Bad and the Ugly  
*Saturday lecture*



**Henry A. Gremillion, DDS**

## **Occlusion**

The Dynamics and Function of the Masticatory System:  
The Multiple (Inter)Faces of Occlusion  
*Friday lecture*



**Gerard Kugel, DMD, MS, PhD**

## **Esthetic Dentistry**

The Do's And Don'ts of Porcelain Laminate Veneers  
*Thursday workshop*

Esthetic Dentistry: Materials and Techniques Update  
*Friday lecture*



# CDA's Night at Disney

Oh, what a night it will be. Just \$65 gets you a Twilight Park Hopper® Ticket and all the fun at both *Disneyland*® and *Disney California Adventure*® Park, plus a \$25 meal voucher to enjoy in the theme parks. Join in the fun at CDA's Night at Disney.

**Date:** Friday, May 4, 2012  
**Time:** 4 p.m. – Park Closing (Midnight for *Disneyland*® and 10 p.m. for *Disney California Adventure*® Park)  
**Event #:** 055  
**Fee:** \$65

Purchase tickets at [cdapresents.com](http://cdapresents.com)



## Exhibit Hall

*CDA Presents* will feature more than 550 exhibiting companies showcasing the latest in dental technology, products and services. Stay ahead of the curve by exploring the innovative new products being launched in the exhibit hall.

**Thursday–Saturday,  
May 3–5, 2012**

**Visit [cdapresents.com](http://cdapresents.com) to maximize  
your tradeshow experience.**

### Grand Opening

**Thursday, 9:30 a.m.**

### New Exhibit Hall Days and Hours

**Thursday, May 3, 9:30 a.m.–5:30 p.m.**

**Friday, May 4, 9:30 a.m.–5:30 p.m.**

**Saturday, May 5, 9:30 a.m.–4:30 p.m.**

### Family Hours

**Daily, 9:30 a.m.–noon**





Join us for interactive wine activities and trivia. You'll learn to distinguish the various scents and flavors in wine by tasting both white and red varietals and about pairings with both cheese and chocolate. Plus, you'll have the opportunity to put your knowledge to the test and win prizes!



This contemporary lounge in the exhibit hall features a Cool Product display, Net Café and charging station, a C.E. Pavilion, and an educational theater that is the venue for the Smart Dentist Series of free, one-hour lectures.

### Thursday

- |                 |                                                                                              |
|-----------------|----------------------------------------------------------------------------------------------|
| 9:30–10:30 a.m. | Nutrition (C.E.: none)<br><i>Juli Kagan, RDH, MEd</i>                                        |
| 11 a.m.–noon    | Establishing an Office Policy Handbook (C.E.: 20% – 1.0)<br><i>Robyn Thomason</i>            |
| Noon–1 p.m.     | Handling Refund Requests From Insurance Plans (C.E.: 20% – 1.0)<br><i>Patti Cheesebrough</i> |
| 1–2 p.m.        | Nutrition (C.E.: none)<br><i>Juli Kagan, RDH, MEd</i>                                        |

### Friday

- |                 |                                                                             |
|-----------------|-----------------------------------------------------------------------------|
| 9:30–10:30 a.m. | Yogernomics (C.E.: 20% – 1.0)<br><i>Juli Kagan, RDH, MEd</i>                |
| 11 a.m.–noon    | Patient and Parent Communication (C.E.: 20% – 1.0)<br><i>Katie Fornelli</i> |
| Noon–1 p.m.     | Managing Patient Conflicts (C.E.: 20% – 1.0)<br><i>Brooke Kozak</i>         |
| 1–2 p.m.        | Yogernomics (C.E.: 20% – 1.0)<br><i>Juli Kagan, RDH, MEd</i>                |
| 4–5:30 p.m.     | Wine Seminar (Ticket Required)                                              |

### Saturday

- |                    |                                                                                              |
|--------------------|----------------------------------------------------------------------------------------------|
| 9:30–10:30 a.m.    | Staff Building (C.E.: 20% – 1.0)<br><i>Art Wiederman, CPA</i>                                |
| 11 a.m.–12:30 p.m. | Making the Best Decisions for Your Practice (C.E.: 20% – 1.5)<br><i>William Van Dyk, DDS</i> |

Check the On-Site Show Guide for updated program information.

### Save time and money and reach all the CDA hotels with one phone call.

Our ability to offer you the best conference dates and competitive hotel rates is directly tied to the number of rooms that are reserved under our block in the Anaheim Resort.™ Reserve early to get the hotel of your choice. A limited number of rooms is available at these preferred rates, so call CDA's Housing Bureau as soon as possible. Every effort will be made to accommodate your first hotel choice. If your requested hotel is not available, CDA's Housing Bureau will confirm comparable accommodations for you. **Hotel reservations must be made by April 6, 2012.**

#### Phone

714.765.8868

Office hours are 8:30 a.m.–5 p.m., Pacific Time.

#### Fax

714.776.2688

#### Online/New Reservations

Making reservations is easier than ever. Just log onto **cdapresents.com**, and you can make your hotel reservation. The online service has been upgraded to be more convenient and flexible in making and changing reservations. You may phone, fax, complete the online housing form, or write to make your reservations. Be sure to have a copy of the housing form and your credit card information on hand if you call, or complete the housing form and mail or fax to CDA's Housing Bureau. Please do not do both!

#### Reservation Acknowledgments

Will be sent to you directly from CDA's Housing Bureau.

#### Mail

CDA Housing Bureau  
800 W. Katella Ave.  
P.O. Box 4270  
Anaheim, CA 92803

#### Deposit/Cancellation Policy

Reservations will only be accepted with a credit card or check payment. All credit cards will be charged a one-night room and tax deposit. Check must be made payable to requested hotel.

Reservations must be canceled before 5 p.m. Pacific Time on Friday, March 9, 2012, to receive a full refund. Reservations canceled after 5 p.m. Pacific Time on March 9, but before 5 p.m. Pacific Time on Friday, April 6, 2012, will be charged a \$35 processing fee per room. **Cancellations received after 5 p.m. Pacific Time on April 6, 2012, will forfeit their entire deposit.**

Be sure to include a return fax number or email address in case of questions or problems with the fax transmission. Make reservations as soon as possible through CDA's Housing Bureau, by April 6, 2012. After this date, reservations will be made on a space-available basis. **Do not mail or fax forms to CDA headquarters because this will delay your request.**

#### Changes, Cancellations, Refunds

All changes, cancellations and refund requests must be made in writing directly with CDA's Housing Bureau. This can be done by mail, fax or email ([iesparza@anaheimoc.org](mailto:iesparza@anaheimoc.org)). An acknowledgment of your request will be sent to you once it has been completed. Refund and cancellation requests must be received prior to March 9, 2012, for full refund of hotel deposit. **Reservations canceled after 5 p.m., Pacific Time April 6, 2012, will forfeit their deposit.**

## Reservation Deadline: April 6, 2012

(After this date, reservations will be made on a space-available basis.)

ONLINE:  
Book online anytime:  
cdapresents.com

MAIL TO:  
CDA Housing Bureau  
800 W. Katella Ave.  
P.O. Box 4270  
Anaheim, CA 92803

PHONE:  
714.765.8868  
Office hours are:  
8:30 a.m.–5 p.m., PT

FAX:  
714.776.2688

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

Phone \_\_\_\_\_ Fax \_\_\_\_\_ Email \_\_\_\_\_

Name of person making the reservation \_\_\_\_\_

Please indicate how your hotel selection was made: Location \_\_\_\_\_ Rate \_\_\_\_\_

| HOTEL PREFERENCE |            |
|------------------|------------|
| 1st choice _____ | Rate _____ |
| 2nd choice _____ | Rate _____ |
| 3rd choice _____ | Rate _____ |

| *ROOM TYPE                                                                                                          |                    |
|---------------------------------------------------------------------------------------------------------------------|--------------------|
| <i>*Room types vary by hotel. Please call the housing bureau for details, including suite information and rates</i> |                    |
| (1) Single                                                                                                          | (1 person)         |
| (2) Double                                                                                                          | (2 people, 1 bed)  |
| (3) Double/Double                                                                                                   | (2 people, 2 beds) |
| (4) Triple                                                                                                          | (3 people, 2 beds) |
| (5) Quad                                                                                                            | (4 people, 2 beds) |

| NAMES OF OCCUPANTS | ARRIVAL | DEPARTURE | ROOM TYPE<br><small>*List corresponding # for room type</small> |
|--------------------|---------|-----------|-----------------------------------------------------------------|
|                    |         |           |                                                                 |
|                    |         |           |                                                                 |
|                    |         |           |                                                                 |

CREDIT CARD INFORMATION *All rooms require a deposit in the amount of a night's lodging at the time of booking.*

### ADDITIONAL RESERVATION INFORMATION:

- Reservations will not be processed without a first night's deposit.
- If you are making more than one reservation, you will need to provide a card and billing address for each room.
- Billing address should be provided if different than address of card holder.
- Once a credit card deposit has been applied to a reservation, it cannot be transferred to another card.
- Once a deposit has been posted to a reservation, it cannot be transferred to another reservation.
- Each credit card must be valid through the reservation dates of the stay.
- To pay by check, make check payable to requested hotel.
- For fax or group reservations, you will receive a confirmation within five business days.
- No refunds on room deposits will be given after April 6, 2012.**

Credit card number \_\_\_\_\_ Exp. date \_\_\_\_\_

Signature \_\_\_\_\_ Print name as it appears on card \_\_\_\_\_

**IMPORTANT – PLEASE READ:** If you do not receive a confirmation within five days, please call for assistance. Please note duplicate/double booking of reservation will result in "No show" charges on your credit card. **Deposit policy:** Reservations will only be accepted with a credit card or check payment. All credit cards will be charged a one-night room and tax deposit at the time of reservation. Reservations and changes are subject to hotel availability. **Cancellation policy:** All cancellations must be made in writing through the CDA Housing Bureau. Reservations must be canceled before 5 p.m. Pacific Time on Friday, March 9, 2012, to receive a full refund. Reservations canceled after March 9, but before 5 p.m. Pacific Time on Friday, April 6, 2012, will be charged a \$35 processing fee per room.

**No refunds on room deposits will be given after April 6, 2012.**

### Three Ways to Register

**Online:** [cdapresents.com](http://cdapresents.com)  
(Best option) Receive immediate confirmation

**Fax:** 877.714.3184

**Mail:** CDA Presents  
1201 K St., 16th Floor  
Sacramento, CA 95814

### Registration Information

- Register at [cdapresents.com](http://cdapresents.com) to secure an immediate spot in your preferred workshop, required course or special event based on availability. A confirmation email will be sent upon completion of your registration.
- Registration forms that are faxed or mailed to CDA will be processed in the order received and do not guarantee an immediate spot in workshops or special events. Phone registrations cannot be accepted.
- CDA member dentists will be registered at no charge.
- Dentists may register staff and guests, but not other dentists. Dentists may not register under any category except dentist, and nonmembers must be identified. **Membership dues must be paid for the current year to register as a member.**
- **Special \$75 registration fee for California nonmembers:** Nonmembers can save \$815 on registration by taking advantage of a special \$75 one-time meeting registration fee. If you are already a member, tell your nonmember colleagues about this limited offer. Materials for this category will not be mailed in advance, but will be available on-site at the membership counter. If you have already taken advantage of this special rate at either CDA Presents meeting, your fee will be the standard nonmember rate. If you had a membership in 2011, you are not eligible for the nonmember \$75 one-time registration fee for 2012.
- Register by **March 1, 2012**, to have your materials mailed to you in advance. (Note: Badge mailing will begin early March for registrations completed prior to this time.) This excludes the one-time nonmember reduced rate.

- Extended online registration will be available starting March 2, 2012. (Faxed and mailed registrations will not be accepted after March 1, 2012.) If you register online during this extended period, obtain your materials at Email Express Pick-Up at the Anaheim Convention Center beginning at 6:30 a.m. on Thursday, May 3, 2012.
- If you register an employee who is no longer attending, bring the badge of the person not attending to exchange on-site for a new badge at no charge.
- To ensure a seat for every ticket holder, courses will not be oversold.
- Refunds will be given if requested in writing and badges and tickets are returned by **March 28, 2012**.
- CDA will process and mail your registration materials at least two weeks prior to the meeting. If you do not receive your materials within this time frame, please call CDA at 800.232.7645. If you have corrections, additions or changes, please notify CDA in writing before March 28, 2012.



## Dentist Registration Categories

| Abbreviation | Registration Category                                | Advance Reg. Fee | On-Site Fee |
|--------------|------------------------------------------------------|------------------|-------------|
| A            | CDA member dentist (2012 dues must be current)       | Free             | Free        |
| B            | ADA lifetime member                                  | Free             | Free        |
| C            | Out-of-state ADA member dentist                      | \$200            | \$225       |
| D            | International dentist                                | \$200            | \$225       |
| E            | Active military dentist (VA, federal, state dentist) | \$75             | \$100       |
| F            | CA nonmember dentist (one-time rate)                 | \$75             | \$75        |
| G            | CA nonmember dentist                                 | \$800            | \$890       |
| H            | Inactive dental license                              | \$250            | \$275       |
| I            | Dental student/CDA member                            | Free             | Free        |
| J            | Dental student/graduate non-CDA member               | \$25             | \$50        |

**Please Note:** Dentists may register staff and guests, but not other dentists. Dentists may not register under any category except dentist, and nonmembers must be identified.

## Allied Dental Health Professional Categories (ADHP)

ADHP includes RDA, RDH, RDA(EF), RDH(EF), RDHAP, DA, business administrative staff (AS), and dental laboratory technician (LT). Include license number and type on form when registering.

| Abbreviation | Registration Category                             | Advance Reg. Fee | On-Site Fee |
|--------------|---------------------------------------------------|------------------|-------------|
| K            | ADHP CDA member* (2012 dues must be current)      | Free             | Free        |
| L            | ADHP Non-CDA member registering with a dentist    | \$5              | \$25        |
| M            | ADHP Non-CDA member registering without a dentist | \$20             | \$25        |
| N            | Guest of ADHP                                     | \$20             | \$25        |

\*An ADHP member is a dental professional who is not a dentist but has an independent, paid 2012 membership with CDA.

## Other Registration Categories

| Abbreviation | Registration Category                                  | Advance Reg. Fee | On-Site Fee |
|--------------|--------------------------------------------------------|------------------|-------------|
| O            | Non-exhibiting dental dealer, manufacturer, consultant | \$150            | \$175       |
| P            | Non-dental professional (MD, DVM, RN etc.)             | \$150            | \$175       |
| Q            | Guest of dentist (includes ADHP nonmember)             | \$5              | \$25        |

## Saturday Exhibits-Only Pass

Nonmember dentists who want to explore the exhibit hall can register on-site for a one-day pass on Saturday, May 5. The cost is \$175 and is for Saturday exhibit hall hours only. It is not valid for continuing education courses. To register, please visit the membership counter during on-site registration hours on Saturday, May 5. Then experience all that the *CDA Presents* exhibit hall has to offer.

| Required Courses                           | Speaker               | Course # | Day/a.m./p.m. | Fee   |
|--------------------------------------------|-----------------------|----------|---------------|-------|
| California Dental Practice Act             | Robin                 | 001      | Thursday      | \$20  |
| Infection Control                          | Simon                 | 002      | Thursday      | \$20  |
| California Dental Practice Act             | Curley                | 003      | Friday        | \$20  |
| Infection Control                          | Simon                 | 004      | Friday        | \$20  |
| California Dental Practice Act             | Curley                | 005      | Saturday      | \$20  |
| Infection Control                          | Andrews               | 006      | Saturday      | \$20  |
| <b>Thursday Workshops, May 3</b>           |                       |          |               |       |
| Embezzlement (dentist)                     | Gunn                  | 007      | a.m.          | \$50  |
| Embezzlement(dentist & spouse)             | Gunn                  | 008      | a.m.          | \$75  |
| QuickBooks                                 | Gunn                  | 009      | p.m.          | \$140 |
| Oral Surgery                               | Koerner               | 010      | a.m.          | \$250 |
|                                            |                       | 011      | p.m.          | \$250 |
| Esthetics — Veneers                        | Kugel                 | 012      | a.m.          | \$295 |
|                                            |                       | 013      | p.m.          | \$295 |
| Implants                                   | Little                | 014      | p.m.          | \$295 |
| Equipment Repair                           | Yaeger Sr./Yaeger Jr. | 015      | a.m.          | \$185 |
|                                            |                       | 016      | p.m.          | \$185 |
| Lasers                                     | Coluzzi               | 017      | a.m.          | \$125 |
|                                            |                       | 018      | p.m.          | \$125 |
| TDIC Risk Management Courses               | Jansen/Weiss          | 759      | a.m.          | \$50  |
|                                            |                       | 760      | p.m.          | \$50  |
| <b>Friday Workshops, May 4</b>             |                       |          |               |       |
| Endodontics                                | Brave/Koch            | 021      | a.m.          | \$350 |
|                                            |                       | 022      | p.m.          | \$350 |
| Provisionals — Anterior                    | Brady                 | 023      | a.m.          | \$375 |
|                                            |                       | 024      | p.m.          | \$375 |
| Composites                                 | Clark                 | 025      | a.m.          | \$250 |
| Composites — Anterior                      | Clark                 | 026      | p.m.          | \$250 |
| Composites a.m. & p.m. combined            | Clark                 | 027      | Full day      | \$475 |
| Practice Transition Track (junior dentist) | Industry Speakers     | 028      | Full day      | \$75  |
| Practice Transition Track (senior dentist) | Industry Speakers     | 029      | Full day      | \$75  |
| Photography                                | Dunn                  | 030      | Full day      | \$205 |

| Friday Workshops, May 4 (continued)                                                                                   | Speaker               | Course # | Day/a.m./p.m. | Fee     |
|-----------------------------------------------------------------------------------------------------------------------|-----------------------|----------|---------------|---------|
| Technology                                                                                                            | Guichet               | 031      | a.m.          | \$155   |
|                                                                                                                       |                       | 032      | p.m.          | \$155   |
| Crown Lengthening                                                                                                     | Hempton               | 033      | Full day      | \$595   |
| Implants                                                                                                              | Little                | 034      | p.m.          | \$295   |
| Sports Dentistry                                                                                                      | Padilla               | 035      | a.m.          | \$195   |
|                                                                                                                       |                       | 036      | p.m.          | \$195   |
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# Dental Sleep Medicine

MICHAEL S. SIMMONS, DMD

Sleep is taken for granted in much of our society; and cheating sleep is considered glorious, as there is more time for personal growth and enjoyment of the pleasures in our lives. The truth is you cannot cheat sleep, just as you cannot cheat death. Without sleep, we cannot function; and poor sleep can lead to serious consequences.

## GUEST EDITOR

**Michael S. Simmons, DMD,** is a diplomate ABOFP, FAGD, lecturer at the University of California, Los Angeles, a clinical assistant professor at the University of Southern California, serves on the Board of AADSM and ASAA, and is engaged in furthering dentistry's involvement in sleep medicine.

As dentists, we have been focused on the teeth and surrounding periodontium, oral health, esthetics, and function. Dental professionals have a tendency to look in the mouth and stop at the distal enamel or retromolar pads. Medical professionals, on the other hand, tend to look right past the teeth and peer at the pharyngeal areas and beyond, if they choose to look at all.

This issue of the *Journal of the California Dental Association* speaks to one of the clear overlapping areas between dentistry and medicine. Dentistry and medicine are no more separate than the head is to the whole body. The dental/medical overlap addressed here is sleep medicine, and, in particular, sleep-disordered breathing, a topic that ranges from snoring

to severe sleep apnea. Sleep-disordered breathing is an enormous unmet health care problem, with many medical illness associations, that could benefit from the involvement of the dental profession. Topics addressed in this *Journal* include:

- Medical associations and consequences of sleep-disordered breathing, by Daniel Norman, MD; Paul B. Haberman, MD; and Edwin M. Valladares, MS;
- A variety of health care viewpoints in addressing sleep-disordered breathing with multidisciplinary approaches and suggested treatment algorithms, by this author and multiple other authors;
- The neurology of sleep-disordered breathing and relationship to bruxism, by Jerald H. Simmons, MD; and
- Past, present, and future use of oral

appliance therapy in sleep-disordered breathing, by Robert R. Rogers, DMD.

Somnology is a young field. The first U.S. medical sleep society was created in the 1970s. Dentistry engaged in researching oral appliance therapy for sleep-disordered breathing in the early 1980s, and pioneers of dental sleep medicine are still actively engaged in this topic. Over recent years our own California Dental Association's House of Delegates has debated resolutions addressing the dentist's involvement in specific sleep disorders. This culminated in November 2011 with the passage of resolution 25RC proposed by CDA's Policy Development Council. We have now reached a criti-

cal point where there is enough interest in the dental community, scientific proof of effective treatments, and overall general awareness to recognize that dentists are important collaborators in addressing specific sleep disorders.

Collaboration speaks to the question of how many health professionals are really looking at the upper airway and taking note of its dimensions? Who routinely checks tongue dimensions, tonicity and resting position, mandibular and maxillary arch forms and their relationships, tonsil size, soft palate extension, pharyngeal walls, neck circumference, nasal patency, and the length of the uvula? When my oldest son complained of a

sore throat, he said, "I know you are just a dentist and don't really know anything, but would you take a look at my sore throat?" So, I took a look and found the cause of his complaint, a rather large ulceration in the left pharynx neal pillar.

The real eye-opener, however, was something else: the unmistakable kissing tonsils. How could I have missed them all these years? Perhaps this also explained why he occasionally slept with his mouth open and head hyperextended. More importantly, who else missed this airway blockage and why? We are talking about yearly physicals by different physicians and many other visits to medical specialists to address a myriad of medical issues in growing up.

Maintaining the upper airway is tantamount to survival. When one is awake, the upper airway is maintained by muscle tonicity. During sleep, especially during REM muscle paralysis sleep, tonicity is reduced. Our tongues may also drop back during sleep, further reducing our air flow. As dentists, we have significant experience in addressing airway issues and we manage the tongue and airway dimension well. However, dentistry as a health care field must be increasingly recognized as a major player in the area of identifying and treating specific sleep disorders that involve the airway. This is an opportunity for dentistry to make a huge impact on society in a meaningful and beneficial way. We already look into the oral cavity, so we are poised precisely to be main "gatekeepers" of upper airway encroachment issues. We simply have to look with more intent and request answers to a few pointed questions about sleep. By including this routine in our initial and update examinations, we become team players in the medical field of sleep, and we contribute to the overall health of society and the specific health needs of our patients. ■■■■



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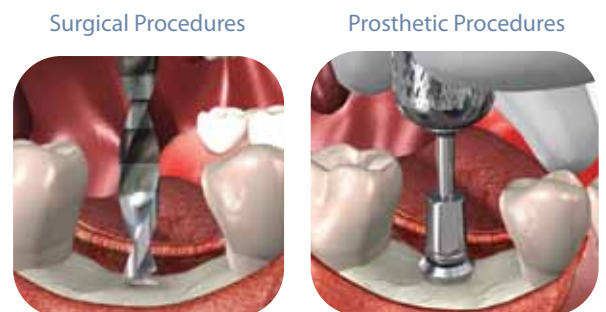
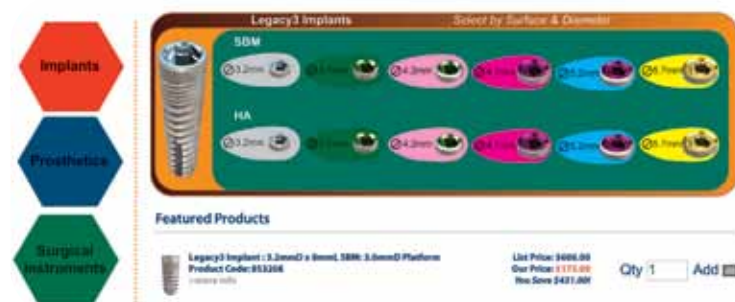
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# Somnology 101: A Primer on Sleep Disorders, Their Impact on Society, and a Role for Dentistry

MICHAEL S. SIMMONS, DMD

**ABSTRACT** Sleep is necessary for our existence. It is one-third of a commitment to health along with nutrition and exercise. While we spend one-third of our lives asleep, studies show one-third of the U.S. population suffers with a significant sleep disorder at some point in their lifetime. This manuscript introduces sleep and sleep disorders, focuses on those sleep disorders within the domain of dentistry, and addresses contributions the dental community can make toward specific sleep problems.

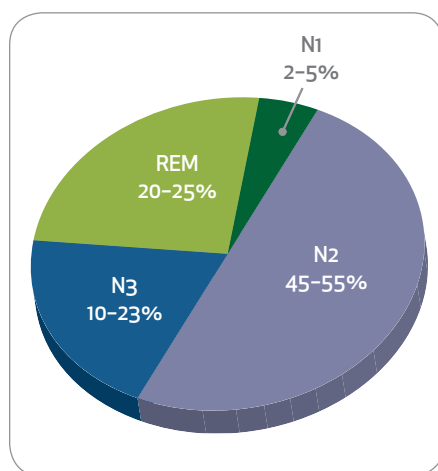
## AUTHOR

**Michael S. Simmons, DMD**, is a diplomate ABOFP, FAGD, lecturer at the University of California, Los Angeles, a clinical assistant professor at the University of Southern California, serves on the Board of AADSM and ASAA, and is engaged in furthering dentistry's involvement in sleep medicine.

Sleep is not optional, at least if peak performance is desired, quality health is aspired, and optimum life expectancy is to be achieved. However, studies show lack of professional education with U.S. medical schools devoting only about two hours total education in their four-year MD programs to all sleep-related topics.<sup>1</sup> Additionally, only about 2 percent of content in our standard medical textbooks relates to somnology.<sup>2</sup> Normal sleep is defined as “The cyclic, temporary, and physiologic loss of consciousness that is readily, promptly, and completely reversed with appropriate stimuli.” All animals require sleep, starting with the much-studied fruit fly, *drosophila melanogaster*, used in elucidating molecular mechanisms and functions of sleep.<sup>3</sup>

Sleep requirements range according to species and survival demands. Some

animals such as bottlenose dolphins have adapted to deep or slow brain wave sleep (SWS) with half a brain and do not have REM (rapid-eye movement, dream, or paradoxical) sleep.<sup>4</sup> Studies show humans require about seven hours of sleep for the longest potential survival, although extended average sleep time in “long sleepers” of  $\geq 10$  hours/day surprisingly increases all cause mortality more significantly than the “short sleeper” group with  $< 5$  hours/day.<sup>5</sup> Sleep demands change during our lifetimes and while infants sleep up to 18 hours per day with 50 percent devoted to REM, as we age, the SWS, REM, and total sleep time (TST) often progressively decrease and become more disrupted. Why we sleep is still unknown, although many theories abound and include common sense avoidance of danger in the dark, such as predators or unseen obstacles, like cliffs or crevices underfoot. More recent scientific evidence showed



**FIGURE 1.** Sleep stage proportion in young adults.

the release of growth hormones during SWS improved learning and memory consolidation with sleep and that sleep is essential for immune homeostasis.<sup>6-8</sup>

Theories of repair, regeneration, and recharging are all reasonable but hard to prove. Rat studies show ill effects of sleep deprivation such as ragged appearance, increased food intake with weight loss, poor homeostasis, and the likelihood of death within two to three weeks with total sleep deprivation.<sup>9,10</sup> Even partial sleep loss and disrupted circadian sleep cycles in humans with development of sleep debt results in reduced neurobehavioral function and contributes to many daily transportation-type crashes, job injuries, and even catastrophic accidents such as those that occurred at Three Mile Island, Chernobyl, Bhopal, and the Alaskan grounding of the Exxon Valdez.<sup>11,12</sup>

Sleep is divided into non-REM (NREM) and REM states. Each state has different but characteristic brain wave patterns. The awake and REM brain wave patterns are very similar in both amplitude and frequency consistent with the notion that the brain is very active during REM sleep. NREM sleep ranges between the lightest stage N1 to the deepest SWS N3 sleep. Early on in the daily sleep cycle there is more SWS implying its relative importance, and following sleep deprivation, there is often SWS rebound recovery.

**TABLE 1**

### Classification of Sleep Disorders (Refer to Table 2 for Abbreviations)

| Diagnosis ICSD-2                              | Categories                                                                                                                                 | Prevalence                                                     | Common Presentation                                                                       |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| I. Insomnia                                   | Sleep onset, sleep maintenance, early waking                                                                                               | 25%                                                            | Sleepy, irritable                                                                         |
| II. SRBD<br>Sleep-related breathing disorders | OSA(S), CSA hyperventilation/hypoxemia                                                                                                     | M 24% (4%)<br>F 9% (2%)<br>CSA unknown                         | Sleepy, irritable, BMI ≥ 30 M age 35+ and postmenopausal F                                |
| III. Hypersomnias                             | Narcolepsy +/- cataplexy, idiopathic, recurrent, due to medical condition or meds, etc.                                                    | 0.05%                                                          | Sudden REM sleep onset +/- muscle weakness                                                |
| IV. Circadian rhythm sleep disorder           | Delayed (or advanced) phase shift, jetlag, shift work type, due to meds, etc.                                                              | 11% (1%)                                                       | Altered time pattern of sleep; work-related; teenagers                                    |
| V. Parasomnias                                | Sleep-related walking, eating, groaning, enuresis, paralysis, terrors, RBD, confusional arousals, due to drugs or medical conditions, etc. | 17% children<br>4% adults<br>RBD 0.8%                          | Disorders of arousal from sleep in NREM and REM                                           |
| VI. SRMD<br>Sleep-related movement disorders  | RLS, PLMS, rhythmic movement, leg cramps, bruxism                                                                                          | 10% adults<br>2% children<br>Bruxism 8% adults<br>children 16% | RLS -Need to move limbs. PLMS limb movements in sleep                                     |
| VII. Isolated symptoms and normal variants    | Snoring, long/short sleeper, sleep talking, myoclonus                                                                                      | Snoring<br>M 40% F 24%<br>10% children                         | Intermittent snoring caused by alcohol, fatigue, allergic rhinitis, supine position, etc. |
| VIII. Other sleep disorders                   | Sleep disorders not classifiable elsewhere, environmental noise, etc.                                                                      | Undefined                                                      | Noisy or moving bed partner. Noisy surroundings                                           |

Each night's sleep is not homogeneous but a cycling up and down through sleep levels and typically a healthy adult will experience about four to six 90-minute sleep cycles interspersed with increasing periods of REM dream sleep. NREM sleep may also include dreams but they lack the depth of storyline and if woken and questioned, subjects recall few details compared to the subject woken to recall their dream during REM sleep (**FIGURE 1**).

### Sleep Disorders, Epidemiology and Their Impact on Society

The 2003 National Heart Lung and Blood Institute report conservatively estimated that 50-70 million in the United States are chronically affected by sleep disorders, and the 2006 landmark report by the Institute of Medicine validated that sleep disorders and sleep deprivation remain an enormous unmet public health problem.<sup>13,14</sup> Sleep deprivation costs the

TABLE 2

**Dangers of Drowsy Driving**

| Important Aspects of Drowsy Driving (DD)                                   | Reference# |
|----------------------------------------------------------------------------|------------|
| 57% of MVC with truck driver death attributed to fatigue/sleepiness        | 57         |
| 110,00 injuries, 5,000 fatalities/yr DD involve commercial trucks          | 58         |
| 16-29 y.o. drivers are most likely age group to have fall asleep MVC       | 59         |
| Sleep-deprived adults drive as poorly as alcohol-challenged                | 60         |
| 10% of drivers report nodding off while driving $\geq$ 1-2 days/month      | 35         |
| 60% drivers self-report drowsy driving                                     | 61         |
| 41% drivers report fallen asleep at the wheel at some point in their lives | 62         |
| 20% MVC attributable to drowsy driving                                     | 63         |
| 20% of all serious MVC associated with driver sleepiness                   | 64         |
| OSA w/AHI $\geq$ 10 have odds ratio for MVC of 6.3 times normals           | 65         |

U.S. economy an estimated \$40 billion annually in lost productivity and, across numerous settings, accidents attributable to sleepiness are estimated at \$43 billion to \$56 billion in 1988 dollars.<sup>15,16</sup> The estimated annual medical cost alone for untreated obstructive sleep apnea (OSA), a subcategory of sleep-related breathing disorders (SRBD), in 1999 was \$3.4 billion.<sup>17</sup>

There currently are about 100 different sleep disorders classified into eight categories by the International Classification of Sleep Disorders -Version 2 (ICSD-2)<sup>18</sup> (TABLES 1 AND 2).

Some of the most fascinating sleep disorders are parasomnias such as sleepwalking, sleep eating, sleep terrors, exploding head syndrome, and REM behavior disorder (RBD) where subjects physically act out dream content. However, it is the more common sleep disorders that appear to earn less than their deserved time and attention.<sup>19</sup> The four most common ICSD-2 sleep disorders account for the vast majority of all sleep disorders and are from most to least prevalent: insomnia, SRBD, sleep-related movement disorders (SRMD) and circadian rhythm sleep disorders (CRSD).

Some sleep problems have significant overlap with others. For example

39 percent to 58 percent of patients with OSA report insomnia symptoms, and 29 percent to 67 percent of patients with insomnia have OSA.<sup>20</sup> Startling statistics on sleep disorders include >20 percent of the 146 million U.S. labor force performs some sort of shift work, many never adapt, and about 10 percent of these develop shift work disorder (SWD) with its attendant risk increases in breast cancer, duodenal ulcers, cardiovascular morbidity and mortality.<sup>21-26</sup> Therefore, it is prudent for those health care providers involved in treating one common sleep problem to have more than superficial knowledge of the others.

**Dentistry's Connection to Somnology**

The two main associations between the fields of dentistry and somnology occur with movement and breathing disorders. SRMDs are a group ranging from sleep-related leg cramps to periodic limb-movement disorder, restless leg syndrome, and also include sleep bruxism (SB). Dentistry has long held the connection to sleep via oromotor activity witnessed often as tooth gnashing sounds during sleep and noted by parents and bed partners. For many years these oral parafunctional habits, which include clenching, grimacing, cheek biting, tongue activity, and tooth

grinding have been debated as to cause and relationship to the occlusion and psychophysiologic status of the individual. While SB is noted to be more prevalent in children affecting almost 20 percent under age 11, SB continues in many adults with an overall incidence averaging 8 percent but reducing to 3 percent at age 60.<sup>27,28</sup> SB may be primary/idiopathic or secondarily caused by a myriad of medical/psychiatric conditions, and/or in response to medications. It can be subdivided into tonic or rhythmic masticatory muscle activity (RMMA). Tonic activity could be viewed as clenching or abnormal jaw posturing whereas RMMA would be reflected in complex movements such as newborn infants suckling or tooth grinding.

SB is now being investigated in its relationship to sleep patterns and some interesting associations are found. SB occurs mainly in stage 1-2 sleep, 10-25 percent in REM sleep with its associated skeletal muscle paralysis/atonía but rarely occurs in deep sleep.<sup>29</sup> In a sample population of bruxers, 74 percent of RMMA and swallowing events were scored in the supine position compared to 23 percent in the lateral decubitus position.<sup>30</sup> SB occurs subsequent to alpha (awakening) EEG brain activity and 60-80 percent of SB episodes are associated with leg muscle activity.<sup>31,32</sup> This suggests that bruxism and other motor activity are connected to the arousal mechanism from sleep. One study concluded that the primary treatment for bruxism, an occlusal splint, is associated with risk of aggravation of SRBD as the apnea hypopnea index (AHI) increased > 50 percent in half the subjects tested.<sup>33</sup> While SRMDs are important and a great deal more information is available elsewhere, this manuscript focuses primarily on sleep-disordered breathing (SDB) as an area where the dental community has the potential for greater impact.

SDB is frequently considered synonymous with SRBD but they are important to distinguish. SDB is a more global term that includes SRBD, upper airway resistance syndrome (UARS), and snoring, making SDB the most prevalent sleep disorder group. Snoring is classified in the ICSD-2 under the heading “isolated symptoms and normal variants,” whereas UARS is not specifically classified due to the ongoing question in the medical community as to its existence. UARS was first described in 1993 to help explain unrestful disrupted sleep believed to be caused by respiratory effort-related arousals (RERAs).<sup>34</sup> Both UAR(S) and OSA(S) are termed (S)yndromes when they include symptomatic sleepiness often referred to as excessive daytime somnolence (EDS). Terms “sleepiness” or “drowsiness” while similar, should be distinguished from tiredness or fatigue, which are not readily reversible by sleep.

## Snoring

“Laugh and the world laughs with you, snore and you sleep alone,” coined by British composer and novelist Anthony Burgess (1917-1993) has never been more apparent. Increased societal snoring manifests in the reported 23 percent of bed partners now sleeping separately.<sup>35</sup> Snoring is attributed to the vibration of soft tissues that may arise from discrete areas of the nose down to the epiglottis. Diagnostic criteria includes a recognizable snoring noise, without specific decibel, waveform or frequency attributes, that is not associated with airflow limitation, arousal from sleep, oxygen desaturation, or dysrhythmia. ICSD-2 snoring terms include benign, simple, habitual snoring (HS), primary snoring (PS), continuous, rhythmic, nonapneic and snoring without sleep apnea. While these terms

No (never) snoring ► responsive snoring (alcohol, common cold, allergic rhinitis, exhaustion, etc.) ► infrequent (occasional) snoring ► positional snoring ► habitual ( $\leq 3$  wk) snoring ► chronic daily snoring ► loud chronic daily snoring ► snoring with breathing pauses ► snoring with EDS (UARS) ► mild OSA ► mild OSAS ► mild OSA w/medical associations ► moderate OSA ► severe OSA ► mixed OSA ► central sleep apnea

FIGURE 2. Potential snoring progression.

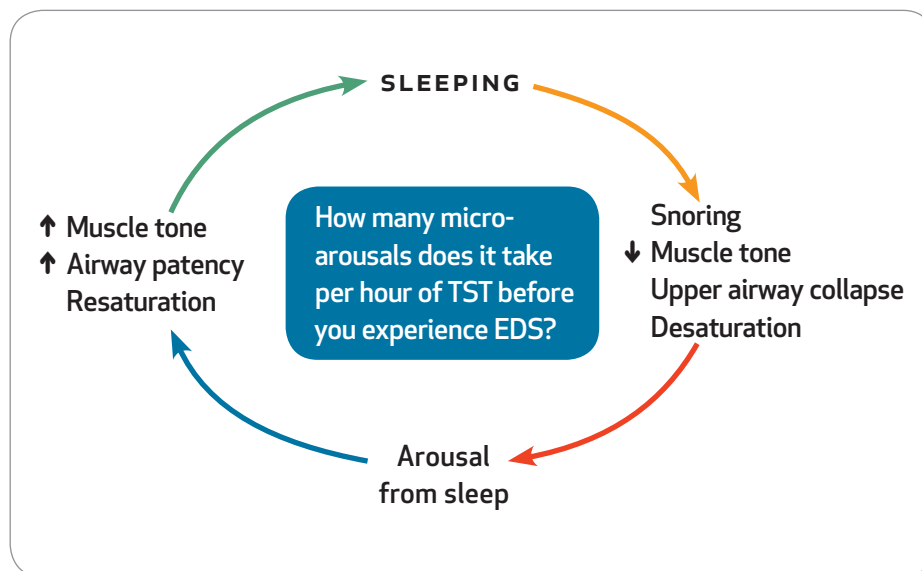
are not well-dissected and certainly not identical, this ICSD-2 category of isolated symptoms and normal variants appears of less interest to medical somnologists and they are content to defer its management elsewhere.

Epidemiologic studies, however, point to about 50 percent of habitual snorers as having OSA. This 50 percent figure results from juxtapositioning Lugaresi's epidemiologic snoring data that shows approximately 40 percent males and 20 percent females aged 30-60 chronically snore with Young's seminal work on the same age group showing approximately 24 percent males and 9 percent females having OSA.<sup>36,37</sup> This is consistent with Young's additional data showing snoring affecting 40 percent males and 24 percent females. The prevalence of snoring increases with age peaking at 65-70 years old.

While the ICSD-2 snoring category includes the term “benign,” there are a number of studies indicating snorers have increased medical comorbidities as compared to nonsnorers including neurocognitive deficits, stroke, dementia, cardiovascular (CV) conditions, myocardial infarct, as well as increased mortality rates.<sup>38-43</sup> Snoring in children has been associated with increased blood pressure in 6- to 13-year-olds and neurobehavioral changes in 5- to 7-year-olds suggesting it takes little time to develop comorbidities.<sup>44-46</sup> The dose-dependent nature of snoring and medical comorbidities has been shown in large population studies.<sup>47</sup> A recent door-to-door survey taken by nurses in

Hungary on 12,643 subjects found 60 percent prevalence of PS. This study revealed increasing incidence of CV disease, EDS, motor vehicle crashes (MVC) and workplace accidents occurring from nonsnorers, through habitual snorers, and, most of all, in loud snorers.<sup>48</sup> Another recent study showed intensity/loudness of snoring increased in a dose-dependent fashion with the increased OSA severity and another study found human carotid atherosclerosis increased in a dose-dependent fashion with snoring severity independent of the severity of OSA.<sup>49,50</sup> Carotid atherosclerosis was not matched by femoral artery atherosclerosis and the authors hypothesized that transmitted snoring vibrations led to the nearby carotid vascular endothelial damage and atherogenesis.

Clearly all snoring is not benign but clarity on which type(s) of snoring should be addressed remains to be determined. This is an important issue for dentists treating PS without medical collaboration especially since snoring typically worsens over time. While it is a significant burden on the medical health system for dentists to repeatedly refer the snoring patient for medical consult, and physicians typically do not wish to manage benign snoring, it is challenging for the dental team to determine when to refer. Only a sleep study interpreted ideally by a medical sleep specialist (MSS) in conjunction with a medical exam can rule in or out benign snoring. Increased associated medical comorbidities such as CV or metabolic disorders should however serve as red flags for physician referral (FIGURE 2).



**FIGURE 3.** Relationship between sleep-disordered breathing and excessive daytime somnolence.

### Historical to Current Approaches in Dentistry

The historical connection of dentistry to SDB was first published in 1923 by Pierre Robin, a French stomatologist, who noted micrognathia and glossoptosis problems often included upper airway obstruction and U-shaped cleft palate.<sup>51</sup> Treatment options included suturing the tongue forward to the lower lip, and promoting survival by opening the airway that was otherwise obtunded. While Robin also proposed the first intraoral appliance a “monobloc” in 1902 for the retrognathia, it was not until 1982 that a peer-reviewed publication first validated use of oral appliances in enabling airway patency during sleep.<sup>52</sup> Dentistry has since engaged in proving the positive impact on the sleeper’s airway of moving the mandible and/or tongue both surgically, via oral appliance therapy (OAT) and through orthodontic arch development.

The American Academy of Sleep Medicine (AASM) took note of dentists’ contribution in managing SDB in their 1995 position paper on OAT.<sup>53</sup> In 2006, the AASM published an updated position paper based upon in-depth review, acknowledging that OAT could

be considered the primary alternative treatment to continuous positive airway pressure (CPAP) for managing OSA when provided by trained dentists.<sup>54,55</sup> While CPAP is more universally effective when consistently used, OAT enjoys more patient compliance and in crossover trials where subjects choose CPAP or OAT after using both therapies, OAT was preferred.<sup>56</sup> Patient treatment preference of OAT, along with proof of OAT effectiveness, has supported dentistry’s increased interest in treating SDB. Additionally, the proven effectiveness of telegnathic surgical approaches to anteriorize tongue position by maxillofacial surgeons as a “cure-” type therapy has further engaged dentistry in treating SDB conditions. While orthodontic approaches to increasing the airway are a reasonable consideration, validated long-term research is lacking.

### Understanding Measures of SDB

Sleep studies reflect defined sleep disruption events such as where breathing difficulties may cause microarousals from sleep and/or desaturations ( $\text{SaO}_2$ ) of oxygen in the blood stream. Events may include prolonged apneas, or

breathing lapses in excess of a minute, that are quite perplexing to an observer. Not all microarousals are attributed to obstructed breathing. Other causes may include SRMD activity or an extrinsic event like an infant briefly crying. Apneas, defined as breathing cessation ( $>70$  percent reduction of airflow) of  $\geq 10$  seconds duration, are tabulated and averaged per hour as the apnea index (AI). Hypopneas, or reduced breathing, are defined by ICSD-2 as a sudden decrease in  $\text{SaO}_2$  by  $>4$  percent along with  $>30$  percent diminished airflow or amplitude of thoracoabdominal movement, often in conjunction with an arousal. Combined, the apneas and hypopneas are averaged per hour over the TST becoming the AHI. An AHI of less than 5 is normal,  $\geq 5 < 15$  mild,  $\geq 15 < 30$  moderate, and  $\geq 30$  is severe OSA.

The respiratory disturbance index (RDI), is another common measure which adds RERAs to the AHIs and may reflect more sleep disruptions. Some patients are more resistant to the ravages of disrupted sleep and therefore a high index may not reflect pathology. Sleep indexes are also typically higher when limited to time periods spent supine or during REM sleep with its attendant muscle atonia. Outcomes of sleep studies therefore depend on the amount of REM sleep, recent events such as sleep deprivation, alcohol or medication intake, body position, level of sleepiness, depression, cardiac issues, and many other factors. Indexes can reflect differences with the first night of a multnight study or in a split night study where a portion of the study is devoted to testing an intervention such as CPAP or OAT. It is therefore important for a MSS to interpret sleep study findings in context of a medical and sleep history (FIGURE 3).

## Understanding the Effects of Poor Sleep From SDB

There are many medical associations seen with SDB sleep, which are addressed in another paper in this journal. Social consequences of SDB may range from sleeping alone to national catastrophes. However, work accidents and transportation crashes may be preventable with appropriate dissemination of information about the importance of restful sleep. For example the National Traffic and Highway Safety Association (NHTSA) estimates that drowsy driving is the cause of 100,000 motor vehicle crashes (MVCs) and 1,500 fatalities every year. However, this is probably a gross underestimate as it accounts for only about 2-3 percent of all MVCs. Other developed countries average about 20 percent of all MVCs attributable to drowsy driving (DD) and landmark studies, such as the 2005 Virginia Tech Transportation Institute ground-breaking 100-car naturalistic study, confirm the 20 percent attribution of all MVCs to drowsiness. A few important facts on drowsy driving are listed in **TABLE 3**.

Subjects driving after 24 hours awake display equally poor reaction time and judgment to driving with a blood-alcohol count of 1.0 ppm, which is above the legal limit of .08 percent blood-alcohol content in all U.S. states. New Jersey passed General Assembly Bill 74-4, known as Maggie's Law, on Aug. 5, 2003, as a result of, and six years following, the untimely death of Maggie McDonnell. She was a 20-year-old driver killed by a drowsy driver awake for 30 hours. Due to lack of drowsy driving laws at that time, the drowsy driver received the same minimal penalty as if he hit a tree.

Essentially, Maggie's Law made choosing to drive when drowsy the same reckless behavior as choosing to drive drunk. Unfortunately, there still does not exist a

**TABLE 3**

### Brief Comparison of Drunk and Drowsy Driving

| Drunk Driving                                          | Drowsy Driving                 |
|--------------------------------------------------------|--------------------------------|
| .05 – .08 BAC                                          | No standard measure            |
| Compromised judgment                                   | Little → No judgment           |
| Delayed reaction time                                  | Delayed → No reaction time     |
| Poor avoidance strategy                                | Little → No avoidance strategy |
| Variable severity crashes                              | Highest severity crashes       |
| 15,000 deaths/year                                     | 1,500 deaths/year? (x5-10)     |
| Serious legal consequences                             | No? Legal consequences         |
| Ubiquitous education                                   | No → minimal education         |
| MADD since 1981                                        | DADD ? Since 2008              |
| AADSM promotes Dentists Against Drowsy Driving (DADD). |                                |

precise measure for drowsiness to be used by law enforcement at such crashes, and, to further complicate matters, the combination of a little alcohol with drowsiness is dramatically worse than either individually. Focusing on reducing MVCs, two grass roots campaigns developed in the early 1980s and expanded over time with national to global impact. These include Mothers Against Drunk Driving (MADD) and Students Against Destructive Decisions (SADD). Both campaigns changed the attitudes of society resulting in improved road safety. Dentists now have started a small measure in this direction and, while proposed by the AADSM, the concept of Dentists Against Drowsy Driving (DADD) is in its infancy and has yet to realize its potential.

## Approaches by the Dental Community to the Patient With SDB

Two main approaches to the SDB patient by the dental field relate to screening and co-treatment with physician colleagues. While all dental offices would ideally screen for SDB as with high blood pressure and oral cancer, SDB treatment requires medical collaboration. Those interested in somnology must invest the time and effort in developing the necessary expertise. Given >2,500 AADSM members in 2011 among perhaps 5,000

U.S. dentists routinely treating SDB for the conservatively 40 million affected; there is a need for more treating dentists. This is a rewarding field for those committed to providing excellent care but the journey to expertise may take several years.

Integration of sleep disorders into a dental practice can be done stepwise and could begin by including: 1) subjective information through a few screening questions verbally or added to health history forms. The questions are simple such as "Do you snore frequently or loudly?" "Do you have pauses in breathing during sleep?" and "Do you have daytime sleepiness?" Bed partners often give more accurate answers and, if complaints of the snoring noises preceded moving to another room, it may give some useful insights. For the dental office wanting to include more detailed screening, there are many validated sleep questionnaires, some shown in **TABLE 4**. 2) Objective morphometric information can be added as part of the oral cancer exam. Data to consider collecting at the time of screening include neck circumference, modified Mallampati or Friedman scoring of upper airway patency, and documenting if the uvula, tonsils, tongue, pharyngeal tissues or soft palate crowd the airway. If considering treating SDB, a more in-depth history and exam

TABLE 4

## Some Standardized Sleep Questionnaires

| Questionnaire           | Number and Type of Questions                                                      | Use or Advantage                             |
|-------------------------|-----------------------------------------------------------------------------------|----------------------------------------------|
| Epworth (ESS)           | 8 subjective score 0-24 ( $\geq 10$ = sleepy)                                     | Standard drowsiness survey                   |
| STOP                    | 3 subj 1 objective score 0-4 ( $\geq 2$ ) high risk                               | Anesthesiology based – quick                 |
| STOP-bang               | 3 subj 5 objective score 0-8 ( $\geq 3$ ) high risk                               | Quick + high accuracy                        |
| ARES                    | ESS + 18 subjective 2 objective                                                   | Fits well with ARES Home Test                |
| Apnea score “Kapuniai”  | 2 subjective – stops breathing + loud snoring                                     | V. Quick – minimal                           |
| Karolinska & Stanford   | Subjective 1 Range K(0-9) S (0-7)                                                 | Research use scales - higher # = more sleepy |
| Pictorial               |  | For children                                 |
| VAS                     | Just about asleep -> As wide awake as can be<br> -----10 cm line-----             | Visual analogue scale                        |
| Berlin                  | 9 subjective 1 objective put into 3 categories                                    | Category scoring grid                        |
| Pittsburg quality index | 19 subjective questions                                                           | Quality of sleep previous month              |
| Sleep 50                | 50 subjective                                                                     | Screens most sleep disorders                 |

is indicated prior to generating a medical report and collaborating with the patient's physician. On average, a typical dental office would note a frequency of significant SDB of  $> 1$  in 6 adult patients seen.

The dental team interested in treating SDB with OAT requires a different mindset and model to the typical surgical-based dental practice. Other than a potential cure from some telegnathic surgical procedures such as the mandibular and maxillary advancement (MMA) or possible preventive approaches with orthodontics, SDB patients are managed rather than cured. This is most similar to periodontal disease where continued diligence, monitoring, and ongoing care are indicated. Dental practitioners must be prepared for higher failure rates than experienced with routine dental procedures, and, until better prognostic information is available, the failure rate for OSA single therapy with OAT may be as high as 70 percent with severe OSA. The success rate may, however, exceed 80 percent in milder presentations of SDB.

### Future Challenges

1) At this time, Medicare has refused payment when dentists prescribe or administer sleep testing and other insurance companies may follow suit. This is not in the best interest of patients who may go undiagnosed until significant medical comorbidities are present.

2) Sleep is a much overlooked aspect of health and requires more focused attention by health professionals. Dentists could actively engage their patients in the topic of sleep, employ sleep health questionnaires, view the upper airway, and ask questions to better help serve their patients health.

3) Dentists could investigate sleep organizations and credible websites (TABLE 5), take an active role in societal aspects of sleep disorders and thereby contribute to greater public safety.

4) Dentistry should encourage additional research in the sleep field and the early manifestations of the SDB continuum. This would include dissecting out truly benign from nonbenign snoring, validating

effects of OAT in slowing the progression of SDB, and determining which populations are most and least likely to benefit from OAT and other dental interventions.

### Conclusion

#### Learn to Look and Look to Learn

Dentists should incorporate active viewing of the mouth not only for decay and periodontal disease but also to rule out the life-threatening issues such as lesions and airway crowding. By visualizing the upper airway, the dental team can learn about the patient's potential difficulty with SDB. A few questions can open the conversation to further discovery. It is only with such unified focus that dentistry can significantly impact our epidemic of sleep disorders. It is therefore incumbent on dentists as health care professionals, positioned as sentries to the gateway of the upper airway, to keep a look out for potential problems. This is good for the patients we serve and it promotes the field of dentistry

TABLE 5

## A Few Sleep Organizations and Credible Web Sources of Information

|                           |                                                                                                                                                                                                                                                |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| aadsm.org                 | American Academy of Dental Sleep Medicine. More than 2,500 members                                                                                                                                                                             |
| aasmnet.org               | American Academy of Sleep Medicine. More than 9,000 members                                                                                                                                                                                    |
| nhlbi.nih.gov/about/nesdr | The U.S. National Center on Sleep Disorders Research of the NIH. Coordinates government-supported sleep research training and education to improve health                                                                                      |
| sleepapnea.org            | American Sleep Apnea Association. Dedicated to reducing injury, disability and death from sleep apnea through education, awareness, and research. Also promotes voluntary support groups.                                                      |
| sleepfoundation.org       | The U.S. National Sleep Foundation –independent nonprofit organization dedicated to improving public health and safety by achieving understanding of sleep and sleep disorders. It supports education and sleep-related research and advocacy. |

in a positive collaborative manner with other health providers. Dentists can make an enormous difference in society and serve the public in a meaningful way by catching SDB early on in the continuum and co-treating with physician colleagues. We can save more than a tooth. We may even save a life. ■■■■

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TO REQUEST A PRINTED COPY OF THIS ARTICLE, PLEASE CONTACT Michael Simmons, DMD, Department of Oral Medicine and Orofacial Pain, University of California, Los Angeles, School of Dentistry, 10833 Le Conte Ave., Los Angeles, CA 90024.



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DDS/Broker

## ASK THE BROKER

### Question:

**Is now a good time to associate, or is it better to buy a practice?**

If you are an associate, of course I think it is always a good time to buy a practice!!

If you review your W-2 or 1099 you just received and realize that Uncle Sam is going to take a bigger portion of that check than *if* you owned your own business, you should arrive at the same conclusion. Of course, the caveat is to buy the right type of practice that will fulfill your needs, and a practice that hopefully leaves more money in your pocket after debt service and taxes. This is not as difficult as one would imagine. Most of us went to dental school to control our own destinies. Some of us enjoy collecting a paycheck, and there is nothing wrong with that. But most of us that have had the experience of both associating and then eventually owning our practices agree that we were more successful and enjoyed our profession more as an owner.

Many of the young graduates are in debt for more than \$300,000, which is an insanely outrageous large sum of money! In this negative economic environment, they are afraid to take on an even bigger debt load to purchase their own practice. While that certainly seems to make sense, the reality is that once they have approximately 2 years of experience under their belts, they can make a lot more money after debt service if they owned their own practice. Believe it or not, there is still 100% financing available to purchase a practice, and the interest rates are at historic lows. The banks have also produced more options on their loan products to ease the financial burdens of the younger graduates. Depending on the loan, the interest rates can be fixed in the range of 5 to 6%, which are incredibly low interest rates and make owning a practice that much more affordable.

The other problem in a soft economy is that the associate positions are not as readily available. Some of the larger practices that perhaps needed a full-time associate no longer have the amount of work to keep an associate busy. The senior doctors are also more likely to keep the ideal and productive treatment plans to themselves.

My advice is to plot your best course of action, sit down with your accountant and map out a financial plan based on the financing available in the marketplace. **Make your debt work for you in a practice that you can be productive and profitable. Debt that produces income is not necessarily bad debt.** It is all about "return on investment" and what you have left over to pay your bills and feed your family. Even highly paid associates would have more money in their pockets after taxes and debt service *if* they had purchased a comparable practice to their own production capabilities.

Timothy G. Giroux, DDS is currently the Owner & Broker at **Western Practice Sales** ([westernpracticesales.com](http://westernpracticesales.com)) and a member of the nationally recognized dental organization, ADS Transitions. You may contact **Dr Giroux at: [wps@succeed.net](mailto:wps@succeed.net) or 800.641.4179**

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**\$950,000 Pedit Practice in the Inland Empire**, San Bernardino County, Southern California with six (6) dental chairs, five (5) open bay, one (1) surgical suite, sterilization room, private office and great cash flow in a mixed-use building. **In Escrow.**

**\$150,000 Orthodontic Practice in Pico Rivera**, Los Angeles County, Southern California, with four (4) chairs, open bay, sterilization-lab combo, adjustment lab, reception area, business office/consultation room, and private office in a professional building.

**\$300,000 General Dentistry Practice in Brea**, Orange County, Southern California, with four (4) operatories, includes equipment, sterilization room, private office in a shopping center near mall and freeway.

**\$500,000 General Dentistry Practice in South Orange County**, Southern California with four (4) operatories, fully equipped, sterilization-lab combo, adjustment lab, staff lounge, private office, over 31 years of goodwill, doctor retiring.

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# Medical Consequences and Associations With Untreated Sleep-Related Breathing Disorders and Outcomes of Treatments

DANIEL NORMAN, MD; PAUL B. HABERMAN, MD; AND EDWIN M. VALLADARES, MS

**ABSTRACT** Sleep-related breathing disorders are a broad group of disorders that include obstructive sleep apnea, central sleep apnea, and periodic breathing disorders. This article reviews the scientific literature that links SRBD to various medical conditions including hypertension, coronary artery disease, cardiac arrhythmias, stroke, diabetes mellitus, obesity, and depression. Pathophysiologic mechanisms by which SRBD may contribute to these disorders will be discussed, as will data on the degree to which treatment of SRBD may improve these conditions.

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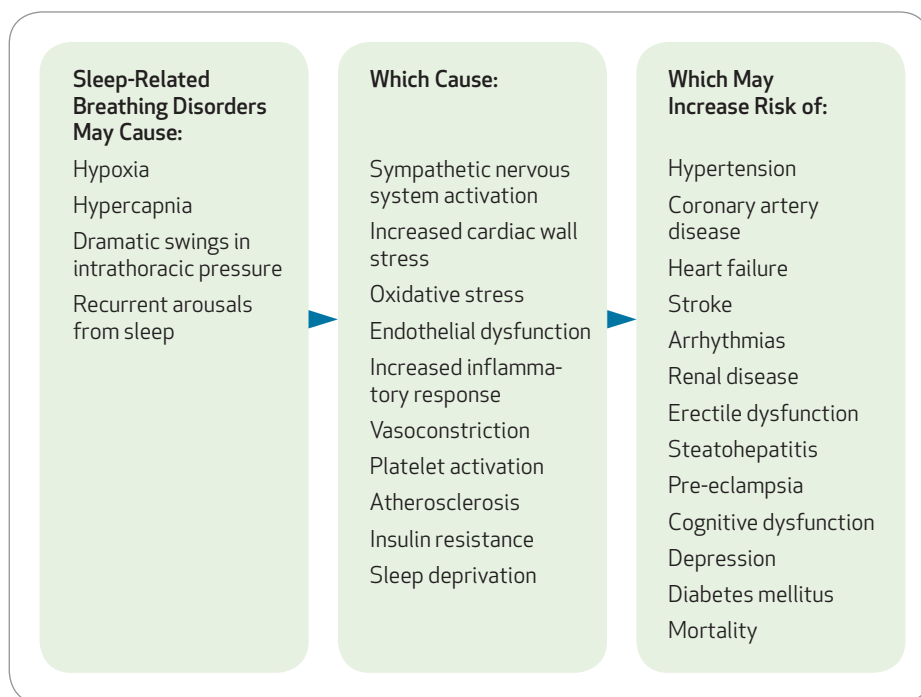
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Sleep-related breathing disorders (SRBD) encompass a wide range of medical conditions, including disorders involving upper airway narrowing or obstruction during sleep, disorders of waxing and waning respiratory effort during sleep (such as the Cheyne-Stokes breathing pattern), and disorders characterized by episodic pauses in respiratory effort during sleep (central sleep apnea or CSA). While many patients who suffer from SRBD have only one type of breathing disorder, some individuals may have combinations of two or more categories of SRBD. All of the above SRBD may present with symptoms of restless sleep, recurrent nighttime awakenings, and/or excessive daytime somnolence. However, obstructive SRBD are the most prevalent of the above categories that

have led to a larger volume of research data regarding medical conditions that may result from, or associate with, these disorders versus other types of SRBD.

In all individuals, there exists a normal tendency for pharyngeal airway dilator muscles to relax during sleep. Ordinarily, this muscle relaxation is mild and does not impede normal patterns of airflow.

However, if : 1) there is excessive tendency toward airway muscle relaxation during sleep, or 2) the oropharynx is narrow to begin with (i.e., from excessive submucosal fat deposits, large tonsils, a large uvula, droopy soft palate, a large tongue base, micrognathia/retrognathia, or other structural abnormalities), or 3) any combination of both of the above can impede airflow from compromised pharyngeal structures that reside from the level of



**FIGURE 1.** Mechanisms by which SRBD may cause or contribute to the development of various medical conditions.

the soft palate down to the level of the epiglottis. In mild cases, vibration of these various structures may cause turbulent airflow, which manifests as snoring. However, if the airway narrows beyond a certain point, there can be partial obstruction (called an obstructive hypopnea) or complete obstruction (an obstructive apnea) of the airway. The physiologic consequences of this airway narrowing, and the body's responses to it, likely play a significant role in the increased risk of medical morbidity and mortality associated with obstructive sleep apnea (OSA). Before discussing specific conditions associated with sleep apnea, it makes sense to discuss the physiologic mechanisms that are affected by SRBD, and are likely to play a significant role in the association between SRBD and various diseases.

### Mechanisms of Disease

While many people are aware that apneas and hypopneas are associated with recurrent (and sometimes quite severe) episodes of hypoxemia during sleep, there are a large

number of additional pathways by which apneas and hypopneas adversely affect the human body (**FIGURE 1**). Apneas and hypopneas also cause transient carbon dioxide retention. Chemoreflex-mediated activation of the sympathetic nervous system ensues from the hypoxia and hypercarbia, which results in a transient spike in blood pressure and heart rate during individual apnea/hypopnea episodes.<sup>1</sup> Ongoing respiratory effort in the setting of upper airway obstruction generates significant negative intra-thoracic pressures, which may impact systolic and diastolic heart function, affect cardiac preload, and put additional wall stress on the heart chambers and aorta.<sup>2</sup>

The strain on the cardiovascular system is magnified as the acute rise in heart rate, blood pressure, heart chamber wall stress, and adrenergic activity associated with obstructive sleep apnea are typically most prominent at the time in which the heart is exposed to the greatest levels of hypoxia and hypercarbia. The increased sympathetic nervous system activity is initially transient and associated with each obstructive

event. However, over time, patients with untreated OSA develop heightened sympathetic nervous system activity not only at night but also during the daytime.<sup>3</sup>

Intermittent hypoxia during sleep also triggers increased oxidative stress, contributes to endothelial dysfunction, and increases release of vasoactive substances (such as endothelin), which may cause lasting vasoconstriction of blood vessels.<sup>4,5</sup> These factors may all contribute to reductions in daytime heart rate variability and increases in blood pressure variability noted in patients with OSA.<sup>6</sup> Furthermore, autonomic alterations may result from injury to brain regions that mediate autonomic control.<sup>7</sup> Additionally, intermittent hypoxemia and sleep disruption or deprivation may also be associated with increased inflammation and increased levels of fibrinogen and platelet activation.<sup>8,9</sup> These factors, in turn, may contribute to accelerated risk of atherosclerosis and thrombosis. Lastly, increased adrenergic activity and sleep deprivation may both contribute to increased insulin resistance.<sup>10</sup> Insulin resistance will be covered in greater detail below, but it is important to mention here as a mechanism by which sleep apnea contributes to increased risk of cardiovascular disease. While there are many associations of disorders and disease states with SRBD it is far more difficult to prove cause. In the paragraphs below, research data will be presented for various medical conditions with an emphasis on whether an association or causal data has been found.

### Specific Medical Conditions Associated With SRBD

#### Hypertension

It is estimated that one-half of OSA patients suffer from hypertension.<sup>11</sup> Approximately one-third of all patients with essential hypertension and approximately 83 percent of patients with drug-resistant

hypertension have OSA.<sup>12,13</sup> A large number of observational studies have shown a step-wise association between increasing OSA severity and greater risk for (and severity of) hypertension. One of the most well-known of these studies, the Sleep Heart Health Study (SHHS), was a multicenter study which performed polysomnography on 6,132 middle-aged and older adults. The SHHS results showed significant associations between measures of sleep apnea severity (apnea hypopnea index; AHI) and percentage of sleep time with oxygen saturation below 90 percent and both systolic and diastolic blood pressure.<sup>14</sup> Importantly, the step-wise increase in risk of hypertension with increasing levels of apnea severity persisted even after controlling for age, gender, ethnicity, body mass index, smoking and alcohol use history, neck size, and waist-to-hip ratio. Specifically, when compared with subjects who did not have OSA (AHI<1.5/h), the risk of hypertension was 20 percent higher among those with mild OSA (AHI= 5-14.9/h), 25 percent higher among those with moderate OSA (AHI=15-29.9/h), and 37 percent higher among those with severe OSA (AHI>30/h). Another large-scale population study found similar trends: there were higher mean arterial blood pressures both during wakefulness and sleep in those with OSA compared to those without, and threefold higher prevalence rates of hypertension among those with severe OSA (AHI>30/h) compared with those without OSA (AHI=0/h).<sup>15,16</sup>

Prospective studies of patients with OSA have found that presence of mild OSA at baseline doubles the risk of subsequent development of hypertension four years later, and the presence of moderate or severe sleep apnea increases the risk by nearly threefold.<sup>17</sup> The association between hypertension and OSA is so well-established that in 2003, the National Institutes of Health's Joint

National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure began recommending that newly identified hypertensive patients be screened for OSA.<sup>18</sup>

#### *Effects of Continuous Positive Airway Pressure Therapy on Hypertension in OSA*

A number of randomized placebo-controlled trials have been performed (using subtherapeutic or sham-continuous positive airway pressure {CPAP} as a placebo) in order to demonstrate

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the effects of CPAP therapy on 24-hour ambulatory blood pressure. One demonstrated dramatic (~10 mmHg) reductions in daytime and nighttime mean arterial pressure (MAP) with nine weeks of CPAP versus subtherapeutic CPAP therapy.<sup>19</sup> Other studies have shown more modest reductions (of 2-4 mmHg) in day and nighttime MAP with two to four weeks of CPAP therapy, while yet others have shown no significant change in MAP with CPAP use.<sup>20,21</sup> A recent meta-analysis of 16 randomized clinical trials comparing at least two weeks of CPAP use to control showed a mean net decrease of 2.2 mmHg in MAP day and night with CPAP therapy.<sup>22</sup> Another recent meta-analysis estimated that there would be a 1.39 mmHg decrease in MAP for every one-hour increase in effective nightly use of CPAP.<sup>23</sup>

#### *Effects of Mandibular Advancement Appliance Therapy on Hypertension*

An uncontrolled study of 29 consecutive OSA patients using a mandibular advancement device (MAD) reported significant reductions in both systolic and diastolic blood pressure at three months and at three years of follow-up.<sup>24</sup> Three randomized controlled trials have examined the effects of oral appliance therapy (OAT) for OSA on blood pressure. The first demonstrated an approximately 2 mmHg mean reduction in 24-hour diastolic blood pressure with four weeks of MAD therapy.<sup>25</sup> The second demonstrated a 2 mmHg improvement in nighttime diastolic blood pressure but no change in nighttime systolic pressure or daytime blood pressure with three months of OAT, and showed no change in blood pressure with three months of CPAP therapy for mild to moderate OSA.<sup>26</sup> A third showed that 10 weeks of OAT or CPAP similarly reduced morning diastolic blood pressure (mean 5 mmHg reduction with CPAP, 3 mmHg reduction with oral appliance) in patients with mild to moderate OSA.<sup>27</sup>

#### *Effects of Upper Airway Surgery on Hypertension*

Early studies in the 1970s described substantial (~40 mmHg) reduction in mean arterial blood pressure (and pulmonary artery pressures) following tracheostomy for treatment of OSA.<sup>28</sup> While one would anticipate that the likelihood of improving blood pressure would depend on the degree to which respiratory disturbances were eliminated, published data on the effects of other upper airway surgeries (such as uvulopalatopharyngoplasty (UPPP), genioglossus advancement, hyoid suspension, and maxillomandibular advancement surgery) on blood pressure in adults with OSA has

been lacking. A study of normotensive snorers found that patients undergoing UPPP and nasal septoplasty had a tendency toward a transient increase in nighttime systolic blood pressures during the first postoperative day, related to transient increase in the respiratory disturbance index (perhaps due to short-term upper airway edema) following surgery.<sup>29</sup>

In children with OSA, adenotonsillectomy is usually considered first-line therapy and there are a couple of studies demonstrating effects of surgery on blood pressure. One study using 24-hour ambulatory blood pressure monitoring on 44 children with OSA found that diastolic blood pressure decreased significantly following adenotonsillectomy. Six of the eight children who were hypertensive prior to surgery actually became normotensive following surgery.<sup>30</sup> However, another study demonstrated that children, who have recurrence of obstructive OSA after adenotonsillectomy, have a higher risk of development of hypertension one year following surgery than those who do not experience recurrence of their sleep apnea.<sup>31</sup>

### Cardiac Arrhythmias

OSA has been associated with the development of various arrhythmias.<sup>32</sup> Patients with severe SRBD are more likely to develop complex arrhythmias than controls without sleep-disordered breathing.<sup>33</sup> In a sample of 57 participants from the Sleep Heart Health Study who had arrhythmias during their polysomnography, the odds of an arrhythmia (including paroxysmal atrial fibrillation and nonsustained ventricular tachycardia) during the 90 seconds following a respiratory disturbance were nearly 18 times higher than that of having an arrhythmia following a 90-second period

of normal breathing.<sup>34</sup> Furthermore, the type of arrhythmia appears to be associated with type of SRBD.<sup>35,36</sup> Mehra and colleagues have found an association between atrial fibrillation with central sleep apnea; and complex ventricular ectopy with OSA in older men.<sup>35</sup>

Lanfranchi and colleagues also found a higher incidence of nonsustained ventricular tachycardia in patients with severe CSA.<sup>36</sup> Yet, other studies have shown that the prevalence of OSA is

**THE PREVALENCE  
of OSA in patients  
with heart failure  
has been estimated  
to be between 40 percent  
and 70 percent.**

significantly higher (48 percent) in patients with atrial fibrillation compared with unselected patients from a general cardiology group practice (32 percent).<sup>37</sup>

CPAP therapy has been strongly associated with a reduction in rate of arrhythmias in patients with OSA. In a prospective study of 43 patients with known OSA who were undergoing electrical cardioversion for atrial fibrillation, the risk of recurrence of atrial fibrillation at 12 months follow-up was 82 percent in those who were not using CPAP (or using it inappropriately) versus a risk of recurrence of only 42 percent among those who were using CPAP therapy.<sup>38</sup> Another study found that 59 percent of patients with OSA (versus only 37 percent of patients without OSA) had a recurrence of

atrial fibrillation at an average of seven months follow-up after a single radiofrequency ablation procedure. This study also reported that the presence of OSA was the strongest predictor of recurrence for atrial fibrillation following radiofrequency ablation, even when compared against many of the risk factors that are traditionally associated with atrial fibrillation, such as patient age, duration of atrial fibrillation, BMI, hypertension, left atrial size, and left ventricular ejection fraction.<sup>39</sup> Furthermore, a Japanese study found that CPAP significantly reduced the occurrence of multiple arrhythmias, including paroxysmal atrial fibrillation, premature ventricular contractions, sinus bradycardia, and sinus pauses.<sup>40</sup>

### Heart Failure

The prevalence of OSA in patients with heart failure has been estimated to be between 40 percent and 70 percent.<sup>41</sup> One prospective study with an average of 2.9 years of follow-up found that heart failure patients with moderate to severe untreated OSA (AHI >15/hour) have more than twice the mortality compared with those with an AHI <15/hour.<sup>42</sup> OSA has been associated with both systolic and diastolic heart failure.<sup>43</sup> CSA has also been reported in 21 percent of patients with systolic heart failure and 55 percent of patients with diastolic heart failure.<sup>36,43</sup> The American College of Cardiology and the American Heart Association have recommended sleep apnea screening in newly diagnosed heart failure patients.<sup>44</sup>

Effective OSA treatment in heart failure patients improves Left Ventricular Ejection Fraction (LVEF).<sup>45</sup> In patients with moderate to severe OSA, six months of CPAP therapy can result in significant improvement in systolic

and diastolic dysfunction.<sup>46</sup> Compliance with CPAP therapy may reduce the mortality rate in heart failure patients who have Cheyne-Stokes respiration and CSA.<sup>47</sup> However, given that heart failure patients may have a greater tendency toward central apneas, CPAP or OAT may not always be the best treatment.<sup>48</sup> Adaptive servo-ventilation is a type of positive airway pressure therapy that adapts to the patient's periodic breathing patterns and provides variable amounts of air pressure support to reduce tendency toward recurrent central apneas.<sup>49</sup>

Kasai and colleagues studied 31 heart failure patients who had OSA and Cheyne-Stokes respiration. The participants were assigned to either a CPAP treatment group or an adaptive servo-ventilation treatment group. When compared to the CPAP treatment group, the group assigned to use adaptive servo-ventilation showed fewer respiratory events, and greater improvements in LVEF and SRBD treatment compliance.<sup>50</sup> There has been a paucity of literature on mandibular advancement device therapy in patients with heart failure. One study reported that the use of mandibular advancement device therapy in OSA patients with stable congestive heart failure was associated with improvements in sleep apnea-related symptoms, reductions in plasma levels of brain-natriuretic peptide (a marker of congestive heart failure), and reductions in five-year mortality.<sup>51</sup>

### Coronary Artery Disease

Even after one adjusts for various other risk factors, such as age, BMI, hypertension, hypercholesterolemia, diabetes mellitus, cigarette smoking, the presence of OSA is independently as-

sociated with increased risk of coronary artery disease (odds ratio 3.1, 95 percent CI 1.2-8.3).<sup>52</sup> Furthermore, among patients with pre-existing coronary artery disease, the presence of and severity of OSA both predict increased risk for mortality over the following five years.<sup>52</sup> While people without OSA are at highest risk of sudden cardiac death between 6-11 a.m., those with known OSA are at highest risk between 10 p.m.-6 a.m., the period most often associated with sleep.<sup>53</sup>

**DEPRESSIVE SYMPTOMS,  
excessive daytime  
somnolence, and overall  
quality of life scores  
improved with nasal  
CPAP therapy.**

While there are no randomized, controlled trials on the effects of sleep apnea therapy on risk of developing coronary artery disease or its associated mortality, there have been a number of observational studies which show that treatment with CPAP significantly reduces risk of occurrence of both fatal and nonfatal cardiovascular events in patients with coronary artery disease.<sup>54</sup>

### Depression

It is estimated that 17 percent of OSA patients in the community suffer from depression.<sup>55</sup> A study of 51 patients with comorbid depression and insomnia found that 39 percent suffered from at least moderate (AHI > 15/hour) OSA.<sup>56</sup> In a study of 17 OSA patients with continued

major depressive disorder symptoms despite pharmacotherapy, two months of CPAP therapy resulted in significant improvements in depression symptoms as measured by the Beck Depression Inventory and the Hamilton Rating Scale for Depression.<sup>57</sup> Another study of 132 OSA patients and controls found that patients with severe OSA had poorer quality of life scores and were more depressed than control subjects at baseline, but that depressive symptoms, excessive daytime somnolence, and overall quality of life scores improved with nasal CPAP therapy.<sup>58</sup> One randomized controlled crossover study of 73 OSA patients found improvements on the somatic component of the Beck depression inventory and fatigue-inertia scales of the Profile of Mood States test with mandibular advancement appliance therapy.<sup>59</sup>

### Stroke

Sleep apnea prevalence rates of up to 72 percent have been reported in patients with a prior stroke.<sup>60</sup> However, it has been difficult to evaluate the significance of such findings, as sleep apnea, through many of the mechanisms/diseases described above, may contribute to increased risk for stroke, but the neurologic injury that results from a stroke may also increase the likelihood of developing both obstructive and CSA.<sup>61</sup> Some studies have shown increased mortality risk in stroke patients who have obstructive (but not central) sleep apnea.<sup>62</sup>

CPAP therapy for OSA significantly reduces risk of new vascular events in patients who have had an ischemic stroke and also reduces mortality rates in these patients.<sup>63,64</sup> However, no studies have been published on the efficacy of OAT or upper airway surgery in morbidity or mortality in patients with prior stroke.

### Diabetes Mellitus

The prevalence of OSA among men with type 2 diabetes mellitus has been estimated at 28 percent.<sup>65</sup> In a study of 595 men referred to a sleep lab for suspected OSA, Meslier et al. found that type 2 diabetes was present in 30 percent of OSA patients, versus 14 percent of nonapneic snorers.<sup>66</sup> OSA may contribute to increased insulin resistance through sympathetic nervous system activation and sleep deprivation. In both obese and nonobese patients with OSA, AHI and minimum oxygen saturation during sleep have been reported by some as independent determinants of insulin resistance.<sup>67</sup> However, other studies have not found an independent link between OSA and insulin resistance.<sup>68</sup> Some authors have found improvements in insulin sensitivity in nonobese OSA patients following as little as two days of CPAP therapy whereas others studying obese OSA patients have found improvements in insulin sensitivity only after three months of CPAP therapy.<sup>69,70</sup> However, the data on this subject are conflicting, as other studies have not demonstrated significant changes in insulin resistance with CPAP therapy or have shown no change in insulin, but significant changes in leptin levels following CPAP therapy.<sup>71,72</sup>

### Obesity

There is a clear association between obesity and increased risk for OSA. Body mass index and neck girth are both significant predictors of OSA.<sup>73</sup> In the Wisconsin Sleep Cohort, each standard deviation increase in BMI was associated with a greater than four-fold increase in risk for having sleep apnea.<sup>74</sup> While estimated prevalence rates for OSA in the general population are typically between 2 and 7 percent, OSA prevalence rates of 77 percent have

been reported among obese patients undergoing bariatric surgery.<sup>75,76</sup> Longitudinal data from the Wisconsin Sleep Cohort have demonstrated that, relative to stable body weight, a 10 percent increase in body weight translates into a 32 percent higher AHI and sixfold higher risk of developing moderate-to-severe OSA. Conversely, a 10 percent decrease in body weight results in an average of 26 percent decrease in AHI.<sup>77</sup> While individuals with normal body weight may also suffer from OSA, obesity is thought

**OSA MAY CONTRIBUTE  
to increased insulin  
resistance through  
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system activation and  
sleep deprivation.**

to increase OSA risk through a number of mechanisms, including upper airway narrowing from increased submucosal fat deposition, greater degrees of pharyngeal collapsibility due to diminished traction on the trachea associated with lower lung volumes in people who have higher abdominal girth, and through central nervous system signaling proteins released by fat cells.<sup>78</sup>

Some authors have speculated that OSA may in turn contribute to obesity, through a variety of putative mechanisms, including decreased daytime physical activity related to fatigue, increased insulin resistance, changes in sympathetic nervous system activity, and changes in levels of hormones (such as leptin) related to hunger regulation and metabolism.<sup>79</sup>

### Mortality

In a prospective observational study of men with OSA or simple snorers from a sleep clinic, and age- and BMI-matched control subjects from the community, patients with untreated severe sleep apnea had more than three times the rate of fatal cardiovascular events (myocardial infarction, stroke), versus simple snorers and healthy participants.<sup>54</sup> Men with untreated mild-to-moderate OSA had a smaller (~1.6-fold) increase in mortality rates versus snorers and healthy controls a difference that was not statistically significant. Recently published 18-year mortality follow-up data from the Wisconsin Sleep Cohort Sample showed that patients with untreated severe SRBD had 3.8-fold higher all-cause mortality, and 5.2 times higher cardiovascular mortality versus those without SRBD.<sup>80</sup> Treatment with CPAP lowers mortality rates in patients with OSA to rates similar to that of simple snorers and healthy controls.<sup>54</sup> To our knowledge, there are no studies reporting a mortality benefit from OAT or upper airway surgery for adults with OSA. One retrospective study compared OSA patients treated with UPPP to those treated with CPAP and found that their mortality rates were similar over six years of follow-up.<sup>81</sup>

In addition to cardiovascular disease, another potential contributor to higher mortality rates in OSA patients may be motor vehicle accidents (MVA). One study found that untreated OSA patients had three times the rate of MVA than nonapneic controls.<sup>82</sup> Furthermore, OSA patients had twice as many driving citations as the controls.<sup>83</sup> CPAP has been shown to reduce the risk of MVA in OSA patients.<sup>82</sup> Although long-term data regarding changes in MVA risk with OAT are not available, a 25-minute simulated driving performance test on 16 control subjects and 20 OSA patients

before and after randomized treatment with either CPAP or OAT showed that OSA patients had significantly higher lapses of attention than controls prior to treatment, and that OAT and CPAP both resulted in significant and similar improvements in simulated driving.<sup>84</sup>

### Other Disorders

In addition to the above, SRBD have been associated with a number of other medical conditions, including cognitive impairment, dementia, attention deficit disorder, impotence, kidney disease, gastroesophageal reflux disease, nocturia, erythrocytosis, pulmonary hypertension, polycystic ovary syndrome, pre-eclampsia, and Down syndrome.<sup>85-96</sup> While detailed discussions of these conditions is beyond the scope of this article, it is important to note that anatomic and/or neurologic features associated with some of these conditions (i.e., Down syndrome) may be predisposed to OSA. However, for most of the above conditions, it is believed that oxidative stress, hypertension, insulin resistance, and increased sympathetic nervous system activity from SRBD play a causative role.

### Conclusion

SRBD have been linked with a myriad of medical conditions. There are multiple pathophysiologic mechanisms by which SRBD are likely to play a causal or contributory role to the development of hypertension, coronary artery disease, stroke, heart failure, arrhythmias, insulin resistance, depression, and perhaps even gastroesophageal reflux. Through excessive daytime somnolence and inattentiveness, OSA also increases the risk of accidents. While the greatest amount of efficacy data exists for CPAP therapy, there is also a growing body of data on the efficacy of OAT, and some data on upper airway

surgery that demonstrate that treatment of OSA can lower the risk of morbidity and mortality associated with many of the above disorders and conditions.

CPAP is more effective than OAT at normalizing respiratory disturbances and oxyhemoglobin saturation during sleep, particularly as apnea severity increases.<sup>97</sup> However, it is often quoted that compliance with CPAP therapy is poor, with 54 percent of patients initially prescribed CPAP still using it after a mean follow-up period of 64 months.<sup>98</sup> While patients who respond

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adequately to both CPAP and OAT often find OAT more comfortable than CPAP, the long-term compliance data for OAT (51-62 percent at two years, and only 38 percent at five years), also leave significant room for improvement.<sup>26,99,100</sup> Soft-tissue upper airway surgeries (such as UPPP and tongue advancement procedures) typically have lower success rates than CPAP or OAT, and are generally not recommended as first line treatment for OSA.<sup>101</sup> Patients undergoing maxillomandibular advancement (MMA) surgery demonstrate more substantial improvements in AHI, but there are limited data on long-term effects of MMA on various medical disorders described above.<sup>102</sup>

In light of the significant potential for morbidity and mortality related to the various medical conditions associated with SRBD, it is important for both

medical doctors and dentists to not only identify patients who might be at risk, but also help them understand the risks and benefits of all treatment options, as well as the significant risks of not undergoing, or not adhering to therapy. No matter which treatment option the patient chooses, long-term follow-up should also be planned, to look for and address potential side effects from treatment, and to make sure that the therapy that has been prescribed is still in use, and is still effective. If a patient has had significant weight gain, has started using sedatives or chronic opioid pain medications, has had recurrence of symptoms of SRBD (i.e., increased intensity of snoring, increased daytime somnolence or inattentiveness), or has developed worsening hypertension, new arrhythmias, congestive heart failure, stroke, or other significant change in their health status, it may be necessary to have a sleep specialist re-evaluate the patient, and see if apnea type or severity has changed, and evaluate whether their therapy is still effective.

If residual OSA remains present, CPAP settings or oral appliances may need adjustment, or additional airway surgery may be considered. If CSA or periodic breathing disturbances of sleep are found, other therapies, such as adaptive servo-ventilation, may be warranted.

Additionally, some patients may benefit from combinations of oral appliance, CPAP, and/or upper airway surgical therapy, to either treat residual obstruction, to lower therapeutic airway pressure requirements, or to better accommodate their lifestyle. Lastly, follow-up office visits present an ideal time to look for evidence of development or exacerbation of any comorbid medical conditions and intervene, hopefully before significant health effects from these conditions have occurred. ■■■■

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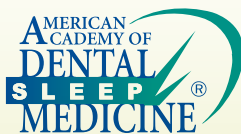
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# Past, Present, and Future Use of Oral Appliance Therapies in Sleep-Related Breathing Disorders

ROBERT R. ROGERS, DMD

**ABSTRACT** Upper airway patency is a delicate balancing act pitting pharyngeal anatomy and baseline muscle tone against the negative pressures created upon inhalation. This uniquely human phenomenon has created for some patients the need for upper airway management during sleep. In this regard, the ability of removable oral appliances utilized during sleep to create and maintain a patent airway has seen the creation of a new area of interest in dentistry termed dental sleep medicine.

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*"The acquisition and processing of oxygen is the primary mission of any air-breathing vertebrate. Chewing, walking, reproducing and thinking are all fine, but first one must breathe ..."*

**T**he human pharynx is unique in the animal kingdom in that it is predisposed to collapse during sleep. Being intimately involved with swallowing, breathing, and speaking, it is called upon to be alternately stiff or flexible depending on the task at hand. Upper airway patency is a delicate balancing act pitting pharyngeal anatomy and baseline muscle tone against the negative pressures created upon inhalation.

Why is this so? Comparing the differences in pharyngeal function between humans and other mammals is revealing. Postmortem dissections on many types of mammals reveal that the epiglottis

extends up behind the soft palate to directly join the larynx to the nasopharynx. This provides a firm, uninterrupted air channel from the external nares, through the nasal cavities and nasopharynx, past the larynx, and down to the trachea and lungs. As such, no pharyngeal muscles were designed specifically to maintain upper airway patency since none were necessary. In addition, the tongue is located anteriorly, entirely within the oral cavity and separate from the pharynx, so it cannot impact the pharyngeal space at any time. This allows the animal to eat and breathe at the same time, preserving a sense of smell so necessary for survival.

Over time, however, human evolution has given rise to the separation of the epiglottis and soft palate to create an upper airway that is longer and more flexible.<sup>2</sup> This separation allows the tongue

to reside partially within the pharynx to create a soft-walled oropharynx unique to modern humans, which provides a resonating chamber for refined vocalizations (speech and language). Unfortunately, it also provides the opportunity for sleep-induced collapse of the upper airway. To complicate matters, continuing evolution of our species resulted in an erect posture that brought the facial skeleton to lie below the frontal region of the brain case, rather than in front of it as in most quadruped animals.

This uniquely human phenomenon has created the need for upper airway management during sleep. In this regard, the ability of removable oral appliances utilized during sleep to create and maintain a patent airway has seen the creation of a new area of interest in dentistry and medicine — dental sleep medicine. By manipulating the mandible, and, hence, related oropharyngeal tissues, a properly trained and experienced dentist can utilize intraoral devices to manage sleep-disordered breathing (SDB).

The basic concept underlying oral appliance therapy (OAT) has been well-known for many years. In the early 1900s, surgeons occasionally saved the lives of micrognathic infants by suturing the tongue in a forward position to the lower lip in an effort to open and stabilize the upper airway during sleep. By 1930, helmets and chin straps were utilized by physicians for mandibular repositioning in an effort to accomplish the same goal. The first use of an intraoral mandibular repositioning device (MRD) is generally attributed to Pierre Robin, a French pediatrician, in 1934. More recently, surgical advancement of the maxilla and mandible has been reported and, in 1982, Charles Samuelson, a Chicago psychiatrist, designed a tongue-retaining device that was shown to be effective.<sup>3</sup>

Since then, substantial progress has been documented in the growing literature. In 1995, a milestone review of the topic appeared in literature that effectively summarized the efficacy of this new therapy and for the first time, suggested practice parameters.<sup>4,5</sup> A decade later, in 2005, these two documents were revised and republished reflecting the newer data in this burgeoning field.<sup>6,7</sup> Today, the literature is replete with scientific investigations supporting OAT and most recently, the American Academy of Sleep Medicine

### STABILIZATION OF THE mandible and hyoid bone prevents posterior rotation of the mandible and relapse of the tongue during sleep.

has, for the first time, published guidelines for the evaluation, management, and long-term care of obstructive sleep apnea (OSA) in adults that cites OAT as an effective option for the management of SDB.<sup>8</sup>

#### Mechanism of Action

It is generally thought that the efficacy of oral appliances (mandibular-repositioning devices and tongue-retaining devices) stems from the anterior movement of the tongue and resulting increase in the anteroposterior dimensions of the oropharynx. Interestingly, studies utilizing computed tomography, magnetic resonance imaging and nasopharyngoscopy indicate that the cross-sectional area of the velopharynx increases in both the lateral and anteroposterior dimensions, while the oropharynx increases in

the lateral dimension during mandibular advancement in awake patients.<sup>6,9</sup>

It is quite likely that the interplay of the muscles of the tongue, soft palate, lateral pharyngeal walls, and related mandibular attachments are responsible for these changes due to the mechanical stretching of the palatoglossal and palatopharyngeal arches. In addition, stabilization of the mandible and hyoid bone prevents posterior rotation of the mandible and relapse of the tongue during sleep.<sup>10</sup> A positive effect on airflow dynamics has also been demonstrated with use of mandibular advancement due to diminished airway curvature in the velopharynx.<sup>11</sup> Finally, neuromuscular properties of the upper airway appear to be affected by mandibular repositioning.<sup>12</sup>

Of critical importance to the clinical practitioner is the variability in airway response to oral appliances, most likely due to the inconsistent effect of mandibular/tongue movement to these muscle systems.

#### Validation of Efficacy

Subjectively, reports from patients and their bed partners indicate that oral appliance therapy generally results in a significant reduction of snoring in a high proportion of cases.<sup>13</sup>

Improvements in daytime sleepiness, work performance, and sleep quality of both patient and bed partner are also reported benefits.<sup>14,15</sup> Objectively, sleep tests show improvements in snoring frequency and intensity, apnea-hypopnea index (AHI), oxygen desaturation frequency and intensity, and the number of arousals during sleep.<sup>15-17</sup> Significant increases in slow wave and rapid eye movement sleep have also been demonstrated in studies.<sup>17,18</sup>

Complete treatment success, defined as an AHI of fewer than five events per hour and resolution of symptoms, has



**FIGURE 1.** MRD with anterior-adjusting mechanism.

been reported to occur in 19 percent to 75 percent of patients with mild to moderate OSA. Higher success rates have been reported in studies using a more liberal definition of success, namely an AHI of fewer than 10 events per hour.<sup>6,15</sup>

A blood pressure-lowering effect has been demonstrated in more recent studies with mandibular repositioning devices where the results were similar in magnitude to that achieved with continuous positive airway pressure (CPAP).<sup>19</sup> In addition, other studies demonstrated improvements in the quality of life and aspects of neurocognitive performance such as psychomotor speed when MRDs are used.<sup>20</sup>

The clinical practitioner should keep in mind that even against the background of an inadequate improvement in AHI, patients may report fewer symptoms when initiating oral appliance therapy.<sup>6</sup> In fact, an increase in AHI has been reported in approximately 13 percent of OSA patients following appliance therapy.<sup>21</sup> Due to this risk of increased or suboptimal AHI, an objective, follow-up sleep study should always be performed to verify efficacy.

Long-term effectiveness of oral appliances in treating OSA appears to be in the proximity of 80 percent after follow-up periods ranging from two to five years.<sup>22,23</sup> A similar, but slightly lower percentage of patients experience a long-term satisfactory effect on snoring with OAT.



**FIGURE 2.** Tongue-retaining device.

As such, a gradual, diminution in treatment effect can be expected in some cases that may be due to aging, increasing body weight, and failure to properly monitor the therapeutic mandibular position.<sup>24</sup>

### Follow-Up

Following titration of the oral appliance based on resolution of subjective symptoms, the patient is referred back to the medical clinician for objective evaluation of the treatment outcome. A follow-up sleep study is generally recommended, especially in cases of moderate to severe OSA because baseline improvement in symptoms is not always accompanied by an adequate reduction in AHI.

Long-term follow-up evaluation by the sleep-disorders dentist is generally undertaken six months after final titration and then annually thereafter.<sup>6</sup> At these periodic visits, the dentist monitors usage, general satisfaction, symptoms, weight increase, side effects, dental and oral health, degree of jaw repositioning, and integrity of the appliance. Ongoing communication with the appropriate medical clinicians is necessary to ensure adequate long-term care.

### Design Variations

Presently, there are nearly 100 different oral appliance designs available to the dental practitioner with many accepted by the Food and Drug Administration. The vast majority of them fall into the

category of MRDs, which are utilized far more often worldwide and are supported by the most research. Tongue-retaining devices (TRDs) represent a very tiny percentage of appliance utilization and are studied far less often (**FIGURES 1 AND 2**).

MRDs all function to reposition and stabilize the mandible in a protruded position during sleep. Within this functional classification, numerous design variations exist giving rise to the plethora of MRDs. To date, no significant research has clearly demonstrated any great advantage of one design feature over another; however, studies suggest they may impact efficacy and tolerance.<sup>25,26</sup> Dual-block MRDs consist of maxillary and mandibular components that are joined by one of several modes, including elastic or plastic connectors, metal rod and tube connectors, hook connectors, acrylic resin extensions, or magnets. These dual-block devices are most advantageous because they facilitate incremental adjustment of mandibular position over time. Fixed or mono-block appliances are quite tedious and time-consuming to adjust requiring physical separation and rejoining of the upper and lower component, which precludes precise, incremental, reproducible, and easily referenced jaw positions (**FIGURES 3-5**).

Certain trends are driving the evolution of appliance design and are vital for the practitioner to recognize. Of primary importance are the serial protrusive adjustability of the MRD and the notion of titrating the device to ascertain both an effective and comfortable jaw position. Other important design variations include durability to resist the hostile environment of the oral cavity, improved materials to increase the retention to the dentition, and freedom of mandibular movement to allow greater temporomandibular joint (TMJ) comfort (**FIGURES 6 AND 7**).



FIGURE 3.



FIGURE 4.



FIGURE 5.

FIGURES 3-5. MRDs with buccal adjustment mechanisms.



FIGURE 6. MRD with palatal adjustment mechanism



FIGURE 7. MRD with nonmechanical adjustment mechanism



FIGURE 8. MRD; noncustom appliance

Custom-made laboratory appliances are generally felt to offer more comfort, better retention, increased durability, and more sophisticated protrusive engineering than the noncustom “boil and bite” designs whose major advantages seem to be limited to immediate availability and decreased cost. A recent study has shown that custom-made appliances are superior in efficacy and patient acceptance<sup>27</sup> (FIGURE 8).

TRDs do not enjoy the popularity of MRDs but nonetheless offer the practitioner and the patient an alternative to mandibular repositioning. Therapy with TRDs has been objectively studied, most notably in the mid-1980s, and shown to be effective in some cases.<sup>28</sup> TRDs function by directly engaging the tongue and holding it in a forward position to open the upper airway during sleep. Few variations of the TRD exist and many practitioners have little or no experience with this design type. The major advantage of the TRD may be its ability to promote forward tongue po-

sition without having to engage the dentition or significantly stressing the TMJ. As such, these appliances may offer significant advantage for patients with loose or no teeth, or those with TMJ dysfunction.

It is incumbent upon the sleep-disorders dentist to become familiar with the design variations of numerous appliances and develop clinical preferences over time based on experience and objective scientific observation.

### The Sleep-Disorders Dentist Qualifications and Competency

A 2006 review of the literature by the American Academy of Sleep Medicine stated that,

*“The dentist who provides therapy with oral appliances for the management of sleep-related breathing disorders should have adequate knowledge and skill to provide safe and effective treatment. Therefore, the dental clinician must be thoroughly familiar with the sleep-induced changes in the physiology of various organ systems including, but not*

*limited to the neurological, musculoskeletal, cardiac, and respiratory systems as well as possess a good knowledge of the symptoms associated with sleep-related breathing disorders. In addition, the dental practitioner should be proficient in understanding various diagnostic and follow-up testing modalities including, but not limited to the polysomnographic evaluation, multiple sleep latency test (MSLT), maintenance of wakefulness test (MWT), Epworth sleepiness scale (ESS) and pulse oximetry, and be adept at interacting with medical sleep specialists and other attending physicians for the purposes of proper diagnosis, treatment, and follow-up.*

*Finally, the dentist who provides therapy with oral appliances should understand the functional characteristics and design variations of many different oral appliances and must be able to recognize and manage the side effects and complications associated with oral appliances, especially occlusal changes, tooth movement and temporomandibular joint symptoms. The prudent practitioner understands the implications*

of lifelong therapy and the importance of regular, periodic, follow-up examinations.

*Qualified practitioners are those who are board-certified as diplomates of the American Board of Dental Sleep Medicine or others who have undertaken comprehensive training in sleep medicine and/or sleep-related breathing disorders with an emphasis on the scientific literature and the use of appropriate protocol for diagnosis, treatment, and follow-up. Treatment provided by individuals who have little or no training and education in this unique multidisciplinary area should be discouraged.”<sup>6</sup>*

## Clinical Protocol

Treatment of sleep-disordered breathing with oral appliances requires a team approach. Presently, diagnosis falls within the realm of physicians while construction and management of the oral appliance dwells in the dental arena. As the experience, technology, and skills of dentists evolve, the dentist may play a larger role and the lines between diagnosis and treatment may blur. Today, however, it is ethically and legally prudent for the dentist to appreciate an objective medical diagnosis prior to any treatment with an oral appliance.

According to published *Practice Parameters*, oral appliances are indicated for patients with mild to moderate OSA who prefer this form of treatment over CPAP or who do not respond to or are unable to tolerate CPAP.<sup>29</sup> The guidelines also recommend that, whenever possible, CPAP be considered for patients with severe OSA in preference to oral appliances, given its greater efficacy.

Following an objective diagnostic evaluation by a physician, the patient may be referred to the dental practitioner for consideration of oral appliance therapy. The dentist conducts a thorough dental/medical and oral/cranio-mandibular evalu-

ation as is customary within the dental profession. Additionally, the history of present illness places specific emphasis on symptoms of snoring and daytime sleepiness while the oral exam places additional emphasis on the pharyngeal aperture including data on tongue size and uvula/soft palate configuration. General consensus holds that the presence of eight to 10 healthy teeth in each arch and a minimum 5 mm protrusive capacity of the mandible are usually required for optimum results from MRD treatment.

**PRESENTLY, DIAGNOSIS  
falls within the realm  
of physicians while  
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in the dental arena.**

Following medical/dental assessment, the dentist engages the patient in a discussion exploring chances of treatment success versus side effects. The need for objective follow-up testing and long-term monitoring is emphasized, and written informed consent is obtained.

High-quality intraoral impressions are made along with a therapeutic bite, then an appropriate oral appliance is custom-fabricated by the dental laboratory. The appliance is delivered with instructions on use, care, and jaw advancement protocol. The appliance is typically advanced (titrated) slowly, as comfort allows, over a period of weeks or months to achieve resolution of subjective symptoms such as snoring and daytime sleepiness. The patient may be seen in two- to four-week intervals to monitor these changes and troubleshoot

any problem areas. Home-monitoring devices may be employed by the dentist to more objectively assess snoring, airflow, and nocturnal oxygen saturation.

Following adequate subjective response, the patient is referred back to the physician for objective, medical evaluation of the treatment outcome. Adjustments to the appliance can be made pending the outcome data. Long-term follow-up is essential to monitor subjective satisfaction, compliance, resolution of symptoms, integrity of the oral appliance, and health of the oral structures.

## In-Lab Titration

The estimation of the proper, therapeutic jaw position prior to objective testing is generally predicated on resolution of subjective symptomatology, i.e., diminution of snoring and daytime somnolence as per patient/bed partner report. Then, historically, an objective sleep test is performed to assess the efficacy of that particular jaw position. If shown to be less than adequate, the patient returns to the dentist for further appliance adjustment and then additional objective testing. While this protocol can produce positive outcomes, it tends to be time-consuming, expensive, and tedious.

Presently, protocols are developing that allow for the real-time titration of mandibular repositioning devices during an attended, in-lab sleep study much the same as a CPAP titration. Recent studies demonstrate 55 percent of patients who are subjectively self-titrated at home are successfully treated after polysomnographic assessment.<sup>30,31</sup> Notably, 27 percent to 32 percent of the self-titrated failures become successes utilizing the added in-lab PSG titration.

While this new approach to appliance titration seems to provide for more efficient and better outcomes, it must be refined and validated with regard to adjustment protocols during the study.

### Benefit Versus Risk of Treatment

As with any therapeutic modality, the benefits of treatment must be weighed against the adverse effects inherent in the therapy. When oral appliances are effective in treating SDB, patients may realize a diminution in snoring, daytime somnolence and social disruption, as well as decreased risk of cardiovascular and neurocognitive impairment. However, utilization of oral appliances presents the patient and practitioner with an array of side effects ranging from minor and transient to significant and permanent. Prior to initiating therapy the patient and clinician should thoroughly review all possible side effects and be comfortable with the benefit versus risk.

During the initial period of use, tenderness of the teeth and jaws, gum irritation, excessive salivation, or xerostomia may be reported by patients.<sup>32,33</sup> Mild complaints of pain and strain of the masticatory muscles and the TMJ also occur frequently during the initial period of use.<sup>34</sup> In addition, a transient occlusal change after removal of the appliance each morning almost always occurs in patients.<sup>35</sup> Although unsupported in the scientific literature, it is thought that this phenomenon may be attributed to a partially contracted lateral pterygoid muscle and accumulation of retrodiskal blood in the TMJ area after full-night mandibular protrusion. Small movements of the anterior teeth due to the nocturnal forces of the appliance may also play a role. Occasionally, treatment may be complicated by involuntary removal of the device, an exaggerated gag reflex, periodontal damage, or fractured teeth and fillings.<sup>34,36</sup> Fortunately, these relatively minor and transient occurrences are easily managed by the experienced practitioner or gradually subside naturally as treatment progresses.

Over time, oral appliance therapy may aggravate TMJ disease in certain patients or increase the tendency for bruxism.<sup>22,32</sup> However, in the clinical situation signs or symptoms of TMJ disorders resulting from OAT are not commonly reported.<sup>37</sup> On the other hand, orthodontic effects on the teeth and dentofacial structures are observed more frequently and may be permanent.<sup>37</sup> In most cases these orthodontic effects amount to permanent alterations in the dental occlusion.<sup>38</sup> The overjet and overbite may diminish and the occlusion may open laterally.<sup>39</sup>

It is considered reasonable to continue with oral appliance therapy in the presence of acceptable and nonprogressive adverse effects contingent upon appropriate patient follow-up given the risk of medical comorbidity associated with untreated OSA. Bite change is inevitable with many oral appliance patients and simply needs to be managed by an experienced sleep-disorders dentist. Orthodontic correction would merely be reversed by further appliance usage. Ultimately, the effective treatment of a life-threatening disease such as OSA supersedes the maintenance of baseline occlusion.<sup>39</sup>

### Combination Oral Appliance/CPAP Therapy

Traditionally, definitive therapy to manage sleep-disordered breathing has included positive airway pressure, oral appliance therapy and surgery. Most often, these approaches are independent of each other and are recommended based on the background and experience of the practitioner. It is understood that no treatment modality is universally accepted and effective, and it is quite evident that new approaches are warranted (FIGURE 9).

Positive airway pressure modalities (CPAP, BiPAP) have been shown to



FIGURE 9. Combination oral appliance/CPAP interface.

be extraordinarily effective in creating and maintaining a patent airway during sleep but lack a great measure of success because of poor compliance often due to poor mask fit, mask leak, discomfort from straps, and excessive air pressure requirements. Therapy with oral appliances is much more acceptable to patients but lacks the ability to adequately open the airway in a significant number of cases.

For more than a decade, inventors have been focusing on a variety of combination oral appliance/CPAP interfaces in an effort to utilize the benefits of each while minimizing shortcomings. As such, several products are available that offer a positive airway pressure mask directly attached to an oral appliance.

It is believed that the oral appliance component of the interface can offer superior anchorage for the mask providing added comfort and stability in the absence of straps and headgear. In addition, since the oral appliance provides a measure of mandibular splinting and/or protrusion, it is believed that positive airway pressure requirements may be decreased in many cases. The positive airway pressure component can serve to maintain airway patency where an oral appliance alone is not effective.

Support in the scientific literature for this approach is scant with no large-scale or long-term studies. However, more and more attention is being focused on this new area and appliance manufacturers are constantly refining technology.

## Future Trends

Presently, oral appliance therapy has reached a critical tipping point with the acceptance by physicians, dentists, patients and insurance companies as a legitimate and necessary treatment for SDB. We have arrived at this juncture following several decades of basic research and clinical application with dental sleep medicine becoming a rapidly growing field in the sleep arena. The American Academy of Dental Sleep Medicine (AADSM) membership has grown 645 percent over the last decade and now boasts more than 2,000 members.

The use of oral appliances to impact the upper airway during sleep will continue to evolve. As mentioned above, the application of intraoral devices in tandem with positive airway pressure appears to be a very promising direction. In addition, preliminary work is being done in areas seemingly tangential to the direct application of the oral appliance to mechanically reposition the tongue/mandible. For example, oral appliances that utilize intrinsic (genomic) and extrinsic (epigenetic) factors in cephalic growth are being studied in an effort to regulate and improve craniofacial form and possibly airway patency.<sup>40</sup> In addition, work is underway to examine how unique oral devices can impact the “chronically overstimulated” autonomic nervous system by positively affecting the ease of breathing, swallowing, and speaking.

Finally, commercial entities have seriously entered the fray due to the recent rapid growth of oral appliance therapy and the obvious commercial opportunities. In this regard, the next decade will witness further transformation as appliance manufacturers, home care companies and sleep labs work with clinicians, scientists and professional academies to balance the need for easy access to care with the necessity of well-trained practitioners and high-quality clinical outcomes. ■■■■

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# Neurology of Sleep and Sleep-Related Breathing Disorders and Their Relationships to Sleep Bruxism

JERALD H. SIMMONS, MD

**ABSTRACT** Conditions that affect sleep can impact overall health. More than 70 million Americans suffer from problems with sleep. The purpose of this article is to provide the basic science of sleep physiology and how it relates to disorders that are pertinent to dentistry. Concepts are presented that explain airway dynamics and how the jaw and tongue influence airway obstruction. Additionally, explanation is given on an association between temporomandibular jaw dysfunction and bruxism during sleep.

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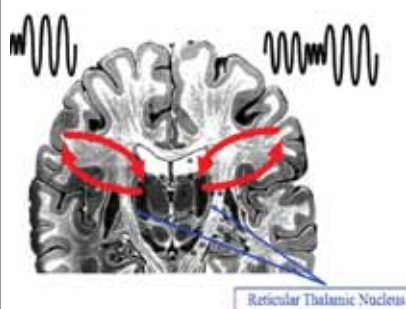
Relative to other disciplines, sleep medicine is in its infancy. For years the delay in development of this field stemmed primarily from the limited technology available to assess the sleeping process.<sup>1</sup> As technology developed and improved, the ability to understand the governing mechanisms of sleep in a meaningful fashion became possible. Over the past 50 years, tremendous strides have occurred that led to the current knowledge and establishment of the field of sleep disorders medicine. Unlike other areas of the medical field, sleep medicine focuses on a physiologic process and not an organ system, and it integrates many disciplines under a single umbrella. The American Academy of Dental Sleep Medicine (AADSM) was originally founded as the Sleep Disorders Dental Society

in 1991 and has grown extensively in the past 20 years. Now dentists can become involved, and, to assure they properly address sleep medicine, there now exists a dental sleep medicine board that provides guidelines for dentists who wish to credential in this area of medicine.<sup>2,3</sup>

There is a full spectrum of conditions that affect sleep that have a far-reaching impact on patients with a variety of conditions. The purpose of this article is to provide the basic science of sleep physiology and how it relates to disorders that are pertinent to dentistry. Concepts are presented and build toward a knowledge base that will bring the reader to understand not only how modification of the jaw relationship can enhance breathing but also explains how abnormal conditions during sleep can be associated with sleep bruxism (SB) and TMJ dysfunction (TMD).

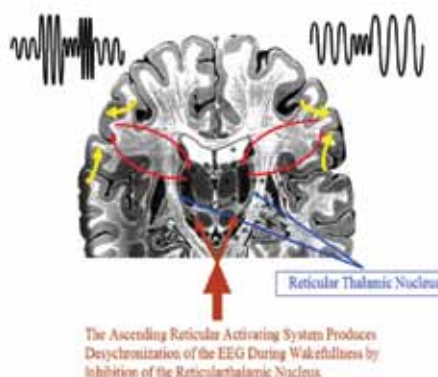
### Non-REM Sleep

The reticular thalamic nucleus inhibits sensory input from the thalamus along the thalamo-cortical pathways which produces synchronous EEG activity during Non-REM sleep.



### Wakefulness

The ascending reticular activating system inhibits the reticular thalamic nucleus allowing the cortex to be active during wakefulness.



**FIGURE 1.** In non-REM sleep the cortex is not processing information from sensory input and the two hemispheres display EEG that is synchronized, meaning that the activity is similar on both sides of the head. This synchronization is governed by the reticular thalamic nucleus and is a key feature of non-REM sleep. During wakefulness the ascending reticular activating system stimulates the thalamus in regions that turn down the filtering mechanism of the reticular thalamic nucleus. This allows sensory input to pass through the thalamus, onto the cortex. In so doing each cortical region performs specific processing and this result in changes in changes in the EEG that are different in each region, thus desynchronizing the EEG signal.

### Basic Sleep Physiology and the Stages of Sleep

Sleep is divided into two main categories or stages: REM and non-REM. REM refers to rapid-eye movement sleep, but first it would be appropriate to describe non-REM sleep, since it constitutes the majority of the sleeping process. Non-REM sleep is divided into three progressively deeper stages, referred to as N1, N2, and N3.<sup>4</sup> N3 is considered the deepest, most restorative level of sleep and is also referred to as slow wave sleep.<sup>5,6</sup> During non-REM sleep, the brain utilizes a filtering mechanism within the deep brain structures in a region known as the reticular thalamic nucleus that blocks the sensory input coming from throughout the body from reaching the cerebral cortex. This filtering mechanism involves gamma aminobutyric acid (GABA), an inhibitory neurotransmitter. During non-REM sleep there is a global filtering of the incoming sensory signals from throughout the body at the thalamic

level.<sup>7</sup> The filtering is most robust during stage N3 and it is during this portion of sleep that certain hormonal changes take place. For example, growth hormone secretion achieves its highest level during stage N3 sleep. It is now recognized that the greatest restoration of the body occurs during non-REM sleep, and most specifically during stage N3.<sup>5,6</sup> (FIGURE 1).

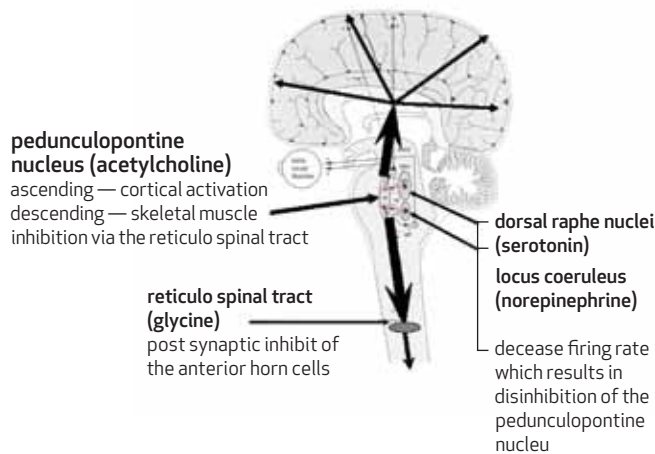
REM sleep has very different characteristics. During REM, an individual is actively dreaming or hallucinating and the cortex acts almost as though it is awake. There are three neurotransmitters that play an important role in REM sleep. These are acetylcholine (ACh), norepinephrine (NE) and serotonin (5HT). In the brainstem, the dorsal raphe nucleus, which utilizes 5HT and the locus coeruleus that utilizes NE, are actively firing while awake and during non-REM sleep. These two nuclei, through 5HT and NE, suppress a region of the brainstem known as the pedunculopontine tegmental (PPT) nucleus which, when

not suppressed, sends output to both the lower brainstem and to the thalamus with fibers that release ACh as its transmitter.

REM sleep occurs when the locus coeruleus and the dorsal raphe nucleus stop their inhibitory activity over the PPT nucleus. In effect, this results in activation of the two ACh pathways of the PPT nucleus. Pathway 1 ascends into the thalamus as part of the ascending reticular activating system having an activating affect on the cortex creating hallucinatory phenomena during REM sleep. Pathway 2 descends to the bottom of the brainstem (medulla) ending at the reticulo-spinal track nucleus. The reticulo-spinal track consists of neurons that descend down into the spinal cord and release glycine as a neurotransmitter. This causes post-synaptic inhibition on the motor neurons that leave the spinal cord, resulting in paralysis of the body during REM sleep. Therefore, during REM sleep the body becomes paralyzed while the cortex is very actively hallucinating. This muscle paralysis prevents the body from acting out on the impulses generated from the brain's cortex during REM sleep.<sup>6,8-10</sup> This change of muscle tone activity that occurs during REM sleep has significant ramifications on aspects of breathing and influences the degree of obstructive breathing as will be outlined later below<sup>11</sup> (FIGURE 2).

During the day, a person maintains a focused attention that shifts from one object or thought to another. This capability of shifting our concentration in a focused fashion is provided by the brain's ability to filter out irrelevant stimuli.<sup>12-14</sup> As the brain fatigues there is a breakdown in the brain's ability to filter out irrelevant stimuli. This results in inattention and distractibility and occurs with sleep deprivation.<sup>15</sup> The part of the brain that provides the filtration and focusing of attention is also within the thalamus.

### Brainstem regulation and control of REM



**FIGURE 2.** Diagram shows the brainstem regions responsible for the regulation of REM sleep.

As described above, during non-REM sleep, the thalamus provides a global filtration of incoming sensory stimuli. As we become more sleep deprived this filtering effect is enhanced in order to achieve sufficient filtration of sensory input necessary for us to fall off to sleep.

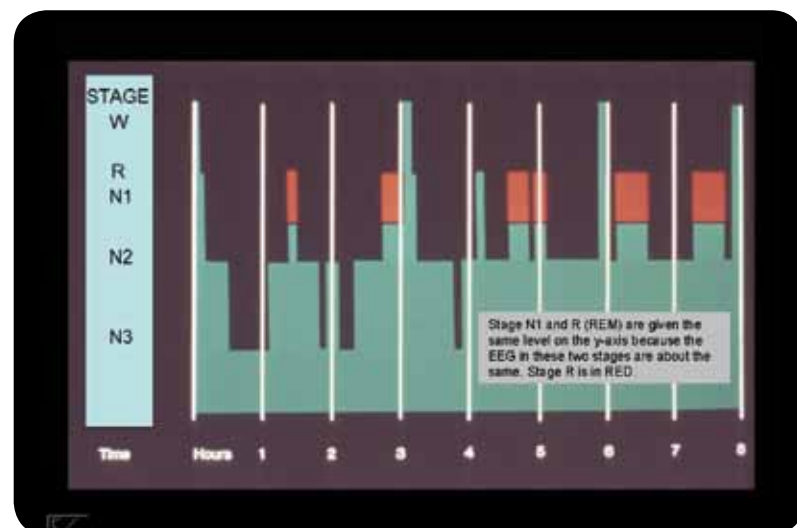
While wide awake maintaining a focused attention on a complex task the brain is functioning in a completely opposite fashion as to what occurs during non-REM sleep, during which there is no specific cortical processing taking place and the cortex is globally under inhibition by the reticular thalamic nucleus. Trying to maintain focused attention while sleep deprived may prove challenging because of a globally enhanced degree of filtering exhibited by the reticular thalamic nucleus. Frequently, to maintain wakefulness when sleep deprived a person increases their stimulation level to stay awake. This is achieved by changes in behavior such as fidgeting, shifting in a chair, getting up to walk around etc. In essence they become hyperactive as a compensation to override the enhanced sleep drive of the reticular thalamic nucleus.<sup>16-18</sup>

The brain cycles through stages of N1, N2, N3, and REM over a 90-minute period, with REM sleep occurring ap-

proximately every 90 minutes throughout the night. Each of these 90-minute segments is referred to as a sleep cycle. As the brain progresses through these sleep cycles there is a decreased amount of N3 sleep and an increase in the amount of REM sleep.<sup>4,19</sup> As a result, the last portion of the night typically has no N3 or slow wave sleep and the largest portion of REM sleep of the night. Therefore, most of REM sleep occurs during the second-half of the night (**FIGURE 3**).

### Fragmentation of Sleep and Daytime Consequences

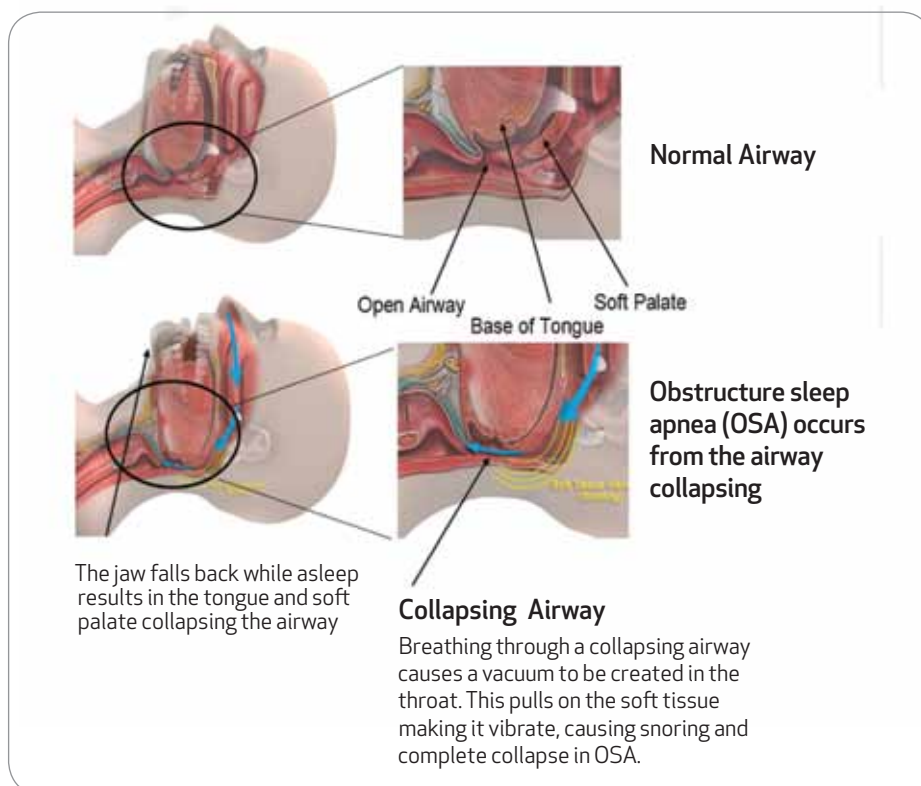
Repetitive disruptions in sleep continuity lowers the restorative properties that sleep is intended to provide. Increased sleepiness throughout the day results from a heightened level of filtering from the reticular thalamic nucleus as it attempts to put the brain to sleep.<sup>7</sup> There are several common conditions that disrupt the continuity of sleep and are important to understand in order to identify common sleep disturbances. One common condition referred to as periodic limb movements of sleep or PLMS. This phenomena frequently occurs in patients who have restless leg syndrome (RLS) but can also be seen in people without RLS.<sup>6,20</sup> A more elaborate discussion of this condition is outside the scope of this article. Another common condition that is important for dentists to recognize relates to obstructive breathing during sleep. The hallmark condition in this category is referred to as obstructive sleep apnea (OSA).<sup>6,21,22</sup>



**FIGURE 3.** Diagram shows a typical hypnogram of the different sleep stages that occur throughout the night.

## The Principles of Obstructive Breathing During Sleep

To understand obstructive breathing, first refer to a principle of the physics known as the Bernoulli Effect. As flow goes through a space, there is a negative pressure or vacuum that develops within that space. If the space becomes narrower and the flow volume is maintained constant then there is an increase in the degree of negative pressure or vacuum. An example of this phenomena is demonstrated by flow of water in the shower where the shower curtain is pulled in toward the flow of water if the water stream is brisk. If the shower curtain is pushed away from the water, expanding the space, this lowers the amount of negative pressure within the space. This same principle occurs in the back of the throat. The tongue attaches to the inner aspect of the mandible and then travels posterior toward the pharyngeal wall and also curves upward and forward into the oral cavity. As the mandibular muscles relax and the mandible retrudes, the base of the tongue moves with it and encroaches on the posterior pharyngeal wall. As this occurs the posterior pharynx narrows and this results in an increase in negative pressure during breathing. When an individual goes to sleep it is normal for there to be an increase in the magnitude of negative pressure of the posterior pharyngeal airway. Typically, an awake person generates approximately  $-2$  to  $-5$  cm  $H_2O$  pressure in this region. When they fall off to sleep, generally it increases to  $-5$  to  $-8$  cm  $H_2O$ . Under abnormal conditions, such as with patients who have OSA, when the individual falls asleep, the pharyngeal space narrows to a degree where the negative pressures can range from  $-15$  to  $-30$  cm  $H_2O$  and, when severe, can even generate levels beyond  $-100$  cm  $H_2O$ .<sup>6,23-28</sup>



**FIGURE 4.** Diagram demonstrating the changes in the airway structure during sleep and the resulting effects of breathing with the development of negative pressure within the pharynx.

Abnormal degrees of negative pressure in the posterior pharynx causes the tissue of the posterior pharynx to vibrate as it is pulled downward. This vibration causes snoring. Depending on the muscle tone of the entire pharyngeal region, which is influenced also by the various sleep stages and other factors, the airway may collapse from this negative pressure vacuum. In some patients the pharyngeal walls have more resistance toward collapse where  $-50$  cm  $H_2O$  does not cause complete collapse of the airway. In other cases, the airway may be very collapsible and completely collapse at lower magnitudes of negative pressure.<sup>6,25,26</sup>

OSA is classically described when the airway completely collapses, cutting off flow while the chest muscles continue to attempt respirations. This type of phenomena can clearly be seen on a sleep study. From a practical standpoint, there is a spectrum of the degree of obstructive events with complete obstruction on one end and normal breathing on the other

with various degrees of partial blockage in between. With partial blockage, airflow continues to be maintained but may be decreased without pauses in breathing. Frequently when this occurs there may even be a reduction in the blood oxygen level resulting from the decreased amount of air flow. However, many experts contend that a reduction in the oxygen level is not necessary for an event to be significant if there is a disruption in sleep continuity from the partial obstruction. These partial obstructions lasting 10 seconds or longer are known as hypopneas. Respiratory events that occur during an individual's sleep, including both apneas and hypopneas are reported using the apnea hypopnea index (AHI) that refers to the averaged, hourly frequency of these types of events. These events are reported together in the AHI because research has not demonstrated a distinction in the detrimental effects produced by severe hypopneas versus severe apneas (**FIGURE 4**).

## The Upper Airway Resistance Syndrome

Many subtle respiratory events from partial airway obstruction occur and are demonstrated with an increased magnitude of negative pressure with each breath, leading to disrupted sleep. Frequently, these subtle events go untabulated by routine PSG testing methods because the breathing efforts recording belt technology, airflow monitors, and oxymetry monitoring used do not always demonstrate changes associated in breathing leading to arousals in sleep. These subtle events trigger the muscles of the throat, tongue, and mandible, increasing muscle tone and opening the airway to normalize respirations. More subtle respiratory events known as respiratory effort-related arousals of sleep (RERAS) are best identified and tabulated when the sleep study is performed with the addition of a small, soft catheter placed through an individual's nose and swallowed by the patient such that the tip of the catheter resides in the esophagus within the midthoracic level. This probe, measuring internal negative pressures during sleep, allows for the proper tabulation of these RERAs that would otherwise go undetected and is called esophageal pressure (Pes) testing. (Pes denotes pressure within the esophagus.)

When an individual has fragmented sleep and sleepiness primarily resulting from these more subtle respiratory events the diagnosis of upper airway resistance syndrome (UARS) is given.<sup>29-31</sup> Another method for picking up RERAs using a pressure cannula at the nostrils show patterns of flow restriction, known as flow limitation, do not show the degree of effort being exerted and are not the gold standard of measuring RERAs.

The UARS, consisting of subtle respiratory events, is a very common disorder but its occurrence is unknown in part due to the fact that most sleep disorders centers do not employ Pes testing to objectively establish the diagnosis.<sup>29-31</sup>

## Factors That Change in the Collapsibility of the Upper Airway Throughout the Night

The likelihood of airway collapse fluctuates during the night based on sleep stage and body position, in addition to other factors. When someone is lying in a supine position, gravity plays a role in the collapsibility of the pharynx.<sup>11</sup> Gravity can pull the tongue and mandible downward, increasing the degree of obstructive breathing as compared to lying in the lateral position. Frequently, individuals

**IT IS FREQUENTLY demonstrated that patients with severe sleep apnea have their worst obstructive respiratory episodes during REM sleep.**

with severe obstructive respirations during sleep tend to prefer sleeping in the lateral or prone position. This preference in body position is probably a subconscious preference to improve respiration. Sleep stage also influences the collapsibility of the airway primarily as a function of muscle tone. For example, during REM sleep, muscle paralysis is manifested throughout the body as it decreases the muscle tone of the upper airway muscles contributing to its collapsibility. As a result, it is frequently demonstrated that patients with severe sleep apnea have their worst obstructive respiratory episodes during REM sleep. Since REM sleep occurs more toward the last portion of the night there would be a minimal amount of REM sleep measured with a split night study (in which only half the night is done in a diagnostic fashion).

As a result, the full severity of the person's obstructive respirations may go unrecognized. For this reason, it is important to not rely on sleep studies conducted with a split night protocol when establishing a severity rating of obstructive breathing for an individual, unless, however, the half night demonstrates severe OSA. Frequently, partial night studies show individuals to have a lesser severity of obstructive respiration than would have otherwise been recognized had the diagnostic study been performed the entire night. Rendering a designation of mild or moderate OSA to a patient who has had a split night study is not appropriate for this reason.

For reasons not yet fully understood, the upper airway is more resistant to collapse during slow wave or N3 sleep.<sup>32-34</sup> Frequently, individuals exert large degrees of negative pressure during slow wave sleep to breathe against a partially collapsed airway and do not develop complete collapse of the upper airway. The same individual during other stages of sleep, such as N1 or N2, will have complete airway collapse at much lower degrees of negative pressure.

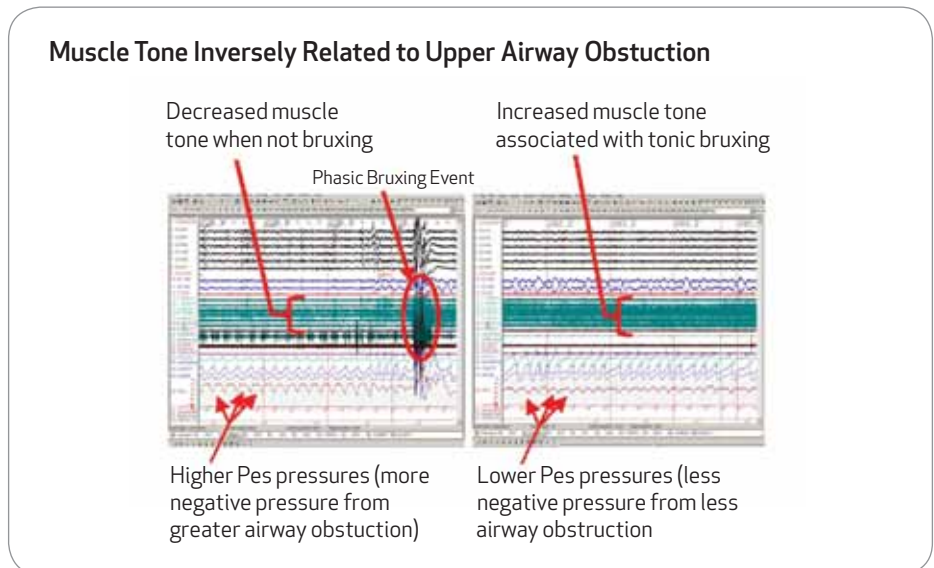
Various medications such as those that cause muscle relaxation are known to enhance the degree of collapsibility of the upper airway by decreasing the airway muscle tone. Opiate medications can also blunt the ability to increase airway tone in the presence of increased negative pressure and thus enhance obstructive respirations. Alcohol has a similar effect to that of muscle relaxants medications.<sup>34-35</sup> Sleep deprivation also has the effect of blunting the ability to increase upper airway tone in the presence of obstruction, and, as a result, obstructive respirations become worse when a person is sleep deprived. This clearly is observed in individuals who provide a history of snoring to a greater degree after having been awake for 24 hours.<sup>6</sup>

## Treatment of Obstructive Respirations During Sleep

There are a variety of methods that can be implemented to treat OSA. Surgical methods are provided elsewhere. For patients in whom adipose tissue is a significant factor, weight reduction is beneficial. The most reliable method for treating this condition is through the administration of continuous positive airway pressure (CPAP), which was initially studied by Colin Sullivan, MD, and published in 1981.<sup>37</sup> Over the past 30-plus years, significant improvements in CPAP treatment have been implemented. CPAP works by providing positive pressure to nullify the Bernoulli Effect, described earlier, and neutralizing the vacuum of the upper airway, preventing upper airway collapse. This allows an individual to maintain respirations without repetitive arousals, improving sleep so individuals awaken refreshed.

Various types of masks have been developed to accommodate the variety of facial structures and personal preferences that exist within a general population. CPAP therapy has been successfully implemented in patients as young as under the age of 1 and in the elderly beyond 90 years old. In some, special accommodations are necessary to overcome pitfalls in CPAP therapy. Sometimes simple measures such as the addition of an elastic chin strap that holds the mandible closed can provide the difference between treatment failure and treatment success. The mouth falling open may result in CPAP pressure leakage that nullifies the effect.

Recently there have been innovative techniques that utilize a combination between dental appliances and CPAP such that the CPAP mask is anchored onto an appliance resulting in a stable mask without straps around the head.<sup>38</sup> Also made are full-face masks moulded



**FIGURE 5.** The two tracings above are from the same patient at different points during the night. The tracing on the left demonstrates less EMG activity in the muscles influencing the mandible, when compared to the tracing on the right. As a result, there is a greater degree of obstruction and negative pressure on the left tracing compared to the right. This is a demonstration of how tonic bruxism opens up the airway and reduces the obstruction. The phasic increase in EMG seen the left tracing as part of the arousal is a result of the obstructive hypopnea.

from an impression of the patient's face that attach to a dental appliance. This results in a mask covering the nose and mouth without any straps around the head. The advantage of using a dental appliance in conjunction with a CPAP mask is that it helps stabilize the mandible in a more anterior or at least in a neutral position, enhancing the treatment from CPAP alone by opening the posterior pharyngeal airway space. Standard full-face masks have a tendency to push the mandible back, particularly if the straps are tightened, and this has the effect of increasing airway obstruction and making the administration of CPAP therapy more difficult. Stabilizing the mandible with a dental appliance has demonstrated to improve the use of full-face masks when this problem occurs.<sup>39</sup>

Properly administering CPAP requires a PSG study that carefully assesses the changes in breathing with the different CPAP levels, and the technologist titrates the pressure to identify the optimal settings for each patient. Many patients require very specific settings.

## Bruxism During Sleep as a Protective Mechanism of Upper Airway Collapse

The brain has inherent mechanisms utilized to decrease or eliminate the obstruction of the upper airway during sleep. The preference of body position mentioned above is one subconscious technique frequently utilized. Another method may be sleep clenching or bruxism. SB brings the mandible into occlusion, with or without tongue thrusting, and may reduce obstruction of the upper airway that would otherwise occur in the absence of such mechanical maneuvers.

Historically, it has been recognized that SB and TMD have been associated with obstructive sleep apnea patients.<sup>40-43</sup> The cause for this association has not been previously well-established and assumed to be brought on by the arousals triggered by OSA. Thus, bruxing or clenching phenomena were considered part of the arousal process.<sup>44-46</sup> Recent research by Simmons and Prehn has demonstrated that SB or clenching may occur as a mechanism to prevent airway collapse. Their studies have demonstrated that during the

SB process there is a reduction of negative pressures of the upper airway, measured by pressure catheter Pes monitoring.<sup>47-49</sup> When the SB process is not present, there is an increase in airway obstruction. Studying this population is difficult because SB throughout the night minimizes the obstruction and, as a result, the degree of obstruction referenced by the AHI may not meet the threshold necessary to be considered abnormal by most sleep disorder centers not utilizing Pes monitoring, and not tabulating RERAs properly. Treatment of obstructive breathing with CPAP alone reduces the bruxism/clenching and improves TMD symptoms in a high percentage of patients.<sup>50-52</sup> This sheds additional light on the importance of airway dynamics and dentistry (FIGURE 5).

Establishing the sleep-disorder diagnoses early could result in a significant improvement in overall health. This is significant for cardiovascular and cerebral vascular disease since these conditions are now known to be worsened by the ongoing process of obstructive breathing during sleep.<sup>50-55</sup> Establishing that a patient's airway is vulnerable to collapse at a point in the pathogenesis when they are attempting to compensate for the collapse by bruxing may prevent the escalation of this disturbance into OSA when compensation either no longer is being exerted or no longer provides adequate airway protection.

As our health care system matures, opportunities for collaboration between physicians and dentists are clearly evolving. Changes in the upper airway, particularly the mandibular anatomy and position, affect airway dynamics and can influence sleep. Only through greater initiative within dentistry will the dentist's impact in our overall health care system be fully recognized. The aspects of sleep and sleep physiology covered in this article can help the dentist work closer with physicians to improve their patient's health. ■■■■

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# Dentistry-Based Approaches to Sleep-Disordered Breathing, Algorithms, and Multidisciplinary Perspectives

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**ABSTRACT** Sleep disorders affect more than 20 percent of the U.S. population, but less than 7 percent have been medically diagnosed. Dentists are ideally positioned to identify many patients who fall under the grouping of sleep-disordered breathing. This paper presents perspectives on sleep-related issues from various medical specialties with a goal to broaden the dentist's appreciation of this topic and open avenues of communication. Algorithms are proposed to guide dentists following positive screenings for sleep-disordered breathing.

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According to a 2006 landmark report by the Institute of Medicine, sleep disorders and sleep deprivation remain an enormous unmet public health problem, yet sleep disorder "awareness among the general public and health care professional is low, given the magnitude of the burden."<sup>1</sup> About 50 to 70 million people were reported in 2003 to be chronically affected by sleep disorders in the United States, with these numbers increasing in concert with the obesity epidemic.<sup>2,3</sup> The International Classification of Sleep Disorders (ICSD-2) lists approximately 100 different sleep disorders.<sup>4</sup> The four main sleep disorder categories, according to most people affected, include insomnia (5 percent to 35 percent of the U.S. population) circadian rhythm prob-

lems (7 percent to 16 percent), sleep-related movement disorders (4 percent to 12 percent), and sleep-related breathing disorders (SRBDs, 3 percent to 25 percent).<sup>4-12</sup> These ranges in prevalence vary by the population sample and the inclusionary diagnostic criteria. For example, Schroeder et al. determined that obstructive sleep apnea (OSA, a most serious form of SDB) occurred in 50 percent of individuals >65 years old in a random community sample.<sup>13</sup> Shochat et al. found the prevalence of insomnia to be 69 percent in a primary care population, and Sack et al. reported circadian rhythm disorders in >50 percent of the totally blind.<sup>14,15</sup> In addition to those directly affected by sleep disorders and sleep deprivation are bed partners, nearby sleepers, parents of affected children, and even children of affected parents. It

is therefore reasonable to conclude that at least one-third of the U.S. population will be impacted by a significant sleep disturbance during their life.<sup>16</sup>

In terms of morbidity and mortality, the most important ICSD-2 sleep disorder diagnostic category is SRBD (which includes OSA), and it is here that dental professionals can make significant contributions as part of the sleep medicine team.<sup>17</sup> Only about 5 percent to 10 percent of patients with OSA are diagnosed; overlooked are 82 percent of males and 93 percent of females with moderate to severe and symptomatic OSA.<sup>18,19</sup> Even fewer patients receive adequate treatment with therapies such as continuous positive airway pressure (CPAP).<sup>20</sup> Given the 300 million dental patient visits per year in the United States, the dental office may be an ideal environment to apply routine SDB or sleep wellness screening, possibly identifying many affected individuals before the onset of serious medical and psychosocial consequences.<sup>21</sup>

In spite of the high prevalence of sleep disorders, there is a great deficit in our health care educational system addressing sleep medicine. In 1978, Orr et al. reported less than one hour was spent on sleep medicine during the four-year MD educational process.<sup>22</sup> By 1993, educational time had increased to about two hours, and by 1998 reported time spent was up to 2.11 hours.<sup>23,24</sup> With such limited exposure it is no wonder that physicians are generally not well-prepared to identify and address the gamut of sleep disorders. On the positive side, there is a burgeoning interest in sleep medicine. The American Academy of Sleep Medicine (AASM) now boasts more than 9,100 members, with 3,655 diplomates of the American Board of Sleep Medicine. Additional boarded sleep specialists are recognized since 2007 in the medical disciplines of inter-

nal medicine, family practice, pediatrics, otolaryngology and neurology/psychiatry. These would all be considered medical sleep specialists (MSS). Additionally, the American Academy of Dental Sleep Medicine (AADSM), the premier dental group devoted to sleep issues, now has a membership of more than 2,500 with more than 160 diplomates, and is one of the fastest-growing professional sleep organizations. In support of this interest by dentistry is the increasing education given at the predoctoral level, where the time devoted to sleep medicine has increased from a mean of about 30 minutes in 2003 to almost three hours in 2009.<sup>25</sup>

If a dentist wishes to include sleep medicine as a part of his/her clinical practice, gaining perspectives of clinicians from other medical specialties provides insights that can enhance multidisciplinary care. Primary care physicians (PCPs), along with dental sleep medicine experts (DSEs), can together adequately manage a large number of the simpler SDB cases. For those dentists who would prefer to just screen for SDB, they may consider the PCP, DSE, or MSS for referral to manage the case. More involvement by the dentist still requires reliance on the MSS and/or other medical specialists to assist in management, depending on the complexity of each case.

## Specialist Input

### Anesthesiologist

OSA is an independent risk factor for anesthetic mortality and is linked to various comorbidities that also have implications for anesthesia care: morbid obesity, pulmonary and treatment-resistant hypertension, congestive heart failure, cardiac dysrhythmias, metabolic syndrome and type 2 diabetes mellitus, hypothyroidism, gastroesophageal reflux disease (GERD),

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TABLE 1

### OSA and Anesthesia Management

- Screen patients for OSA preoperatively. Refer patients for preoperative evaluation and treatment where the probability of OSA is high, surgery is elective, and there is a likely need for postoperative opioid analgesia or sedation.
- Develop an anesthetic plan tailored to the severity of the patient's OSA and the planned procedure.
- When diagnosed with OSA and compliant with PAP, encourage its use preoperatively and ensure it is available for perioperative use.
- Where previously diagnosed but not compliant with PAP, reinstruct in its use.
- Avoid sedative premedication unless the patient's ventilation is being continuously monitored.
- Use regional anesthesia and analgesia where feasible.
- When general anesthesia is used, intubation is preferred. Be prepared for difficult intubation and other problems in airway maintenance. Use techniques that allow early return of consciousness (e.g., desflurane, nitrous oxide, propofol, remifentanyl).
- Try to minimize postoperative opioid analgesia or sedation (consider acetaminophen, nonsteroidal analgesics, dexmedetomidine, low-dose ketamine).
- Keep patients on continuous ventilatory monitoring postoperatively and resume PAP as soon as feasible. Continuous monitoring may be discontinued if oxygen saturations during sleep remain above 90 percent while breathing room air. Patients requiring ongoing opioid analgesia or sedation should remain monitored until this need abates.
- Avoid the supine position. Use lateral positioning, a nasopharyngeal airway, and oxygen therapy where PAP is refused and upper airway obstruction is problematic.
- Inform patients with unanticipated difficult airways of the possibility of OSA and refer for sleep studies when clinically indicated.

*Modified from references Nos. 27 and 29.*

and head and neck cancer. Anesthetic concerns specific to OSA begin preoperatively and extend well into the postoperative period. The same anatomic and neurophysiologic derangements in people with OSA that promote repeated collapse of the airway during sleep underlie the respiratory complications associated with anesthesia. These derangements include a narrow supraglottic airway and excessive relaxation of muscles that, during consciousness, maintain pharyngeal wall tension (e.g., sternohyoid) and prevent the tongue (e.g., genioglossus) and soft palate (e.g., tensor veli palatini) from occluding the airway.

Benzodiazepines and other sedative drugs prescribed or administered for preoperative anxiety control may easily induce sleep in chronically fatigued individuals. Because these drugs obtund the protective arousal response that restores airway

patency following acute obstruction and hypoxia/hypercarbia, patients with OSA are at increased risk of anoxic death. During induction, there is a much greater likelihood of encountering a difficult airway, which can complicate both ventilation and intubation. The greatest danger, however, lies in the postoperative period. Airway obstruction and apnea are particularly likely when parenteral opioids are required for postoperative pain relief. Case reports document lethal outcomes when such patients are not intensively monitored for extended periods after anesthesia.<sup>26</sup>

In 2006, the American Society of Anesthesiologists (ASA) published guidelines for the perioperative management of patients with OSA; subsequently, algorithms for the preoperative evaluation and perioperative management of patients with known or sus-

pected OSA have been developed.<sup>27,28</sup>

Several instruments exist that can help clinicians identify and classify patients with OSA, including the Berlin Questionnaire, the ASA Checklist, and the Stop-Bang Questionnaire.<sup>28</sup> Of these, the Stop-Bang Questionnaire is easy to use and has the highest sensitivity with acceptable specificity.

TABLE 1 outlines the anesthetic management of patients with OSA.<sup>27,29</sup>

The recommendations listed in TABLE 1 directly apply to dentists (oral surgeons, dentist anesthesiologists) who administer deep sedation/general anesthesia. For other dentists, the implications inherent in TABLE 1 strongly suggest that patients with OSA are poor candidates for in-office sedation using oral or parenteral benzodiazepines or similar agents. Even the prescription of oral opioids for postoperative pain relief may be problematic and should be approached with caution. This speaks clearly to the dentist minimally screening for SDB.

### Bariatric Surgeon

The most common modifiable cause of sleep apnea is obesity, which is defined as a body mass index (BMI)  $>30 \text{ kg/m}^2$ . For every 10-point increase in BMI there is a 32 percent increase in the apnea-hypopnea index (AHI, the number of episodes of sleep-disordered breathing per hour).<sup>30</sup> As the epidemic of obesity continues to spread, one-third of Americans are now considered obese, and the fastest-growing subset is the super morbidly obese (BMI  $>50$ , or 150 pounds above the ideal body weight).<sup>29,31,32</sup> Management approaches utilizing oral appliances and even upper airway soft- and hard-tissue surgery have their greatest failures within this population as a result of the anatomical and functional restrictions of the obese airway. Only tracheostomy is a predict-

able upper airway surgical approach.

Although a loss of 10 percent of body weight was found to decrease AHI by 26 percent, only intensive medically supervised diets produced 10 to 20 kg of weight loss within six months, and this weight was universally regained within weeks of ceasing dieting.<sup>30,33,34</sup> Bariatric surgery, either gastric bypass or lap-band surgery, has been shown to maintain weight loss for 10 years or longer and to reduce overall mortality by 24 percent. Sleep apnea resolution after bariatric surgery occurs in concert with the weight loss and can start in the first three months after surgery.

A recent meta-analysis showed that postoperatively the AHI improved from 55 to 16 episodes per hour.<sup>35</sup> Despite these improvements, the AHI remains sufficiently high for some patients to warrant continued therapy. Since OSA is grossly underdiagnosed even in patients with morbid obesity who present for bariatric surgery, mandatory testing of all patients for OSA with polysomnography before bariatric surgery is recommended.<sup>36</sup>

### Cardiologist

OSA has potentially deleterious effects on the cardiovascular system. A recent review identified nine different physiological mechanisms by which apneas can derange cardiovascular function.<sup>37</sup> Moreover, these mechanisms impact all major cardiovascular disease entities: hypertension, heart failure, dysrhythmias, atherosclerosis, and ischemia. Clinical studies show about a 50 percent prevalence of OSA in patients with hypertensive cardiovascular disease, 33 percent with coronary artery disease, 30 percent to 40 percent with heart failure, and 50 percent with stroke. About half of the patients with atrial fibrillation have OSA.<sup>38</sup> It is believed the

severe repeated oxygen desaturations occurring with OSA can cause various dysrhythmias, such as severe bradycardia, heart block, and premature ventricular contractions. Finally, OSA has been associated with increased risk of death from nocturnal cardiac events, in particular from midnight to 6 a.m., when sudden death from cardiac causes occurred in 46 percent of people with OSA compared to 21 percent of people without OSA.<sup>39</sup>

Despite these associations, it is not possible to describe succinctly the degree

## A RECENT REVIEW identified nine different physiological mechanisms by which apneas can derange cardiovascular function.

to which OSA causes or exacerbates cardiovascular disease or the effect of OSA treatment on cardiovascular disease, for two reasons: 1) the relationship depends on the severity of both the OSA and the cardiovascular disease; and 2) data from the limited clinical studies to date are often equivocal.<sup>40,41</sup> Formal communication is recommended as cardiologists are, in general, increasingly conscious of the detrimental effects of OSA.<sup>41</sup> Cardiology patients with severe OSA and/or severe cardiovascular disease should generate the most immediate concern. For example, some patients with advanced heart failure are very sensitive to changes in blood pressure, fluid status, or other demands on the heart. Because dental treatment can transiently alter blood pressure and cardiac demand for the worse, coordina-

tion with the cardiologist is advisable in these patients. Patients taking multiple blood pressure or heart medicines are another population of concern, for the same reasons. Finally, in the unlikely event that a dentist is asked to treat central sleep apnea, cardiological consultation should be obtained first as the apnea may be a sign of inadequately treated heart failure.

### Neurologist/Psychiatrist

There are many neurologic and psychiatric conditions that overlap with sleep disorders. Morning headache, for example, can stem from the sleep pathology of OSA.<sup>42</sup> Similarly, studies show a great range in association of depression (7 percent to 63 percent) and anxiety (11 percent to 70 percent) with OSA.<sup>43</sup> Several conditions are discussed below to assist the dentist's knowledge of conditions they may encounter when delving into a patient's sleep history.

Movement disorders may occur during any part of the wake and sleep cycle, and restless legs syndrome (RLS) occurs in both. It is a common condition presenting as an irresistible urge to move the symptomatic limbs, which then provides temporary relief. RLS affects about 10 percent of the adult population (increasingly in the elderly) and 2 percent of children. It occurs in women almost twice as often as in men. A patient lying in the dental chair who keeps shifting may have RLS even though appearing to have anxiety or another psychological condition. RLS responds well to dopamine agonists and, if unaddressed, can disrupt sleep to a significant degree. Periodic limb movements during sleep (PLMS) are usually complaints by the bed partner rather than by the patient, although the movements may disrupt both sleepers sufficiently to cause excessive daytime sleepiness (EDS). Clues include disrupted bedding and bed partner-witnessed kicking, flailing, or

other recurrent or potentially violent movements during the middle of the night. If such a sleep-related movement history is obtained, it should be considered quite significant and followed up with referral. The majority of patients with PLMS also have daytime RLS.<sup>44</sup>

Nocturnal myoclonus is in some ways similar to PLMS except that movements are more isolated, not periodic and usually occur in the transition between wakefulness and sleep.

REM behavior disorder (RBD) may appear as a movement disorder but is a parasomnia in which the patient acts out dream content such as talking, swinging arms, or exiting the bed in elaborate imaginary confrontations. A lack of the normal muscle atonia during REM sleep is the cause for this condition. There are a variety of etiologies and recent studies have described RBD as an early symptom of Parkinson's disease. Additionally under the topic of movement disorders is nocturnal or sleep bruxism (SB), which may be a forme fruste of a focal, mild, or more generalized dystonia. SB is intimately linked with SDB. The presence of temporomandibular joint dysfunction or arthritis in these patients may be a result of bruxism or be incidental to it.

Sleep-induced seizures often arise out of instability in the brain as it transitions between wakefulness and sleep. While some of these patients also have daytime seizures, those with only nocturnal seizures may go undiagnosed for years, and, unless their bed partner is able to give a clear history, they may never be identified. Such patients, however, may complain of muscle aches on awakening, enuresis (bedwetting or nocturnal urinary incontinence), traumatized oral tissues (e.g., bitten tongue), unexplained bruises or unexplained confusion on awakening. Other brain-related manifestations of OSA may

include cognitive deficits especially in higher levels of executive functioning.<sup>45</sup>

Chronic pain conditions such as fibromyalgia have long been recognized as associated with poor sleep, which lowers the underlying pain threshold. Patients who present with a diagnosis of fibromyalgia or chronic pain without identifiable pathology should be considered for screening of sleep disturbances. Narcolepsy is fairly renowned despite its limited prevalence (less than 0.05 percent of the population<sup>46</sup>). Although

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this condition is notorious for extreme hypersomnolence, its most specific characteristic is cataplexy, the sudden loss of muscle strength brought on by an emotional event, such as laughing. This muscle weakness is attributed to the precipitous onset of a REM atonic state.

Many psychiatric conditions, such as depression, are associated with sleep disorders. Falling asleep may be easily accomplished, but the affected individual awakens early, typically around 2 to 4 a.m., and is then unable to fall back asleep. Sleep-onset insomnia is more associated with anxiety, obsessive compulsive disorder, mania, hypomania, bipolar disorder, cyclothymic personality (where mood fluctuates but not to the extent as seen in bipolar disorder), and some forms of schizophrenia.<sup>47</sup> Reduced sleep in

psychiatric conditions generally relates to reduced time in REM sleep, reduced total sleep time and reduced sleep efficiency. Medications addressing some psychiatric disorders influence sleep, as do some over-the-counter medications used for sleep. For example, antihistamines often taken as a sleep inducer can cause cognitive decline and memory problems in the elderly, which may not develop for weeks to months after starting the medication.<sup>48</sup> Opioids, anxiolytics, and sedative-hypnotics taken for insomnia, may similarly contribute to cognitive disorders, especially in the elderly who are more sensitive to such adverse effects. Of course, these drugs may also aggravate SDB.

### *Oral and Maxillofacial Surgeon*

Oral and maxillofacial surgeons (OMFSs) have made important contributions to sleep disorder therapy by introducing surgical procedures for OSA and reporting on their outcomes. No treatment for sleep apnea is easily accomplished and acceptable to all patients.<sup>38</sup> Furthermore, the long-term compliance required of patients being treated with positive airway pressure (PAP) and oral appliances is not an issue for patients successfully cured with surgery.<sup>47,48</sup> It is therefore likely that surgery will maintain an important role in the treatment of OSA for those patients who cannot tolerate or who fail or decline nonsurgical treatment.<sup>49</sup>

No one surgical treatment algorithm has been adopted by the surgical community. Some surgeons treat OSA in an escalating manner, beginning with phase 1 surgery such as variations of adenoidectomy, tonsillectomy, uvulopalatopharyngoplasty, nasal or tongue surgery, and hyoid myotomy and suspension. Patients failing these procedures undergo maxillomandibular advancement (MMA) as a second

phase. Others advocate MMA as a primary definitive surgery, particularly for those patients with diffuse upper airway obstruction or facial skeletal anomalies.<sup>50-54</sup>

Over the last two decades, the trend toward MMA as a definitive primary surgery has gained support.<sup>50</sup> The Adult Obstructive Sleep Apnea Task Force of the American Academy of Sleep Medicine stated that, while MMA can improve sleep study parameters comparable to PAP, most other sleep apnea surgeries may improve clinical outcomes but are rarely curative for OSA.<sup>55</sup>

Referral to the OMFS for surgery is appropriate when a diagnosis of OSA has been established and when other treatment modalities such as PAP and oral appliances have been deemed inappropriate or ineffective by the clinician or declined by the patient. In addition to conservative therapy failure, OSA patients who may be referred to the OMFS practice include, most commonly, the adolescent or adult patient with a facial skeletal anomaly, particularly retrognathia, who has been referred by an orthodontist for orthognathic surgery. A diagnosis of OSA has often already been established, and the patient is seeking surgery to address both concerns. Otherwise, sleep disturbance information is elicited to confirm a possible diagnosis of OSA, and formal sleep consultation and polysomnography are obtained as indicated. This work-up is especially important for the cleft population, where OSA is known to be more prevalent.<sup>56</sup> All patients undergoing MMA must be informed of the risk of complications, and the discussion should include the heightened risk of sensory disturbance in the adult patient, stability issues and potential temporomandibular joint problems owing to the relatively larger maxillary and mandibular advancements commonly performed to treat OSA.

A less frequent but important referral to the OMFS is the infant or child with severe micrognathia who has been referred for mandibular distraction osteogenesis. Although patients with Pierre Robin sequence or a craniofacial malformation with associated micrognathia do not have OSA, there is a much more immediate risk of death from airway obstruction. Many other medical and surgical specialists are generally involved in the care of these children, who often have

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additional life-threatening anomalies and comorbid conditions. For these patients, decisions about alternative airway management, such as nasopharyngeal intubation, tongue-lip adhesion and tracheostomy, must be made by the multidisciplinary team of clinicians and the parents.<sup>57,58</sup> Even though mandibular distraction osteogenesis offers the possibility of definitive treatment, the benefits of this surgery must be weighed against the risks, including damage to tooth buds, mandibular nerve injury and premature consolidation of the osteotomy requiring reoperation. Its success is highly dependent upon the diligence of caregivers to perform daily activation of the distraction devices, and it requires a certain degree of patient cooperation.

### **Otolaryngologist**

Snoring and OSA are caused by upper airway obstruction. It is important that dentists be aware of the many separate anatomic factors that contribute to these disorders. Snoring or OSA can result from nasal airway obstruction, obesity, mouth breathing, lesions within the upper airway, hypertrophy or enlargement of the adenoids, tonsils and base of the tongue, and vibration of structures such as the uvula and soft palate. Otolaryngologists can be useful partners to dentists who have an interest in screening for or who specifically focus on sleep disorders in their practices. While general dentists most commonly focus on ameliorating obstruction of airflow by the fabrication of custom oral appliances that advance the mandible and/or tongue base, otolaryngologists are accustomed to evaluating and managing the nasal and oropharyngeal blockage leading to upper airway obstruction. For example, adenotonsillectomy is a commonly employed procedure effective for SDB in children.<sup>59,60</sup>

Otolaryngologists perform several core surgical procedures to improve nasal breathing, including septoplasty (straightening of the nasal septum), turbinate reduction, and nasal valve reconstruction (adding internal cartilage grafts that support the nasal sidewalls to prevent collapse of the nostrils). These can be important to aid the use of nasal CPAP, reducing dependence on more cumbersome full-face masks.<sup>61</sup> Other soft-tissue surgical procedures that may help reduce snoring and alleviate OSA in appropriately selected patients include adenotonsillectomy, UPPP, radiofrequency palatoplasty, placement of soft-palate Pillar implants, lingual tonsillectomy, radiofrequency tongue-base reduction and hyoid suspension.<sup>62</sup> The overall efficacy of these individual procedures is still under inves-

tigation, and although there has been a trend toward concurrent multilevel approaches, some procedures have lost favor following long-term results analysis.<sup>63,64</sup>

Additionally, otolaryngologists are considered a last resort for unmanageable SDB for the morbidly obese, failure of all other reasonable therapies or, in rare instances, those who are born with congenital central hypoventilation syndrome.<sup>65,66</sup> The management of these severe disorders requires performance of a surgical bypass of the collapsible upper airway, i.e., tracheostomy. Although this approach is not as socially acceptable, it is life-saving, and patients can learn adaptive techniques for masking the surgical site. Finally, other upper airway pathology, such as throat cancer, epiglottitis and Ludwig's angina, may cause acute upper airway obstruction and require the creation of a surgical airway in the neck.

### **Pediatrician**

The prevalence of OSA in the pediatric population is estimated to be 1 percent to 3 percent for children 2 to 18 years old.<sup>67</sup> The prevalence of primary snoring in children is believed to be 9 percent to 12 percent.<sup>68</sup> OSA occurs in all age groups, from infancy through senescence, but the peak age of presentation is 2 to 6 years, during which time the tonsils and adenoids are proportionately large relative to the airway. Ethnicity also influences the prevalence of OSA, with higher rates reported in African-Americans and Asians. Obesity has become an increasingly important factor in childhood OSA as obesity continues to increase in the pediatric population. Obesity may further narrow the upper airway because of fat deposition, mass loading of the neck with subcutaneous tissue, decreased upper airway caliber from additional loading of the chest wall and decreased lung volumes and, in some cas-

es, abnormal central respiratory control.

Studies comparing neuropsychological functions in children with OSA have found impairments in tasks involving reaction time and vigilance, attention, executive functions, motor skills and memory, as well as impairments in school performance.<sup>69,70</sup> Measures of behavior and neuropsychological functioning in children following treatment (usually adenotonsillectomy) for SDB have documented significant improvement in daytime sleepiness, behavior and aca-

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ademic performance and neuropsychological measurements of attention, vigilance, reaction time, and cognitive functions.<sup>71</sup> Finally, several studies examining the prevalence of SDB symptoms in children with identified behavioral and academic problems have found an increased prevalence of snoring in children with behavioral concerns and in children being evaluated for or diagnosed with attention-deficit hyperactivity disorder.<sup>72</sup> A recent report indicates that children with OSA are heavy consumers of health care resources and that early diagnosis and treatment may be cost-effective in reducing the associated morbidity and mortality.<sup>73</sup>

Routine screening for snoring should be a part of normal health care visits.<sup>74</sup> Various testing methods, including imaging and home sleep testing, have

not been validated; thus, full-night polysomnography in accredited sleep laboratories remains the "gold standard" for diagnosing children of all ages and development using age-appropriate equipment and well-trained staff.

Adenotonsillectomy is usually the first line of treatment for pediatric OSA. Reported cure rates after adenotonsillectomy range from 75 percent to 100 percent in normal healthy children.<sup>75</sup> Cure rates in obese children may not be as good, but even obese children benefit from adenotonsillectomy. The severity of the OSA affects the timing of surgery and the perioperative care. Children with very severe OSA who are at high risk of operative mortality related to surgery warrant stabilization beforehand. A sleep specialist should be involved in such circumstances. PAP is an effective and reasonably well-tolerated treatment option for a wide range of children with OSA, including infants, children with craniofacial syndrome, Down syndrome and those with developmental delay.<sup>76</sup> PAP has been successfully used as the initial treatment for children in whom surgery is not an option, in children who continue to have OSA despite surgery and also to stabilize the child medically before surgery.

### **Pulmonologist**

Many respiratory conditions can affect sleep quality. Nocturnal dyspnea from a multitude of conditions, including chronic obstructive pulmonary disease (COPD), chronic cough and asthma, can lead to repetitive nocturnal awakenings, poor quality sleep, and EDS.<sup>77</sup> Patients with restrictive pulmonary disease, such as those who are morbidly obese, or individuals with neurologic disease and concomitant respiratory muscle weakness, may hypoventilate during sleep. Patients with chronic lung disease, whether it be

obstructive or restrictive, may suffer from chronic dyspnea leading to impaired sleep consolidation and nonrestorative sleep.<sup>78</sup> Such patients are also predisposed to suffer from abnormalities of gas exchange, making them more susceptible to the development of nocturnal hypoxemia and/or hypercarbia. These complications may arise with or without concomitant upper airway obstruction or apnea.<sup>79</sup>

As a general statement, patients with more complex heart-lung disease and concomitant OSA will require treatment with positive pressure ventilation and are not appropriate candidates for initial treatment with oral appliances.<sup>80,81</sup> CPAP-intolerant patients however, may be appropriate candidates for oral appliance therapy (OAT). Patients with a history of cardiopulmonary disease and sleep complaints are best advised to speak with their PCP or a pulmonologist.

#### **Primary Care Physician (Internist/Family Practice)**

Fortunately, attitudes toward the importance of sleep health are changing. The result is a broader recognition among both the health care community and patients that how much and how well we sleep matters. Patients increasingly self-refer to sleep disorders centers. The Internet is replete with sleep health websites covering topics ranging from insomnia to snoring to sleep apnea.

A dentist who is involved with using appliances for the treatment of snoring or OSA needs to recognize that patients with medical conditions should be followed in conjunction with their PCP. Hopefully, PCPs will be increasingly receptive to recognizing sleep disturbances and directing patients toward proper care.

#### **The Medical Sleep Specialist**

Sleep specialists come from many different medical specialties; when properly trained, they should be able

to handle the full spectrum of sleep disorders. The MSS can be considered the quarterback for patients who are found to have a sleep disorder. A properly trained MSS should recognize the important role OAT plays in the treatment armament. The goal for each dentist expanding his/her practice to include dental sleep medicine is to partner with a MSS so that the dentist is not functioning beyond the scope of dentistry while involved in this field of clinical practice.

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#### **Behavioral Sleep Specialist — Psychologist**

Insomnia is often associated with SDB, has additive negative effects and therefore should be addressed to enable better triage by the dentist.<sup>82,83</sup> A bad night's sleep on an infrequent basis is different from insomnia that lasts a month or more. There are many causes of insomnia, with psychological, medical, and environmental contributors. Patients with insomnia report having insufficient sleep and often present with symptoms of daytime hypersomnolence, moodiness, reduced affect, and decreased work productivity. The two primary treatment strategies are pharmacotherapy and cognitive/behavioral therapy (CBT). Medications, including hypnotics, anti-anxiety agents and antidepressants, are used particularly in acute cases, but CBT is more effective over extended periods.<sup>84-87</sup> Combining both therapies can

also be effective.<sup>88,89</sup> Health care providers on a routine basis see patients who have insomnia complaints. Patients with problems remaining asleep likely require a sleep study, especially if experiencing EDS.

Determining the primary diagnosis of sleep disturbances can be challenging. Many patients referred to sleep centers often take medication for depression or anxiety. For some, the primary problem has to do with sleep, or the lack of it. Once the sleep disorder is treated, the patient no longer requires psychoactive medication. Other EDS can be related to time-shift changes or difficulty adapting to night or swing shifts. These circadian rhythm sleep disorders are diagnosed and treated by sleep specialists usually with behavioral approaches. When possible, the patient's sleep/wake schedule is progressively shifted (normalized) with use of artificial light to stimulate the brain wake times; medications such as melatonin may also help. Individuals certified in behavioral sleep medicine by the American Board of Sleep Medicine are highly competent in the utilization of CBT and other treatments for insomnia.

#### **The Dentist's Role in SDB**

Since many patients see their dentist more regularly than their primary care physician, the dentist may be the first health care provider to interface with the patient about sleep-related difficulties, especially regarding snoring, OSA, and bruxism. With this increasingly visible role of dentists in the management paradigm of SDB comes an increased responsibility to include sleep-related concerns within the scope of their health survey. Three flow-sheets in this paper summarize for dentists the general overview approach to SDB (FIGURE 1) and specific aspects of screening (FIGURE 2) and co-treatment (FIGURE 3). In comparison with other health care providers, the dentist may have a firmer founda-

## Overview Algorithm

### DDS collaborating with MSS on sleep disorders

#### Methods of screening

Each contributes toward a full assessment, but referral to a MSS can occur by any of these methods

#### KEY

- MSS or medical doctor (PCP)
- Dentist

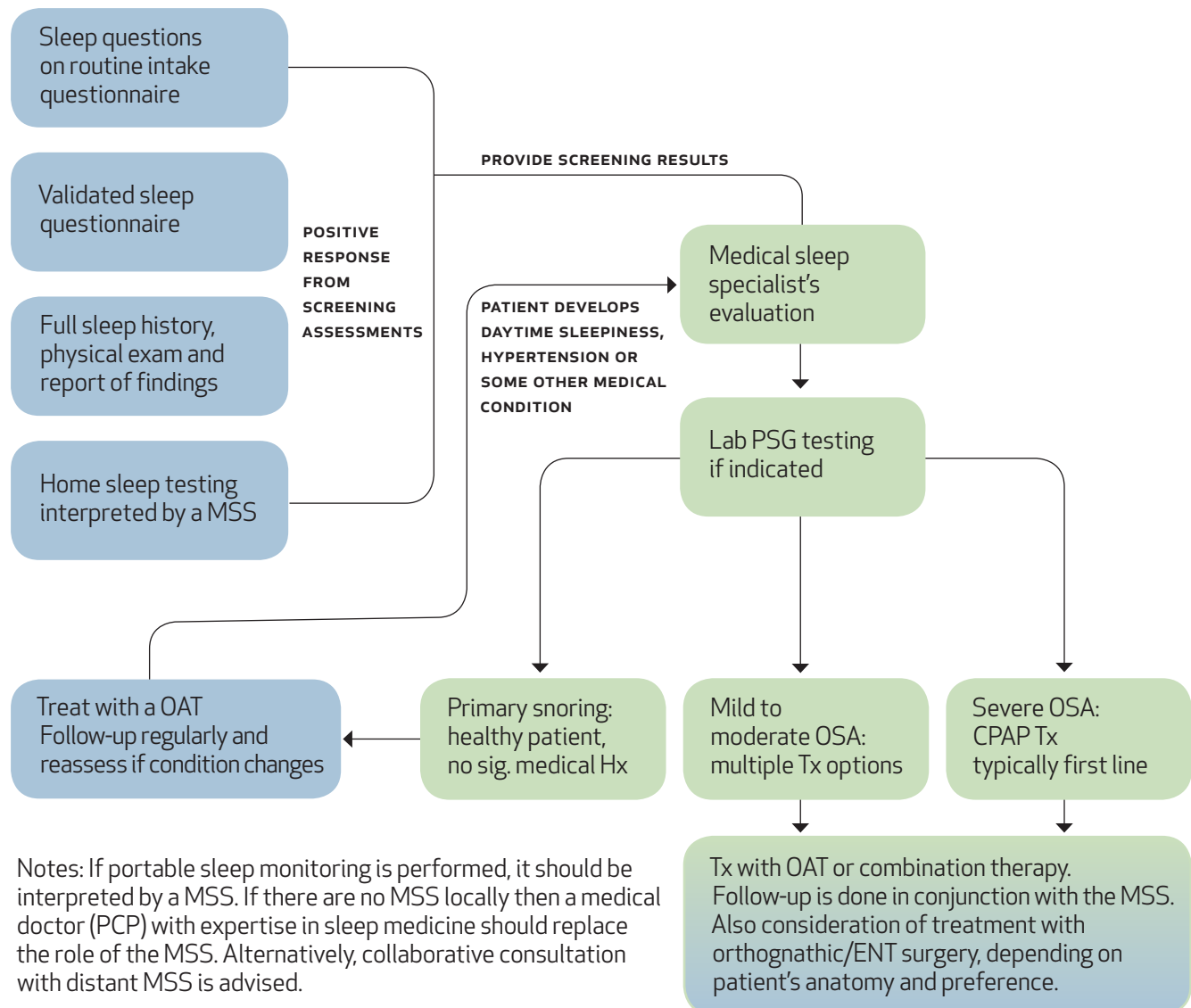


FIGURE 1. General overview algorithm for dentists.

## Screening Algorithm

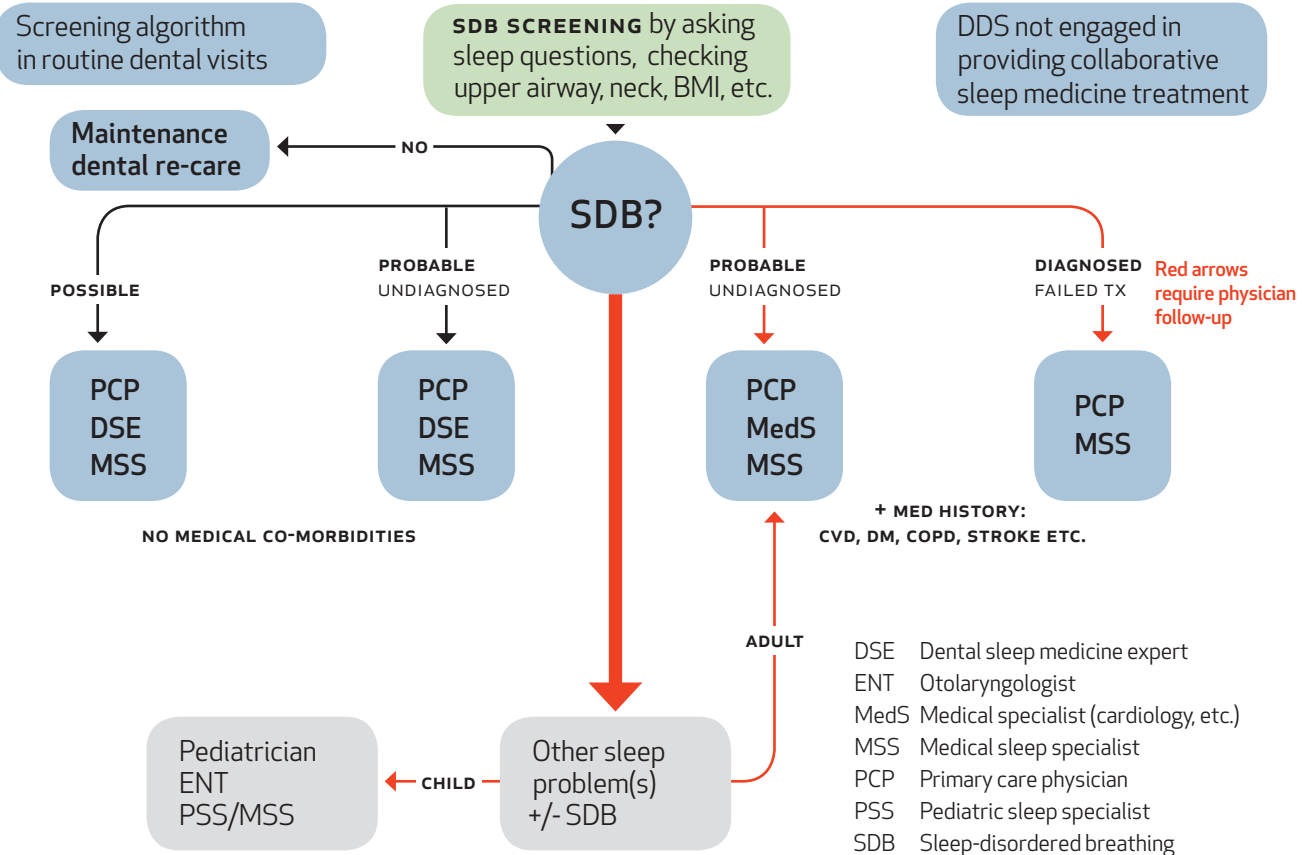


FIGURE 2. Screening algorithm for dentists.

tion on many sleep disorder presentations and be more comfortable in engaging other doctors in a multidisciplinary model.

An important issue for the dental practitioner is to determine when snoring is just simple primary snoring (PS) versus when is it nonbenign snoring, a marker for OSA or another nocturnal respiratory disturbance. The definition of PS is audible snoring without complaints of insomnia, EDS, or sleep disruption attributable to snoring or airflow limitation. The noises are not associated with significant airflow limitation, significant arousals from sleep, oxygen desaturation, or cardiac dysrhythmias.<sup>5</sup> Snoring may emanate from the nasopharynx down through the hypophar-

ynx and glottis and be caused by such disparate conditions as allergic rhinitis, tonsillar hypertrophy, and inspiratory pharyngeal collapse. OAT might be quite successful for velopharyngeal airway collapse but it would likely not provide any airway benefit for allergic rhinitis. Designating a patient with a diagnosis of PS requires clear exclusion of any associated medical abnormalities.

A history must be void of conditions such as hypertension, daytime sleepiness, fatigue, etc., and a sleep study, at minimum home sleep monitoring, needs to yield normal results. Also not everyone who snores and is tired has sleep apnea. Just like any other medical condition, the diagnosis and management of a sleep-related complaint

calls for a complete history and physical examination. Patients who snore but have only limited or marginal concerns related to their sleep, no comorbidities, a normal BMI, and a normal head and neck examination should probably only be encouraged to discuss their condition with their PCP or dentist sleep expert. If there are concomitant medical problems, such as hypertension, coronary artery disease, prior myocardial infarction or cerebrovascular accident, GERD, diabetes mellitus, or respiratory illness (e.g., asthma or COPD), they should raise red flags for the dentist. These problems, along with complaints of EDS and/or physical findings strongly correlated with OSA (e.g., obesity or crowding of the airway), should also heighten

## OAT Treatment Algorithm

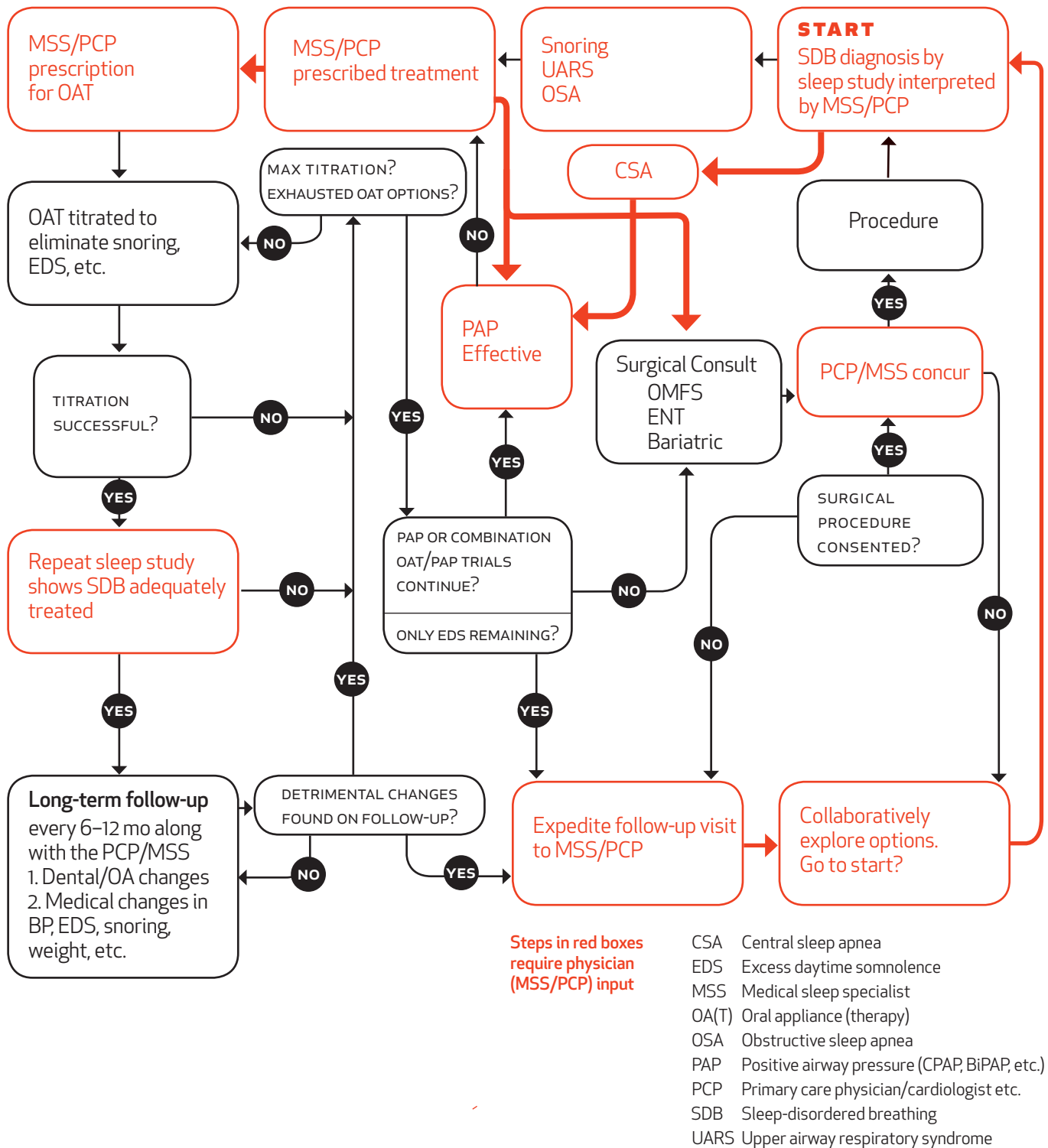


FIGURE 3. Treatment algorithm for dentists.

concern for the presence of significant SDB.

Knowledge of these signs and symptoms should stimulate communication with the patient's PCP. It might be necessary for the dentist to educate the physician regarding SDB. If this is the case, tact and support are essential to gently educate the PCP about sleep medicine. Another area needing dentist input is CPAP compliance. This area is an "orphan" not well-managed by sleep technicians or even prescribing physicians. Since less than 50 percent of CPAP patients consistently use their devices as prescribed, there is an obvious vacuum to be filled. CPAP treatment of OSA has suffered greatly from lack of focus on this ubiquitous problem. It is logical that the dentist could become an effective "compliance officer" for CPAP. A collaborative relationship between health professionals engenders shared confidence, and participation in holistic care is beneficial to both professionals and patients.

## Conclusion

In its 2006 report regarding increasing awareness among health professionals of sleep-related problems, the Institute of Medicine stated, "In particular, medical, nursing, dentistry, and pharmacy students require greater exposure to the public health burden of sleep loss and sleep disorders."<sup>2</sup> Sleep medicine has proposed various strategies for the screening, treatment, and collaborative care of SDB by various health practitioners who limit dentist involvement to treating cases involving failure of CPAP.<sup>36</sup> By suggesting screening and treatment protocols for sleep disorders with the dental community's perspective in mind, the authors offer a potentially enhanced approach to patient care. Evolving treatment paradigms can enable the multidisciplinary field of somnology to move forward with a consistent, coordinated, and collaborative therapeutic approach benefiting all patients with SDB. Dentists are uniquely positioned as front-line health

care practitioners to educate and engage patients. As a primary care screener and active participant in the identification and/or treatment of SDB, the dentist can play an integral role alongside the PCP and MSS. ■■■■

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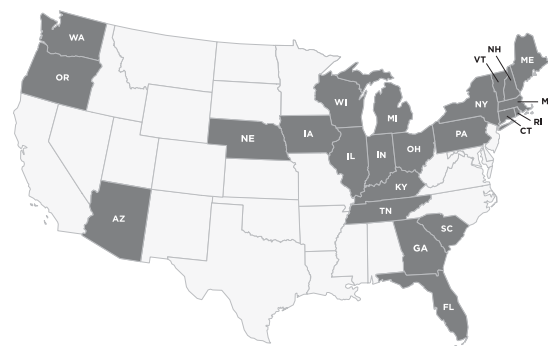
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**ENCINO** - Leasehold & Equip Only! - Corner location w/ good window views. A great starter opportunity / 3 spacious eq. ops. ID#3971.  
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**INGLEWOOD** - Long established Turnkey office in single standing bldg. w/ 5 ops. Has great street visibility and signage.ID# 4095  
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**MONTEBELLO** - Located in a free standing building w/ over 25 yrs of gdwl. Great street visibility, signage and foot traffic. ID #4051.  
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## ORANGE COUNTY

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**RANCHO STA MARGARITA** - Leasehold & Equip Only! In modern single story med prof. bldg w/ mountain views. ID #4079.  
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**BN-031 BERKELEY** - Established 30+ yrs, "State of the art" FFS Practice ~1200sf w/5 ops **\$1.3M**

**BG-029 Facility ANTIOCH**—Would cost more to duplicate! Spacious, attractive, 2-story mixed Prof complex. Great location! 1,650 sq. ft. w/5 ops **\$80k**

**C-8901 SANTA ROSA**—Residential area. 40+ new pats/mo. Highly Visible! 1291sf & 3 + 1 op. **\$468k**

**C-976 PETALUMA**—Prestigious area! ~ 800 sf w/2 fully equipped ops **\$295k**

**C-989 SANTA ROSA** - Foot traffic generates new patients & continuous growth for this modernly equipped office. ~2,500sf w/ 5ops. **ONLY \$150k**

**C-1016 MARIN CO**—Well-established w/wonderful patient base! 800 sf w/3 ops **\$280k**

**CG-025 NAPA FACILITY**—Large, picturesque, floor-to-ceiling windows capture scenes of bustling heart of town! 1,285 sf w/ 4 ops. **Only \$45k**

**CG-021 SUISUN CITY**—Quality, FFS Practice. With only 2 DDS in town of 28k, this is expertly located in historic Dwntrwn on Main St. 1,200 sf & 3 ops **\$348k**

**CC-027 MILL VALLEY**—Quality practice w/stable patient base! 2,088sf w/5 ops **\$650k**

**D-9091 ATHONTON**—Turnkey operation 969 sf & 3 ops **Call for Details!**

**D-845 San JOSE Facility Only** - Great Location! Office is ~2080sf, 5 ops + 1 add'l. **Now Only \$79k!**

**D-960 Facility only SAN JOSE** - Reasonable rent & great lease. Opportunity to purchase condo suite also! 1,158sf w/3 ops **NOW ONLY \$65k**

**D-965 WATSONVILLE** - Office ~ 2,400 sf, w/ 4 equipped ops + plumbed for 4 add'l ops. **\$420k**

**D-967 SAN JOSE - FACILITY**—Beautiful! Office ~1,600+ sf w/ 4 ops **Only \$110k Seller fin. avail. to qualified buyer w/10% down!**

**D-982 SUNNYVALE Facility** - 2 ops & space to add an add'l op & business office - Rent only \$1,750 including triple-net! **Now Only \$108k**

**D-991 SANTA CRUZ**—Practice by the beach! 1,050 sf w/ 3 ops + plumbed for more! **\$195k**

## BAY AREA CONTINUED

**D-9921 SANTA CRUZ CO** - Professional center, good design for patient flow. 1,140 sf w/3 ops **\$225k**

**D-1015 SAN JOSE** - 1,160 sf w/3 ops w/ plumbing and space for 2 additional ops **\$250k**

**D-997 SAN JOSE** -Well established, FFS practice. ~ 1,008 sf w/ 3 ops + 1 add. **\$230k**

**D-1020 CASTRO VALLEY** - Quality, fee-for-service practice. 1,784 sf w/5 ops **\$545k**

## NORTHERN CALIFORNIA

**E-8641 SACRAMENTO-FACILITY** - 2,100+ sf w/ 3 ops & plumbed for 1 add'l **\$50k**

**E-969 FAIR OAKS** Everyday will be a joy to come to work. Office is ~ 600sf w/2 ops. **\$250k**

**E-995 ELK GROVE** -Quality, FFS practice. \$900k+ in 2010! ~1,692sf w/ 5 ops. **\$600k**

**E-1018 Facility Only FOLSOM**—Sparkling! Medical/Dental building. ~2305sf w/ 5ops. **\$150k**

**EN-026 ROSEVILLE**—Warm Caring Environment, ~1000sf, w/ 3 ops. **\$380k**

**EN-035 CITRUS HEIGHTS** - Established practice in a desirable neighborhood. 1,700 sf w/4 ops **\$125k**

**EN-037 CARMICHAEL**—Seller Retiring! 30+ yrs goodwill w/stable patient base. 1,498 sf 4 ops **\$450k**

**F-1013 FORTUNA**—Well respected FFS GP. Loyal stable patient base. 1,000 sf w/ 3 ops **\$195k**

**G-875 YUBA CITY**—Estab. 30+ yrs, GP, FFS, 3,575sf/9 ops, **\$1.63m w/Cerec ~ Buy-In Op!**

**G-883 CHICO VICINITY**—Quality FFS GP. Attractive Prof Plaza. 1,990 sf w/ 5 ops **\$495k**

**G-998 CHICO/PARADISE**—Surrounded by breathtaking natural beauty! ~898sf, 3 ops. **\$275k**

**H-856 SOUTH LAKE TAHOE** Over 50 new patients/mo Respected & Growing! 1568 sf & 4 ops **\$325k**

**G-1019 CHICO AREA**—Small Community practice! ~1,600sf w/ 2 ops. **\$215k**

**GN-034 PARADISE**—Central Local and great views! ~1168sf w/ 3ops. **\$210k**

## SOUTHERN CALIFORNIA

**K-986 NEWPORT BEACH** -Attractive, multi-story Medical/Dental bldg. 1,000 sf w/2 ops **\$195k**

**KG-023 IMPERIAL VALLEY**—Free-standing, Medical Prof Bldg. 1,050 sf w/3 ops **\$195k**

## CENTRAL VALLEY

**I-966 MODESTO - Facility** Newly renovated, w/ prof. décor and floor plan~ 700sf w/2 ops, **\$89k**

**I-9721 STOCKTON**—Prof. complex 1,450 sf w/3 ops & plumbed for 1 add'l op. **\$75k.**

**I-996 MERCED**—Collected \$500k w/owner dds. Ready for new owner to revitalize wall of charts. 1,450 sf - 3 ops **\$140k**

**I-1005 SAN JOAQUIN VLY**—Long-established High-End Restoratives. 2,500+ sf w/ 6 ops **\$650k**

**I-1012 MANTECA**—Location, Growth, High Profit. Well-equipped 780 sf w/2 ops **\$479k**

**IN-024 MERCED** - This immaculate practice is an absolute jewel! ~1250sf, 3 ops + 1 add'l **\$240k**

**IN-032 GREATER MERCED AREA** - Prime Location! Modern equip ~1,100 sf w/ 4 ops **\$335k**

**J-1000 TULARE**—Real Estate Available too! Great highly visible location! ~ 1650sf w/ 4op. **\$349k and R.E. \$249k**

**J-1001 LINDSEY**—All American City! Conveniently located ~3,380sf w/5ops. **Now Only \$264k**

**J-928 ATWATER** - Established & respected for gentle treatment. 1,313 sf w/3 spacious ops **\$230k**

**J-1009 VISALIA**—Buy 50% or 100%! Prof Bldg. Desirable area. 4 ops. **\$250k/\$500k**

## SPECIALTY PRACTICES

**I-7861 CTRL VLY ORTHO**—2,000sf, open bay w/8 chairs. FFS. 60-70 patients/day. Prof Plaza. **\$370k**

**I-9461 CENTRAL VALLEY/ORTHO** - ~ 1,650 sf w/5 chairs/bays + (2) add'l plumbed. **\$140k**

**E-980 SACRAMENTO VICINITY ORTHO**—4 for the price of 1! Sold as cluster of satellite offices in multiple locations, grab this w/ no regrets! **\$1.5M**

**J-983 CENTRAL VALLEY ORTHO** - Attractive, single-story ~1,773sf w/ 6 chairs/bays. **\$325k**

**G-975 CHICO ORTHO**—Providing quality care 2 Denti-Cal patient base. ~ 900 sf w/ 2 + ops. **\$90k**

**DN-022 ENDO TRI-VALLEY**—30 new pats/mo. 975 sf w/ 2 fully equipped ops **\$275k**

**BC-033 ALAMEDA CO ORTHO**—~ 50 pats/day. Highly visible. 1,250 sf w/4 Chairs/Bays **\$450k**



Timothy G. Giroux, DDS



Jon B. Noble, MBA



Mona Chang, DDS



John M. Cahill, MBA



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More information is available on our website regarding practices listed in other states, articles, upcoming seminars and more.

- **EL DORADO HILLS:** *For Sale-General Dentistry Practice.* 2009 GR \$790,758, adjusted net income of \$312K. Intra-oral camera, pano, Softdent software, 4-equipped ops. 6-hygiene days. Practice has been in its present location for past 18 years. Owner retiring. **SOLD**
- **EL DORADO HILLS:** *For Sale-General dentistry practice.* Gross Receipts of \$834K with an adjusted net of \$389K, 53% overhead. Office has five equipped operators in 1485 sq.ft. Pano, Intra-oral Camera, Dentrix, 5 days of hygiene. Owner retiring. **SOLD**
- **FOLSOM:** *For Sale-General Dentistry Practice.* Gross Receipts in 2010 were \$703K with an adjusted net income of \$300K. 5 days of hygiene and approx 3,100 active patients. Leased Office is 2,000 sq ft with 4 equipped operatories-5 possible. Patient Base software. Owner to retire. **SOLD**
- **FOLSOM:** *For Sale-General Dentistry Practice.* Gross Receipts in excess of 1.5M the past three years. Adjusted Net of \$550K. 2,700 sq. ft. office with 4 ops. Digital, Dentrix, Intra-Oral Camera, Laser, 5+year old equipment, 8 days hygiene. Beautiful office, great location. Owner retiring. #14336 **SOLD**
- **FOUNTAIN VALLEY:** *For Sale-General Dentistry Practice.* Gross Receipts \$284,000 with only a 47% overhead. Practice has been in its present location for the past 37 years. There are two equipped operatories in this 5 op office. E2 2000 software. Doctor is retiring.
- **FRESNO:** *For Sale-General Dentistry IV Sedation Practice. (MERGER OPPORTUNITY)* Owner would like to merge his practice into another high quality general dentistry or IV sedation practice. The merger would be into Buyers office. Seller would like to continue to work as either a partner or associate after the merger. 2010 collections were \$993K with a \$422K adjusted net income. There are 7 days of hygiene. #14250.
- **GLENDALE:** *FACILITY SALE-General Dentistry Office Space & Leasehold Improvements Sale-* Office located in a medical plaza, 1760 sq. ft. 7 operatories, computerized equipment approximately 5 years old. Two 5-year options available. #14373
- **GRASS VALLEY:** *For Sale-General Dentistry Practice.* GR of \$307,590 (3 days/wk) with adjusted net income of \$105K. 3 Ops. refers out most/all Ortho. Perio, Endo, Surgery. Intra-Oral Camera, Diagnodent, EZ Dental Software. Good Location. Owner retiring. #14337.
- **GRASS VALLEY:** *For Sale-General Dentistry Practice.* GR 545K 3 days/wk (4 avail). 3 hygiene days/week. 5 Ops (6 Avail) 1,950 sq ft. Refers out most/all Ortho, Perio, Endo, Surgery. Office has Laser, Intraoral Camera, Pano, & Dentrix Software. Owner retiring. #14372.

- **GRASS VALLEY:** *For Sale-General Dentistry Practice.* Gross Receipts \$491K with an adjusted net income of \$130K. Overhead 73%. Office leased 1,555 sq ft. 4 equipped operatories 5 available. Laser, Intra-Oral Camera, Cerac, & Eaglesoft software. Owner would like to retire. #37108.
- **GREATER CHICO:** *For Sale-General Dentistry Practice.* Gross receipts in 2010 were \$584K, with an adjusted net income of \$152K. Approx 1,100 active patients. 4 operatories, Pano, Intra-Oral Camera. Easy dental software. Leased office 1,200 sq. ft. Owner is retiring. #14359.
- **GREATER SAN JOSE AREA:** *For Sale-General Endodontic Practice.* 2009 Collections were \$1,187MIL with an adjusted net income of \$696K. There are 4 ops in this nicely decorated 1,400 sq. ft. office space. 4 microscopes. Owner has been in same location for 26 years with long-term employees. Owner is retiring but will continue to work 1 1/2 to 2 years through the transition with the buyer. **SOLD**
- **HAWAII (MAUI):** *For Sale-General dentistry practice.* Gross Receipts of \$636K. Office has four equipped operatories in 1198 sq.ft. Pano, Laser, I.O. Camera, Fiber Optics, 2 1/2 days of hygiene. Owner retiring: Don't miss this opportunity to live and work in paradise. #20101
- **HAYWARD:** *For Sale-General Dentistry Practice.* This practice consists of 1,600 sq ft with 4 treatment rooms in an excellent location. 2010 Gross was \$501,000 with a \$228K adjusted net income. Dental Vision software, Average age of equipment is 8 yrs. Approximately 1,200 active patients. **SOLD**
- **IRVINE & COSTA MESA:** *For Sale-General Dentistry practice combined.* Gross receipts combined \$781K with adjusted net of \$396K. Both office spaces are leased with 4-5 ops in each. Both are 1,600 sq. ft. Irvine is equipped with Intra-Oral Camera, Pano & Dentrix. Costa Mesa is equipped with Laser, Intra-Oral Camera, Pano and Dentrix. #14355.
- **LAGUNA NIGUEL:** *For Sale-General Dentistry Practice.* 2010 gross receipts were \$503K. 4 operatories, Pan, computerized with EZ dental software. 1,500 sq. ft. lease. 10 years in present location. Owner retiring. #14352
- **LAKE COUNTY:** *For Sale-General Dentistry Practice.* Gross Receipts 904K with adjusted net \$302K. Practice has been in same location for past 23 yrs, and 25 yrs in previous location. 2,600 sq ft with 8 equipped treatment rooms. Intra-Oral Camera, Pano, and Data Con software. Owner to retire. #14338
- **LANCASTER:** *For Sale-General Dentistry Practice.* This 4 operator office is located in 2,360 Sq Ft on the second floor

of an attractive Medical Dental office building. Gross receipts were \$676,000 with a \$174K adjusted net income. Dentist is retiring after 39 years. 4 days of hygiene. Additional operatories could be added to existing space. Great location. #14376.

- **LEMOORE/HANFORD AREA:** *For Sale-General Dentistry Practice & Building.* Owner has worked in this location since 1971. Gross Receipts were \$378K with \$139K adj. net income. There are 3 equipped operatories and 3 days of hygiene. Purchase of the building is optional to the Buyer. 100% financing is available for both building and practice. Excellent opportunity for new grad or satellite practice. #14375.
- **LINDSAY:** *For Sale-General Dentistry Practice & building.* Gross Receipts \$330K with adjusted net income of \$219K. Owner has operated in present location for 27 years. Office space 1,489 sq. ft., 3 operatories available (2 equipped), Intra-Oral Camera, Soft-Dent software. 3-hygiene days a week. Owner retiring. #14363.
- **LIVERMORE:** *For Sale-General Dentistry Practice.* 2009 Collections were \$688K with an adjusted net income of \$287K. There are 4 ops in this nicely decorated 1,082 sq. ft. office space. Dentrix software, 6-days/wk hygiene. Owner has been in same location for 36 years with long-term employees. Owner is retiring. #14326 **SOLD**
- **LOS ANGELES:** *For Sale-General Dentistry Practice.* 1,200 sq ft 4ops, 29 yrs in present location. Gross Receipts \$274K with adjusted net income of \$89K. Owner to retire. #14348
- **MARIN COUNTY:** *For Sale-General Dentistry Practice.* This is a small 650 sq.ft. office with three treatment rooms. The practice has a very low overhead of only 48%. 2010 gross receipts were \$179,000 with \$90,000 adjusted net. Practice includes Panoramic X-ray and Easy Dental Software. Refers out O.S., Perio., & Endo. Practice has been in its present location for 30 years. This is an ideal practice for the new grad or satellite practice for the established dentist. Owner is retiring. #14370
- **MODESTO-TRACY-STOCKTON AREA:** *For Sale-Pediatric Practice.* \$677,000 in collections in 2010 with a \$357,000 net income. This 3-chair office is located in approximately 1,250 sq ft & has recently been remodeled. Patient Base software. Office equipped for NO2 & IV sedation. Practice has operated in its present location for 20 years.
- **NEWPORT BEACH:** *For Sale-General Dentistry Practice.* Practice has operated at its present location since 1986. Located in a highly affluent Newport Beach community. Three (3) hygiene days per week. Leased office space with 4 ops. in 1,450 sq. ft. Pano & Practice Works software. #14354. **SOLD**

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California Regional Corporate Office

**DR. DENNIS HOOVER, Broker**

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- **NORTHERN FRESNO:** For Sale-General Dentistry Practice. This is a perfect starter or satellite practice. Excellent location in North Fresno. Gross Receipts in 2010 were \$173K. Approximately 450 active patients. 3 operatories. Dentrix software. Leased office 1,200 sq. ft. Owner has been accepted to an Endodontic Residency after starting practice 1 1/2 years ago.
- **NORTHERN CALIFORNIA:** For Sale-Endodontic Practice. This Endodontic practice is located in an upscale professional office complex. The owners condominium occupies 1,770 sq ft. There are 4 equipped treatment rooms with an additional 5th room available. Gross Receipts were \$638K with \$239K adjusted net income. Owner will stay for transition to introduce buyer. Owner is retiring. #14251
- **NORTHERN CALIFORNIA:** For Sale-Pediatric practice. Owner has operated in same location for 32 years. Approx 1,760 active pts, 1,160 sq ft, panoramic X-Ray, Dexis Digital and Dentrix software in this 3-chair office. 2009 Gross Receipts \$713K with 48% overhead. Owner retiring. Call for Details.
- **OCEANSIDE:** For Sale-Modern looking office. 4 op, office space and equipment only. Belmont chairs. Gendex x-ray system, intraoral camera, approx 1,200 sq ft. Low overhead-Rent is \$1,900/month, and it's a 3-year lease. Staff is available for rehire-front desk \$15/hr, assistant 13/hr. Update all the computer systems after purchasing the office in 07. Computers and monitors in every room. #14346
- **PLUMAS COUNTY:** For Sale-3 equipped ops. Space available for 4th op. 1,245 sf office in good location. Gross Receipts \$475K. Practice in present location over 50 years. Owner is retiring. #14318
- **RENO:** For Sale-General Dentistry Practice and Dental Building: 2009 Gross Receipts \$517K with adjusted net income of \$165K. 4 1/2 hygiene days/week, 800 sq. ft. with 6 equipped ops. (7 Avail). Dentrix software, Pano. Practice has been in its present location for 40 years. Owner retiring
- **ROCKLIN:** For Sale-General Dentistry Practice. Gross Receipts \$593K in 2010 with \$240K adjusted net income. Office is 1,630 sq. ft., with 4 operatories equipped with fiber optics. Owner has been in present location for the past 13 years. 3 1/2 days hygiene. Intra-Oral Camera, Dentrix software. Owner to retire.
- **ROSEVILLE:** For Sale-General Dentistry Practice. Great Location. 2009 GR \$900K with adjusted net income of \$300K. 1,975 sq. ft. with 4 ops, 8 day hygiene/wk. Digital, Intra-Oral Camera, Dentrix, Trojan, fiber optics, P & C chairs - all less than 5 years old. Owner is retiring. #14327
- **SACRAMENTO:** For Sale-General Dentistry Practice. Gross Receipts \$546K with adjusted net income of \$159K. Office is 2,400 sq ft with 7 operatories. Practice has been operating in the same location for the past 50 years. Pano, Softdent software. Owner to retire. #14374
- **SACRAMENTO/ROSEVILLE:** For Sale-One of many partners is retiring in this highly successful General Dentistry Group Practice. Intra-Oral Camera, Digital Pano-Dexis, electronic charts, owner Financing. Call for further information. #14334
- **SAN BERNARDINO:** For Sale-General Dentistry Practice. GR \$972K. Practice has been in its present location for the past 35 years. Leased 4,500 sq ft of office space- 12 equipped operatories. Dentrix software, Pano and Cerac. Accepts HMO. Multi-specialty practice. Owner to relocate. #14377
- **SAN DIEGO:** For Sale-General Dentistry practice. Gross Receipts \$414K. Practice has been operated by the same owner for the past 6 years. Leased 950 sq. ft. office with 3 equipped operatories. Dentrix software, Intra-Oral camera, Panoramic X-Ray. Owner to relocate. #14356.
- **SAN DIEGO:** For Sale-General Dentistry Practice. 6 ops, Intra-Oral camera, Eagle Soft Software. Office square feet 2,300 with 3 years remaining on lease. 2009 Gross Receipts \$1,448,520, with an adjusted net income of \$545K. Doctor would like to phase out then retire. #14331
- **SANTA BARBARA:** For Sale-General Dentistry Practice. This excellent practice's 2009 gross Receipts \$891K with steady increase every year. Practice has 6 days of hygiene. 1,690 sq. ft., 5 ops, Laser, Intra-Oral Camera, Schick Digital X-Ray, Datacan software. Doctor has been practice in same location for the past eleven years of his 31 years in Santa Barbara. Doctor is retiring. #14333
- **SAN LUIS OBISPO:** For Sale - Two Doctor General Dentistry Practice. Gross receipts \$1,537,142 for 2010 with an adjusted net income of \$691K. The office has 2,331 sq. ft. with 8 equipped operatories, Pano, E4D, and Dentrix software. Practice started in 1990 and has been in its present location since 1998. Approx. 3000 active patients. Great location with nice views. #14353.
- **SANTA CLARA:** For Sale - BUILDING ONLY: This building is located just west of Westfield Mall and Santana Row. The building has two units. One side is designed and plumbed for dentistry and the other was a law office. There is 3,776 sq. ft. of office space. The dental office is approximately 1,800 sq. ft. with 6 operatories. The building has been recently re-roofed. Excellent opportunity for a startup practice or for the dentist that needs more space. Financing available through various dental lenders. #14368
- **SANTA CRUZ:** For Sale-General Dentistry practice. Gross Receipts \$300K with a 57% overhead. Office is 1,140 sq. ft. 3 equipped operatories. Intra-Oral Camera, Pano, Digital X-Rays, and Dentrix software. Practice has been in its present location since 1980. Owner retiring. #14358.
- **SANTA CRUZ:** For Sale-General Dentistry practice. This excellent practice is centrally located in a professional complex. Office is approx. 1,885 sq. ft., 4 operatories with room for one additional. There are approx. 2000 active patients with 6 days of hygiene per week. Practice Pano, Intra-Oral Camera and Easy Dental software. Owner is retiring. Reasonable lease available. #14361
- **TORRANCE:** For Sale-General Dentistry practice. This excellent practice is centrally located in a professional complex. Office is approx. 1,885 sq. ft., 4 operatories with room for one additional. There are approx. 2000 active patients with 6 days of hygiene per week. Practice Pano, Intra-Oral Camera and Easy Dental software. Owner is retiring. Reasonable lease available. #14320
- **TORRANCE:** For Sale - General Dentistry Practice. Gross Receipts \$413K with an adjusted net income of \$203K. 50% overhead. Practice has been in its present location for the past 25 years. The office has been tastefully remodeled. Office is 800+ sq. ft. with 3 equipped operatories. 4 -hygiene days per week. Doctor is to retire. #14369
- **TRACY:** For Sale-Equipment, furnishings, and leaseholds only. In the Central Valley. Fully equipped including 4 Belmont Accutrac chairs, 2 Midmark chairs, 6 DCI rear delivery units, 3 Gendex x-ray units, 1 Sonex digital x-ray processor, 1 Statim 5000, 1 Harvey autoclave. 2,800 Sq ft, 6 Ops. New lease available from landlord. #14335.
- **VISALIA:** For Sale- General Dentistry Practice. Gross Receipts \$616K with an adjusted net income of \$ 321K. Office is 1,380 sq ft with 3 equipped operatories, Intra-Oral Camera, Digital X-Rays, Mogo software, equipment & leaseholds look new. 5 years in present location. Owner to relocate. #14347

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**OPPORTUNITY AVAILABLE — A**

growing private office with private patients and PPOs only in Las Vegas is in need of an experienced GP full time. Great opportunity for those who want great compensation for now and have an option to BUY in the future. The computerized Dentrux office is extremely efficient for highly productive doctors that are self-motivated and have well rounded clinical skills. This is not a fast paced, high volume, big corporation type of practice. There is no pressure, you can make your own decision and be your own boss. The owner wants to retire. Must have active NV license and currently effective malpractice insurance before working interview. Please email your resumes to [tap.1999@yahoo.com](mailto:tap.1999@yahoo.com) or call 702-348-4462.

**OPPORTUNITY AVAILABLE** — Looking for a sweet and energetic GP with experience working with children. Preferred having oral conscious sedation license. Full-time position. If interested contact Dr. Camila Borrero by email at [camilaborrerodds@yahoo.com](mailto:camilaborrerodds@yahoo.com).

**OPPORTUNITY AVAILABLE** — Looking for Bilingual Spanish Dental Associate for dental office in Huntington Park. Please email resume to [prodentista@gmail.com](mailto:prodentista@gmail.com).

**OPPORTUNITY AVAILABLE** — Dental Hygienist in Smith River. 2-days/wk. Rare opportunity to work in a state-of-the-art dental facility as part of a comprehensive health care organization. We strive to

CONTINUES ON 190



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## **3068 MONTEREY COUNTY GP**

Practice on the Monterey Peninsula surrounded by natural scenery in a well-established general and cosmetic practice. Located in a desirable commercial and residential mix neighborhood on a well traveled street surrounded by two upscale shopping areas. The 2,000 sq. ft. office is state-of-the-art w/digital x-ray and 6 modern and fully-equipped ops. Long term & loyal staff. Approx. 1,500 active patients all fee-for-service. 3 year avg. GR \$1.7M, 2011 GR on schedule for \$1.8M. Avg. net profit \$700K+. Asking \$1,374,000.

## **3049 SAN JOSE GP**

Well-located, across from O'Connor Hospital, general practice in 2,118 sq. ft. state-of-the-art facility w/ 3 fully-equipped ops. 2 pvt. offices (1 can be plumbed for 4th op.). This office is beautifully designed and is stunning. In addition to his general practice, owner treats sleep apnea patients. Owner selling just the general operative portion of the practice and is willing to help for a smooth transition. Ideal for an experienced dentist looking to merge an existing practice. Asking \$195K.

## **3059 SANTA CRUZ COUNTY GP & BDG**

Charming practice tucked among soaring redwoods in Santa Cruz County. Located in a single level professional building in the heart of town. Well established and part of the small community landscape. 2010 GR \$595K+ w/3 doctor days. All fee-for-service. Owner retiring and willing to help for a smooth transition. This is a great turn key practice and opportunity to own a hidden gem. Practice asking price \$373K, building is also available.

## **3061 SAN JOSE DENTAL FACILITY**

Dental facility ideal for Pediatric or easily converted to GP. Located in desirable Evergreen area in a two-story, handicap accessible, high profile, **SOLD** ideal and professional building. Gross lease with utilities included expires July 2013 with 5 year option to renew. Modern, tastefully designed, approximately 1,321 square feet. Asking \$95K.

## **3064 SAN JOSE GP**

Now available. Great turnkey opportunity. Beautiful 1,500 sq. ft. facility with 4 fully equipped ops. State-of-the-art fully networked office, Dentrix software, digital x-ray & recently purchased dental & office equipment. Avg. GR \$328K+ with 4 doctor-days. Owner willing to help in transition. Asking \$220K.

## **3065 FREMONT GP**

Don't miss this opportunity. Spacious 1,150 sq. ft. office w/3 ops. No Capitation. 2010 GR 169K+ w/just 2-2.5 doctor days. Perfect opportunity **SOLD** to take this practice to the next level. Owner retiring. Asking \$124K.

## **3057 SAN JOSE GP**

Priced to sell. Located in 2 story professional building w/3 fully-equipped ops. in 990 sq. ft. office. Part of historic Rose Garden neighborhood **SOLD** block from the Alameda, & near a well travelled intersection. Seller transitioning due to health reasons. FY 2010 GR \$415K. Asking Price \$120K.

## **3069 NAPA VALLEY ENDO**

Endodontic practice now available in Napa Valley. Gorgeous state-of-the-art 1,450 sq. ft. facility w/4 fully-equipped ops & microscope in every op. Single story professional building. Well-established w/seasoned & loyal staff. Avg. GR over \$1M past 3 years w/4.5 doctor days. Excellent referral sources and upside opportunity.

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## CLASSIFIEDS, CONTINUED FROM 188

provide quality, comprehensive dental care in a comfortable caring environment. Must have an AA degree or equivalent combination of education and experience from an accredited dental hygiene school and minimum of 1 year related experience. Must possess a CA Dental Hygienist license. Salary is \$22.67/hr and up DOE. Email [trudy.adams@crihb.net](mailto:trudy.adams@crihb.net) or call 707-825-4036.

**OPPORTUNITY AVAILABLE —** Dentist in Arcata, CA. United Indian Health Services (UIHS), a non-profit community clinic providing health care to American Indian people and their families, is seeking a FT Dentist to provide outpatient care. Located in beautiful Northern California, UIHS offers an opportunity for personal and professional growth. This position will

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CONTINUES ON 90



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- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
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| <p><b>5999</b> <b>"SOLD" PLEASANTON</b> Adjacent to Hacienda Business Park. 2011 tracking \$900,000. Strong profits. Digital radiography with computers in Ops. Great visibility.</p> <p><b>6003</b> <b>"SOLD" PINOLE - HERCULES AREA</b> 4-days of Hygiene. 90%+ effective Recall. Produced \$740,000 and collected \$709,500. Low AR balance. Endo referred.</p> <p><b>6004</b> <b>"SOLD" SAN JOSE'S SANTA TERESA AREA</b> Asking slightly more than what it would cost to replicate this office today. Digital &amp; paperless 3-Op suite. 2010 produced \$385,000 with collections of \$277,000 and Profits of \$190,000+. Gorgeous facility. Lease allows occupancy thru 9/30/2024.</p> <p><b>6008</b> <b>MENDOCINO COAST - FORT BRAGG</b> Nestled in desirable cultural haven creates attractive lifestyle. 4-days of Hygiene. 2011's collections totaled \$725,000. Owner works 3-day week and states he could work more if desired. Computerized Ops and digital radiography.</p> <p><b>6010</b> <b>"SOLD" BERKELEY - ALTA BATES MEDICAL VILLAGE</b> Attractive revenues. Last 2-years Profits have averaged \$225,000. 2011 doing better!</p> <p><b>6011</b> <b>"SOLD" SAN JOSE - WEST OF I-280</b> Long established practice off Saratoga Avenue. Has averaged \$400,000 per year in collections. 3-Ops with 4th available in 1,000 sq. ft. suite.</p> <p><b>6012</b> <b>"SOLD" FREMONT</b> Well established practice as evidenced by 6+ days of Hygiene. Fantastic Recall System. Great location. Collects just shy of \$900,000 per year. Total Available Profits in 2010 were \$360,000. 5-Ops.</p> | <p><b>6013</b> <b>"SOLD" LIVERMORE</b> Not yet 4-years old, tracking \$430,000+ in collections 2011. Attractive 4-Op suite fully networked, employs computer charting and digital radiography.</p> <p><b>6014</b> <b>"SOLD" SAN FRANCISCO</b> Located in "Heart" of the Mission. Owner does not speak Spanish. 2011 tracking \$425,000+ with \$185,000 in Profits on 3-day week. 3-Ops. Great opportunity for Successor who shall devote more attention. Building has private garage for tenants.</p> <p><b>6015</b> <b>SONOMA COUNTY'S HEALDSBURG</b> Vibrant economy and great small town atmosphere. Anchored by 4-day per week Hygiene schedule and great Office Manager. Revenues tracking \$545,000 with Profits of \$235,000 in 2011.</p> <p><b>6017</b> <b>CAMPBELL</b> 2011 shall collect \$600,000. Adec delivery systems, computer charting, digital radiography, Biolase Waterlase, Panorex. \$380,000 invested here. Full price \$350,000.</p> <p><b>6018</b> <b>SAN JOSE'S CAMPBELL</b> Senior partner in esteemed Group Practice is retiring. Produced \$460,000 and collected \$420,000 in 2010 with Profits of \$190,000+. Great opportunity to simply treat patients and go home as Administrator oversees all front-end operations. Full price \$230,000.</p> <p><b>6020</b> <b>"COMING UP" - PEDO PRACTICE - SACRAMENTO AREA</b> Generates \$500,000 per year. Beautiful office. Shall be available shortly.</p> <p><b>6021</b> <b>SANTA CRUZ</b> Great central location. 44-hours of Hygiene per week creates strong foundation. 2011 collected \$415,000. Optional purchase is Seller's interest in building or Seller can extend long term Lease.</p> |
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*"I will always remember your statement when I questioned your contract being only four months. You stated: 'If I can't sell your practice in that time, you should get someone else.' Well, you did with time to spare!"*

*"Before I called Ray, I had a listing with another prominent Broker. After eleven months without a sale, I called Ray. He sold it in about a month! Would I recommend Ray? Yes!"*

*"In April, I asked Ray Irving to sell my practice. At the same time my friend decided to sell his practice. He employed another firm. My practice sold June 22. My friend's practice still hasn't sold and he was putting his dreams on hold."*

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Paul Maimone  
Broker/Owner

**BAKERSFIELD #21** - (10) op G.P. & Bldg. on a main St. (3) ops fully eq't'd. (3) ops part eq't'd & (4) add. Plmbd. Store front. Collects ~\$500K/yr. Cash/Ins/PPO/<1 % Denti-Cal. **NEW**.

**COVINA #2** - (4) op comput. G.P. (3) ops eq't'd/ 4<sup>th</sup> plmbd. 2011 Gross Collect ~ \$220K on a 2 day wk. Mixed patient base. **REDUCED AGAIN**

**COVINA #3** - (3) op comput. G.P. Cash/Ins/PPO. Gross Collect \$242K+ on an easy (3) day wk. Located in a small prof/medical/dental bldg. w off street parking. Seller retiring. **NEW**

**GLENDALE #6** - (5) op state of the art comput. G.P. 4 ops eq't'd, 5<sup>th</sup> op plumbed. Digital x-ray & networked. Mixed pt base. In a free stand bldg. Annual Gross Collect ~ \$500K.

**GLENDORA** - (3) op comput. G.P. Cash/Ins/PPO very small % Denti-Cal pt. base. Very low overhead office with a very high % net. 2011 Gross Collect \$296K+. Seller moving. **NEW**

**L.A. (SILVERLAKE - ATWATER)** - (3) op G.P. located in the trendy Silverlake-Atwater area. (28) years of Goodwill. Cash/Ins/PPO. Gross Collect \$140K p.t. Retail Store front. **NEW**

**NEWPORT BEACH** - (5) op comput. G.P. 4 ops eq't'd/5<sup>th</sup> plmbd. In a prof. bldg. on the Marina. Cash/Ins/PPO small % cap. Dentrux & Shick. Collects \$400K+ on a (2) day wk. **NEW**

**No. COUNTY SAN DIEGO** - (4) op comput G.P. in a shop ctr. w excell exposure & signage. Cash/Ins/PPO/HMO pts. Dentrux s/w, & digital. Gross Collections \$900K+/yr. **PENDING**

**OXNARD #5** - (4) op comput G.P. Can purchase w or w/o single use free stand. bldg. Mixed pt base. 2011 Gross Collect ~ \$447K. Locate on a heavily traveled main road. **REDUCED**

**RESEDA #6** - (3) op comput G.P. located in a well know, easily accessible prof. bldg. Cash/Ins/PPO pts. Annual Gross Collections ~ \$150K on a p.t. schedule. **REDUCED**

**SANTA BARBARA #2/GOLETA** - (4) op computerized G.P. located in a garden style prof. bldg. w St. frontage. (3) ops eq't'd/4th plumbed. Cash/Ins/PPO pt. base. (4) days of hygiene/wk., approx. (20) new pts/mos. Pano eq't'd. Collects. \$400K+/yr. on a (4) day wk. **REDUCED**

**SANTA BARBARA #3** - (3) op comput. G.P. in a prof/med/dental bldg. Cash/Ins/PPO. 8-10 new pts/mos. Gross Collect. \$250K+ on a (4) day wk. Digital x-ray. Seller retiring. **REDUCED**

**So. TULARE COUNTY No. of BAKERSFIELD** - (6) op comput. G.P. in a shop. ctr. w exposure/visibility/signage. Cash/Ins/PPO/Denti-Cal pts. Annual Gross Collect. \$500K+. **NEW**

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## DR. BOB, CONTINUED FROM 197

on, scanning the nutritional facts can take up to an extra 10 minutes per item. This has the full approval of market gurus; a slow-moving shopper always spends more than a person with a list and a schedule.

Disclosing the chemicals in their product must have been a bother to food manufacturers. To soften the impact of discovering you were about to choose an item with enough sugar, say, to satisfy your daily allowance for three months, they skillfully and legally printed in 4-point font the fact that this one single package with a net weight

of 510.3 hectoliters had a “serving size” about that of a thimble. It doesn’t really help to note that “no MSG added” frequently means added to what was already there.

As an individual who can cheerfully put away a family-sized bag of potato chips during a single evening, I am chopfallen to learn that the serving size of my own personal 18-oz. bag is listed as “about seven chips” with a sodium total of 2,070 mg for the whole bag! Who can eat seven chips and quit?

Surveying a favorite can of Campbell’s Chunky soup (“The soup that

eats like a meal”), the sodium content is listed as 790 mg. The company companionably assumes that the contents will be shared by another soup lover and that each diner will get his fair amount of 790 mg of sodium. If I am gluttonous enough to eat the whole can myself, 1,580 mg of sodium serves me right, they imply. I eat it anyway. What kind of a person eats only a half can of soup?

Obviously, the nation is hell-bent on escaping its own Sodium and Gomorrah. My only advice is to keep moving and try not to look back. We don’t need any more salt. ■■■■



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DR. BOB, CONTINUED FROM 198

the pepper. The present brouhaha with sodium has caused it to be banished to the rear of a kitchen cupboard back by an ancient flour sifter.

We — all of us, except me — eat too much salt. The USDA says so. Dr. Mehmet Oz concurs as he enthalls an audience of women rapturously awaiting a summons to don a white lab coat and participate in elaborate but simple demonstrations of the dangers of OD'ing on sodium.

About 4,000 years ago, a biblical character named Lot fled with his wife from the equivalent of Las Vegas located in a couple of cities on a plain in the Valley of Siddim just south of the Dead Sea. A big piece of celestially inspired history was about to happen and it seemed propitious to get out of Dodge before it began.

They were accompanied on their exodus by a gaggle of so-called “delivering angels” who were flying shotgun on the fleeing Lots. The angels were quite explicit in warning Lot not to look back at the cataclysmic destruction about to be wrought unto the sin cities of Sodom and Gomorrah because ... well, “just don't do it,” they chorused.

Lot correctly discerned that whatever happens in Sodom and Gomorrah should stay there. That is why the Las Vegas Chamber of Commerce maintains a 24-hour watch for angels swooping down to discourage impoverished visitors trudging homeward from looking back at their money.

Equipped with a deep instinct for self-preservation, Lot echoed this command to his wife.

“For Heaven's sake, Mrs. Lot,” he barked (back in those days, women didn't have names, nor could they vote or drive cars), “Don't look back!”

Big mistake! One does not command one's spouse not to do something. His nameless wife, her magnificent bosom heaving in accordance with the laws

## Lot correctly discerned that whatever happens in Sodom and Gomorrah should stay there.

governing the heaving of magnificent bosoms, sneaked a peek back and was immediately turned into a pillar of salt. One disregards angels at his own expense! It was for this reason the Morton Salt Company (“When it rains, it pours”) dropped the idea of using this pillar for the company logo 6,000 years later.

For reasons that defy analysis, turning a person into a chunk of salt seems, in retrospect, a little much, especially when dealt by an angel. The standard toad metamorphosis would have been just as effective. Confiscating her credit card for a month would have worked even better.

Salt in the form of sodium chloride is an essential nutrient for humans and animals where it performs many scientific functions including killing you if you take too much. Don't do that.

In order to determine how much is just right for you, the benevolent Food and Drug Administration in 2010 joined the American Heart Association in recommending that a healthy adult needs to reduce his consumption of sodium to less than 2.3 grams of sodium per day. The American public has never cottoned to the metric system, believing it to be a mystical mish-mash conceived by a decadent cult, possibly the Druids after a night of heavy mead consumption. Since we couldn't recognize a gram from a gramophone, the daily requirement has been dumbed down to a teaspoon, a common tool seen around the house.

Don't inscribe this in granite because the AHA is planning to reduce the

recommended upper threshold of salt to 2 grams per day in 2013 and to 1.5 grams per day for everyone by 2020. What this is translated to teaspoons is anybody's guess. Mine is a smidgin or a pinch.

It is difficult to fathom, but many years ago, people who felt their food needed a condiment were required to sprinkle salt on their food themselves. This tedious task has been almost completely assumed by thoughtful processed food purveyors. A fast meal is a happy meal, particularly if there is a small polycarbonate reward with no moving parts involved.

Commercially processed food comprising a high percentage of our diet is now conveniently loaded with more salt than Mrs. Lot's pillar. Having eliminated the dreaded transfat and replaced it with dietary fiber that is probably as good for you as it sounds, manufacturers are on a roll, providing enough nutritional facts, percentage of daily requirements and caloric content to challenge the combined intellects of Stephen Hawking and the late Jack LaLanne.

But wait! Growing numbers of alert shoppers, Blu-ray devices welded to an ear as they consult with unseen advisors, are seen in markets searching for that one little isolated section of the aisle dimly labeled “Diet.” Pricing is not their goal. They know by now that leaving something out of a product is frequently dearer than putting it in. Witness “reduced fat,” “sugar free,” “low sodium,” or palming off uncooked fish as “sushi.”

In an effort to give the public a fair shake when trying to work out what food items — other than produce and meat — are comprised of, a federal requirement to list the nutritional facts on the package became a law a few years ago. Rather than just pop a can of something into the basket and move

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# Salt: There's Na-thing Like It



The present brouhaha with sodium has caused it to be banished to the rear of a kitchen cupboard back by an ancient flour sifter.

→ Robert E. Horseman, DDS

ILLUSTRATION  
BY DAN HUBIG

There is a serious concern going on in this country today amongst nutritionists that, oddly enough, has nothing to do with the Middle East or keeping up with the Kardashians. The problem is so serious that the federal government has been forced to intervene, forming committees to study solutions and agencies and bureaus to issue guidelines and regulations. That this has never worked before only underlines how serious it is.

The culprit — the fly in the soup of America's pathetic nutrition — is dietary sodium, an element so common that the ocean, which occupies 70 percent of the world's surface, is full of it. How long before scientists realize that salt water is not good for living things,

especially fish? How long before Al Gore points the finger at sodium vapor lights?

Sodium's chemical abbreviation is Na. First published by Jön Jakob Berzelius in his system of atomic symbols, Na was initially thought to be the opposite of the Russian word for "yes" (da) and is still widely used in the Western world in the form of "nah," meaning "I don't think so." Unfortunately, the original symbol has now been almost entirely forgotten in the excitement of tracking Lady Gaga's wardrobe, reappearing but briefly via some irritating trivia contestant on *Jeopardy*. That's how serious the problem is.

In my house, we referred to consumer sodium as salt. It was formerly housed in a little shaker right beside

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